UNIVERSITY OF SOUTHERN QUEENSLAND

“Electronic Communities of Care - Measuring the Benefits”

A Dissertation submitted by

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ABSTRACT

Collaborative technologies including web, mobile applications, social media and smart devices are driving new models of healthcare where providers and consumers can connect together in virtual communities that facilitate real-time communications and encourage consumers to take a greater role in the management of their health.

As technology enabled care models evolve, it will become imperative for program researchers and evaluators to quantify their impacts and to answer the many efficiency and effectiveness questions that different stakeholders are likely to pose.

The primary aim of this study was to develop a framework that would enable the health and socio-economic benefits of technology enabled health care (e-Healthcare) models to be evaluated from the perspectives of providers, recipients and funders.

To achieve this aim, a multi-dimensional framework, incorporating Information Systems and Health Economics theory, was developed and refined through input from multiple case studies. These studies included an Australian Research Council (ARC) case using Health technologies to minimise unnecessary hospitalisation of elderly patients; an Australian E-Health Research Centre (EHRC) case using Tele-Health to deliver cardiac rehabilitation services; and a regional Australian care collaboration case involving multiple care providers from different disciplines.

In each of these cases, the positive impacts of e-Healthcare models were clearly evident, with outcomes including increased access to services, increased participation, better health outcomes, improved safety and quality and more cost-effective use of resources.

The learnings from this study are many, including that even where it can be clearly demonstrated that the e-Healthcare model can provide significant benefits and is a preferred choice by users that this does not guarantee its continued operation and main stream uptake.

This study will contribute to the literature by providing a framework and methodologies for evaluating and comparing the benefits and costs of service-Healthcare models. It will also assist researchers to better understand how the level of collaboration between providers and with recipients impacts on care outcomes and the delivery of sustainable care, in an increasingly ageing society.

CERTIFICATION OF DISSERTATION

I certify that the ideas, experimental work, results, analyses, software and conclusions reported in this dissertation are entirely my own effort, except where otherwise acknowledged. I also certify that the work is original and has not been previously submitted for any other award, except where otherwise acknowledged.

Frank Whittaker

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Firstly, I dedicate this dissertation to my wife Sharon and our five beautiful children to whom I am so grateful for enduring this journey with me and allowing me to work away over the past five years.

Secondly, I dedicate this dissertation to my mum, who sadly passed away before I finished, but who encouraged me immensely through her poetry and writings.

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CHAPTER 1 - INTRODUCTION

1.1 Background

Health and aged-care costs are expected to almost double in the next 40 years for federal and state governments, says the Business Council of Australia, which has called for a debate on the nation's priorities. Research commissioned by the council suggests that on present rates of population growth and ageing the cost of care to governments in Australia will surge to 14.5 per cent of gross domestic product by 2049-50 from 8 per cent in 2009-10 (Business Council of Australia, 2011).

An ageing population, combined with a rapid increase in chronic disease is placing unprecedented demand on limited health resources, with more than half of all potentially preventable hospitalisations from selected chronic conditions. In 2007-08, 19.24 (per 1,000 separations) were for chronic conditions such as diabetes, asthma, angina, hypertension, congestive heart failure (CHF) and chronic obstructive pulmonary disease (COPD) (AIHW, 2009). The Centres for Disease Control and Prevention (CDC) estimated that, in the United States, the number of people diagnosed with diabetes increased from 5.8 million in 1980 to 15.8 million in 2005; and as of 2009, 23.6 million people have diabetes (National Center for Health Statistics, 2011).

By 2051, the percentage of people over-the age of 65 in Australia is projected to double (ABS, 2003). The largest increase projected is in the over 85 group which will rise from 1% in 2002 to between 6 and 9% by 2051; a massive 500-700% increase (AIHW, 2006). This cohort is more likely to experience frailty and will impact greatly on the cost of health services in Australia (MacMillan et al., 2001) and (Stuttle, 2008). In response, new models of care are urgently required.

The current ageing population and increasing incidence of long-term conditions presents the health sector with a major challenge. Often older people are living with more than one long-term condition and have both clinical and social problems. Caring for these people consumes a large proportion of health and social care resources. Better streamlined care would ensure the effectiveness and safety of care for the frail aged population (Stuttle, 2008).

Older people commonly present to hospitals with multiple, complex conditions. Because of the bottlenecks in Accident and Emergency departments and for expedience, they tend to be admitted because clinicians have insufficient time to explore other options and the patient's suitability for these (Soar et al., 2008). In response, health professionals, policy makers and institutions in many countries are increasingly recognizing the need to respond to those with complex health needs and are initiating new models of service delivery designed to achieve better coordination of services across the continuum of care (Conrad & Shortell, 1996).

Modest admission reductions or length of stay (LOS) savings can be achieved by effective application of hospital discharge planning (Kumar & Grimmer-Somers, 2007). Hospital in the Home (HITH) involves the provision of acute, sub-acute and post-acute treatments by health care professionals at a patient's usual place of residence as a substitute for inpatient care received at a hospital.

"Hospital Avoidance" or reducing avoidable admissions is a field that the research team has been researching in both grant-supported research as well as research commissioned by state Departments of Health. Indications are that the savings from Hospital Avoidance can be significant. Each episode of Hospital Avoidance, involving resettling back into a person's home and ensuring the provision of all appropriate services, saved the cost of half of one hospital bed-day per avoidance, potentially offering massive savings for hospitals and state health departments (Soar et al., 2007a).

Home care has been identified as a less costly alternative to institutional care and is often preferred by patients (Melby, 2005; Robinson, 1999). Unlike hospital care where systems, process and resources are centralised, the delivery of home and community based care requires providers from multiple disciplines, with different systems and cultures to converge together in the delivery of care. Providing cost effective, quality home based care requires providers from multiple disciplines to integrate the coordination and delivery of care. This requires the disparate systems of multiple providers to integrate together so that information can be shared between them.

Effective integration of care requires (as a minimum) that health care professionals share information about – and with – patients at appropriate points in the care or treatment process. This will only be possible if the necessary infrastructural arrangements – such as shared patient records, regional collaboration, and a clear, transparent incentive structure are in place (Winthereik & Bansler, 2007).

In 2010, the Australian Government committed $466.7M to e-Health initiatives over the subsequent two years, which it claims would improve patient safety and help cut waste and duplication within the health system (Australian Government, 2010). These initiatives including unique identifiers for Providers and Consumers, a Personally Controlled Electronic Health Record (PCEHR), and Systematized Nomenclature of Medicine Clinical Terms are aimed to foster collaboration and data sharing across all disciplines.

Recent studies have shown that an increase in patient-healthcare practitioner (HCP) interaction is linked to the successful treatment and management of diabetes (Levine et al., 2009). Patients generally enjoy better health when managing diabetes using software products that modify behaviour, than those who do not (The Diabetes Control and Complications Trial (DCCT) study at the National Institute of Health), (National Institute of Health, 2000). A stepped care program for depressed primary care patients led to substantial increases in treatment effectiveness and moderate increases in costs. These findings are consistent with those of other randomized trials.

The announcement by the previous Prime Minister of Australia, Kevin Rudd in May 2010, of a flexible and pragmatic funding program for the care of diabetes sufferers augurs well for the development of the long-mooted e-Health system in Australia. The Pharmaceutical Society of Australia (PSA) has long been pointing out that e-Health is the only truly cost effective way of managing many medical conditions (Pharmaceutical Society of Australia, 2005).

1.2 The Research Context

Previous studies, as referenced above, show a correlation between the provision of care and the outcomes achieved for persons with chronic conditions. They also show that the level of collaboration between members of a care team can clearly impact on the cost-effectiveness and quality of care outcomes for persons with chronic and disabling conditions.

Collaborative technologies including web, mobile apps, social media and smart devices are driving new models of healthcare where providers and consumers can connect together in virtual communities that facilitate real-time communications and encourage consumers to take a greater role in the management of their health.

In the context of this study, e-Healthcare is defined as the combination of health care services, technology and information systems to deliver remote and home based care.

As new e-Healthcare models emerge, it will become imperative for program researchers and evaluators to quantify their impacts and to answer the many efficiency and effectiveness questions that various stakeholders are likely to pose.

Question 1 "How will the e-Healthcare model provide more cost-effective services and better care outcomes for older persons and persons with chronic and disabling conditions?"

AND

Question 2 "What are the barriers that will inhibit its uptake?"

1.3 Study Purpose

The complexities involved in changing from essentially a face-to-face care delivery model to a technology enabled Healthcare (e-Healthcare) model that either fully or partially facilitates the delivery of remote care, are immense. In the context of this study, remote care refers to services delivered at a distance via web, mobile, telephone, in-home and personal technologies to people in their own homes or community setting.

The purpose of this study was to measure the impacts of e-Health technologies on the provision of community based care to older persons and persons with acute and disabling conditions.

This study also aimed to demonstrate how the level of collaboration between providers and recipients within a Healthcare community impacts on the outcomes of the service model.

1.4 Contribution to Knowledge

This study will contribute to the literature by providing a framework and methodologies for evaluating and comparing the benefits and costs of technology enabled health care (e-Healthcare) service models. It will also assist researchers to better understand how the level of collaboration between providers and with recipients impacts on care outcomes and the delivery of sustainable care, in an

increasingly ageing society. The findings from this study also have the potential to inform and guide future policy decisions in the design and implementation of e-Healthcare strategies.

The methodologies and techniques utilised to develop the evaluation framework and methodologies will add to the body of knowledge in information systems design and potentially contribute to the better design and implementation of home-based care services. This study was not directly related to the outcomes of individuals, but it does incorporate a number of elements that support the theory that the level of interconnectivity within a care model can substantially impact on the outcomes of individuals receiving care.

1.5 The Research Framework

To achieve the aims of this study, a framework was required that could capture the complex economic, system and social perspectives of a technology enables Healthcare (e-Healthcare) model. In the context of this research e-Healthcare service models have three core components:

- Collaborative technologies, including web, mobile apps, social media and smart devices;
- Health care services provided by health and allied professionals; and
- Information services incorporating data, images and communications.

These three components can combine together in a variety of ways to enable the delivery of care to people in their own homes or community setting.

The researcher initially developed a multi-dimensional conceptual framework, based on the (Delone & McLean, 2003) IS success model, that incorporated Information Systems theory and Health Economics theory. This framework was then used as a basis for evaluating the impacts of three e-Healthcare service models, during which time it was refined to take into the accounts the specific requirements of each case.

Information systems (IS) is the study of complementary networks of hardware and software that people and organizations use to collect, filter, process, create, and distribute data (Archibald, 1975)

Health economics is a branch of economics concerned with issues related to efficiency, effectiveness, value and behaviour in the production and consumption of health and health care. This theoretical background is placed within the framework of the evaluation of health care programs using cost-effectiveness, cost-utility and cost-benefits analysis.

1.6 Research Approach

This study focused on evaluating the impact of collaborative technologies in the delivery of health care, firstly through an extensive literature review and then through the search for and development of a theoretical framework to guide the research.

Creating a framework and methods that can be used to measure the costs and benefits of moving to a remote model and the impacts this will have on providers, consumers and other stakeholders can be a challenge.

To meet this challenge, the researcher has drawn from the literature and his own experience in developing and implementing health care solutions, cost accounting and business analysis to create an initial conceptual framework. The researcher has then completed an extensive search of the literature to refine his methodologies and used the framework and methodologies to evaluate three cases studies

An initial conceptual framework and methodologies, based on an adaptation of the updated Delone and McLean (2003) IS Success framework and the researchers previous experience, was refined through multiple case studies using e-Healthcare technologies. These studies included an Australian Research Council (ARC) case using Health technologies to minimise unnecessary hospitalisation of elderly patients; an Australian E-Health Research Centre (EHRC) case using Tele-Health to deliver cardiac rehabilitation services; and a regional Australian care collaboration case involving multiple care providers from different disciplines. To guide the research, a Multiple case study Design was adopted, from (Yin, 2003), as shown in

.

- The first stage defined the purpose of the study and the related theories that the researcher / investigator is seeking to explore, the selection of cases that can be related to the theories and identifying how and from whom data were collected.
- The second stage involved preparing the data collection process for each case study and analysis of the data collected.
- The third stage focused on the analysis of each case study, both individually and collectively, and how the learning's from the cases can be used to refine the theory and associated methodologies.

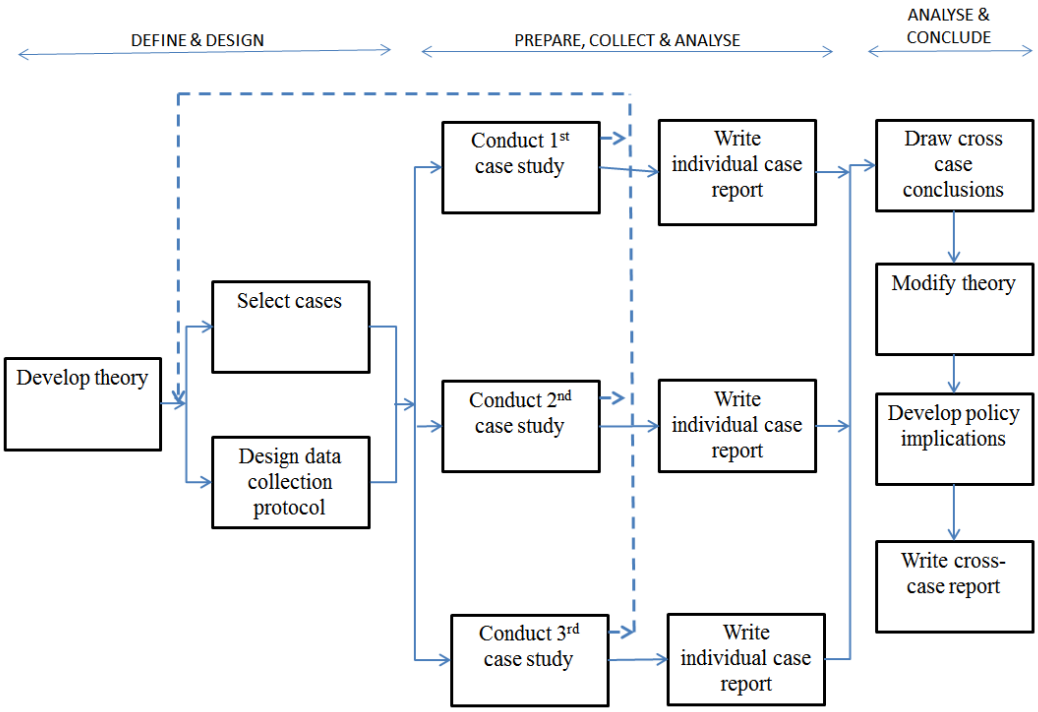


Figure 1-1 Case Study Method adapted from Yin (2003)

SOURCE:(Gulsecen & Kubat, 2006)

During the course of these studies, the evaluation framework was refined and the learnings re-applied to the other studies. Each of the studies were analysed both separately and collectively, which clearly evidenced the impacts of collaborative technologies on care outcomes including; increased access to services, increased participation, better health outcomes, improved safety and quality and more cost-effective use of resources.

1.7 Methodology

The research approach chosen demanded a methodology that would enable alternative care models to be evaluated and compared and the learnings from this to be utilised to refine the framework and methodologies.

A mixed methods approach incorporating Action Research methods (Act, Observe, and Reflect) combined with case study methodology captured both qualitative and quantitative data, which was then used to validate the framework.

Data collected included assessments, surveys, observation, semi-structured interviews, and focus groups, statistical outputs from the studies and operations data. Operations data included service inputs and outputs, intervention types, resources, costs, service volumes, processes, manual processes, duplication of activities, barriers to service delivery, stakeholder perspectives, issues and problems, quality of care indicators, hospital attendances, Length of Stay and comparative costs.

For each of the case studies, there was a project establishment, letters of invitations to become involved in the research, formalisation of research protocols, data requirements, inclusions and exclusions, confidentiality and ethics considerations. Throughout the studies, direct contact was only made by the Researcher with providers of care services and other stakeholders, not with the recipients of care.

During the course of the studies, feedback and reports were provided as required by each stakeholder. Coded protection of identity was used for all statistical outputs, and information on each project was only disseminated to approved stakeholders, as per advised by the project managers.

Transcripts from workshops and interviews and the evaluation results of case studies were made available to stakeholders via the Project web site. Anonymity of participants was ensured through a process of coded references. Comparative evaluations undertaken between studies will be made available to all stakeholders involved, upon request.

1.8 Study Outline

1.8.1 Chapter 1: Introduction

The chapter provides an introduction to the study; allowing the reader an overarching view of the whole thesis.

1.8.2 Chapter 2: Literature Review

The literature review highlights the challenges facing the health care services, with rising demand from an ageing population, higher instances of chronic disease, complex and antiquated funding models and increasingly restrictive privacy and

security policies. It then explores the potential benefits that have been achieved by providing technology enabled home-based care, how difficult these are to measure and the barriers to uptake and mainstream usage. It concludes with a review of evaluation methods, tools and measures which are then used as a basis for suitable evaluation frameworks.

1.8.3 Chapter 3: Theoretical Framework

This chapter used the research findings from the literature review to investigate frameworks that may be suitable for evaluating the impact of collaborative technologies. After a lengthy review, an initial conceptual framework and methodologies, based on an adaptation of the updated Delone and McLean (2003) IS Success framework and the researchers previous experience, was selected. This was later refined through multiple case studies using e-Healthcare technologies.

1.8.4 Chapter 4: General Methodology

This chapter outlines the general methodology, which acted as a guide for each of the case studies, including project establishment, data collection, processes, cost calculations and benefits calculation. The methodology was extensively updated over the course of the cases.

1.8.5 Chapter 5: Error! Reference source not found.

The first case study evaluated how collaboration between community care providers, assisted by technology had a positive impact on the delivery of care to older persons in the Murray Mallee region of South Australia. There are multiple service providers for the 3 types of community packages across sub regions of the Murray Mallee. The demand for services is greater than the supply of packages, and so services maintain a file of referrals from which they select clients as vacancies occur.

1.8.6 Chapter 6: CASE STUDY 2

The second case study was an Australian Research Council (ARC) project that focused on minimising the unnecessary hospitalisation of older persons through the development and implementation of an e-Healthcare solution to facilitate the delivery of care in the community. This study contributed significantly to the understanding of the barriers to uptake of e-Healthcare solutions and care models.

1.8.7 Chapter 7: Error! Reference source not found.

The third and primary case study was a CSIRO Australia e-Health Research Centre project that focused on the use of a Telehealth solution to provide an alternative to hospital/centre based rehabilitation program for people who have suffered a myocardial infarction. This study contributed significantly to the initial conception, constructs and methodologies developed for the e-Healthcare evaluation framework.

1.8.8 Chapter 8: Results and Discussions

This chapter reviews the outcomes for each case study and draws conclusions on the constructs and the process leading to the final framework. It concludes with a summary discussion of the major findings.

1.8.9 Chapter 9: Conclusions

This chapter provides concluding remarks for the study and briefly revisits the practical use of the framework and suggested future research opportunities; the contribution of the study, its applicability, limitations and implications for theory.

CHAPTER 2 - LITERATURE REVIEW

There is evidence that improving collaboration between providers and recipients can result in better care outcomes, better access, more cost-effective services, and improved quality of care outcomes for persons with chronic and disabling conditions (Soar et al., 2008).

There is also evidence, that for some services, care delivery at a distance can be as beneficial and more cost effective, than traditional face-to-face services. While face to face care is needed it does not need to be all face to face (Sarela et al., 2009a). Web, mobile apps, social media and remote device technologies can collectively facilitate collaboration by individuals who may be located in vastly different geographical areas. These may include online and mobile tools specifically developed to address the health needs of communities around the world.

2.1 Searches

This literature review considered a range of primary studies that explore the demands on the health system and the strategic shift to deliver an increasing level of home based care, as an alternative to institutional care at a hospital or residential facility. It then considered primary studies and expert opinion on the key enabling technologies that are driving this shift and the difficulties in measuring the benefits, costs and quality aspects of these emerging care models. Included were randomised controlled trials and quasi-randomised controlled trials where technology enabled home based care models have replaced or reduced the need for facility (hospital or residential) based care.

Also considered, were relevant conference reports and proceedings, as well as expert opinion texts and commentaries. The review strategy included primary published studies. An initial EBSCOhost MegaFILE Complete search was performed (including Cumulative Index to Nursing and Allied Health Literature, Australian New Zealand Reference Publications, Health Business Elite, and Health Source Academic). (EBSCOhost databases and discovery technologies are the most-used, premium online information resources for tens of thousands of institutions worldwide, representing millions of end-users). Following this terms identified and synonyms used by databases were used to complete a second comprehensive search.

A second search using all key words of home based care, remote care, e-Health, eCare, video consults, assistive technologies, hospital in the home, hospital avoidance, medication management, collaboration, collaborative care models, client portal, patient portal, mobile health, aged care, chronic illness, disabilities, integrated technologies; and index terms was undertaken across all databases. An analysis of the key words, text words contained in the title, and abstract and index terms used to describe the article was completed.

Third, the reference lists of all articles were searched for additional studies.

- Reference lists of articles retrieved were hand searched, as well as a range of literature from health, legal, ethical and emergency services.
- Grey literature was sourced using a number of Internet sites such as Google Scholar and personal email communication with authors of relevant studies

and known researchers in the field were initiated where appropriate. Selection criteria papers were retrieved if they provided information about consumer attitudes or experiences or perceptions of assistive technology.

The main themes to emerge from the literature review raised some dimensions in relation to the independence, terminology, national and international trends in relation to e-Healthcare and acceptance of healthcare technologies. The emergent themes provided the framework for this literature review, including:

- Trends towards providing home based care as an alternative to hospital care;
- Roles and successes of e-Healthcare technologies;
- Changing trends, social media and collaboration;
- The need for evaluation;
- Cost Benefit modelling;
- Barriers to implementation;
- Solution development and Information System (IS) theory; and
- Collaboration theory.

2.2 Trend towards Providing Home Based Care as an Alternative to Facility Based Care

Current models of care coordination are inefficient and with use of hospital services spiralling upward from around 50 years of age (Soar et al., 2007a), new models of client management are urgently required. In Australia patients over 65 years account for 46% of acute hospital bed days and 33% of hospital separations, even though they represent only 12% of the total population (The Australian Institute of Health and Welfare, 2006). By 2051, the percentage of over 65s in the Australian population is projected to double. The largest increase will be in the over-85 group from 1% in 2002 to between 6 and 9% by 2051; a massive 500-700% increase (The Australian Institute of Health and Welfare, 2006). This cohort is more likely to experience frailty, and their increase in the population will impact greatly on the cost of health services in Australia (MacMillan et al., 2001). As the population ages, general practitioners are seeing more patients with multiple, complex and chronic conditions, who are often treated by a team that consists of multiple clinicians of whom the rest of the team know little.

2.3 Reducing the Risk of Unnecessary Hospitalisation

Aged patients commonly present to hospitals with multiple, complex conditions and tend to be admitted because clinicians have insufficient time to explore other options and the patient's suitability for these (Bruen, 2005). Frail aged people are often poorly managed in emergency departments of hospitals as their needs do not comply with a straightforward diagnosis and planned management approach. Better assessment strategies and protocols need to be utilised by the health sector. This in turn may require higher involvement by allied health groups (Gonski, 1997). One third of problems presented in primary care general practice and hospital emergency departments are now chronic in nature (Britt et al., 2005).

2.4 Role and Success of Health Technologies

Globally, governments are considering strategies to reduce demand on hospitals by providing e-Healthcare for the aged and chronic ill where they reside. There is a paucity of research about effective ways to achieve this. In Australia home care has been identified as a less costly alternative to institutional care and is often preferred by patients (Melby, 2005; Robinson, 1999).

In Australia, the Federal and State Governments are also increasingly interested in ways to reduce avoidable hospital admissions of the aged, and several trials have been sponsored (South Australia, Northern Territory and the ACT). Because of this paucity of research, the effectiveness of these strategies are unknown, but what is certain is that general practice and other community practitioners will shoulder the responsibility for the treatment of these people.

In 2005, a national workshop sponsored by the Australian Department of Health and Ageing (DOHA) on hospital admission minimisation of the aged, identified a lack of consistent and reliable identification of candidates for hospital avoidance as a major barrier to admission minimisation. This is because Australia has:

- Laborious manual processes of organising services with multiple providers;
- An inefficient manual processing of referral requests; and
- An inefficient sometime non-existent tracking of service delivery to ensure that patients, particularly those with high risk conditions, have been attended to in a timely manner.

Despite the identified need to reduce the fragmentation of care for the aged population and facilitate referrals between providers (Coleman et al., 2004) in Australia this is in its infancy. Information and Communication Technology (ICT) is expected to provide the tools to streamline clinical workflow and effectively coordinate decision making and communication between multidisciplinary care teams (Conrick, 2006). To date the reality has been many trials, with some successful, but many that have not been, and a lack of a national approach to this strategy.

2.5 Technology Challenges

Unlike hospital care where systems, process and resources are centralised, the delivery of home and community based care requires providers from multiple disciplines and organisations to collaborate and coordinate the delivery of care. In Community care, different systems and practices combined with privacy concerns and silo mentality, often results in poorly coordinated activities, duplication, errors and wastage, all of which impact on the quality of services delivered.

In 1996, chronic disease in Australia was estimated to account for around 80% of the total burden of disease, mental illnesses and injury as measured in disability adjusted life years (The Australian Institute of Health and Welfare, 2006). The Commonwealth's Medicare funded GP Management Plans (GPMP) and Team Care Arrangements (TCA) (Items 721 & 723) were intended as a partial response to this need having been designed to encourage more systemic care planning for patients with chronic disease. Anecdotal evidence is that there has been only limited take-up of these Medicare items within general practice.

The National Health Alliance repeatedly urged governments to provide a properly resourced and integrated health care system for the aged. They stated that communities must ensure that all artificial barriers between care settings are removed or reduced so that a structure can be created where all elements of health care services are well integrated and coordinated. There needs to be a funded and integrated collaboration to aged care across the three care settings-health, community and residential care facilities (The Australian Institute of Health and Welfare, 2006).

2.6 Challenges for People Living Independently at Home

Challenges for people living independently at home include undertaking normal activities of daily living which increase in difficulty in circumstances where individuals have multiple health conditions (Godfrey et al., 2010; DeRuyter, 1995). In these instances the performance of self-care may pose further challenges to both recipients and providers of care. For example, individuals with osteoarthritis have a high rate of co-morbidity with chronic conditions such as hypertension, cardiovascular diseases, obesity, and respiratory diseases (Godfrey et al., 2010).

Both the number of conditions and their severity are associated with limitations in activities and increased pain (Mihailidis et al., 2008). Similarly, individuals with diabetes and co-morbid mental health conditions, such as depression, testify to lower medication adherence and greater difficulties managing their medical care (Bayliss et al., 2007; McCreadie & Tinker, 2005; Mihailidis et al., 2008). Integrating self-management tasks for coexisting and often interacting diseases is complex (Bayliss et al., 2007) and may reduce an individual's and/or their family's ability to perform self-care activities.

Cognitive impairment is also important when considering supporting older community dwelling people. According to (Bewernitz et al., 2009), nearly 14% of people over age 71 have some form of dementia, with prevalence increasing to nearly 40% of those over age 90. As dementia progresses, it impacts a person's independent functions and can increase the burden on caregivers. Bewernitz et al. (2009) has suggested that the use of assistive devices (AD) can help individuals with dementia live more independently.

Older individuals with cognitive impairment often have difficulties using assistive technology devices, because the devices are not designed to address their needs. The development of "smart devices" has potential in assisting older adults with cognitive impairment (Bewernitz et al., 2009).

Many older people living in the community are assisted by community health professionals, who may include community health nurses, physiotherapists or occupational therapists. These professionals, as well as others such as social workers and carers, work in a field where there is a high likelihood of adverse events, conditions and unmet needs. These adverse events include falls, difficulties in managing medications, incontinence, social isolation, fear of crime, depression, cognitive decline and associated challenges such as wandering and safety concerns (Soar & Youngjoon, 2007).

Previous work by the research team Hegney et al. (2006), has found that the aged and community sector workforce – and particularly those in rural and remote

communities – often does not have access to suitable ICT infrastructure, support and training to assist them in their work.

Improved coordination across sector boundaries is a priority for aged care. Throughout their journey, from General Practitioners (GPs) to hospital, to community care, to residential care, the frail aged person frequently experiences a range of care providers who do not appear to be aware of previous (or concurrent) treatments.

2.7 Technology Enabled Care Programs

As health care becomes increasingly participatory and collaborative, digital-social health has the potential to transform the patient populace from being mere passengers to responsible drivers of their health. An empowered, educated, and responsible patient, family and community is then more motivated and better positioned to access information and understand the implications of lifestyle and health care options. Once they have more support and knowledge, they are better positioned to leverage social health platforms to spread what they learn, create a larger social health support team, and eventually make choices that improve individual health as well as the health of their children, families and communities (Chai, 2012).

Collaborative technologies can have a substantial impact on the delivery of care as they can provide immediateness in communication and information sharing. For example, an Endocrinologist (Diabetes specialist) can now complete a remote consultation using video technologies, through which they can observe a patient taking their blood pressure, glucose level and medications.

Collaboration and communication tools can improve the way providers collaborate and share information, quicker and more seamlessly. These tools include shared Electronic Health records (EHRs), shared documents, secure messaging, person-to-person workflow procedures, document management, video, mobile and web apps and personal portals. Such abilities become valuable since they enhance interaction among care teams, located in various locations and permit for them to work jointly, and to share information and strategies. Also, they permit live meetings to take place in the technological way rather than the physical way (Boulos et al., 2006).

Collaborative technologies associate people together in the processes that alter the way they perform and how they provide their services. The design of presence technologies enables people to view if anyone is accessible and reachable for communications across different channels. In an ideal world, a GP consulting with a patient, could see if the patient's specialist were available to discuss an urgent concern, simply by looking on their PC or tablet and if the specialist were available, arrange for an immediate discussion, instead of sending the person to the emergency department. With these technologies collaboration becomes more reachable and faster. The tools of collaboration offer more practical and attractive choices, providing a diverse way of solving the problems of communications latency (Boulos et al., 2006)

Decreasing the delay in sharing and connecting of information becomes more and more significant in the today's fast-paced world. The cloud is a rapidly emerging vehicle that can significantly reduce the time and effort of establishing collaborative technologies. Cloud computing encourages providers to evaluate their core business,

regarding what they do best and how they can embrace new technologies. With the initiation of cloud computing, the technologies of collaboration become the tools that make it easy for firms, and their workers to work on a total new plane (Boulos et al., 2006).

A key form of collaborative technology is video. The technologies of Video collaboration are reinventing the place of work by permitting the people to meet, efficiently, virtually and reliably starting at nearly any spot on the globe. It has been widely acknowledged that video collaboration assists businesses importantly through decreased travel, improving group collaboration and building trust. These benefits have come out as uniformly significant factors that have not been generally studied (CISCO, 2010).

Innovative technology care programs are able to stem the tide of increasing costs of health care and demand, by utilizing in home observing appliances in tandem with the programs of care management. There are three features in the technology enabled care model; first a patient in the housing setting, second the provider association augmented by the members of the care team and third an Electronic Medical Record related to the Patients' Personal Health Record (Deloitte, 2008).

In Britain a mobile information technology in primary care settings enabled a total of 13,278 acute hospital bed days to be saved by changed admission/ assessment processes (Lowe, 1998). On presentation to hospital, the patient receives a thorough medical assessment that indicates if they need to be admitted immediately or may be suitable for home based care. British research focussed on community assessment centres but the work validated a central assessment centre as leading to admission avoidance (Evers, 2008). On many occasions, community nurses were called to treat patients at home without need for them to go to hospital. According to Stuttle (2008) the need for healthcare staff to focus on maintaining the independence of older patients is paramount.

During the period 2003 to 2006, the Advanced Community Care Association (ACCA) was funded by the Government of South Australia to coordinate short-term community based services. A primary aim of the service was to reduce avoidable hospital admissions by targeting the identification and referral to community care services of likely hospital candidates at the GP practice, residential care facility and outpatients (Soar et al., 2007b). ACCA comprised of a consortium of locally based community providers who collectively delivered alternative to hospital care for 17,000 candidates during the three year period. A key component in the success of the ACCA program was the use of Information and Communication Technologies (ICT) to address the barriers previously stated, by improving the referral process to multiple community providers and enabling service delivery to be tracked. This program demonstrated a proof-of-concept technology solution that reduced the complexity of making a referral to community service organisations. The technology solution provided a business-to-business portal that enabled referrals from hospitals, health practitioners, and residential care facilities to be electronically received by a contact centre that interfaced with a wide range of community based service providers (Whittaker, 2008).

2.8 Electronic Health Networks

The potential benefits obtained from implementing "Electronic Health Networks" (EHN) have been widely proclaimed from Governments around the world. Information and communications technology (ICT) will: integrate the disparate parts of the health sector, facilitate portable electronic health records and bring together databases that will be accessible by multiple service providers, and give patients greater access to health information (WAVE Advisory Board, 2001). Research on organisational communication has consistently shown that working across functional boundaries and sharing knowledge is extremely difficult, because knowledge is always localized, embedded and invested in practice (Brown & Duguid, 2001; Carlile, 2002; Wenger, 1998). This has had an impeding effect on the connectivity between health care providers with a silo mentality existing between them (Whittaker, 2008).

2.9 Integrated Technologies

Most of the studies in technology integration have been condemned for being ad hoc and theoretical, motivated more by the technology affordances rather than the anxieties of subject matter and pedagogy. It is argued that the transmission of multimedia turns to minimize the studying into the simple content, since it is too complex to convey complex content through multimedia (Huber, 1990).

There is substantive evidence that providers of healthcare who choose a greater level of integration, through the use of technologies, will perform higher than providers of healthcare who are choosing a lesser level of technology integration. It is in the service of healthcare that more uncertainty and variability can be found at the point of service compared to any other economic activity (Li & Benton, 2006).

The greater the level of integration of technologies, and the greater the use of these technologies in each stage of the delivery of healthcare leads to a higher ability to deliver more cost-effective, high quality healthcare. The providers of healthcare that have the greatest level of integration of technology are posited to be greater in terms of the capabilities with the uppermost level of the preparedness of the medical record by the way of storage of information and access to the information that assist better quality and apt clinical decision making (Kelly, 1994). The UK National Heath Alliance urged governments to provide a properly resourced and integrated health care system for the aged, stating that communities must ensure that all artificial barriers between care settings are removed or reduced so that a structure can be created where all elements of health care services are well integrated and coordinated. There needs to be a funded and integrated infrastructure for collaboration in care across the three care settings: hospital; community; and residential care facilities (Wu et al., 2011).

Integration presupposes what Timmermans and Berg (2003) denote compatibility standards, i.e. negotiated agreements about what and how to share and exchange information across multiple local settings and systems (Ellingsen & Monteiro, 2006). Unfortunately, the term "Integration", is more often than not, perceived as being predominantly technical and excludes the socio-political aspects of integration. Winthereik and Bansler (2007) highlight that information systems for health care have so far primarily been developed to support the computerization of patients' records and work flows within individual health care organizations. Opposed to this,

the development of ICT systems to facilitate integrated care must support communication in highly heterogeneous networks of healthcare professionals, home care workers and patients – across institutional, organizational and professional boundaries. Research on organizational communication has consistently shown that working across functional boundaries and sharing knowledge is extremely difficult because knowledge is always localized, embedded and invested in practice (Brown & Duguid, 2001; Carlile, 2002; Wenger, 1998).

Effective integration of care requires (as a minimum) that health care professionals share information about – and with – patients at appropriate points in the care or treatment process. This, will only be possible if the necessary infrastructural arrangements – such as shared patient records, regional collaboration, and a clear, transparent incentive structure are in place (Winthereik & Bansler, 2007).

New health care models are rapidly evolving in the delivery of aged and disability care driven by consumer demands, funding models, workforce, technology, quality, transparency and accountability. These changes are driving innovation and the emergence of a number of new care/ business models.

2.10 Collaborative Technologies

In a broad sense, collaboration requires individuals working together in a coordinated fashion, towards a common goal. Accomplishing the goal is the primary purpose for bringing the team together. Collaborative technologies help facilitate action-oriented teams working together over geographic distances by providing tools that aid communication, collaboration and the process of problem solving. Additionally, collaborative technologies may support project management functions, such as task assignments, managing deadlines and shared calendars (Schrage, 1990).

2.11 Changing Trends, Social Media and Collaboration

In terms of health and social care, collaborative technologies enable care providers, care recipients and family and other carers to remotely communicate, share information, monitor conditions and participate in the care service (Ocker & Yaverbaum, 2001). The most commonly known collaborative technologies are:

- Tele-Care, which enables the, health status of patients at home to be monitored remotely, using a combination of an emergency call service combined with alarms, sensors and other equipment to support functional independence (Cook, 2008; National Health System (NHS), 2009);
- Tele-Health, which utilises video and data sharing in the delivery of clinical services to patients by providers who are physically located at a distance;
- Web 2.0 and mobile sociable technologies and social software, which are enablers in health and health care, for organizations, clinicians, patients and laypersons. They include social networking services, collaborative filtering, social bookmarking, folksonomies, social search engines, file sharing and tagging, mashups, instant messaging, and online multi-player gaming; and
- Electronic Health Records, which enable health and clinical information to be transferred, or shared between providers and or recipients.

2.12 Tele-Care

There are many definitions for Tele-Care. According to the Department of Health report, BTiE (Building Tele-Care in England), Tele-Care is explained as the equipment that has been offered to support an individual in her / his home and tailored to meet their requirements. This could be as easy as the basic community service of an alarm, which is capable of responding during an emergency and offers regular contact over telephone (Adler & Ziglio, 1996).

Tele-Care is a term for providing isolated care for the elder and physically less able individuals, offering the reassurance and care required to permit them to stay living in their own homes. The use of sensors, backed up by active monitoring can offer support for individuals with illnesses including dementia, or people at the high risk of falling. Tele-Care varies from that of Tele-Health and Telemedicine. Tele-Care is referred to the idea of facilitating people to stay independent at their own houses by offering person – centred technologies to support the individual or their carers (Beyer et al., 2008). Over the past decade a wide range of technology assisted (AT) care services have evolved, aimed at enabling care to be delivered safely and cost effectively to persons in their own home instead of in an institutional setting. The terminology around assistive technology can vary greatly and encompasses a variety of specific equipment. Assistive technology has been described as 'any device or system that allows an individual to perform a task that they would otherwise be unable to do, or increases the ease and safety with which the task can be performed (McCreadie & Tinker, 2005; Cowan & Turner-Smith, 1999).

Tele-Care is one form of assistive technology that uses a combination of alarms, sensors and other equipment to support functional independence (Cook, 2008; National Health System (NHS), 2009). Tele-Care extends to a personal emergency alarm supported by a response centre with commonly-available and low-cost peripherals such as flood and extreme heat sensors, bed sensors, movement detectors and door-exit sensors. Typically with Tele-Care, the user will wear a Personal Emergency Alarm button on a pendant or wrist band that they can use to send an alarm signal through their base-station, usually connected to the home telephone, to an operator at a response centre.

Other devices can also be connected to the base station (Department of Health and Ageing, 2009). For instance, a bed occupancy sensor can be used to monitor when a person gets out of bed at night, and if they do not return within a certain period, an alarm would be raised. The bed sensor can be linked with an automatic light sensor, so that when the person gets out of bed the light turns on and allows them to immediately see where they are going. Similarly, door exit sensors will detect if someone opens the front door and movement detectors will provide an alert if the person then leaves their home at a time that might be inappropriate (Department of Health and Ageing, 2009).

The development of AT has greatly progressed and investigations on the suitability and user acceptance continue (Faife, 2007; Marshall, 1999; Wilson et al., 2006). The Queensland Smart Home Initiative established Queensland's first ever demonstrator smart home with assistive technologies in place to enhance home care and independence for people with chronic illness. It undertook Queensland's first project to share patient clinical information across sectors of care-acute, primary, community and aged care. The findings of this initiative suggest that more attention

needs to be paid in tailoring technology to the preferences of the older age group (Hegney et al., 2006). Elderly participants had mixed attitudes toward technology, with most demonstrating interest in specific technologies, for everyday use. Caregivers were similarly interested in specific types of technology, especially to assist with activities of daily living (Harris, 2009).

Emergency call systems, health status, and activity monitoring were rated as useful or very useful, whilst videophones were rated as hardly useful. Intrusion into one's privacy was the most prominent concern. Regarding fears in old age, people were mostly afraid of diseases and loss of independence. It was observed that clients would entrust their medical data to their physicians rather than relatives or caregivers (Marschollek et al., 2009). This study may contribute to systematic analyses of users' perceptions and preferences concerning assistive health-enabling technologies.

Recently, the development of AT has greatly progressed and investigations on the suitability and user acceptance continue (Faife, 2007). The Queensland Smart Home Initiative established Queensland's first ever demonstrator smart home with assistive technologies in place to enhance home care and independence for people with chronic illness (Hegney et al., 2006). It undertook Queensland's first project to share patient clinical information across sectors of care-acute, primary, community and aged care. The findings of this initiative suggest that more attention needs to be paid to the tailoring of technology to the preferences of the older age group (Hegney et al., 2006).

Consideration for the use of Tele-Care is currently linked to the many challenges the aged and community care sector in Australia is facing, such as rising consumer demands, rising costs and regulated revenues, workforce availability and skill levels, and also the challenges of providing services across the vast geographical spread of the aged care population (Wilson et al., 1995; Harrefors et al., 2010; Soar & Youngjoon, 2007). These challenges make it increasingly difficult to meet the needs of the ageing community dwelling population (Department of Health and Ageing, 2009) A study in 2007 by Chiu and Man (2004) evaluated whether an additional home training program on bathing devices would improve the rate of use, personal independence, and service satisfaction of older adults who had experienced stroke and found that in many cases participants became more independent and felt safer using assistive devices following training and support.

The effectiveness of Tele-Care has been demonstrated by Darkins et al. (2008) who found that the USA Veterans' Administration's implementation of home Tele-Care had reduced hospital admissions by 19%, hospital bed days by 25% and re-admissions by 25%.

2.13 Tele-Health

Broadly, Tele-Health is a collaborative technology that encompasses the delivery of health care services at a distance, using information and communications technology. There are numerous definitions, but here we regard Telehealth as the delivery of clinical services to patients by providers who are physically located at a distance (Sood et al., 2007). In this respect, Tele-Health is synonymous with telemedicine, and is a distinct subset of e-health, which encompasses all the uses of information and communications technology supporting health and related fields (Al-Shorbaji & Geissbuhler, 2012). Tele-Health contains several modalities of delivering health care

services, which can be divided into synchronous or real-time applications including. video consultations and asynchronous or store-and-forward applications, including the transmitting of still images or physiological data (Tulu et al., 2007).

Telehealth has most potential for people with chronic conditions such as diabetes, heart failure, chronic obstructive pulmonary disease or multiple conditions. It uses equipment to monitor people's health in their own home. Equipment can be used to monitor vital signs such as blood pressure, blood oxygen levels or weight. These measures are then transmitted to a clinician who can observe health status without the patient leaving home. The clinician can monitor daily readings to look for trends that could indicate deterioration in condition – and intelligent software can monitor readings and alert clinicians when appropriate. Readings that are out of the expected range trigger an alert for the clinician. Tele-Health solutions offer a way of delivering tailored care for patients with long term conditions, which helps improve quality of life and reduce avoidable hospital admissions.

By using Tele-Health equipment individuals can take the same measurements that a nurse or GP would take thereby avoiding frequent visits to the surgery or the need for home visits. Measurements, that monitor the user's progress are automatically sent through the telephone line and can be read by the nurse or GP from their desk at the surgery. Tele-Health is an engaging concept because it has been proposed as an all-in-one solution for several difficult problems in health care delivery, namely lack of access to care for rural and disadvantaged groups, mal-distribution of specialist services, the rising costs of health services, and the need to deliver more care direct to the home for the aging population with chronic diseases (DeVany et al., 2008; Bashur & Shannon, 2009; Tracy et al., 2008). Demand for extending video conferencing to mobile devices is seen to be exploding says chief executive officer of LifeSize Communications (Buechler, 2012). Mobility is enabling companies to get closer to their customers, partners and employees through enterprise-class visual communication.

Over the past few years there has been a rapid expansion of video technologies, with more than 100+ million users of Skype, but surprisingly the use of Tele-Health video technologies has not become mainstream and utilisation has not matched predictions (Wade & Eliott, in press). Studies noting the failure of Tele-Health to be adopted at the expected rate emerged from the late 1990s, with low uptake (Paul et al., 1999; Tanriverdi & Iacono, 1999), uneven diffusion (Grigsby et al., 2002), and failure of pilot projects to translate into ongoing services (Barlow et al., 2003; Kerr & Norris, 2004; Zanaboni & Wootton, 2012; May et al., 2003).

Reports of underutilization appeared across a range of clinical areas, including psychiatry (Grealish et al., 2005; Hailey et al., 2009), rural health (Robinson, 2002; Gagnon et al., 2006), military medicine (Lam & Mackenzie, 2005), pathology (Dennis et al., 2005) and palliative care (Whitten et al., 2009). When the numbers of tele-consultations conducted by individual services were measured, they typically ranged from a few hundred to a few thousand episodes a year (Lamminen et al., 2001; Dillon et al., 2005; Hailey et al., 2009). Numbers of sites and services increased over time, but continued to be a very small fraction of total health care activity (Grigsby et al., 2007). Zanaboni and Wootton (2012) characterizes Telehealth as an immature technology that has stalled.

The technology of Tele-Health benefits in many ways. Tele-Health adds a new concept in healthcare, where the patient is remotely consulted by the physician. The

ability to provide spontaneous video enabled consults has been found to substantially decrease hospitalisation and appointments to the Emergency Department, at the same time as providing better quality of life to patients. Tele-Health also provides advantages to the patients where usual delivery of services of health is pretentious by distance and can be deficient in access to local specialist clinicians (Olmeda, 2000).

The Department of Health's Whole System Demonstrator (WSD), UK commenced during May 2008. This was the greatest randomised examination of Tele-Care and Tele-Health in the whole world, including 6191 patients and 238 GP practices traversing three sites, namely Kent, Newham and Cornwall. In this trial, Three thousand and thirty people, with complications including Chronic Heart Failure (CHF), Diabetes and Chronic Obstructive Pulmonary Disease (COPD), were incorporated. The trials were assessed by the University of Oxford, Nuffield Trust, Imperial College London, London School of Economics, City University London, and University of Manchester. It is inferred from the trials, that with the help of Tele-Care and collaborative care models, there is a 45% decrease in the rates of mortality, 20% decrease in the emergency admissions, 15% decrease in the Accident and Emergency (A&E) visits, 14% decrease in the elective admissions, 14% decrease in the days in the bed, and 8% decrease in the costs of tariff (Norris, 2002).

This disjunction between expectation and reality has prompted much commentary and numerous policy recommendations (Jennett et al., 2004). Researchers began to investigate why the implementation of Tele-Health has been so difficult, and what is needed for successful uptake, typically constructing lists of barriers and enablers that are perceived as influencing the outcome of Tele-Health services. Three reviews of such research collectively indicate that the enablers were well-functioning technology, user training, planned change with provider participation, development of protocols, acceptance by health care providers, support for provider collaboration, use of a business model, and supporting policy and legislation (Broens et al., 2007; Jarvis-Selinger et al., 2008; Obstfelder et al., 2007). Barriers cited were technical problems, lack of technical support, lack of usability, provider concerns about quality and ethic-legal matters, absence of protocols, lack of a business model, and regulatory barriers in licensing and standards.

2.14 Social Technologies and Personal Portals

Over the past five years, there has been an explosion in the uptake of collaborative and social technologies, fuelled by Facebook, Twitter, Skype, linked-in and other services, and also by the enabling hardware, tablets, phones, applications and connectivity. The proportion of older Australians aged 65 years and over who use the internet remains well below that for younger age groups, however, their usage has increased significantly – from 30% in 2007 to 40% in 2009 (Haukka, 2011) (Sheizaf & Noy, 2002). A growing number of older persons are now utilising this medium to stay in touch with family and friends, especially those who are isolated.

Web and mobile sociable technologies and social software are enablers in health and health care, for organizations, clinicians, patients and laypersons. They include social networking services, collaborative filtering, social bookmarking, folksonomies, social search engines, file sharing and tagging, mashups, instant messaging, and online multi-player gaming. Mashups, in web development, are webs, or web applications, that use and combine data, presentation or functionality from two or more sources to create new services.

In recent years, a large number of applications (Apps) have evolved that enable individuals to set health and wellbeing goals, record exercise, weight and other statistics and measure their own progress. One example is the Nokia Wellness Diary, which has been utilised by the CSIRO E-Health Research Centre (EHRC) for their cardiac rehabilitation trial. Additionally, Social Technologies can reduce the isolation factor, particularly for those living at home alone. As the population ages and more people are living alone, social isolation among older people is emerging as one of the major issues facing the industrialised world because of the adverse impact it can have on health and wellbeing (Findlay, 2003).

2.15 Health Apps and Games

Health applications provide a source for users who like to use technology to monitor their exercise, diet, body and their whole well-being. All the health apps will be ranked according to its popularity worldwide. Some of the different health apps are follows: The Wellness Diary, developed by Nokia, enables users to track their exercise, including steps, distance travelled, heart rate and other data via their mobile phone, which is then uploaded automatically to a personalised web portal. The web portal also enables the user to set goals, view histories and receive hints on how to remain healthy. WebMD is a health app offering information on health, tools for managing health and also support to those persons who need advice. SparkPeople is another health app that offers tips on the health and nutrition and provides the resources that are free. The health app MedHelp enables users to access education and monitoring services.

2.16 Electronic Health Records

Electronic Health Records (EHRs) compile and store electronic health information for whole populations and or individual patients. The EHR is a digital record that can be communicated across various health care settings. EHRs may comprise of a variety of data, including medication, demographics, immunization status, medical history, allergies, radiology images, personal stats like the weight and age, billing information and laboratory test results (Habib, 2010).

Effectual and well-organized communications among the patient's care team, and including the patient, can ensure suitable correspondence among the professionals of health care and the physicians, reduce duplication, deliver improved coordination of care, and improve the security of the patient. An incorporated electronic health record is extremely advantageous in the sharing of the information among members of the team (Patients First, 2007).

Many countries have recently introduced EHRs to support care in emergency and unscheduled settings and improve coordination of care, including The UK, Canada, USA and Australia. In Australia a Personally Controlled Electronic Record (PCEHR) has been implemented by the Australian government, commencing from 1 July 2012. Note that EHR's do not necessarily need to be country wide. In fact, in the main, EHRs are small scale technologies implemented on a community basis. Electronic Communities of Care are community based integrated networks that enable providers, from different disciplines and organisations, to electronically share information, coordinate activities, and interface with care recipients and their families or carers (Briffa et al., 2009).

2.17 The Benefits of Collaborative Technologies

The case for investing more in Tele-Care and Telehealth so as to derive benefits for carers' consumers, carer provider organisations and care funders appears to be straight-forward yet investment in these technologies remains exceedingly low. There is some evidence emerging internationally to suggest these can decrease hospital admissions, provide care at lower cost, deliver consumer satisfaction, and improve work-force productivity, better assist consumers in self-care, and many other benefits. In Australia 9% or 552,000 hospital admissions were found to be potentially avoidable, with almost one third of those occurring in the 75 years and over age bracket (Glover et al., 2007).

The Quality in Australian Health Care Study by Wilson et al. (1995) found that 16.6% of admissions of people over the age of 65 years were associated with an "adverse event", which resulted in disability or a longer hospital stay for the patient. Of these adverse events, 51% were considered preventable as they were caused through health care management errors. In 77.1% of these events, the disability had resolved within 12 months, in 13.7 % the disability was permanent, whilst in 4.9% the patient died. Many of adverse events were associated with inadequate or poor quality information or information overload.

Research Australia Limited (2011), suggested that the social return of health R&D in Australia was in the order of $5 for every $1 dollar invested. In some areas, such as cardiovascular research, the returns are estimated to be even higher (in the order of eight to one). This report suggested that the "value" of increased longevity in Australia – approximately eight years added to life expectancy between 1960 and 1999 was worth $5.4 trillion. It argues that a significant portion of this rising life expectancy is the result of improved medical and health diagnosis, treatment and prevention, with many of these improvements being the result of research.

There is evidence of the impact of regional interventions on health outcomes, hospital admission rates and LOS. For example, recent research into integrated region care for elderly patients with complex care needs has indicated the potential to reduce hospital admissions by 28% and length of stay (LOS) by 19% (Bird et al., 2007).

As outlined previously, during the period 2003 to 2006, the Advanced Community Care Association (ACCA), was funded by the Government of South Australia to coordinate short-term community based services, in an attempt to reduce unnecessary hospitalisation. In that time, ACCA handled more than 17,000 short-term community care referrals which on estimates saved approximately $4.00 in the state's health system for every $1.00 spent (von Konkelenberg, 2006). The acceptance and potential value of minimising avoidable admissions was clear during the SA pilot study. The 2005 Oct–Dec quarter increase of 471% alone produced savings of $925,270 in 5,548 acute care bed days (von Konkelenberg, 2006).

The above examples clearly support the wide-scale adoption of collaborative health technologies. To date, there have been some clearly visible stand-out successes as identified. There have also been many failures with billions of dollars wasted globally. It appears from the research that, in most cases, the smaller scale localised trials have provided the greatest benefit, but the results of large scale, longer-term roll-outs have been less positive.

2.18 The Need for Evaluation

As can be seen above, in most cases, the financial and social benefits obtained through the use of technology enabled collaborative care models can fairly easily be quantified. For example, if a person has a fall in their home, and an alert is generated which results in assistance being provided quickly, this could avoid a lengthy hospital stay. Additionally, video technologies could be used to reduce the need for a nurse needs to call at a person's home to deliver a prescriptive medication from say 3 visits per day to 2 visits per day. Instead of the third visit, a nurse in a call centre could observe the candidate take the medication using a video phone.

Li and Benton (2006) explore the important role that technological investments and nursing development and training has on hospital performance from both a quality and cost perspective. The authors cite anecdotal evidence that casts concern on the assumption that technological investment is always appropriate.

2.19 Evaluation of Healthcare

The ecosystem of healthcare is altering. The confluence of technologies and health care pressures is demanding a complete re-evaluation of the systems of healthcare, and how care is delivered. Healthcare systems must evolve rapidly in order to address the forecasted epidemics of chronic disease and the necessities of the aging population. The modernization of healthcare is a main concern as Health authorities across the globe battle with the explosion in chronic disease and an ageing population. The detonation of health care data and the management of that data will also be required. These exacting disputes will result in the healthcare system of the future being underpinned by the facilitating technology and lead to patient – centric services that decrease complexity, increase efficiency and offer better patient results (Oracle Healthcare, 2010).

The change towards virtualised, personal healthcare that empowers patients and delivers life-long care is upon us. In this 21st century, there are great challenges for the healthcare systems which will need to overcome the myriad of obstructions before it can offer the clinical advantages of most of the important advances seen in the life medicine and sciences for the past few decades. An amplified capability to indicate symptoms and risks features, along with the huge data capacity, is providing a better approach into the nature of most of the diseases. These proceeds also offer the instruments to better forecast the progression of disease, particularly in some populations.

The ability to monitor and effectively respond to the changing circumstances of an individual's health may facilitate the moving of services away from facilities and into the home environment for circumstances that would previously have been prohibitive. The altering nature of the detection of diseases and the treatment also will need a substantial change in the systems of care (Oracle Healthcare, 2010).

The healthcare system is in transition. Buffeted by the increasing costs and rising demands for the resources, most of them are faulty systems that require replacement. Transformational answers are needed that will enable the data to be converted into information and the current inward looking systems engineered in order to engage both providers and consumers in associated care and prevention (Oracle Healthcare, 2010).

Measuring the costs and benefits of e-Healthcare models can be difficult and, in most cases, the valuation of outcomes, for example, hospital days avoided, is difficult to prove. A Cochrane review of published research evidence found Telehealth-Health and Tele-Care technologies to be reliable, non-detrimental and well-accepted by patients. The review found little firm evidence to date of benefits, safety or cost-effectiveness (Currell et al., 2010). At the time of this study, apart from trials and pilots around both Australia and the rest of the world, the adoption of AT remains low. More research and greater rigor is required to identify the measurable benefits.

Only the Personal Emergency Alarm has been widely adopted, with around 200,000 units (2009) deployed in Australia by companies such as VitalCall (www.vitalcall.com.au) and Tunstall (www.tunstallap.com). Other Tele-Care and Tele-Health technologies are rarely adopted outside of localised projects. Refer to Appendix C - AT Solutions Investigated for an overview of the alternative AT reviewed during the course of this study. It was in the context of this analysis, that both the socio-political and the technical aspects of the e-Healthcare models were considered. This analysis considered the integration of data and communications from various systems and technologies, integration of new technologies into a prevailing system of people, terms, practices, and information and communication skills. It also considered the integration of mobile, e-health, Telehealth and other technologies into the provision of care.

2.20 Calculating the Costs

Health Institutions, throughout the world, are facing significant challenges in meeting the rising costs of healthcare, and at the same time increasing demands by consumers for higher quality, less invasive, consumer focused services. Governments, health service managers and insurance companies are continuously looking for new and effectual processes and tools of management. Fundamental to these challenges is the need by the administration to have accurate cost information.

Information gained on the basis of historical models of cost accounting is insufficient for evaluating healthcare services. Costing models are required that, facilitate the complex modelling of the benefits and costs of differing models of care and the impact this has on scarce resources.

To meet this challenge, Activity Based Costing (ABC), is a proven costing methodology that, identifies activities in an organization and assigns the cost of each activity to services according to the actual consumption by each type of service. ABC offers advantages over traditional costing because it traces costs to activities via cost drivers rather than just fixed and variable designations. Cost drivers are defined as those things that cause or drive costs, for example, the number of service visits, the length of stay in a hospital bed, or types of interventions provided.

Traditional methods of costing tend to apportion overhead based on output costs. In contrast, ABC attempts to trace overhead to distinct activity measures. This enables more indirect costs (overheads) to be traced to direct costs compared to conventional costing models. Over recent years, ABC methodologies have progressively been adopted within the health care system and are now used extensively to calculate case-mix funding for hospitals and determine the funding levels for a wide range of health care programs (Health Policy Solutions in association with Casemix Consulting and Aspex Consulting, 2011).

ABC offers managers access to dependable, exhaustive and essential information on cost. The data collected from an ABC model can enable resource utilisation to be traced to organizational units, programs, procedures and even down to individual patients, depending on the complexity of the model.

2.21 Calculating the Benefits

With an increasing shortage of accessible resources in healthcare, a prime concern is the evaluation of the costs and advantages of each program. Economic evaluation of health care programs assists decision makers to better manage programs competing for these rare resources.

Cost effectiveness, cost utility and cost benefit analysis are the three main types of economic evaluations, of which the cost effectiveness and the cost utility analysis are the historically most widely used techniques. The key difference of these techniques exists in the units by which the advantages are calculated and valued (Drummond et al., 2005). All three evaluation methods identify cost in dollar terms, but differ in the way they identify benefits:

- Cost - effectiveness analysis (CEA) expresses benefits in terms of physical units, for instance, the quantity of tumours detected and fractures avoided. These types of analysis have a straight application, in that evaluations can be made only when the units of outcome are the same.
- Cost – utility analysis (CUA) enables programs to be compared using commensurable units of outcomes of health, mostly known as quality – adjusted – life – years (QALYs).
- Cost-Benefits analysis (CBA) expresses benefits in monetary units. This enables benefits to be compared against cost and distinct programs to be easily compared.

2.22 Cost Effectiveness Analysis

Cost-effectiveness analysis (CEA) is one form of full economic evaluation where both the costs and consequences of health programs or treatments are examined. CEA enables non-financial benefits to be identified, for example, an increase in life years as a result of a treatment, which can then be used to calculate the cost for each life year saved. For example, a treatment may cost $50,000 and on average provide an additional 5 years of life. This would equate to $10,000 per life year (Drummond et al., 2005 et all, Chapter 5, Pg.103.).

CEA is a tool that facilitates program managers to make knowledgeable decisions regarding the allocation of resources. By calculating and contrasting the costs and the effects of different interventions, their future requirements of resources can be estimated and examined. A key factor in the analysis of cost – effectiveness is that different work options can still lead to the same goal.

The outcomes of the examination are presented in terms of the cost per unit of effectiveness for each option. The ratio of cost – effectiveness is calculated for each option by dividing the price by unit of effect. Then a contrast can be done among these ratios. The option with the lowest cost per unit will usually be favoured on economic grounds. Alternatively, a higher cost per unit option may be considered

due to socio-political influences, for example, where the lower cost option could result negatively on local staff employment.

CEA can therefore assist program funders and service providers to make better decisions on utilizing current and new or fresh resources. The data of the cost – effectiveness can assist planners to evaluate which strategies, and what mixture and quantity of each, will offer the greatest value for money in the circumstance of the desired objectives

Using CEA to measure outcomes of eHealthCare models may prove useful in terms of measuring incremental health effects as a result of a program, for example, a reduction in blood pressure, but it does not take into account the quality aspects of the outcomes.

2.23 Cost-Utility Analysis

Cost-utility analysis (CUA) is a form of evaluation that focuses particular attention on the quality of the health outcome produced, or forgone by health programs or treatments (Drummond et al., 2005 et all, Chapter 6, Pg.137.).

The basic result of a cost – utility analysis is the determination of an incremental cost effectiveness ratio (ICER), or cost per QALY (Quality Adjusted Life Year).

As the distinction in the usual cost of the two interventions, this can be calculated and divided by the distinction in the expected QALYs created by the two interventions. It is assumed in the previous literatures on the cost – utility analysis that the outcomes of these analyses could be utilized to create a league table of cost – utility that provides a ranked list of interventions. These could be utilized by decision makers to categorize which treatments have to be funded, by beginning with the most proficient intervention, that is, the one with the least cost per QALY and working down the table till the budget was exhausted.

Though, this may need details on the incremental cost – effectiveness regarding all the interventions offered by a health service could be calculated. The outcomes of the cost – utility analysis could be used to determine a threshold, below which interventions would be usually funded, whilst interventions above the threshold may not be. The thresholds of an intervention are usually referred to as the readiness to pay for the gain of health (Shepard, 1999).

2.24 Cost Benefit Analysis

Cost-Benefit Analysis (CBA) is a main stream methodology that requires program consequences to be valued in monetary units, thus enabling the analyst to make a direct comparison of the Program's incremental cost with its incremental consequences in commensurate units of measurement, be they dollars, pounds or yen (Drummond et al., 2005Chapter 7, Pg.211.).

CBA simply calculates the advantages of a program and contrasts those advantages to the price of attaining them. In order to conduct a cost – benefit analysis, the dollar benefits of a program need to be calculated and divided by the dollar cost of a program. The outcome of the CBA is characteristically uttered as the advantages per dollar of costs. CBA is suitable in a lot of diverse situations. It is highly useful for contrasting the value of different programs and can be the easiest to perform.

Basically, the CBA is useful in comparing the cost – effectiveness of two alternative programs with the same results. The limitation of CBA is that, reducing the performance of a program to a numeric cost benefit dollar value focuses on the benefits of the program in monetary terms but ignores the socio-political benefits that may also occur (Broadway, 1974).

2.25 Valuing Benefits in Monetary Terms

To assist with the calculations of benefits, wherever possible, previously identified research outcomes should be utilised to substantiate the net benefit derived.

The cost-effectiveness of cardiac rehabilitation is well established (Briffa et al., 2005; National Heart Foundation of Australia, 2010). An Australian study estimated that, among patients who have experienced an acute coronary syndrome (heart attack or unstable angina), cardiac rehabilitation costs approximately $42,535 per quality-adjusted life year saved (allowing for the effect on survival), compared with standard care (National Heart Foundation of Australia, 2010).This level of cost-effectiveness is consistent with the levels accepted by decision-making authorities such as the Pharmaceutical Benefits Advisory Committee.

So, as per the hospital avoidance "Falls" example, where a hospital admission has been prevented, or the length of stay (LOS) reduced, the days saved can then be multiplied by the estimated cost of hospitalisation and related services to generate a benefit and the costs of the service calculated, presuming they were less, to estimate a net financial benefit.

Many of the benefits can be intangible and subjective. For example, a patient may choose to receive care in the familiar surroundings of their home, instead of in a hospital ward as this would allow their family pet to stay by their side. It would be almost impossible to place a value on this benefit. Reduced future costs and improvements in health care outcomes as a result of a program are often much more difficult to quantify and can be distorted by time, secondary health issues and other factors. Additionally, benefits can be viewed from multiple perspectives, including cost, quality, access, health outcomes and participation. Furthermore, a benefit to one stakeholder may not necessarily be viewed as a benefit to another stakeholder. For example, a reduction in nurse visits to provide medications may reduce costs for the provider, a positive benefit, but this may negatively impact on the social and mental needs of the recipient, a negative benefit.

In a review of research articles on measuring the costs and benefits of e-Healthcare, while many studies, papers and presentations have focused on the reduction in costs, most studies have struggled to clearly articulate the non-tangible aspects.

CBA and its related evaluation techniques, CEA and CUA rely on the ability to accurately cost the services provided by, or through the e-Healthcare model. Calculating the costs of delivering a single service, by a distinct workforce, in most cases, is relatively straightforward. Calculating the costs of multiple programs with alternative service models and where care services are delivered by an integrated workforce is a far greater challenge.

2.26 Difficulty in Measuring Quality

While authors agree that the quality aspects of care are multidimensional concepts laden with personal perceptions and judgment, most authors do not define quality and instead proceed immediately to identify defining criteria or indicators of quality. Following the advice of Donabedian (1969), that evaluation of quality of care be approached by examining structure, process, and outcomes of care, most authors organize their discussions of quality of care using these three categories to cluster quality measures or indicators (Rantz et al., 1999).

Evaluating assistive technology (AT) services to demonstrate quality or to measure outcomes is the ethical obligation of the entire AT community (DeRuyter, 1995). Accountability must be accepted by all stakeholders in order to evaluate all aspects of service delivery. Developing an integrated system will require addressing issues that the AT community has not previously had to face (DeRuyter, 1995). Human presence has been identified as an important dimension in this context of care and must be considered when developing concepts for use and evaluation of assistive technology services (Harrefors et al., 2010).

Community health professionals such as registered nurses, occupational therapists, social workers, carers and physiotherapists work in a field where there is a likelihood of a high level of adverse events, conditions and unmet needs of the frail elderly and others needing support in home and community settings (Soar & Youngjoon, 2007). These adverse events include falls, difficulties in managing medications, incontinence, social isolation, fear of crime, depression, cognitive decline and associated challenges such as wandering and safety concerns (Soar & Youngjoon, 2007). Such issues are similarly highlighted by other researchers (McMillen & Soderberg, 2002) who identified that the relationship between the approach that people take to their illness and the acceptance of using assistive technology needs further study. They also suggest that further research concerning the way in which people handle their dependence on assistive devices needs to be conducted.

In an exploratory study undertaken to discover the defining dimensions of nursing home care quality from the viewpoint of consumers of nursing home care, eleven focus groups were conducted in five Missouri communities. The seven dimensions of the consumer multidimensional model of nursing home care quality defined were: staff, care, family involvement, communication, environment, home, and cost. The views of consumers and families were compared with the results of a previous study of providers of nursing home services. An integrated, multidimensional theoretical model was presented for testing and evaluation. An instrument based on the model was used to observe and score the dimensions of nursing home care quality. Copyright (c) 1999 by Aspen Publishers, Inc.

Following an extensive review of research articles on integration, many studies, papers and presentations have focused on the need for and the benefits of integration, at this time, a framework for measuring the level integration and the impact this has on the quality and cost of providing care has not been developed.

2.27 Balanced Scorecard (BSC)

The balanced scorecard is a strategic planning and management system used to align business activities to the vision and strategy of the organization, improve internal and external communications, and monitor organizational performance against strategic goals (Balanced Scorecard Institute, 2012). The balanced scorecard (BSC) is a means to evaluate corporate performance from four different perspectives: the financial perspective, the internal business process perspective, the customer perspective, and the learning and growth perspective (Protti, 2002).

2.27.1 How the BSC can be used in Health Care?

The balanced scorecard (BSC), which strikes a balance between financial and non-financial measures, has commonly been applied in evaluating organization-based performance. This enables organisations to consider their performance goal of customer satisfaction and other intangible goals in addition to financial performance (Wu & Kuo, 2012).

In an environment of expanding demand on the health care system usage of information communication technology is one of the strategies identified to provide equitable, accessible and safe health care. It is agreed by most stakeholders in health services that an Electronic Health Record (EHR) is a valuable tool towards achieving better health care using such technology. In reality though, across the world EHR implementations have experienced a high failure rate. Nevertheless South Africa has made a strategic decision to implement EHR system in the public health sector. An evaluation toolkit was developed, to measure the state of readiness of health institutions in South Africa in implementing EHR based on Kaplan and Norton's work on Balanced Score Card (BSC), and the subsequent variant model developed by (Protti, 2002). A Critical Success Factor (CSF) scorecard to assess the state of readiness and a Balanced Score Card matrix was developed as a strategic framework. These tools were validated using critiques by a panel of experts. The toolkit developed has the potential to assist the organization towards a better EHR implementation path (Yogeswaran & Wright, 2010).

The BSC therefore offers us a tool to evaluate and present the non-financial benefits of health care.

2.28 Barriers to e-Healthcare Implementations

Healthcare involves a wide range of actors and activities, linked together in a complex web of relationships between each other and with the technologies they use (Houghton, 2003). This highly fragmented environment, which incorporates a wide range of complex transactions, policies, privacy issues and funding models, presents a significant barrier to the application of ICT.

Though the costs and benefits of an e-Healthcare program may provide a convincing argument, there may still be barriers to implementation that either prevent the program from being implemented in the first instance, or may result in its pre-mature conclusion. For example, in the ACCA trial, even though there were many proponents who supported the trial, some clinicians in the public hospitals involved in the trial, argued that there were no savings for their hospitals, as their beds were fully occupied prior to the trial and during the trial.

If there was no benefit to the hospital occupancy, then this leaves us with several other alternative outcomes. These, include:

- The 17,000 referrals, or a major proportion of them, were not valid. In an independent review by a group of clinicians and GPs, there was convincing evidence that at least 85% of the participants would have been admitted to hospital (Soar et al., 2008).
- There were savings in other hospitals. There was only circumstantial evidence for this.
- Waiting times for admission for elective procedures had reduced. Again there was only circumstantial evidence to support this.

The independent evaluator, appointed by the South Australia Government, identified a $4 saving for every $1 invested, and yet the ACCA service was eventually dismantled. In a post-mortem evaluation of the trial, the feedback from the organisations involved in the trial conclusively agreed that there was not enough effort placed on collecting substantive evidence to demonstrate the cost effectiveness of the program.

This disjunction between expectation and reality has prompted much commentary and numerous policy recommendations (Jennett et al., 2004). A number of studies have focused on Tele-Health, which has promised so much. Researchers investigating why implementations have been so difficult, and what is needed for successful uptake, typically construct lists of barriers and enablers that are perceived as influencing the outcome. Three reviews of such research collectively indicate that the enablers were well-functioning technology, user training, planned change with provider participation, development of protocols, acceptance by health care providers, support for provider collaboration, use of a business model, and supporting policy and legislation (Broens et al., 2007; Jarvis-Selinger et al., 2008; Obstfelder et al., 2007). Barriers cited were technical problems, lack of technical support, lack of usability, provider concerns about quality and ethico-legal matters, absence of protocols, lack of a business model, and regulatory barriers in licensing and standards.

This approach to understanding how innovative practice is adopted in health care delivery is commonly used, however, it lacks an explicit theoretical framework as does the majority of research in Tele-Health (Gammon et al., 2008). The implicit assumptions are that each factor has some degree of impact and that the use of Tele-Health can be encouraged by increasing the enablers and reducing the barriers. A recent meta-review by Mair et al. (2012) of the uptake of e-health, concluded that despite the proliferation of reviews of barriers and enablers, the underlying mechanisms have not been well characterized or explained. A systematic review by Robert et al. (2010) of assimilation of technologies into health care, also noted that the vast majority of adoption research was theoretical and that no simple, fully predictive model had been developed.

2.28.1 Silos

Silos, as the name confers contain information that is not easily accessed or shared with others. Silos are present in both the micro and macro levels in healthcare. At the macro level silos exist across the health continuum, including government, hospitals, practices, residential and home care providers and other agencies.

At the micro level, inside each of these organisations more silos exist between work units, including management, IT, HR., Quality, Nursing, Medicine and between programs and services. Within healthcare there is anticipation that the daily work will increase, requiring services to be completed at a faster pace and in more cost proficient ways, adding pressure to already strained services. The outcome of this fragmentation is resulting in spasmodic, uncoordinated care instead of holistic care.

One of the total objectives in the reform of healthcare is to shift from a system of fragmented services to an integrated model that offers services more effectively and has a lower cost. Breaking down the silos can assist health providers to deliver coordinated care that improves the flow of patients and the total effectiveness of the firm.

It is proposed that e-Healthcare has the potential to break down these barriers, by enabling care professionals to seamlessly access and share information, and strive towards the goal of delivering holistic care.

2.28.2 Funding Models

As healthcare costs increase, government and agency funding models will come under increasing pressure to deliver more outcomes for the same cost. Decisions on the policies and allocations will not be easy as funds are directed away from services that are deemed as important but not essential, towards services that are deemed to be critical, for example, the Emergency Department at a major city hospital.

A detailed, but non-exhaustive evaluation of the literature provided a restricted number of arguments on ethical considerations in regards to funding policies and how funds could be better spent. Without exception, the moral justifications in the revised literature are based on the attitude of justice and / or outcome or consequence. From a search of the literature, five e-Healthcare funding models have been identified, including Expansion models, Potential / Age -Rationed Model, Traditional Disease Model, Social Fairness Model and Prevention / Personal Responsibility Model. These models work objectively, for the purpose of funding for the healthcare. There are also many supports and refutes for each of the particular e-Healthcare funding models (Niessen et al., 2000).

In an environment of expanding demand on the health care system to provide equitable, accessible and safe health care, usage of information communication technology is one of the strategies identified to fulfil such expectations.

2.28.3 Ethical Considerations

The ethics involved in providing AT is not widely discussed in the literature reviewed for this study (Zwijsen et al., 2011). This is evidenced in a warning sounded in 2011 and again in 2012 in relation to continued global trials of short term implementation of AT (Goodwin, 2012; Kerr & Murray, 2010). They suggest being wary of not working closely within a unified system. Partnerships between industry and consumers and purchaser of the technology must be established and long term (3-5- years at least) this signifies that industry must make a long term commitment (Goodwin, 2012). Not to do so could lead to outcomes to be avoided such as AT not being user friendly and easy to manage, escalating costs, poor operational efficiencies across and between systems with ongoing poor service and staff burnout.

Kerr and Murray (2010) raise a cautionary voice in relation to ethics and the use of AT. They propose that any approach based on individual assessed needs will always present ethical dilemmas (p.38) and that decision making about AT must respect the rights for the independence of individuals and that there may be many ethical issues between providers and clients. They ask what are the legal issues about overriding peoples' desires for AT; can we legitimately prioritise the risks against aspirations of users (p.34-38), how may the AT actually limit the users freedoms and rights and how should decisions made be recorded?

Another intriguing thought posed by these authors considers that AT is being used to impose a controlled lifestyle, where that may not be the preference of the recipient. Because of health providers duty of care to clients there is the possibility that at times, institutional policies may conflict with user expectations (Kerr & Murray, 2010; Valios, 2008). It is suggested that the answer to these questions is that providers have the responsibility to make decisions that are ethically defensible and legal (p.37).

These are always significant points to be dealt with when working closely with clients and carers. It is of interest that not many authors have addressed the ethical issues involved in decision making about AT. They have informally suggested that, consumers must be involved in all decision making and should always be listened to, stopping short of actually exploring the impact of ethics and AT provision (Weaver et al., 2008; Tinker & Lansley, 2005; Young, 2003; Vergados, 2010; Valios, 2008).

It has been suggested by Bonner and Idris (2012) that while there has been some debate about the ethics of using AT. One area that has not yet been resolved is that of the concerns of professionals involved in providing the AT into homes. Suggestions from these authors indicate that this may pose a barrier to the uptake of the AT as well as making the home so complicated that it becomes beyond the abilities of the carers and clients to manage, and in doing so has the potential to damage self-esteem. It is also suggested that the provision of AT may pose the risk of fostering a one sided approach rather than a focus on the abilities of the client and developing these (p.5).

2.28.4 Uptake of Healthcare Programs by Consumers

Cardiac rehabilitation is increasingly recognised as an integral component of comprehensive cardiac care. The evidence supporting its effectiveness in reducing morbidity and mortality and improving quality of life is compelling. Yet, despite this recognition and exhortations that its implementation should be a key priority, most cardiac patients do not receive rehabilitation. Service provision varies markedly and many programs that focus on select populations often operate in an inflexible manner and fail to add potential value. Issues of suboptimal referral, enrolment and completion are poorly addressed and the potential for embracing novel methods and the latest technology are rarely exploited (Thompson & Clark, 2009).

2.28.5 Solution Development and Information Systems (IS) Research

Solution development is an activity specifically related to Information Systems (IS) research, which in turn is an integral component of Management Information Systems (MIS). Researchers of MIS are primarily focused on the integration of systems with their study efforts spanning a diversity of methodologies. These efforts of integrated research, which are usually referred to as the projects, can have comparatively long lifetimes and stages through which they evolve, concept, development, impact. Accordingly, the development of systems can be viewed not only as a genuine approach to the information system research, but also as a serious provider among the available methodologies.

Possibly the chief motivation in the research and evaluation of Information Systems is regarding what processes can be automated, and how they can become more effective and efficient. This is consistent with the model of concept, development and impact. It is suggested that the theories that are required to offer an ongoing test bed for the system, and that evaluations of specific instances are required to quantify the failure or success of a system in both social-political and technical terms. System development involves five levels. These are the design of the concept, building of the architecture of the system, prototyping, development of product and transfer of technology. In the concept design the adaptation and grouping of technological and the theoretic advances into the probably practical applications. The prototyping is utilized a proof of the idea to validate viability. Much of the research on the systems development stops at this level since it fails to meet primary expectations. Constructing a prototype system is a concept of engineering. Often the researchers in the development of systems conduct their study by constructing a prototype system. If the system has to be tested in a real – world setting, an exertion to further construct a prototype into an invention and the shifting of the product into a firm is required. The gathered knowledge and the experiences will be more helpful in the redesigning of the system. After the system had been built, empirical studies regarding the usability and functionality of a system will be performed (Hitch & McKean, 1960).

In a critical review of systems development in information systems (IS) research, several classification schemes of research are described, and systems development is identified as a developmental, engineering, and formative type of research. A framework of research is proposed to explain the dual nature of systems development as a research methodology and a research domain in IS research. Progress in several disciplinary areas is reviewed to provide a basis to argue that systems development is a valid research methodology. A systems development research process is presented from a methodological perspective. Software engineering, the basic method is applying the systems development research methodology, is then discussed. A framework to classify IS research domain and various research methodologies in studying systems development are presented. It is suggested that systems development and empirical research methodologies are complementary to each other. It is further proposed that an integrated multidimensional and multi-methodological approach will generate fruitful research results in IS research

2.29 Collaboration Theory

Currently there exists a wide range of collaboration concepts and theories, but no consolidated, general theory of collaboration (GTC) could be identified in this review. Such a theory could provide a common language and framework for those seeking to better understand and expand the collaborative aspects of any given field of human endeavour. Additionally, a GTC would provide a body of knowledge on which those developing collaborative software and other design-based enterprises might draw.

Collaboration is fostered when there is an expected beneficial outcome by the collaborators. If human nature is basically selfish, due to our inherent primal survival instincts, collaboration is a step above selfish thinking when we can see the benefits of our combined efforts. Successful Collaboration has been described as Synergy, where the sum is greater than all the parts; i.e. 2+2=5. This can be true if all four collaborators are outcome driven, and have left their selfish interests behind. Unfortunately, due to the independent nature of modern western man, it is all too common that 2 + 2= 3 depending on the net loss of effort caused by selfish interests.

2.30 Summary

The main points of this review have demonstrated that a gap clearly exists in the area of effective evaluation of e-Healthcare solutions aimed at delivering care at a distance. Based on the findings of the literature review and utilising the key elements of the outcomes of the review with each of the above techniques, a Cost-Benefits Scorecard (CBS) has been proposed as a framework for evaluating e-Healthcare models. This framework will enable both the financial and no-financial elements of e-Healthcare service models and their underlying technologies to be evaluated and presented.

The CBS framework enables the costs and benefits of a technology enabled care service to be quantified and presented in an integrated scorecard that summarises the costs, benefits and effectiveness of alternative care models. At a detailed level, the CBS model provides quantifiable measures that can be used to identify aspects of a service that can be improved, with the use of appropriate technologies.

CHAPTER 3 - RESEARCH FRAMEWORK

Outlining his vision for the future of healthcare, Flower (1999) suggested that:

"Health care, at its base, is about a deep, ongoing series of connections, between the patient, the doctor, the doctor's colleagues and peers, the institution, the pharmacy, the vendors, the patient's family and support network, the home health providers, the emergency medical technicians, the public health network, and the whole world of knowledge about health, disease, medicine and prevention. All of those connections will become closer, more intimate, deeper, wider, more easily navigated and searched".

Information Communication and Technologies (ICTs) are altering the relationship and balance of power between patients and providers, leading to more empowered consumers and enhanced self, home and community care capabilities. Perhaps the greatest change in the patient-provider relationship will be brought about by the use of internet by patients. Broshy (1998) suggested that two types of information will be particularly important – information about managing health and chronic disease, and information about provider quality and cost. With the rise of more informed consumers, there will be increasing scope for stakeholders to influence e-Healthcare behaviour, prescription, treatment and referral decisions and compliance through patients, as well as through doctors.

The aim of this section is to clearly outline the research purpose and the nature of the research framework. It commences with defining the research purpose, which is followed by a review of theoretical concepts and their applicability to this study, the selection of a Framework and finally the research approach.

3.1 Research Purpose

As advances in technologies enable new e-Healthcare models to emerge, it will become imperative for program researchers and evaluators to employ an array of quantitative and qualitative methods and techniques to answer the many efficiency and effectiveness questions that various stakeholders are likely to pose (Chen et al., 2010). When designing, developing or implementing an e-Healthcare model, the primary questions that the researcher proposed to guide this research project are:

Question 1 "How will the e-Healthcare model provide more cost-effective services and better care outcomes for older persons and persons with chronic and disabling conditions?"

AND

Question 2 "What are the barriers that will inhibit its uptake?"

The research literature includes numerous studies reporting on evaluations of health care interventions. The majority of these are focused around the delivery of face-to-face interventions, immunizations and medication management, whilst a smaller number have focused on the use of Tele-Health and Tele-Care to deliver services at a distance (Rychetnik et al., 2002).

For the purposes of this study:

- E-Healthcare is defined as the merging of collaborative technologies, health services and information systems to enable care to be delivered at a distance.
- Collaborative technologies are defined as both hard and soft technologies that enable us to interact with each other, and collect and share information.

Efforts to identify studies that evaluated the use of collaborative technologies in delivering care at a distance have provided a growing number of papers, but a lack of conceptual frameworks to guide the evaluation. Evaluating the effectiveness of an e-Healthcare model will require the researcher to take a multi-dimensional view of the model, in order to measure its effectiveness (Yee et al., 2006).

The primary aim of this project was to develop a framework that would enable the health and socio-economic benefits of e-Healthcare models to be evaluated from the multiple perspectives of providers, recipients and funders. This framework would also take into account the impact of barriers, enablers and cultural influences on the implementation, uptake and success of the e-Healthcare model (Ball & Lillis, 2001).

This would be achieved by firstly developing an initial e-Healthcare evaluation framework, drawn from the literature and the researcher's previous experience, and then refining the framework through a series of case studies.

It is proposed that this thesis will provide Government, Providers, Researchers and Solutions developers with a conceptual framework and methodologies that will assist them to evaluate the costs and benefits of e-Healthcare models. It will also assist them to better understand how the increasing ability to collaborate between providers and with recipients impacts on care outcomes and the delivery of sustainable care, in an increasingly ageing society (Wickramasinghe et al., 2005).

The methodologies and experiences will also add to the body of knowledge in health care information systems.

3.2 Theoretical Concepts

Theory provides a framework, guiding the selection of intervention components from a huge array of what might work, it guides the choice of study design and samples, and it helps select appropriate outcomes for measuring the effects of the intervention.

3.2.1 The Importance of Theory

Theory provides a systematic view of a phenomenon by specifying the relations among variables and propositions with the purpose to explain or predict a phenomenon that occurs in the world (Creswell, 2002).

Theory offers many advantages to the health care services researcher. Theory helps to identify the appropriate study question and target group; clarify methods and measurement issues; provide more detailed and informative descriptions on characteristics of the intervention and supportive implementation conditions; uncover unintended effects; assist in analysis and interpretation of results; and, the successful application of an intervention to different settings (Weiss, 1998; Sharma et al., 2006).

Theory-driven studies address the challenge of both decision-makers and funding agencies to move beyond simplistic explanations of significance in health services research. Decision-makers are seeking explanations about how an intervention works and whether it will work in a fashion similar to the intervention that was evaluated when applied to a different environment (Bates et al., 1998; Sprague, 2004; Wolff, 2001).

In identifying health program effectiveness, theory may consider program design, implementation and contextual factors. While it is important to know the extent to which a program attains intended outcomes, it is also essential to know how these outcomes were achieved. Even though a program may be successful in one setting, it may not necessarily be successful in another setting. Variation in the success of a program may be due to differences among program providers, target population characteristics, and differences among sites on how the program is delivered. Other factors, including technical, socio-political and locality barriers may impact significantly on outcomes, or even prevent a program from being implemented.

Theory also offers the opportunity to specify the contextual conditions that will influence the effectiveness of a program. Attitudinal factors at the provider level as well as structural, cultural factors at the organizational level have been under appreciated in exploring variations in health care outcomes (Foy et al., 2001; Sheldon, 2001; Ferlie E & Shortell, 2001).

Understanding the influence that contextual factors have on program implementation and outcomes may significantly assist in the successful application of the program in alternate settings. According to Green (2000) the promotion of health requires careful planning to be effective and efficient. Theory can guide planning of program, supporting to assure that interventions attain and have a demonstrable influence on organizations, individuals and communities. Models and theories are an essential form of proof. Theory requires research based proof, alongside evaluations, national policy and academic literature. Scheduling, monitoring, commissioning and implementation methods based on theory are more likely to succeed than those developed without the advantage of a theoretical perspective. Theory offers an important framework for studying issues, developing proper interventions and evaluating their successes. Theory is specifically useful in critical situations.

Similarly Wills and Earle (2007) have described that no individual theory dominates the promotion of health. One of its strengths is that health traces from a vast number of disciplines such as psychology, sociology, biology, economics and geography. Sufficiently representing a health issue will likely need more than one theory. Theory, practice and research are inter-linked. As health research has unfolded through theory guided practice, empirical observations have resulted in the theories being refined. Theory evolution is a desirable and expected consequence of practice and research, with one major criticality. In providing evolving theories to professionals of health care, the question is who will apply theories in their research and practice and as an outcome contribute to the specific theory evolution by verifying its utility?

3.3 Selecting a Theoretical Framework

A theoretical framework is defined in this study as the structure of concepts which exists in the literature, a ready-made map for the study (Liehr & Smith, 2006); it provides the structure for examining a problem and serves as a guide to examine relationships between variables (Ingelse, 1997).

This study seeks to evaluate the effectiveness of e-Healthcare models, in terms of inputs, usage and outcomes. This component of the research focused on the investigation of theoretical frameworks and constructs that could be used to develop a conceptual framework, for evaluating the effectiveness of e-Healthcare models in the delivery of community based care to older persons and persons with chronic and disabling conditions.

A range of frameworks and methodologies were evaluated, and discussions took place with associates working in financial, social and management roles. This research has also involved, interpreting and understanding the technical, financial, social and political relationships involved in the implementation of healthcare technologies.

Key research words used in this thesis include: health care, technology, collaboration, e-Health, eCare, e-Healthcare, coordination, access, participation, health outcomes, safety, quality, resource effectiveness, enablers, costs, cost drivers, barriers, influencers and uptake. In addition to these terms, there is also a myriad of other secondary research words that can be found in the text that may assist in the determination of the theoretical framework, including perspectives, user interface, economic modelling and many others.

3.3.1 Systems Theory

Systems theory promises to offer a powerful conceptual approach for grasping the interrelation of human beings, and the associated cognitive structures and processes specific to them, in both society and nature (Jordan, 1998).

Systems theory can model complex intrapersonal, interpersonal, intergroup, and human/nature interactions without reducing perceptual phenomena to the level of individual stimuli (Jordan, 1998). The method proposed by systems theory is to model complex entities created by the multiple interaction of components by abstracting from certain details of structure and component, and concentrating on the dynamics that define the characteristic functions, properties, and relationships that are internal or external to the system (Jordan, 1998).

For example, in the current study information systems (IS) research is generally interdisciplinary concerned with the study of the effects of information systems on the behaviour of individuals, groups, and organizations (Galliers et al., 2006).

Ciborra (2002) and Hevner et al. (2004) categorized research in IS into two scientific paradigms including; behavioural science, which is to develop and verify theories that explain or predict human or organizational behaviour, and design science, which extends the boundaries of human and organizational capabilities by creating new and innovative artefacts.

3.3.2 Health Services Research Theory

Health services research theory can provide a framework to understand the relationship between program inputs (resources), program outputs or activities (how the program is implemented) and their outcomes (Ricketts, 2005; Lipsey, 1990).This study seeks to understand and evaluate the role of technologies in enhancing the delivery of home-based care to persons with chronic and disabling conditions.

Health services research theory can provide a wide range of qualitative constructs, with additional theory required to articulate the system processes and how these interrelate with individuals who access them. Theories about the relationship between individuals and technology regard usability as the critical success factor in health technology implementation (Kay, 2005). For example, the human factors approach (Salvemini, 1999) and the sociotechnical model (Sittig & Ash, 2011) both deal with the user-technology interface and recommend involving users in system design and testing.

Health technologies can substantially change the way services are delivered. For example, the use of Telehealth can have a significant impact in the delivery of services to regional and remote locations. However, to participate in this type of service requires a mind change away from the need to meet with a person face-to-face, and most importantly the technology must have clinical acceptance. Health technologies, such as Telehealth can therefore be described as being disruptive innovations.

Disruptive innovation is a process theory, which concerns innovations that produce fundamental changes in the market, and are therefore resisted more strenuously than incremental innovations (Schulman et al., 2009).

3.3.3 Collaboration Theory

This study seeks to understand how collaboration between providers and consumers can be enhanced by e-Healthcare models and what impact this may have on the increased participation of consumers in their own health care. From the management sciences field, (Gittell, 2002b) has introduced a framework of relational coordination to understand the dynamics present in teamwork or collaboration.

Several studies have investigated the relational aspects of coordination. Relational coordination has been linked to higher patient-perceived quality of care and reductions in length of stay for joint arthroplasty in hospital orthopaedic departments (Gittell, 2002a; Gittell et al., 2000). In the hospital setting, Shortell et al. (1994) found that higher reported quality of caregiver interactions in intensive care units was strongly associated with lower risk-adjusted Length of Stay (LOS), lower nurse turnover, perceived technical quality of care, and perceived ability to meet family member needs, but was not associated with risk-adjusted mortality (Jeyaraj et al., 2006). In 126 studies of nurse-physician collaboration by Baggs et al. (1992), also in the intensive care setting, suggest that better inter-professional collaboration as reported by nurses may be associated with better patient outcomes and provider satisfaction (Murray, 2005).

Online collaborative tools are the means and mediums of working together on the Internet that facilitate collaboration by individuals who may be located in vastly different geographical areas (Srinivas, 2008).

3.3.4 Uptake Theory

This study sought to understand the forces involved in the implementation of e-Healthcare models and how these can impact on their uptake and success.

Several types of theories focus on processes. For example, life cycle theories suggest that different processes are important at different stages of technology implementation (Jayalath, 2010). Chiu (2010) developed a *lifecycle model of e-health uptake* with acceptance being most important at the initiation stage, progressing to perceived burden of use at the later outcome stage (Chiu & Eysenbach, 2010). This model emphasizes how the level of collaboration between the different stakeholders impacts on the uptake of e-Healthcare services.

3.3.5 Secondary Review

The conclusion from the initial theory review was that there are a number of big picture frameworks that could guide this study, but no one framework could be located that focused on the specifics of the study.

This prompted a secondary review of potential theoretical frameworks, where the primary objective of the study was re-clarified in terms of its basic purpose; that is to develop and trial an evaluation framework and methodology that would assist researchers to measure the benefits of an e-Healthcare model. Using this definition and learnings from the research, the study requirements were identified as requiring a combination of Health Systems Theory, Information Systems Theory and Health Economics Theory.

These frameworks can apply across differing settings and individuals; and provide a framework for analysis. An additional search identified a number of more specific theoretical frameworks that have been applied to studies of technological change in health care and informatics. Importantly, contributions have been made to understanding the role of attitudes (Jeyaraj et al., 2006), and social transmission of innovations between or interactions within actor-networks (Legris et al., 2003). More recently, Greenhalgh and Stones (2010) have offered a high level and abstract theorization of ICT programs from the perspective of Structuration Theory.

March and Smith (1995) proposed a framework for researching different aspects of Information Technology including outputs of the research (research outputs) and activities to carry out this research (research activities). They identified research outputs as follows:

1. Constructs, which can be used to conceptualize interactions within an environment and to highlight problems and possible solutions.
2. A model, which is a set of propositions or statements expressing relationships among constructs.
3. A method, which is a set of steps (an algorithm or guideline), used to perform a task. Methods are based on a set of underlying constructs and a representation (model) of the solution space.

This study was primarily focused on developing a conceptual framework and methodology that could be used to evaluate the potential of healthcare technologies in enhancing the quality of health care, benefits, performance, and effectiveness (for example, health outcomes and cost reductions). To achieve the goals of the study, an

overarching framework was required that could be used to guide the development of the conceptual evaluation framework. In order to achieve the goal of the study, a more specific framework was required. This led to an extensive search of e-Health specific frameworks, as listed in Table 3-1 e-Health Frameworks Investigated:

Table 3-1 e-Health Frameworks Investigated

#	Framework	Description
1	A framework for the design of user-centred tele-consulting services(Esser & Goossens, 2009)	The framework proposes a user-centred design approach for telemedicine systems by taking the first step of mapping the underlying theoretical dimensions relevant for tele-consultations, taking the patient-provider interaction as the starting point. User-centred design is a design approach in which the needs and requirements of users are considered at each stage of the design process.
2	Evaluating e-Health interventions: the need for continuous systemic evaluation (Catwell & Sheikh, 2009)	The framework proposes a comprehensive overall evaluation approach, one that encourages a multifaceted, multi-disciplined approach and facilitates continuous systematic evaluations throughout the lifecycle of an e-Health intervention. The authors state that RCTs alone fail to take sufficient account of the contextual considerations; these design methodologies alone are often less well suited to evaluate the impact of e-Health interventions in a complex environment. According to the authors, design teams need to gain a thorough understanding of the stakeholders' needs, concerns, values, and beliefs, and define (as far as possible) what the eventual system will be expected to provide.
3	An evaluation framework for health information systems: human, organization and technology-fit factors (Yusof et al., 2008)	Structure a debating tool that stakeholders can access in order to know their own health system better. The framework provides **evaluation dimensions** for addressing the fit between human, organization, and technology factors. The **HOT-fit** framework can and should be applied in a flexible way, taking into account different contexts and visions, **stakeholders' point of views**, phases in the system development life cycle, and **evaluation methods**.
4	Evaluation of e-health services: user's perspective criteria (Hamid & Sarmad, 2008)	The framework proposes u**ser-centred evaluation criteria** for e-Health services. The authors state that the evaluation criteria can serve as part of an e-Health evaluation framework. A **sequential multi-method research approach** is adopted by the authors. The framework only considers one stakeholder or a group of
5	Design & evaluation in e-Health: challenges and implications for an interdisciplinary field (Pagliari, 2007)	Framework to facilitate **interdisciplinary collaboration between** software developers and health services researchers. The author discusses the importance of research for ensuring that new e-Health technologies are adopted and effective. Evaluation should ideally be approached as a longitudinal process occurring through a series of overlapping and **iterative stages** relevant to the maturity of the technology in its lifecycle, from initial conception to rollout. The framework presents the **evaluation research methods** during the development and implementation process.
6	Evaluation framework for health information system design, development and implementation (Kaufmann et al., 2006)	The framework provides a heuristic for matching the stage of system design and the level of evaluation (**continuous evaluation**). A **user-centred approach** to design is presented. The authors state that the incorporation of **sound evaluation methodologies** throughout the stages of system development is necessary to increase the potential of information systems in order to influence healthcare processes and outcomes positively.

7	A framework for evaluating e-Health research(Dansky et al., 2006)	Holistic framework (template) integration of four **key-dimensions for e-Health evaluation**. The authors state a **multidisciplinary team** is needed and that roles and responsibilities should be identified. The authors suggest combining both quantitative and qualitative **research approaches** to foster a holistic basis for Health technologies.
8	Determinants of success of inpatient clinical information systems: a literature review (on evaluations of patient care information systems) (Van der Meijden et al., 2003)	The framework proposes **determinants of success** of in-patient clinical information systems. The authors state that the framework is useful in evaluating patient care information systems, with modifications to include contingent factors, such as **user involvement** during system development and implementation and organizational culture. The authors also state that an evaluation should start before the development and should have no fixed end (**continuous formative evaluation**). In evaluations of information systems that employ **multiple methods**, the data from different sources complement each other to provide a more complete picture.
9	"CHEATS": a generic information communication technology (ICT) evaluation framework (Shaw, 2002)	The framework (guideline for gathering information) provides a **comprehensive evaluation strategy** and a **multidisciplinary approach**. The CHEATS framework comprises of six **evaluation aspects** involved in systems design, implementation and use should be taken into account.
10	Beyond effectiveness: the evaluation of information systems using a comprehensive health technology assessment framework (Kazanjian & Green, 2002)	The framework provides guidelines for information seeking during development (four **key dimensions**) **for decision-making** about the adoption of health information technologies; identifying stakeholders, needs-assessment (problems, solutions), value specification (beneficiaries, benefits of technology). Identifying relevant interest groups, wider social and political impact of technologies. A **multidisciplinary approach (**inclusion of all stakeholders) is presented.
11	Evaluation in the design of health information systems: application of approaches emerging from usability engineering (Kushniruk, 2002)	The framework underlines the importance of evaluation throughout the process of software development (**continual evaluation**). The framework provides **continual evaluation methods (**formative) from project planning to design and implementation.
12	Tele-Health success: evaluation framework development (Hebert, 2001)	The framework provides performance indicators to assess Tele-Health success. Similar studies (for example, diabetic homecare) can be examined using the framework to extract commonalities and differences in where Tele-Health is effective as well as what variables demonstrate "success" (for example, satisfaction).
13	A framework for evaluating e-Health: systematic review of studies assessing the quality of health information and services for patients on the Internet (Eysenbach, 2000)	The framework provides quality indicators for health information and services to patients on the Internet. Quality is classified as **structural quality (**the communication setting, infrastructure, and resources), **process quality (**the communication process itself), and **outcome quality (**the effect of communication).
14	Evaluation framework for interactive health communication applications (Eng, 2002)	The framework describes criteria for evaluation activities and methods in the e-Health technologies development cycle. **Key principles for evaluation** and quality improvement issues for e-Health technologies are presented that should be addressed by stakeholders. Four **stakeholder groups must participate** if meaningful evolution and quality improvement of IHC is to occur. The authors state that **evaluation methods** should be woven throughout the conceptualization, design, implementation, and dissemination phases of product development.
15	e-Health - drivers, applications, challenges ahead and strategies: a conceptual framework (Ganesh, 2004)	The conceptual framework proposes **key-enablers for successful deliverance of e-health services**; the author states that e-Health programs should be based on a sound economic framework and deliver significant value for the investment.

		User-centred design is advantageous to provide services that are valuable to users. **Multidisciplinary collaboration** is necessary to assist in the development of effective and sustainable e-Health programs.
16	Grounding a new information technology implementation framework in behavioural science: a systematic analysis of the literature on IT use (Kukafka et al., 2003)	The integrative framework guides IT-implementation plans via a multifactor problem-driven and phased approach. The application of the framework rests on two propositions: (1) IT use is complex, multi-dimensional, and influenced by a variety of factors at individual and organizational levels (2) Success in achieving change is enhanced by the **active participation of members from the target user groups**; to this end the framework promotes participatory design through a linkage system of **critical assessment phases** to ensure that planners have a structure in place to engage end-users effectively from the start.

From this research three potential frameworks, specific to e-Health, were identified. The first framework by Dansky et al. (2006), A framework for evaluating e-Health research, aims:

- To overcome the challenges of implementing e-Health programs.
- To assist e-Health researchers and others to build and evaluate effective e-Health programs.

According to Eng (2002) an essential aspect of e-health is health informatics which offers a new way of informing the health workers and public with opportunities and information for accessing services of health. Several useful electronic materials and websites have been generated to make health care available to the public readily. Though this is regarded as a productive and innovative health care development, there are also risks affected by information technology, including, health data mismanagement and inaccurate information, specifically when services of health relies heavily on health informatics. Thus, e-health evaluation is essential in developing health care. Glasgow (2007) has mentioned that there are vast number of evaluation processes used in healthcare and the tools and approach used will rely on the application. The general process of evaluation of e-health can be depicted in

Gustafson and Wyatt (2004) has described that scheduling an evaluation generally includes the following steps:

- Recognize the evaluation purpose.
- Chose the queries to be addressed;
- Chose the process of gathering the proof;
- The documentation must be prepared to verify the queries to assure they are clear and indicate sufficiently the evaluation purpose.
- Organize the activities for gathering the proof;
- Examine the outcomes; and
- Report on the outcomes.

Wyatt and Liu (2002) mentioned that e-Health often plays an important role in general health care. It enhances creative bridges of interaction and information for services of health, public and health workers. Thus, evaluation is an essential manner in finding whether the product of e-health works.

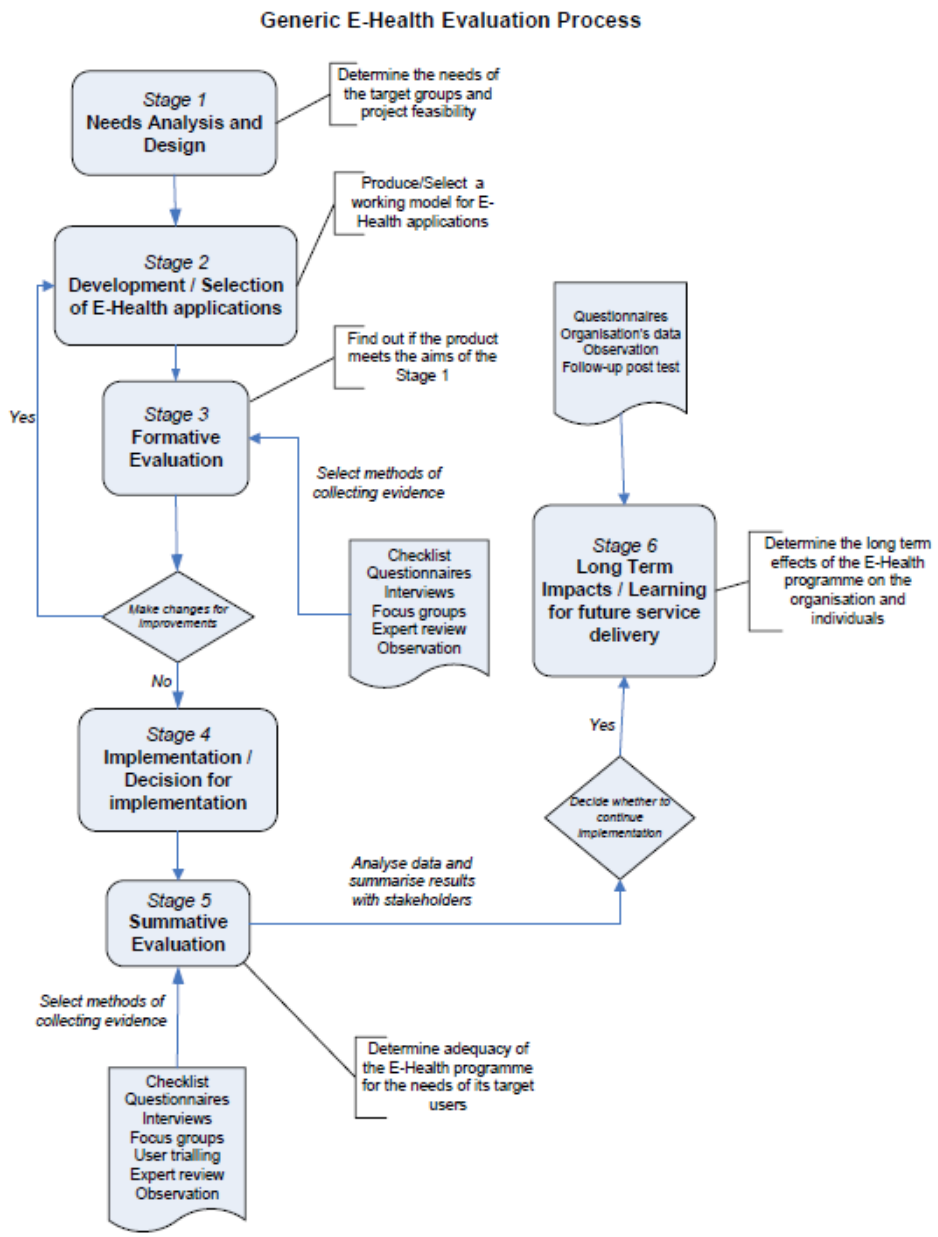


Figure 3-1: General evaluation framework of E-health (Quynh, 2007 pg. 4)

The term "e-Health" has emerged as a central, unifying definition of multiple technologies and modalities; essentially, it refers to: the use of emerging information and communication technology, especially the Internet, to improve or enable health and health care (Eng, 2002). Examples mentioned are:

- Telemedicine/Telehealth for data transmission: one-way systems, for example, tele-radiology and store-and-forward systems and two-way systems, for example, tele-consultation and complex video interactions with medical devices;
- Wireless technologies: electronic medical records (web portals), personal digital assistants used by physicians;
- Online chat (individually or in virtual communities); and
- Health information and services on the web (web-based programs)

In the quest to find the most suitable framework, the following frameworks were more closely evaluated. The Dansky et al. (2006) framework had its foundation based on the Health Insurance Portability and Accountability Act (regulations).

The second framework by Kazanjian and Green (2002) 'Beyond effectiveness: the evaluation of information systems using a comprehensive health technology assessment framework' targeted decision-makers (policy-makers, administrative developers of information systems). Health Technology Assessment (HTA) is the systematic evaluation and synthesis of evidence on the properties, effects, and other impacts of health technologies (Jennett, 1992). The aim of the framework is to provide an empirical, evidence based foundation for health technology decisions. Its foundation is based on theories of epidemiology, sociology, economics, systems, science and critical theory.

The third framework by Hebert (2001), Tele-Health success: evaluation framework development aims:

(1) To develop a body of knowledge around Tele-Health evaluations and supporting more advanced research efforts.

(2) To guide e-Health investments about where Tele-Health is effective as well as what variables demonstrate Tele-Health success (for example, quality patient care, user satisfaction). Its foundations are based on the:

- Donabedian (1980) model for assessing the quality of care;
- Delone and McLean (1992) Dimensions of IS Success; and
- Jennett (1992) Health Technology Assessment (HTA).

The evaluation framework has been tested through mapping of project reports identified in a literature review. Quasi-experimental studies in tele-home health care were used to report their findings using this framework.

From a review of each alternative framework, the three most promising frameworks identified were the Hebert (2001) Tele-Health success: evaluation framework development, as this most closely met the requirements of the research question; the Donabedian (1980) model for assessing the quality of care and the Delone and McLean (1992) Dimensions of IS Success Model "D&M (IS) Success Model".

The Donabedian Quality-of-Care Framework is a classic paradigm for assessing the quality of care based on a three-component approach—structure, process, and outcomes:

- Structure: the attributes of settings where care is delivered;
- Process: whether or not acceptable medical practices are followed; and
- Outcome: impact of the care on health status.

It was considered that the Donabedian's model would provide excellent insight to evaluating the quality of care in an e-Healthcare model. The DeLone and McLean Dimensions of IS Success provides a general and comprehensive definition of IS success that covers different perspectives of evaluating information systems, DeLone and McLean reviewed the existing definitions of IS success and their corresponding measures, and classified them into six major categories. Thus, they created a multidimensional measuring model with interdependencies between the different success categories, as per Figure 3-2.

These measures are included in six system dimensions:

- System Quality (the measures of the information processing system itself);
- Quality (the measures of IS output);
- Service Quality (the measures of technical support or service);
- Information Use (recipient consumption of the output of IS);
- User Satisfaction (recipient response to the use of the output of IS); and
- Net Benefits (the overall IS impact).

Because of the feedback mechanisms, the framework might lead to changed behaviours that could result in either positive or negative outcomes. For example, if the outcomes result in higher net benefits this could lead to increased use of the system. In contrast, insufficient outcomes, resulting in lower net benefits; could act as a disincentive to system use.

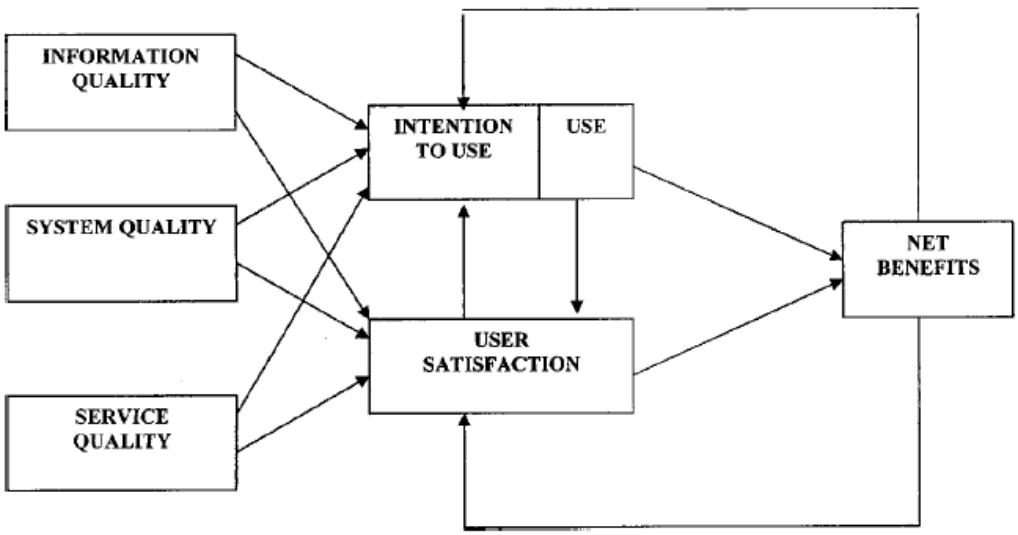


Figure 3. Updated D&M IS Success Model

Figure 3-2: Updated D&M (IS) Success Model

In subsequent research, more than thirty health related models/frameworks were identified as being based on the DeLone and McLean framework, including a benefits evaluation (BE) framework for the health information systems (HIS) that was proposed to be implemented across Canada (Lau et al., 2007). The benefits evaluation (BE) framework for the (HIS) extended the updated D&M (IS) Success Model to provide eight dimensions, including three dimensions of quality (system, information and service), two dimensions of system usage (use and user satisfaction) and three dimensions of net benefits (quality, access and productivity).

Canada Health's Infoway is the primary lead in Canada for e-Health-related activities. Their mission is to foster and accelerate the development and adoption of electronic health information systems with compatible standards and communications technologies on a pan-Canadian basis, with tangible benefits to Canadians (Lau et al., 2007).

3.4 Development of an e-Healthcare Evaluation Framework

The D&M (IS) Success Model provides a coherent, high-level, evidence-based guide for evaluation studies by governments and investment programs. It illustrates clear, specific dimensions of IS success or effectiveness and the relationships between them. The relevance of the Delone & McLean IS Success Model for measuring the effectiveness of an IT health solution is accepted, especially considering the extensive number of citations, and use of this model in a wide range of environments. The D&M (IS) Success Model has predominantly been used for evaluating the technologies used internally by organisations to assist them to deliver services and does not take into account the use of the system to deliver services remotely to consumers. This may sound like a subtle difference, but in fact is of significant importance, as outline below.

In the delivery of a face-to-face service, where the technology component being evaluated, for example, a Patient Management System (PMS) that clinicians and other staff interact with, the technology would be considered as a supporter of the service, but usually not as a critical part of the service.

In the delivery of an e-Healthcare service, where the provider or multiple providers and the consumer of the services remotely interact with each other in an online environment, the technology would more likely be considered as a critical component of the service, without which the service could not be delivered.

For example, compare a Psychiatrist providing a Tele-Health consult to a patient 200 kilometres away versus a face-to-face consult in the specialist's rooms. Consider what the impact may be, if in the middle of a consultation with a patient who was contemplating suicide the power went out. In the Specialists rooms, the result may be that the consult could still continue, perhaps with some discomfort. Conversely, where the specialist is conducting a Tele-Health session and communications were suddenly lost, the result could be devastating.

3.4.1 The Integration of Technology, Service and Information

The D&M (IS) Success Model relates the first three dimensions, system quality, information quality and service quality to the technology, and then in the next dimension shows the connections between the technology and system usage and user satisfaction. For an e-Healthcare service, the model differs in that a care service is being delivered that consists of service (people and infrastructure), technology and information. The researcher therefore identified that the D&M (IS) Success Model was applicable, but required modification to meet the specific requirements of an e-Healthcare service, where people, technologies and information are combined together to provide a service.

Information and communication technologies are used in almost every health care service, including patient management systems (PMS), databases, PC's, laptops, networks, etc. In the e-Healthcare framework, these technologies are primarily aimed at enabling the service to operate and are included under infrastructure.

To meet the needs of an e-Healthcare service model; the service dimension used in the D&M (IS) Success Model has been expanded to include all elements of the service involved in the delivery of services. This may include health professionals,

IT support, buildings, equipment and other service components.

The term system used in the D&M (IS) Success Model has been renamed to technologies. This is the 'e' in e-Healthcare. Technologies are defined in the evaluation framework as, specific technologies that either assist in the delivery of physical health care services, or are in themselves part of the service. Technologies can incorporate systems, connectivity, devices, and web portals, messaging services, mobile applications and other items that are used in the direct provision of services. For example, a mobile phone app that enables a patient to record their blood pressure (BP) using a blue tooth BP measurement device.

The term information used in the D&M (IS) Success Model has been clarified as the data, documentation, messages, communications, dictionaries, images, videos and other forms of media that are used in the provision of services.

3.4.2 The Relationship between Services and Usage

To meet the requirements of the e-Healthcare model, it was considered by the researcher to redefine the second group of dimensions (intention to use, use and user satisfaction), as described in the D&M (IS) Success Model, by combining them into a single dimension called usage and to then create a new dimension called services. Services consist of provider activities, consumer activities and management activities. Provider type activities include the provision of care services, for example, receiving referrals, completing assessments and providing consults. Consumer type activities may include being a part of a Tele-Health consult, taking medications or recording exercise. Management type activities may include, monitoring registrations and usage, content management or user support.

Figure 3-3 illustrates how technology, service and information combine to provide services that are then accessed by consumers. An example may be the provision of a remote monitoring service (the services) to an elderly person living alone, (the consumer), who has an emergency alert pendent (the technology), that triggers and alert to an emergency response centre based on who has the alert, what triggers the alert and how the alert is responded to (the information).

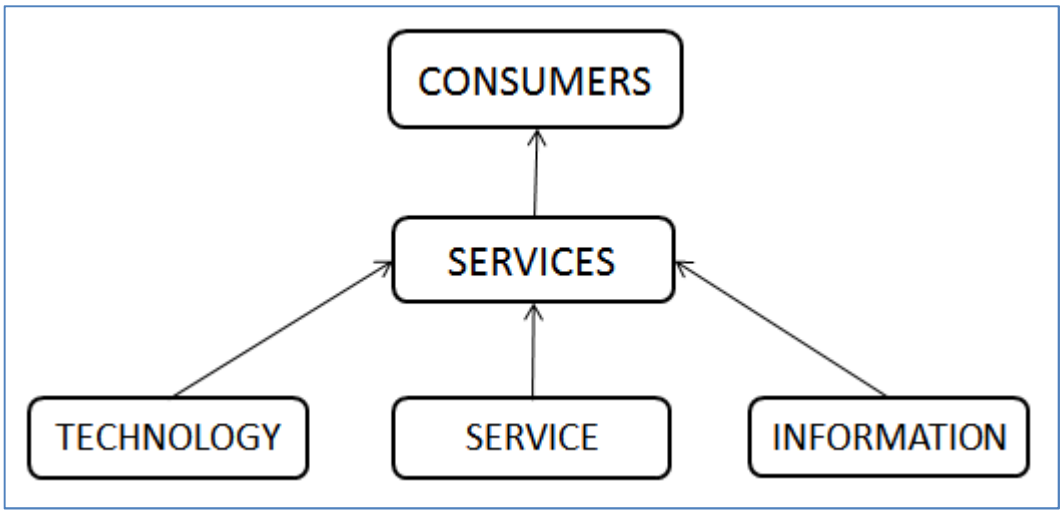


Figure 3-3: Combining technology, service and information to provide services to consumers

There is no distinguishing on how much of either technology or service or information is required to provide the services. Services provided to the consumer could consist of very low usage of technology, for example, a phone call, or conversely care services that could be delivered without the need for a service to be involved, for example, a medications dispenser that creates an alert to the consumer when medications are due, whilst other services may only require access to information, for example, an educational video clip on how to fill up the medication dispenser.

The above model could be further extended to multiple services being provided to consumers, involving different technologies, service models and information, to create an Electronic Community of Care, as illustrated in Figure 3-4.

Figure 3-4: E-Communities of Care Image (ref)

This diagram shows members of a care team interconnecting with the consumer using an e-Healthcare platform and how the consumer is also contributing to their care services through the addition of information from devices used to self-monitor their health and wellbeing.

3.4.3 Outcome Costs and Benefits

In the third group, the D&M (IS) Success Model includes just one dimension called net benefits. If one were evaluating the increase in productivity of the workforce using a solution, compared with the costs of implementing the solution to provide a return on investment (ROI), then net benefit would suit.

In an e-Healthcare model, the benefit dimension needs to be expanded to take into account the outcomes of services, including the number of consumers who have accessed the services, their involvement in the program or service, improvements in

their health and wellbeing, the quality and safety of services and the costs associated with both the provision of the and consumption of the services.

Additionally, the D&M (IS) Success Model is primarily focused on the benefits from an organisational point of view. Was it a good investment? In an e-Healthcare model, the predominant focus is on; "Did it achieve the outcomes from the perspectives of multiple stakeholders, including the consumer, the provider and the funder?" Based on this argument, the Researcher has expanded the single dimension of net benefits into separate dimensions, consisting of benefits and costs.

It can be a given that every health care service provided, no matter where it is provided or what is provided, is subject to cost constraints. Health care providers across the world are under constant pressure to justify how they have spent their funds and what has been the outcome, often not just health benefits, but also the political and social outcomes. Generally then, a health care service will not be provided unless there is some kind of return on investment. This maybe that a sick person gets better, or pain and suffering are reduced as a result of an intervention, or there is a political return, for example, keeping negative items, such as hospital bed crisis from appearing on the front page of the newspaper.

Therefore, the most fundamental task for any health care program or provider is to identify measure and compare the costs and benefits of alternative services. Measuring cost alone is pointless, for example, $10M spent without any mention of a return will not provide any feedback that will enable decisions to be made, on whether the service is worthwhile. Evaluating both the costs and outcomes, for example, $10M spent and 5,000 people successfully treated for a debilitating condition enables decisions to be made about alternative programs.

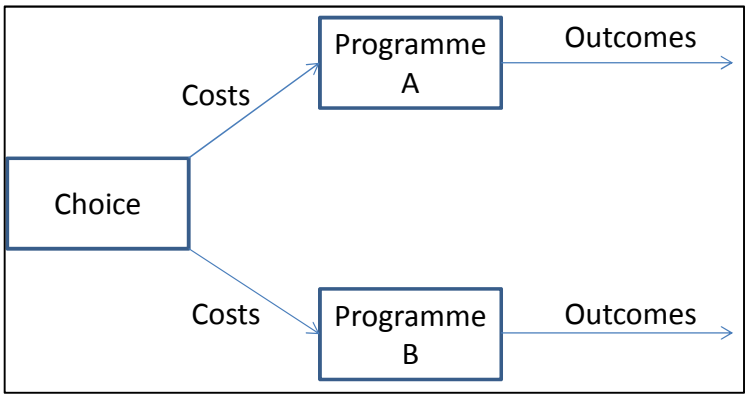


Figure 3-5: Program Cost Benefits Decision Tree

In Figure 3-6, the decision to provide Program A or Program B is a choice, based on the costs and outcomes of each program. Program A may cost twice as much as Program B but Program A may provide far better outcomes than Program B, so may still be the selected Program. Alternatively, Program B may involve doing nothing, and so therefore have no direct costs. This decision to do nothing may still have outcomes. For example, if early treatment were not provided for Malaria, the consequences may be the ongoing sickness or even death of the person, so the outcomes of no program would be negative and could be valued.

Therefore, there is a need to incorporate into the evaluation model the ability to evaluate comparative service models.

3.4.4 Adapting the D&M IS Success Model to e-Healthcare

Taking into consideration the above mentioned requirements, the D&M (IS) Success Model was re-articulated to provide a multi-dimensional e-Healthcare model that enables comparative service models to be evaluated, as shown in

Figure 3-6.

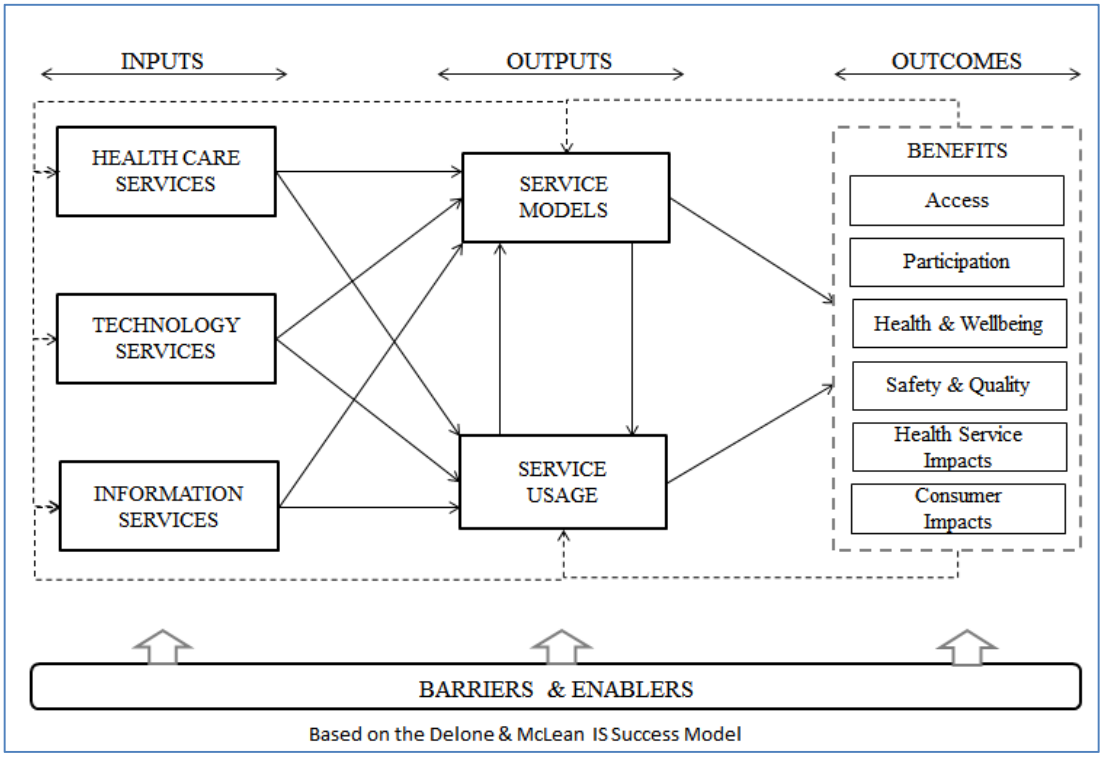


Figure 3-6: Initial adaptation of the DeLone and McLean (IS) Success Model for evaluation of e-Healthcare service models.

The adaptations to the DeLone and McLean (IS) success model were deemed necessary to capture a holistic view of the elements involved in delivering technology enabled health care services to individuals in their own home or community location. Note that the dimensions 'Intention to Use' and 'Use' in the IS Success model have been combined and presented in a single dimension termed Usage in order to capture all aspects of consumption of services in a single dimension and reduce any further complexities.

As a result of using the initial modified version of the D&M (IS) Success Model in the ARC trial, and the subsequent requirements of the CSIRO trial, the Researcher argued that a multi-service model framework was required, that would enable comparative service models to be evaluated and compared. This led to further research and modifications to the framework.

3.5 Balanced Scorecard

The balanced scorecard (BSC) is a strategic planning and management system that is used extensively in business and industry, government, and non-profit organizations worldwide to align business activities to the vision and strategy of the organization, improve internal and external communications, and monitor organization

performance against strategic goals. It was originated by Kaplan and Norton as a performance measurement framework that added strategic non-financial performance measures to traditional financial metrics to give managers and executives a more 'balanced' view of organizational performance (Balanced Scorecard Institute, 2012). An example of the BSC is shown in Figure 3-7

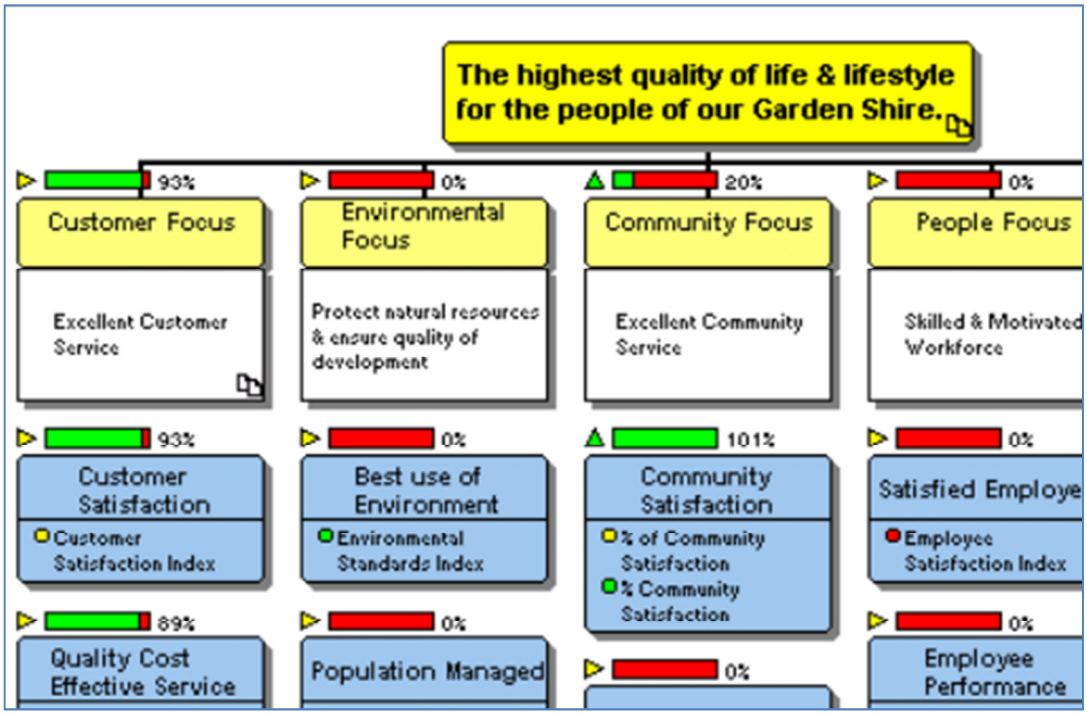


Figure 3-7 Kaplan Balanced Scorecard

The Balanced Scorecard is a performance management tool that, combines financial and non-financial measures together, to measure how well the Organisation / Department is performing at a macro level. The Kaplan scorecard has five elements:

Vision - This is the highest level of the scorecard, which should match with the organisation's or department's vision, for example, "The highest quality of life and lifestyle for the people of our garden shire."

Perspectives – These reflect the core focuses of the organisation or department, and may include Customer, People, Systems, Financial and Learning and Growth and or other priorities.

Objectives - These are what combine together to support the measurement of the perspectives, for example, Customer satisfaction. Objectives need to be measureable so that they can be allocated a value, for example, 93% Customer Satisfaction, as shown in the above example.

Measures – These provide the supporting evidence used to quantify if the objective has been met, for example, a Customer Satisfaction Index

Measure Tools – These are the tools used to obtain the measures, for example, a customer satisfaction survey.

The Researcher has been an advocate of the Balanced Scorecard for over 20 years and has used and adapted it in a variety of settings, including Health, Education, Distribution, Construction and Maintenance Services.

3.6 Creating an Integrated Model

The concepts of the previously modified Cost Benefits Scorecard (CBS) and the concepts of the Balanced Scorecard, the Researcher proposed an integrated CBS as per Figure 3-8 that provides a multi-dimensional view of the costs, benefits and impacts of using collaborative technologies to deliver home based care to persons with chronic or acute conditions.

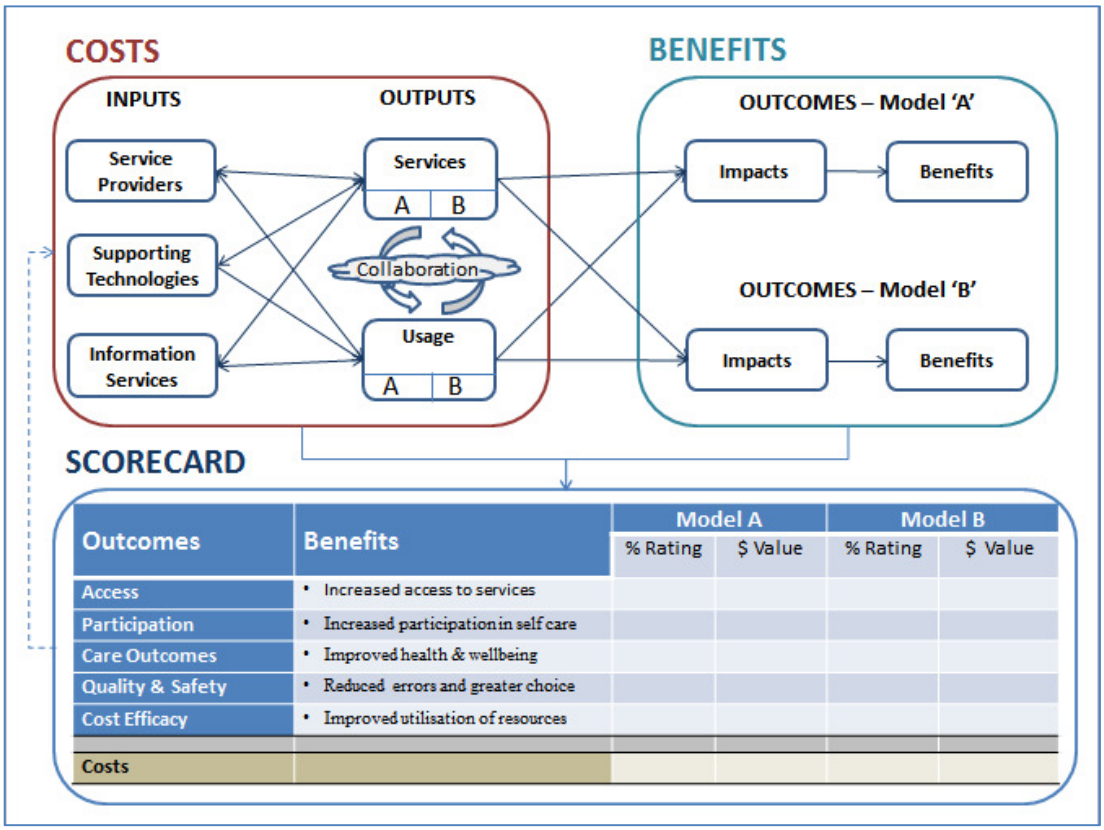


Figure 3-8 Cost Benefits Scorecard (CBS)

In developing the model, the researcher has relied heavily on his extensive (20+ years) experience in utilising each of the above tools and methodologies in a wide range of settings, including the delivery of healthcare technologies, combined with an extensive literature research.

3.7 Terminology:

3.7.1 Costs

The first section "Costs" contains two groups, "Inputs" and "Outputs", each with their own dimensions. Basically, this is the provision of services, where the Inputs (service providers, supporting technologies and information services) combine together to enable services to be provided to, or access by consumers, or other users of the service.

3.7.2 Inputs

The first group in Costs incorporates three dimensions; Service Providers, Supporting Technologies and Information Services, that combine together to deliver the health care services.

3.7.2.1 Service Providers

Service Providers relate to the services provided by health and community care professionals / organisations and or other stakeholders. The dimension Service Providers incorporates the care professional resources, physical facilities, equipment, overheads and indirect supporting services.

3.7.2.2 Supporting Technologies

Supporting Technologies are defined as specific technologies that either assist in the delivery of physical health care services, or are in themselves part, or all of the service, for example, a health & wellbeing web portal. Supporting technologies can incorporate systems, connectivity, devices, web portals, messaging services, mobile apps, data, images, documentation, media and other items that are used in the direct provision of services.

3.7.2.3 Information Services

Information Services relates to the data, documentation, messages, communications, dictionaries, images, videos and other forms of media that are used in the provision of services, and also the controls that govern who, how, when and for what reason information can be accessed, updated and exchanged.

3.7.3 Outputs

The second group incorporates two dimensions (Service Provision and Usage).

3.7.3.1 Services

Services relates to the different service activities provided or accessed. Services are defined as quantifiable units of work that can be specifically allocated to one or more service outputs; for example, receive and process a referral. The services provided are derived from any or, all three of the input dimensions. For example, a traditional face-to-face consult may only require the input of the Service Provider. Alternatively, a Telehealth consult may involve all three inputs, involving a

specialist (Service Provider), video conferencing (Supporting Technologies) and a web based assessment (Information Services).

The Services dimension incorporates two sub-dimensions, labelled as 'A' and 'B'. These sub-dimensions relate to alternative service models, Service Model 'A', for example, a rehabilitation service provided by a therapist via a Tele-Health consult and Service model 'B', for example, a rehabilitation service provided by a therapist via a home visit. The purpose of these sub-dimensions is to enable the total cost of the Inputs to be proportionally distributed to each of the alternative Service Models, based on the Service Model's consumption of inputs.

3.7.3.2 Usage

Usage relates to the consumption of or access to the services in terms of what type, how often, how much and by whom and the satisfaction with, and competency to use or access the services.

3.7.4 Benefits

The second section "Benefits" contains two symmetrical groups, Outcomes – Model 'A" and Outcomes - Model 'B', both of which incorporate two dimensions; Impacts and Benefits. This structure has been designed to enable evaluations of the benefits of comparative service models, for example, where Service Model 'A' is a technology enabled (Tele-Health) medication service and Service Model 'B' is a traditional face-to-face medication service.

3.7.4.1 Impacts

Impacts can be categorised as consumer impacts, provider impacts and health service impacts.

- **Consumer impacts:** relate to the effects of the service on the receiver, or user of the services, for example, where a person has been rehabilitated back to full health or their blood pressure has reduced as a result of the services provided, or they can safely return home from hospital.
- **Provider impacts:** relate to the effects of the services on health care providers, for example, becoming more efficient in delivering care services, a reduction in travel by using video conferencing services, or improved communications with other care providers.
- **Health service impacts:** relate to the effects of the services on the health system, for example, an increase in the number of patients safely discharged to community care services, a reduction in the number of incidents, or better utilisation of resources.

3.7.4.2 Benefits

Benefits, as defined in the CBS framework, are the positive outcomes achieved as a result of the impacts. For example, if the Tele-Health service model "A" made it easier for people to access a rehabilitation service (Impact), then theoretically it could be presumed that this would lead to more people being rehabilitated (Benefit).

3.7.5 Scorecard

The third section "Scorecard" provides a matrix that enables the Costs and Benefits of alternative service models to be compared and reported on. Benefits are grouped by outcomes to provide a summary. A further breakdown can be provided on an individual benefits basis. Costs and Benefits for each of the service models are traced to the scorecard. The Scorecard dimension has no direct relationship with either the costs or benefits dimensions, but it does assist in summarising the results of the costs and benefits, which in itself provides feedback to the inputs and outputs dimensions. The Scorecard provides two values for each outcome benefit.

- % Rating can be used to quantify the benefits of the service in non-monetary terms, for example, 80% of participants rated the program as excellent
- $ Benefit can be used to quantify the benefits of the service in monetary terms, for example, $ savings achieved by reducing hospital re-admissions

3.7.6 Scorecard Levels

The Scorecard structure comprises of three levels:

Level 1: Outcomes – Defines the strategic Outcomes for a care program

Level 2: Benefits – Defines the benefits for each Program Outcome

Level 3: Measures – Defines measure ratings for each Benefit

3.7.7 Program Outcomes

At the top level of the Scorecard, Program Outcomes, as defined in the CBS, equate to the term 'Perspectives' as used in the Kaplan BSC.

Table 3-2 CBS Program Outcomes

Program Outcome	Description
Access	People can access the program within an acceptable time, irrespective of income, physical location or cultural background, including waiting times, rural and remote access, access by indigenous persons and persons who are culturally and linguistically diverse (CALD)
Participation	Services are client focused, encourage participation and maximise retention and completion rates throughout the course of the program, including the involvement of the consumer in the service, their attendance and commitment in a program, goal setting, recording and other activities
Care Outcomes	Care interventions are flexible and relevant to the participant's needs, improve longer term health care outcomes, physical and mental state and reduce secondary re-admissions.
Quality & Safety	The highest quality services are provided with actual or potential harm avoided or reduced to acceptable limits within the environment in the care is delivered including choices offered to consumers in terms of providers and services and what provisions have been put in place in the event of a failure or crisis
Cost Efficacy	Resources are applied in the most cost effective way to achieve the maximum program outputs at the minimal cost, including people, infrastructure and other resources and how these combine together to provide, deliver or access the services

The term 'Program Outcomes', in the CBS, can be used to reflect the different perspectives of providers, consumers and other stakeholders.

Scorecard Outcome dimensions can consist of multiple benefits. NOTE: For simplicity of the construct, only a selected number of benefits have been provided and these will depend on the health care services being evaluated.

Table 3-2 describes five Outcome dimensions, as defined in the CBS framework however these may be replaced or added to, as the program requires.

The Program Outcomes defined below may change to suit the specific needs of a program depending on the type of Program being evaluated.

3.7.7.1 Collaboration

Collaboration is a nebulous dimension, as it can also be considered as an outcome. For example: as a result of the service, collaboration between providers and recipients or between providers and other providers may improve, and therefore this is an outcome.

Alternatively, collaboration may be an influencer on the quality of the services provided and usage of those services. For example: as a result of technologies put in place collaboration improves which then contributes to the success of the service, for example, better health outcomes.

Table 3-3 – Collaboration; A Nebulous Term

Collaboration	Care providers within a care team can easily access and share information with other providers, subject to security and privacy provisions and collectively coordinate care services, including communication, information sharing and coordination of services within a care team, provider to provider and providers to consumers and their carers

3.7.8 Scorecard Benefits

The second level of the CBS, Program "Benefits", equate to the term 'Objectives' in the Kaplan BSC, are used to quantify the monetary and performance Benefits achieved for each Program Outcome. Benefits differ from objectives, in that objectives are used to define what is being aimed for, and benefits are defined as what has been achieved.

Program Benefits will vary depending on the strategic focus of the program or service model, but will generally be related to streamlining processes, reducing waiting lists, reducing costs, both current and future, reducing unnecessary admissions and improving longer term outcomes for participants.

In Table 3-4, the key benefits of a technology based service model have been defined. Additional Benefits that explore other areas of the program or service model can be added, in consultation with different stakeholders. For example, a social equity objective "improve access for disadvantaged persons" may result in an outcome benefit "improved access for disadvantaged persons".

See individual case studies for the specific benefits used in the CBS. As stated, the benefits can be changed to suit the specific needs of a program. To retain the validity of the model and minimise complexity, it is recommended that no more than 5 key Benefits be identified for each Program Outcome (Russell et al., 2011).

Table 3-4 CBS Key Benefits, Grouped by Program

Program Outcomes	Key Benefits
Access	• Increase the number of people accessing the program • Reduced waiting times will result in more people enrolling in the program • Patients living in regional and remote communities will have greater access to the program
Participation	• Improved interactivity between Providers and Recipients will result in higher Participation involvement in their care • Increased patient involvement in their care will result in improved long-term outcomes, and a reduction in secondary re-admissions • Increased participant satisfaction will result in higher retention rates • Processes, systems and responses are constantly being improved to provide a higher quality, more effective service
Care Outcomes	• Improved retention rates will result in more people completing the program • Improved Quality of Life and physical health outcomes for Participants • Improved Physical health outcomes for Participants • Reduced Secondary attacks and Re-Admissions
Quality & Safety	• Adverse events minimised • Reduced adverse consequences resulting from a lack of services available in regional or rural communities • More effective care provided in the community due to clear information provided in a timely manner to all providers involved in the care of a participant
Cost Effectiveness	• Reduced service delivery costs • Increased service capacity, better resource utilisation and more flexible options will reduce the unit cost per Participant • Reduced administration time • Reduced infrastructure costs • Reduced patient costs

3.7.9 Measures

At the third level of the CBS, Measures are used in line with the Kaplan BSC terminology 'Measures' to capture and quantify the outcome benefits related to a Program's Benefits and in turn the related Program Outcomes. Measures are concerned about measuring how much, how well, at what cost and for what benefit a program or service can be delivered.

The CBS is designed to capture both monetary and no-monetary measures using a range of measure instruments and types of measures, as outlined in Table 3-5:

Table 3-5 CBS Measure Types

Measure Type	Description
$ Monetary	Provides a Monetary Cost or (Benefit)
# Quantity	Indicates how many. Also known as Cardinal numbers
% Percentage	The percentage of the whole or sum
Nominal	Enables measures to be categorised
Ordinal	Denoting a position in a sequence ("first", "second", "third", etc.)
Interval	An interval of numbers between a start point and end point
Ratio	The ratio of one to another
QOL	Quality of Life
QALY	Quality Adjusted Life Years

It has also been found beneficial to describe the purpose of the measure, as often the purpose will be different for different stakeholders.

For Example:

Table 3-6 shows a generic CBS measures for the Program Outcomes, 'Access' and the associated key benefit, 'Increased number of people accessing the program'. In this example, the purpose has also been defined, which proves to be useful in data collection, especially when asked why this information is required?

Table 3-6 Cost-Benefits Scorecard (CBS) Measures

Program Outcomes	Key Benefits	Measures	Purpose
Access	Increased number of people accessing the Program	# regional and remote patients referred to the service	Provide improved access to people living in regional and remote communities

A word of caution – If the model becomes too complicated, with too many benefits, or too many measures that need to be collected manually, it will become time consuming and may become unworkable.

3.7.10 Construct Relationships

The relationship between each of the dimensions has been articulated to show the impact that each dimension has on other dimensions within a health care model.

- A two way relationship has been described between each of the inputs dimensions and the services dimension. This illustrates that each input dimension can exist in isolation, or combine together with one or both of the other input dimensions to provide the services being delivered or accessed, for example, a nurse visiting a patient in their home to provide medications versus an automated medication dispenser that can be remotely monitored. In this relationship, the cost and quality of the inputs will have a positive or negative impact on the provision of services. In most cases, this will hold true, especially where there is an increase in the resources (people, equipment and infrastructure). Conversely, where services are provided totally by technology, there may be no increase in cost. Alternatively, an increase in

demand may result in an increase in consumption of Inputs.

- A two way relationship has been described between each of the inputs dimensions and usage. This illustrates the relationship between usage and the quality and cost of the technology, provider and information dimensions. Feedback from service activities to each of the inputs dimensions may influence the quality, quantity and type of inputs.
- A two-way relationship has been described between services and usage to reflect a symbiotic relationship, with changes in one dimension impacting on the other dimension. Theoretically, as consumption of services increases or decreases, provision would also increase or decrease proportionally and visa-versa. Additionally, other factors may also influence this relationship, for example, user satisfaction and competency, or a change in technology.
- A one-way relationship has been described between the provision of services and impacts. This is based on the assumption that the provision of a service may have an impact on the consumer receiving the service, or on a provider of services or the health service. Impacts may be influenced by a change in the service model, or a mix in the services provided, for example, a service provided partly via face-to-face and partly using technology.
- A one-way relationship has been described between the usage of the services and impacts ref. This is based on the assumption that the level of usage, user satisfaction and adherence to a service program may have an impact on the consumer receiving the service.
- A one-way relationship has been described between impacts and benefits. This is based on the theory that the impacts on consumers, providers and the health service will impact on the benefits achieved.
- A one-way relationship has been described between the costs of each service model and the scorecard dimension.
- A one-way relationship has been described between the outcomes of each service model and the scorecard dimension.
- A feedback loop, illustrated with a dashed line has been described from the Scorecard back to inputs and outputs:

Additional relationships and influencers may be possible. For this study, they were not considered as significant so have been ignored by the Researcher. **NOTE:** The above dimensions and constructs could be used for the provision of any health care service, not just an e-Healthcare service. As previously stated, a service may consist of all three inputs or only one input.

3.8 Measuring the Dimensions

Measuring and analysing the effectiveness of each dimension and its impact on other dimensions within an e-Healthcare model requires different evaluation tools and methods. In addition, some or all of the dimensions could be measured and analysed from multiple perspectives, including from a service provider's view, a consumer's view, a funder's view, a technical view or a social or political view.

3.9 Measuring Inputs

The quality and cost of the supporting technologies, service provision and information services are critical to the provision of an e-Healthcare service.

3.9.1 Measuring Quality:

To measure the quality of the inputs a variety of measures have been used in the CBS construct, including:

- Quality measures for the supporting technologies dimension include functionality, connectivity, reliability, flexibility, performance, security, compliance to standards and interoperability;
- Quality measures for service providers include capacity and responsiveness; and
- Quality measures for information services include availability, relevance, content, currency and accuracy.

3.10 Measuring Outputs

Provision of services is at the core of a health care service with service activities including referrals, intake, assessments, care planning, coordination, service delivery, monitoring, documentation, discharge/exit, administration, and reporting and user management. All of these activities will include differing combinations of technology, service and information. Measures for the provision of services include the type and number of services provided, by provider.

3.10.1 Measuring Costs:

There are many challenges in evaluating health programs. Health care can be extremely complex, with many different programs and services being delivered by thousands of organisations, in different locations, with different funding models and management systems and to different persons with a multitude of ailments and situations. Calculating the output costs of a single service, delivered by a distinct workforce, in most cases, is relatively straightforward. Calculating the output costs of multiple programs with alternative service models and where care is delivered by a multi-discipline workforce is a far greater challenge.

To meet this challenge, Activity Based Costing (ABC), is a proven costing methodology that identifies activities in an organization and assigns the cost of each activity to programs according to the actual consumption by each type of service (Anderson, 1996). ABC offers advantages over traditional costing because it traces costs to activities via cost drivers rather than just fixed and variable designations. Traditional methods of costing tend to apportion overhead based on output costs. In contrast, ABC attempts to trace overhead to distinct activity measures.

Activity Based Costing (ABC) enables more indirect costs (overheads) to be traced to direct costs compared to conventional costing models. Over recent years, ABC methodologies have progressively been adopted within the health care system and are now used extensively to calculate case-mix funding for hospitals and determine the funding levels for a wide range of health care programs (Health Policy Solutions in association with Casemix Consulting and Aspex Consulting, 2011).

Calculating the true cost of a Program or service, can be extremely difficult, requiring micro costing to the nth degree. Micro costing requires direct measurement and is ordinarily reserved to cost small scale projects. In calculating program / service costs, analysts should include non-wage labour cost, person-level and institutional overhead, and the cost of development, set-up activities, supplies, space, technology infrastructure and screening of participants. Activity-based cost systems have promise of finding accurate costs of all services provided, but are not yet widely adopted (Barnett, 2009).

3.10.2 Measuring Usage

The usage or consumption of services can be measured by the uptake, use behaviour, competency of the user, user satisfaction and ease of use. Usage of services may also have a cost. For example, travel costs incurred by a person attending a rehabilitation centre, or a cost in terms of lost earnings where a person needs to take time off work. The costs assigned to usage can usually be fairly easily quantified, although personal and social non-monetary costs are far more difficult to quantify.

3.11 Measuring Outcomes

The outcomes as a result of a health care service are the whole purpose of its being. For example in the treatment of a tumour, the inputs and services become secondary to the outcomes benefits achieved.

3.11.1 Measuring Impacts

There are a wide range of measurement tools for measuring the impacts of a health care program or service model. Some of the measures used in the CBS are listed in Table 3-7 Impact Measurement Tools**Error! Reference source not found.**. There are many other tools also available, and impact assessments and surveys can take almost any form, as required by the evaluation. Refer to Appendix D - Measurement Tools used to measure Costs and Benefit for a standard set of measure to use in the CBS.

Ideally, each element would be measured when evaluating an e-Healthcare model, in order to answer the questions. Does the technology enabled program:

- Improve the effectiveness of a care program;
- provide as good as, or better care outcomes; and
- Provide a return on investment.

Table 3-7 Impact Measurement Tools

Assessment	Description
Diets Habit Questionnaire (DHQ),	The Diet History Questionnaire (DHQ) is a food frequency questionnaire (FFQ) developed by staff at the Risk Factor Monitoring and Methods Branch (RFMMB). This FFQ consists of 124 food items and includes both portion size and dietary supplement questions. It takes about 1 hour to complete and was designed, based on cognitive research findings, to be easy to use (National Cancer Institute, 2012).
EQ-5D,	The EQ-5D is a standardised measure of health status to provide a simple, generic measure of health for clinical and economic appraisal. Applicable to a wide range of health conditions and treatments, it provides a simple descriptive profile and a single index value for health status that can be used in the clinical and economic evaluation of health care as well as in population health surveys (EuroQol Group, 1990).
Kessler 10 (K10),	The K10 comprises ten questions about psychological distress. It is designed to quantify the frequency and severity of anxiety- and depression-related symptoms experienced in the four weeks prior to screening (Kessler et al., 2003).

3.11.2 Measuring Benefits

There are different economic evaluation methods that can be used to measure the consequences of e-Healthcare programs. These include, but are not limited to Cost Analysis (CA), Cost-Effectiveness Analysis (CAE), Cost-Utility Analysis (CUA) and Cost-Benefit Analysis (CBA).Cost-Benefit analysis enables the consequences of programs to be measured in monetary terms, so as to make them commensurate with the costs (Drummond et al., 2005). As benefits can be defined in monetary terms, where the benefits exceed the costs, it is theoretical relatively simple to justify a program, and visa-versa. In practical terms though, it can be exceedingly difficult to place a value on a benefit, for example, it is almost impossible to place a value on additional time spent with family as a result of a Tele-Health program.

Program benefits can often be intangible and subjective, and received over a period of time. Reduced future costs and improvements in health care outcomes as a result of a program are often much more difficult to quantify and can be distorted by time, secondary health issues and other factors. Additionally, benefits can be viewed from multiple Program Outcomes, and a benefit to one stakeholder may not necessarily be a benefit to another stakeholder.

Cost-effectiveness analysis avoids the challenges of measuring benefits in monetary units and instead measures the outputs of a program (Estabrooks et al., 2008). If consideration is being given to the quantity of services that can be delivered, then Cost-Effectiveness is a valid method to use and measures that assist the researcher to quantify the outputs of a Program need to be incorporated into the CBS.

Cost-Utility analysis requires benefits to be measured in terms of Quality Adjusted Life Years (QALYs), so where the Outcomes for a recipient of care need to be evaluated, measures that assist the researcher to quantify the Outcomes of a Program need to be incorporated into the e-Healthcare Framework (Drummond et al., 2005).

3.11.3 Measurement Results

Combining the above cost analysis into a measurement model would enable programs to be costed in monetary units and the benefits to be expressed using a combination of monetary values, where these can be calculated and non-monetary values where these are difficult to calculate. If the primary focus was measuring the effectiveness of a care program in terms of service outcomes, for example, number of services rendered, or lives saved, or the number of years of life gained, Cost-Effectiveness Analysis would be the most appropriate measurement tool.

If the primary focus was measuring the consequences of the care program in terms of care outcomes for the care recipient, for example, a return to full health, or an improvement in the physical and mental condition of the recipient, Cost-Utility Analysis would be the most appropriate measurement tool. For a recipient with chronic disease, the most appropriate way to measure these outcomes is in terms of Quality Adjusted Life Years (QALYs), which enables the health state of a person prior to the intervention to be compared against the health state after the intervention. Note that health state includes physical and mental state.

If the primary focus was measuring the monetary benefits of a care program, Cost-Benefits Analysis (CBA) would be the most appropriate measurement tool. Using CBA we can calculate the cost of a benefit divided by the cost of the service ($Benefit/$Cost) to arrive at a ratio of benefits to costs. If the result was for example, 2:1 then we may conclude that this model was value for money as the Benefit (return) was $2 for every $1 Cost (invested). The difference is that in the real-world situation we will also need to consider more than just the $ values of costs and benefits when we are evaluating program care models. We will also need to consider service outcomes and the socio-political forces at work.

3.11.4 Barriers and Enablers

Barriers and Enablers have not been treated as a specific dimension, but they are critical to the success of an e-Healthcare service model.

It is a well quoted saying, that you can build the world's best mousetrap, but unless someone buys it, then the idea is worth nothing. It is the same in e-Healthcare models. The technology, service and information can combine together to provide high quality services, that are both needed and make absolute sense to implement. Unfortunately, if government regulations or inability to penetrate the market prevents the model from being implemented, then it has no value and the promised benefits cannot be realised.

Barriers to implementation can include funding models, technology and service requirements, clinical acceptance, firewalls, security and privacy legislation, government initiatives, education and behaviour change. The impact of these barriers on the success or failure of an e-Healthcare service can be considerable. As previously stated, even if the model is a win-win for everyone, it still may not be implemented due to a political decision or other impasse.

Even if, the barriers to implementation are overcome, further barriers can persist in the uptake and wide use of the technologies. As outlined in the literature review, even where a model is highly successful, it can be shut down as demonstrated in the Advanced Community Care example cited. (See Literature Review) Understanding

and evaluating the barriers to an e-Healthcare model are therefore critical and need to be taken into account.

Opposite to barriers are enablers that can influence the uptake and usage of services, even ineffective services, if the incentive is right. Enablers may include government funded service items, for example, Medicare item numbers, policy changes that favour one service over another or organisations with influential market strength.

3.11.5 Using the Cost-Benefits Scorecard (CBS)

Based on its comprehensive dimensions and outcome measures, the CBS could be applied in a number of ways. It could be used to:

- Assist in the design and development of an e-Healthcare model or service
- Evaluate the effectiveness of an existing e-Healthcare model
- Evaluate and compare the impact of an e-Healthcare model against an existing service.

CHAPTER 4 - METHODOLOGY

Generally speaking, methodology does not describe specific methods despite the attention given to the nature and kinds of processes to be followed in a given procedure or in attaining a benefit. When proper to a study of methodology, such processes constitute a constructive generic model; thus they may be broken down in sub-processes, combined, or their sequence changed (Wyatt & Liu, 2002).

This study focuses on establishing a framework for evaluating the costs and benefits of technology enabled health care (e-Healthcare) models.

A multi-dimensional framework, incorporating Information Systems theory and Health Economics theory, was developed that enables the socio-economic benefits and costs of e-Healthcare service models to be evaluated. This was achieved by first developing an initial framework, drawn from the literature and the researcher's previous experience, and then refining the framework through a series of case studies. A secondary aim was to identify the barriers and influencers that impacted on the implementation and uptake of e-Healthcare models.

The aim of this chapter is to outline the methodology design and research methods used to answer the research question, taking into account the areas highlighted by the literature review, and to relate these to the CBS framework selected for this study.

4.1 Obtaining an Understanding of the Topic and the Problem

In summary, the primary hypothesis for this study is that technology enabled Health Care (e-Healthcare) service models will provide more cost-effective services and better care outcomes for persons with chronic and disabling conditions.

In order to test this hypothesis, and the contributing factors to the success of e-Healthcare models, a mixed methods approach was used for this study, which included 2 components that ran simultaneously throughout the study:

Component (A) Evaluating e-Healthcare service models using the CBS framework and methodologies.

Component (B) Using the feedback and learnings from each of the case studies to refine the framework and methods

4.2 Study Proposal and Ethics Approval

The University of Southern Queensland Human Research Ethics Committee approved this study. Ethics approval number H10REA058.

4.2.1 Recruitment of Participants

The majority of participants recruited into this study were already recruited into either the ARC or CSIRO case studies, for which ethics approvals were separately obtained. Participants from the Nexus project were recruited via an invitation letter, that provided the USQ ethics number. For this specific component of research, a

letter of introduction and research outline was provided to all prospective participants that outlined:

- The purpose of the research and who it was being conducted for.
- How the research would be conducted and how to register,
- An explanation of confidentiality, consent, participant's rights and advocacy
- Address and contact details for advocacy or complaints.

Refer to Appendix A - Letter to Participants and Appendix B - Consent Form

Note that on a number of occasions it was highlighted to participants the Researcher would be pursuing their own individual research on the back of the case studies. Refer to the individual case studies for further details.

There were no known Psychological and other risks to the participants or risks to, or impositions on, any of the participants. This research was non-invasive, and there was no deception of participants.

It was anticipated that this research would assist in improving the manner in which the aged in our society are managed when they present for health services. Furthermore it may relieve pressure on our hospitals, reduce the bottleneck in Accident and Emergency departments and significantly reduce inappropriate and unnecessary admissions for the aged. Unnecessary admissions are stressful to patients and their families and exposes people to the high rate of adverse events in Australian hospitals.

Findings will be presented through formal presentations at industry and professional conferences, seminars, peer-reviewed journals and media. When invited to participate, prospective participants were provided with a plain language statement outlining the study purpose and processes. Participants were advised that they could withdraw from the study at any time, without consequence.

Feedback was provided to stakeholders and participants via meetings and communication emails. A Communications Plan was developed as an early deliverable of the project. Measures were taken to ensure the confidentiality of the participants. Comments and other data gathered from staff will be de-identified except where specific staff may wish to be identified, for example, the Director of Nursing, General Manager or other executives. Any patient-related statistical data was de-identified.

4.2.2 Data Management

All original documents have been treated as the property of the relevant health care institutions that have provided the information. Intermediate data used for analysis has been stored securely, as per NHMRC guidelines and any documentation of a sensitive nature will be destroyed after the completion of the study.

"Validity implies reliability (accuracy). A valid measure must be reliable, but a reliable measure need not be valid. There are two kinds of validity in a test or experimental study: the internal validity (the extent to which the claimed cause-effect relationship between the investigated objects can be accounted for by the variables investigated and the external validity (the extent to which the test results or findings of a research are applicable to contexts beyond the sample group investigated of all of my instruments and measures (Wyatt & Liu, 2002)

The Researcher has defined an initial e-Healthcare conceptual framework and methodologies. This was validated and refined during this study. e-Healthcare models involve the interaction between people, technologies and information, with outcomes that directly impact on lives and society. Creating a methodology for evaluating e-Healthcare models has been challenging, especially applying the CBS and methodology in real-world situations, which was essential to ensure its validity.

Qualitative research is a method of inquiry employed in many different academic disciplines, traditionally in the social sciences, but also in market research and further context (Cooper & Hagan, 1999).

Qualitative researchers argue that, although benefit methods may be appropriate for studying physical events, such as electricity, chemical reactions, and black holes, a benefits approach to studying human events, interpersonal relationships, social structures, creative products, and other events is neither desirable nor, perhaps, even possible (Gubrium & Holstein, 2002; Mann & Stewart, 2002).

In qualitative research, there may be multiple outcomes held by different individuals, with each of these outcomes having equal validity, or truth (Huberman & Miles, 2002; Schall et al., 2002; Shank, 2002). In order to determine the most appropriate methodology for this component of the study, the researcher has reviewed commonly used qualitative research approaches, including:

- Case studies was considered, as it provides analysis of persons, events, decisions, periods, projects, policies, institutions, or other systems that are studied holistically by one or more methods. The case that is the subject of the inquiry will be an instance of a class of phenomena that provides an analytical frame — an object — within which the study is conducted and which the case illuminates and explicates" (Yin, 2003). A typology for the case study in social science following a review of definition, discourse and structure, Qualitative Inquiry (Thomas, 2011).
- Ethnographic Research was considered as it is used for investigating cultures by collecting and describing data that is intended to help in the development of a theory. This method is also called "ethnomethodology" or "methodology of the people". An example of applied ethnographic research is the study of a particular culture and their understanding of the role of a particular disease in their cultural framework (Taxis & Barber, 2003)
- Historical Research was considered, as it allows one to discuss past and present events in the context of the present condition, and allows one to reflect and provide possible answers to current issues and problems. Historical research helps us in answering questions such as: Where have we come from, where are we, who are we now and where are we going (Howell & Prevenier, 2001)?
- Empirical Research was considered, as this form of research enables theories to be proved by gaining knowledge through direct and indirect observation or experience. Empirical evidence (the record of one's direct observations or experiences) can be analysed quantitatively or qualitatively. Through quantifying the evidence or making sense of it in qualitative form, a researcher can answer empirical questions, which should be clearly defined and answerable with the evidence collected (usually called data) (Kelly & Yin, 2007).

- Constructivist Research was considered, as this research is perhaps the most common computer science research method and commonly involves the development of a prototype which is then tested through case studies. This type of approach demands a form of validation that doesn't need to be quite as empirically based as in other types of research like exploratory research (Zimmerman et al., 2007).

Case study methodology was selected as this research focused on providing a real-world solution to a world-wide practical problem. This involved:

- Finding a practically relevant problem
- Obtaining an understanding of the topic and the problem
- Innovation by constructing a conceptual framework
- Applying the CBS framework to real life projects
- Showing theoretical connections and research contributions
- Examining the scope of applicability

As a result of:

- A rapidly increasingly aged society;
- A rapid escalation in chronic disease;
- A rapid escalation in the cost of health services;
- An increasing shortage of health care workers in many countries;
- A rapid evolution of technologies, both physical and virtual; and
- New health care models are emerging that promise to deliver more cost-effective care and better Outcomes for recipients.

Case study methodologies are often used by social scientists, who use this qualitative research method to examine contemporary real-life situations and provide the basis for the application of ideas and extension of methods (Leedy & Ellis, 2005). Researching the impacts of assistive technologies on a program or care service involves the study of real-life situations over a period of time.

The case study means doing of the empirical research of the contemporary phenomenon inside its natural perspective by the utilisation of the numerous sources of indication (Yin, 2003). The topics in a case study may be regarding the events, processes, social groups, programs, persons, institutions and some of the other contemporary phenomena. The research using the case study could be a foundation on their characteristics, functions or disciplinary perceptions.

The case study is explained by the characteristics of the research questions, the quantity of control and the preferred end creation. These are the problems to be taken into account during the time of taking a decision that if the case study will be exact for analysing the problems.

Some of the case study types identified by Scheib (2003) are the:

- instrumental case study (an analysis to get a better knowledge of the theoretical problem or question);
- sociological case study (an analysis grounded in the development, structure, grouped behaviour of an individual or groups and interaction);
- intrinsic case study (an analysis which has its view to study more regarding a

specific group, individual, organization or an event);

- collective case study (an analysis that is made to address a problem in the question);
- ethnographic case study (an analysis that pacts with scientific explanation of particular human cultures);
- historical case study (an analysis pacts with explanation of programs, firms and events overtime); and
- Psychological case study (an analysis that is based on the personal experience and the ways of viewing the world).

Yin (2003) defines the case study research method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used to determine the most appropriate methodology for researching, developing and trialling a framework construct for evaluating e-Healthcare programs. Several alternative research methods were considered, as follows:

This study focuses on facts and cause-and-effect behavioural relationships and includes the development and testing of real-world theories. From an objective attitude, the research paradigm associated with the theories that are scientific is called positivism. The scientific methodology used by the positivists in the way of understanding and researching the social and psychological phenomenon. It is believed by positivists that the reality is steady and could be observed and explained without including the learned phenomenon. The positivism is the primary tradition of analysis in the behavioural sciences and social sciences. The positivism is of an empirical and quantitative in nature. In the method of positivism, the research methodologies view is of the interpretation, elucidation and understanding of the reports of corresponding and action subjects (Newman et al., 2003).

4.3 Case Study Design

The method of case study has received much criticism in the terms of its deficiency of robustness as a tool in research (Yin, 2003). Due to this, crafting of the case study design has high importance. Scholars can adopt either a multiple – case design or single – case design based on the issue in the question. It is in the cases where there are no extra cases accessible for replication; the scholar could implement the single – case design. The disadvantage of a design of single – case is its incapability to offer a simplifying inference, specifically when the procedures are rare.

On the other hand, the multiple – case design could be used with events in real – life that display enormous sources of signals through the replication rather than the logic of sampling. The generalization of the outcomes of the case studies, according to Yin (2003) from either of the multiple or single designs, stems on the theory apart from that of the population. By duplicating the case via the pattern – matching, a method connecting some pieces of information from the similar case to some proposition of theoretical the design of multiple – case improves and supports the before mentioned outcomes (Hancock & Algozzine, 2006). This assists in the increase of the level of sureness in the robustness of the process.

To capture the variation between healthcare service models, it was determined by the researcher to do a multi-case study, as the evidence from multiple cases was considered to provide a more robust analysis. As the objective was to test and refine the CBS framework, a replication approach was adopted, where each specific case study was considered as a whole study within which both the individual cases and multi-cases results could be evaluated and reported on.

The replication approach as defined by (Yin, 2003) and depicted in Figure 4-1, provides a three stage process for a multiple case study was used to define the process followed in this study.

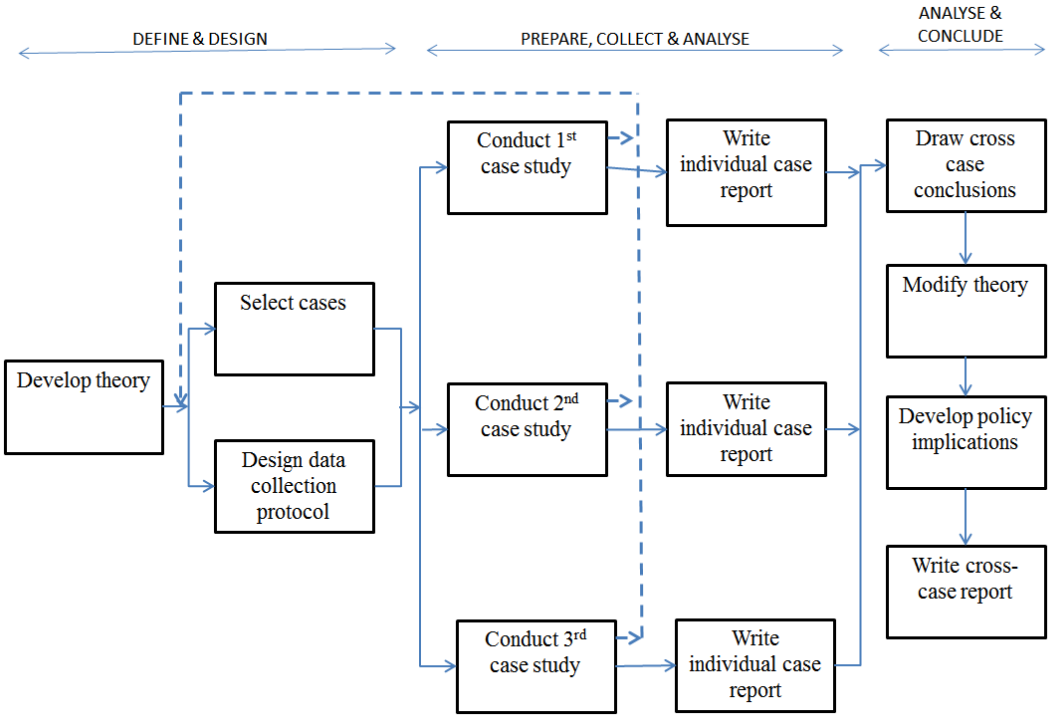


Figure 4-1 Case Study Method adapted from Yin (2003)

SOURCE:(Gulsecen & Kubat, 2006)

The first stage defines the purpose of the study and the related theories that the researcher / investigator is seeking to explore, the selection of cases that can be related to the theories and identifying how and from whom data was to be collected.

The second stage involves preparing for each case study, the data collection process and the analysis of the data collected.

The third stage focuses on the analysis of each case study, both individually and collectively and how the learning's from the cases can be used to refine the theory and associated methodologies and to provide the final report.

4.3.1 Develop Theory

Stage 1 of the Case Study Method, "Define & Design" incorporates the development of the theory, the selection of cases and design of the data collection protocol.

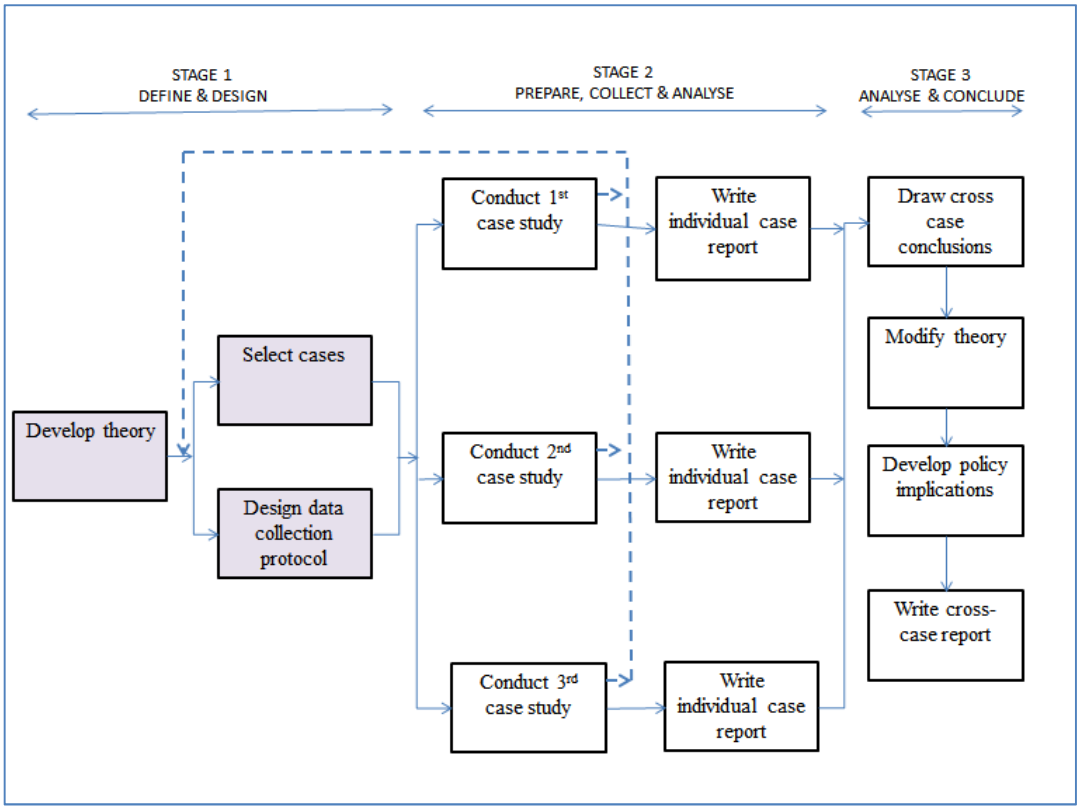


Figure 4-2 Case Study Process - Stage 1

As defined in chapter 3, the redefined Cost Benefits Scorecard (CBS) has been utilised as the core framework for this research, as provided in Figure 3-8 Cost Benefits Scorecard (CBS). This framework was re-engineered multiple times throughout the study, so there are some elements that may not be consistent between the case studies.

Wherever practical these differences have been highlighted.

4.3.2 Select Cases

Three cases were selected with a focus on the use of collaborative technologies to facilitate the delivery of community based care to older people and people with acute and chronic conditions. The first study was an evaluation of how collaboration between community care providers, assisted by technology had a positive impact on the delivery of care to older persons in the Murray Mallee region of South Australia. The second study was in conjunction with an Australian Research Council (ARC) project, where collaborative technologies were developed to assist with the transition of hospital patients to the community. The third study was with the CSIRO Australia e-Health Research Centre that explored the benefits and costs of a home based Tele-Health Cardiac Rehabilitation service.

There was substantial common ground between the three cases selected, although each case had a different focus which added diversity to the research study.

4.3.3 Case Study 1 - Community Waiting List (CWL)

The first case study evaluated how collaboration between community care providers, assisted by technology impacted on the delivery of care to older persons in the

Murray Mallee region of South Australia. There are multiple service providers for the 3 types of community packages across sub regions of the Murray Mallee. The demand for services is greater than the supply of packages and so services maintain a file of referrals from which they select clients as vacancies occur.

The challenge that providers face is the ability to utilise their resources to maximise the care services provided to individuals in the region. A major barrier to achieving this goal was the ability to share information collectively with other providers and to utilise Government funded care efficiently and fairly.

In June 2007, a project was proposed to establish and evaluate an online community waiting list, (CWL) that it was hoped would lead to improved collaboration, greater transparency and improved access to services by the individuals in need.

4.3.4 Case Study 2 - ARC - Minimising the Inappropriate and Unnecessary Admissions of Older People to Hospital

The second case study was an Australian Research Council (ARC) project that focused on the development and implementation of an e-Healthcare solution to minimise the unnecessary hospitalisation of older persons, by facilitating the delivery of care in the community. This study contributed significantly to the understanding of the barriers to the uptake of e-Healthcare service models.

The aims of this project were to develop trial and evaluate a tool that would minimise unnecessary, inappropriate and costly admissions to hospital of older persons. The project used the building blocks established in a South Australian hospital avoidance pilot study called Advanced Community Care, to develop and evaluate a unique, robust model for minimising inappropriate hospital admissions, and determine if the system was associated with overall improvements in care in the community (Meldrum, 2006). It aimed to provide a scalable, more robust, intelligent web-based, community care management system which identified candidates for hospital redirection, mapped services to patients, automated communication between hospitals and community service providers, and tracked and audited service delivery by agencies.

4.3.5 Case Study 3 - Care Assessment Platform Phase 2 (CAP2)

The third and most comprehensive case study was a CSIRO Australia e-Health Research Centre case that focused on the use of an e-Healthcare solution to provide an alternative to hospital/centre based rehabilitation program for people who have suffered a myocardial infarction. This study contributed significantly to the initial conception, constructs and methodologies developed for the e-Healthcare CBS.

CAP is a novel model for a home-based cardiac rehabilitation program, which efficiently uses personal health technologies (mobile phone, Internet technologies, sensors, monitoring devices, and software) in program delivery and patient empowerment. The aim of CAP2 was to demonstrate the effectiveness of home based care combined with ICT intervention for people suffering from cardiac disease, as compared to traditional processes. A randomised controlled clinical trial focused on finding evidence on using Information Technology, specifically Tele-Health systems, to support alternative care models within outpatient cardiac rehabilitation programs. This proposal extended the work and utilised the knowledge derived from clinical trials undertaken in North Lakes during 2007.

4.4 Design Data Collection Protocol

This section outlines the general methods used to guide the Researcher in each case study. Steps specific to a case study have been incorporated into that case study.

The data collection protocols explain the content, timing and the added rules associated with the collection and ascertainment of the information, that is, the manner of assessments. The assessment timing and the particular facts of the process used may differ from case to case, as a result of the different settings in which the assessments take place. The protocols for data collection have to permit data to be gathered for two principal reasons. Initially, the information may be utilized in explaining and describing the causes for the use of the services. Next the data may be utilized in assessing the results. Additionally the collected data may be utilized for secondary research.

There are many phases in the data collection protocol. They are the plan of data collection, collection of the data, examining and synthesizing of data, sharing of outcomes and decision making and storage and demolishing of data. Different types of strategies like the interviews, experiments and questionnaires are done to gather the data on which the test or argument will be made (Struwig & Stead, 2007)

4.5 Collecting Data

During the process of collecting the data from the case studies, the Researcher had many learnings' on what worked and what didn't when it came to obtaining quality data. In order to gather the data, various techniques were used by the Researcher. Data was obtained from surveys, interviews, observation, system data, assessments, and secondary evidence. For the ongoing evaluation of a service model, it was imperative to systematise the collection of measure data, to reduce the ongoing impost on personnel time, and also to improve the accuracy and consistency of the data.

During the studies, the Researcher discovered that:

- Good planning for the collection of data is essential for obtaining quality data on the key uniqueness produced by the procedure.
- Just the collecting of data does not ensure that the specific and relevant data can be obtained.
- The main issue in the data collection is not how the data is collected; rather it is how useful the data is that has been collected.
- The collection of data enables a team to prepare and to test the assumptions of a procedure and to then develop scenarios and cases that might lead to the development of quality features of the service or product (Kumar, 2005).
- It is more significant to perform quasi experiments and experiments because these comprise a research design and the outcomes acquired will generally be well constructed causal outcomes.

4.5.1 Surveys

Survey research was used to collect primary data from all or part of a population in order to determine the incidence, distribution and interrelationship of certain variables. Techniques varied from questionnaires (print and electronic), structured interviews (face-to-face and telephone) and observation techniques (Trochim, 2002). Surveys were also used for collecting feedback from participants, who were scattered geographically. These surveys included service related questions, for example, how easy was it for you to access the service? , with answers ranked using Spearman Rank (Tourangeau, 2004). Surveys are usually the easiest method for obtaining measure data, but there are several drawbacks, including:

- Most surveys are biased towards the personal perspective of the stakeholder, i.e. a patient sees things from their viewpoint and a provider from their s;
- Paper and phone based surveys can be expensive to undertake;
- Paper based surveys are not interactive, i.e. the next question cannot respond to the previous results; and
- Online surveys can provide an interactive format and can be low cost to create by using an internet solution, but consideration needs to be given to spamming legislation.

4.5.2 Interviews

Interviews were conducted to understand participant's points of view. Exploratory and other in-depth interviews were completed using interpretive methods. Exploratory interviews can be immensely useful in the early stages of most research projects (Dick, 2002), and are frequently used in case studies (Trochim, 2002). Interviews generally provided rich data, i.e. more than just answers, with explanations as to why an answer has been proposed. Structured interviews were most appropriate for collecting measures data from service providers, especially in relation to defining the activities that staff members performed and how much time was spent performing the tasks, or in relation to providing data on services.

Unstructured interviews were most appropriate for collecting measures data from stakeholders about the elements of a service, how it was provided, and the issues and difficulties that are encountered. Unstructured interviews took the form of a conversation between the researcher and interviewees. They focused in an unstructured way on the informant's perception of themselves, of their environment and their experiences (Schneider et al., 2002). Unstructured interviews, sometimes called exploratory or in-depth interviews were useful for gaining insights into why things were done the way they were done, and were used to collect extensive data from key people, allowing the respondents to talk expansively on the main subject and/or raising topics within it in any order he/she wished (Beck, 2005).

There were several disadvantages in that unstructured interviews were difficult to record and analyse, and needed to be transcribed; an exercise that was both expensive and time consuming. As such comments and reflections from these interviews were primarily used for adding context to the data. In the CSIRO project, because there was some staff turnover during the course of the trial, it was hard to draw a direct comparison between staff members as they had different experiences and hence perspectives.

4.5.3 Observation

Observational techniques were used to gather first hand data on programs, processes and behaviours being studied. Participant observations are one of the most flexible techniques or set of techniques for doing research (Babbie & Earl, 2003). Observations provided an opportunity to collect data on a wide range of behaviours, to capture a great variety of interactions, and to openly explore the evaluation topic. This was especially true of the first case study.

By directly observing operations and activities, the Researcher gained a holistic perspective, that is, an understanding of the context within which the healthcare service operated. This was especially important where it was not the event that was of interest, but rather how that event fitted into, or was impacted by, a sequence of events. Observational approaches also allowed the evaluator to learn about things the participants or staff may be unaware of or that they were unwilling or unable to discuss in an interview or focus group (Leavitt, 2004).

Observation was most appropriate for collecting measures data on how services were provided, understanding the day to day processes, interactions and issues that occurred in delivering a service. Often Observation methods worked hand-in-hand with unstructured interviews.

4.5.4 Storyboarding

Health systems are complex enough. Add in technology and a myriad of connections, variables and options and the result will be thousands of scenarios, all requiring processes and policies to function. Storyboarding is a useful tool in systems design as like its name, it enables a story to be told; for example, a patient arriving at the Emergency Department (ED) is then triaged and admitted. In systems design, storyboarding usually involves IT interactions, but this is not always the case. Storyboarding was used in both the CWL and ARC cases in order to gain a better understanding of the processes involved in the identification and coordination of services.

4.5.5 Process Mapping

Process mapping is also used in systems design to identify the processes and activities involving both system and non-system components and are often used to create decision pathways, for example, If a patient is triaged at 3, do x, if triaged at 4 do y and if triaged at 5 do z.

Process mapping is a core element of identifying the core activities involved in delivering a health care service and was used in each of the cases.

4.5.6 Use Case Scenarios

Use Case scenarios are predominantly used in the design of IT solutions to enable the developers of systems to understand the interactions of users for different scenarios. Use Case, originating from User Case, enables different types of users, called Actors and their interactions with IT solutions to be mapped, for example, Actor A does this and in response System X does that.

The ARC case required the Researcher to create an extensive list of Use Case scenarios. Use Case scenarios, storyboarding and process mapping were also used to identify performance gaps, service issues and system failures.

4.5.7 System Data

Obtaining statistical data from the Practice / Client Management Solution and other systems used in the delivery of the program was an ideal way to obtain service specific measures data including quantity, time, value, quality and cost. Unfortunately in regards to the case studies where data was held by Queensland health there were significant barriers put in place that made it difficult to collect data.

4.5.8 Assessments

Assessments were used extensively in the CAP2 case, to obtain data on participant's well-being, how they were feeling, physical and mental health status, and were undertaken in an environment which involved both a Provider and the Recipient. Assessments were completed in respect to the service, by professional providers and not by the Researcher. These assessments, included the EQ-5D a standardised measure of health status to provide a simple, generic measure of health for clinical and economic appraisal (EuroQol Group, 1990), the K10 which comprises ten questions about psychological distress (Kessler et al., 2003) and other assessments.

4.5.9 Secondary Evidence

Secondary evidence was obtained from previous experience and research. This was used in conjunction with other types of measures, for example, the impact of waiting times to receive services, which shows that for each day a person has to wait for a cardiac rehabilitation service they are 1% less likely to participate in the program.

Secondary evidence was an important component in calculating the monetary values of benefits, for example, the cost of a readmission for chronic heart failure.

4.6 Conduct Case Studies – General Methodology

It probably makes sense to start with the costs of a health care model, then look at the benefits of that model and then create a framework that enables those benefits to be quantified. Inverse to this is the concept, as Stephen R. Covey (1989), author of the 7 Habits of Highly Effective People states in Habit #2, "Always start with the End in Mind"

The e-Healthcare evaluation methodology does precisely that, by asking upfront:

- What is the primary objective of the research? And;
- What are the key Outcomes of the service model that need to be evaluated?

It really does not matter if the e-Healthcare model being evaluated is a new service model, or has been in existence for some years. Defining the Key Outcomes for the service model will assist the researcher to measure the right elements of the model, as it is pointless to measure elements that do not have any consequence.

The aim of the e-Healthcare evaluation methodology is to provide a step-by-step process for systematically collecting data, costing programs, measuring their Outcomes and effectiveness and then calculating and presenting the net value of the benefits of alternative care service models. These steps include:

- Preliminary
    a. Project Establishment
    b. Defining the care model (s) that will be evaluated
    c. Identification of Project Key Priorities / Objectives
    d. Defining the Study Design Framework
    e. Identifying the locations, personnel and other resources involved in the delivery of the care model
    f. Formalising research protocols, confidentiality and ethics requirements
    g. Obtaining access to data, financial accounts and other information relevant to the project
    h. Care Recipient Selection and Inclusions / Exclusions
    i. Care recipient data collected
- CBS Framework Definition
    a. Define Scorecard Dimensions
        i. Outcomes
        ii. Benefits
        iii. Measures
    b. Define Inputs
        i. Providers
        ii. Technologies
        iii. Information
    c. Define Services Dimensions
        i. Activities
        ii. Usage
- Evaluate Input Dimension – healthcare Services
    a. Define Activities
    b. Trace resources to activities
    c. Calculate healthcare Service costs
- Evaluate Input Dimension – Technology
    a. Define Activities
    b. Trace resources to activities
    c. Identify Technology items

   d. Calculate Technology costs

- Evaluate Input Dimension – Information
   a. Define Activities
   b. Trace resources to activities
   c. Calculate Management costs
- Evaluate Output Dimension – Service Provision
   a. Program Definition
   b. Program Outputs
   c. Program Costs
- Evaluate Output Dimension – Service Usage
   a. Uptake
   b. Usage
   c. Satisfaction
- Evaluate Outcome Dimension - Benefits
   a. Define Benefits
   b. Sub-Dimension - Access
   c. Sub-Dimension - Participation
   d. Sub-Dimension - Health Outcomes
   e. Sub-Dimension - Safety & Quality
   f. Sub-Dimension - Resource Effectiveness
- Evaluate Influencers Dimension
   a. Barriers
   b. Enablers
- Results
   a. Collating costs and benefits results
   b. Presenting the results

Note that several of the steps may run concurrently.

As previously stated, commencing with the end in mind is critical, as accurately defining the Outcomes, Benefits and Measures can influence the entire evaluation process. It is pointless collecting data on access availability to services, if the stakeholder requiring the evaluation is only interested in the financial aspects of a program.

For each of the case studies, a mixed methods approach provided qualitative and quantitative data from observation, semi-structured interviews, focus groups, surveys, system outputs and statistical reports.

The data and knowledge gained from these case studies was then used to enhance and refine the e-Healthcare evaluation framework.

4.7 Preliminary

The preliminary activities required to establish a project, as outlined above, may vary from project to project, but are intended as a guide to the Researcher.

4.8 Articulating the e-Healthcare Evaluation Construct

Before developing a strategy to evaluate case studies, it is imperative to the success of the evaluation to choose the most appropriate methods to gather the information. The techniques of data collection are considered as the tools of the builders and choosing which tools to be utilized will highly depend on the work that has to be finished. The options of focus groups or observation or questionnaires should be directed by the goals of the appropriate assessing exercise.

Because evaluation of the data gathered is a vital part of the research procedure these measurements cannot be final in themselves. Some of the frequently mentioned evaluation models include responsive evaluation, goal free evaluation, consumer - oriented approaches, expertise / accreditation approaches, utilization - focused evaluation, participatory / collaborative evaluation, empowerment evaluation, organizational learning, theory – driven evaluation, adversary / judicial approaches and success case method (Russ-Eft & Preskill, 2001).

As previously stated, begin with the end in mind, as the outcomes and benefits will be what stakeholders will initially focus on, followed by the service to be delivered and then the inputs required.

4.8.1 Defining Outcomes

In the updated CBS, 5 key outcome dimensions were incorporated to create a multidimensional measuring model with interdependencies between the different outcomes. This change was based on the initial Program Outcomes reading more like ‘Objectives’ that would only reflect the positive outcome, instead of ‘States’ that could be reflected both as a positive, for example, Costs reduced, or as a negative, for example, costs increased.

4.8.2 Defining Benefits

The benefits applicable for each case may vary. Table 4-1 Outcomes and Benefits shows a standard list of Outcomes and Benefits, as defined in the CBS framework.

Table 4-1 Outcomes and Benefits

ACCESS - People can access the program within an acceptable time, irrespective of income, physical location or cultural background

- Improved referral processes will increase the number of people accessing the program
- Reduced waiting times will result in more people enrolling in the program
- Patients living in regional and remote communities will have greater access to the program

PARTICIPATION - Service is client focused. Participants are treated with dignity, confidentiality and encouraged to participate in choices that relate to their care

- Improved interactivity between Providers and Recipients will result in higher Participation involvement in their care
- Increased patient involvement in their care will result in improved long-term outcomes and a reduction in secondary attacks and re-admissions
- Increased participant satisfaction will result in higher retention rates

HEALTH CARE OUTCOMES - An effective program with care interventions that are flexible and relevant to the participant's needs will improve retention rates and health care outcomes and reduce secondary attacks and re-admissions

- Improved retention rates will result in more people completing the program
- Improved Quality of Life and physical health outcomes for Participants
- Improved Physical health outcomes for Participants
- Reduced Secondary attacks and Re-Admissions

QUALITY & SAFETY - The highest quality services provided with actual or potential harm from health care management or the environment in which health care is delivered avoided or reduced to acceptable limits

- Adverse events minimised
- Reduced adverse consequences resulting from a lack of services available in regional or rural communities
- More effective care provided in the community due to clear information provided in a timely manner to all providers involved in the care of a participant

SERVICE EFFICIENCY - Resources are applied in the most cost effective way to achieve the lowest costs for both the service provider and the participants

- Increased service capacity, better resource utilisation and more flexible options will reduce the unit cost per Participant
- Reduced service delivery costs
- Reduced administration costs
- Reduced infrastructure costs
- Reduced patient costs
- Increased recovery of funding from external sources through better identification of patient and statistical reporting

The above information can be used to create the initial e-Healthcare evaluation model, which can then be agreed with the stakeholders involved in the Program. It is important to obtain consensus from key stakeholders to agree on the Outcomes and the Benefits and what is most important to compare between the programs.

4.8.3 Identifying Measures

Establishing the measures for the e-Healthcare model will require investigation and often measures will only be discovered through the process and will require a certain amount of backwards and forwarding to get the model correct.

As previously stated, a wide range of measures have been incorporated in the e-Healthcare evaluation framework. These measures have been developed as a result of previous work by the researcher, research of other frameworks and as a result of the case studies.

Surveys can be immensely useful in collecting data, however, it is much more beneficial to obtain consensus for the outcomes and benefits at a stakeholder meeting. Ideally in a stakeholder meeting, the outcomes outlined in the e-Healthcare evaluation framework, which have been established for an e-Healthcare model can be discussed and either these, or alternative ones decided. Then the same process should be applied to benefits.

To identify measures, each benefit needs to be analysed to determine how it can be supported, for example, for the benefit "Increase in number of people accessing the Program" one measure was to identify the number of regional and remote patients referred to the service. The most practical way to identify measures is to:

- Present the different stakeholders with a list of benefits and ask them to define likely measures;
- Collate the measures and distribute them to the stakeholders and ask them to rank the measures; and
- Select the top one, two or three measures for each benefit and then use these for the analysis.

4.9 Measuring Quality

As per the CBS framework, the quality of the inputs will have a direct impact on the quality and cost of the services, and the usage of those services, and this will in turn impact on the outcomes achieved.

To measure the quality of the inputs a variety of measures can be used in the CBS construct, including:

- Quality measures for service providers include capacity, responsiveness and accreditations;
- Quality measures for the supporting technologies dimension include functionality, connectivity, reliability, flexibility, performance, security, compliance to standards and interoperability; and
- Quality measures for information services include availability, relevance, content, currency and accuracy.

These measures may be obtained via surveys, interviews, assessments, or audits.

4.10 Measuring Costs

Once the CBS framework has been created, the next process is to calculate the costs of providing the e-Healthcare model as compared to an alternative care program, a benchmark, or no program.

Activity Based Costing (ABC) methodologies are increasingly being used to provide case mix funding in hospitals and other health. The Independent Hospital Pricing Authority has implemented activity based funding (ABF) in Australian public hospitals from 1 July 2012 (The Independent Hospital Pricing Authority, 2012).

ABC enables costs to be assigned to program outputs based on the activities involved in delivering the program and related services; and how these activities consume resources, including personnel, buildings, equipment, utilities and external services. By identifying how resources are traced to each activity, reverse modelling can be used to create business models that more accurately calculate the required resource for different service volumes.

ABC focuses on processes that drive cost. By tracing healthcare activities back to events that generate cost, a more accurate measurement of financial performance is possible (Canby, 1995). ABC enables costs to be calculated for alternative outputs based on the activities involved in delivering the output, and how these activities consume resources, including personnel, buildings, equipment, utilities and external services (McGraw-Hill, 2003). By identifying how resources are traced to each activity, reverse modelling can be used to calculate the required resources for different service volumes.

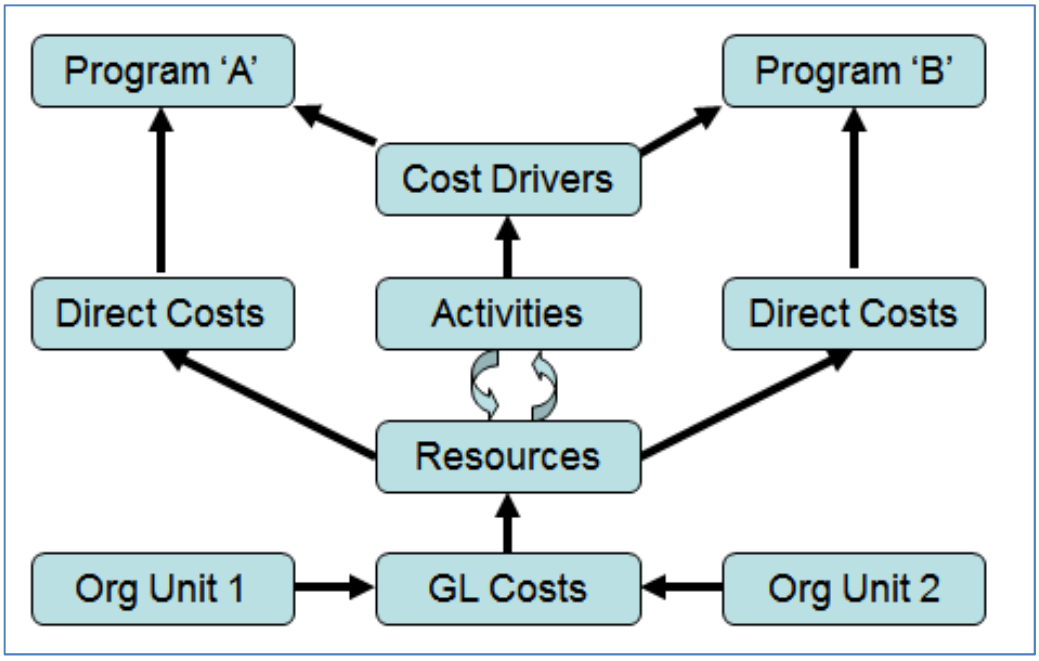


Figure 4-3 Activity Based Costing Model developed by (Whittaker, 2008)

The costing model articulated by the Researcher shows how General ledger (GL) costs are traced to resources, which are then traced either directly to programs, where they only relate to that program or to activities where they may relate to more than one program.

Activities and their costs are then traced to alternative service models (outputs), based on the consumption of activities by the output.

In the CBS framework, costs fall into one of three major categories, each of which will have a driver:

- Fixed costs (FC) are costs that remain the same, regardless of the service quantity, for example, facility costs. Note that in some cases, costs can be fixed based on a certain level of activity and then step up where they again remain fixed for a higher level of activity;
- Direct costs (DC) are costs related directly to an output and can involve both people and non-personnel resources, for example, nursing activities directly involved in the care of patients and associated consumables. Direct costs vary in relation to service activities, and so in most cases can be treated as variable costs; and
- Indirect costs (IC), also known as overheads, are costs that benefit more than one service, so their precise benefits to a specific service are often difficult or impossible to trace, for example, corporate costs, including finance, human resources, quality and executive.

ABC models differ widely, based on the requirements of the type of industry, organisation or service. The CBS Costing model has been developed specifically to measure the costs of health and wellbeing programs and service models.

The CBS Costing model traces staff and other people resources (Personnel), plus other resources and overheads involved in the delivery of the service to activities via cost drivers. Activities are then traced via Activity Drivers to different programs and service models (outputs), based on the consumption of activities by the output. Outputs are then traced to Outcomes in the CBS framework.

ABC modelling can, at first, appear rather daunting and certainly does add an additional level of complexity to program / service evaluation, but once established and, if systematised, the benefits gained can be substantial.

4.11 Data Collection Process:

The processes for gathering the data can be both individualised and progressive, where data can be collected one step at a time or grouped where a number of data elements can be gathered collectively. When completing an evaluation, it is easy to want to jump in and collect data, which can result in wasted effort, inaccurate data and consequently inaccurate conclusions.

The Researcher proposes several phases in the process data collection, which progressively build upon each other to enable a more complete picture and result. These phases include discovering where the data can be obtained from, identifying the procedures for obtaining the data, identifying the kinds of data that can be collected, obtaining permissions for the collection of data, sampling, recording how the data was obtained and the validity of the data, and establishing protocols for managing the collection of data.

Sampling methods can be used to reduce the whole population to a required size in order to reduce errors and to provide a result. Permissions need to be obtained from individuals, stakeholders offering access to sites and to the institutional review

boards. Data sources can be obtained from instruments, public documents or through interviews and observations. The data should be recorded according to the protocols and managed by the standard procedures (Creswell, 2005)

The following process outlines the steps involved in tracing costs to programs or service models:

1. Identify the activities involved in the delivery of the program
2. Trace personnel costs to activities
3. Trace other resource costs to activities
4. Trace overheads to activities
5. Trace activity and direct costs to programs

4.11.1 Identify Activities

Through a consultative approach, either individually or in a workshop setting, selected staff involved in a program, are guided to create process maps for the program being evaluated. Process maps define the key activities involved in delivering a program, commencing with the intake of participants, through to service delivery, discharge and reporting. The number and complexity of the process maps will vary from program to program. They need to be detailed enough to capture the unique requirements of each service model, in order to provide accurate costing, but simple enough to enable the time spent by staff and other resources to be easily traced to each activity.

As a guide only those activities which consume more than 5% of a person's time should be considered, with less time consuming activities allocated to an Admin activity. Example: Table 4-2 outlines some of the key activities involved in delivering home based medication monitoring services. This program incorporates two service models, Face-to-Face (F2F) visits and remote video monitoring, both conducted by Registered Nurses.

Table 4-2 Identification of High Level Activities for example, a Medication Monitoring Program

Activities	Activity Type
Receive Referrals / Enquiries	Direct
Coordinate care programs	Direct
Correspond with Referee's GP	Direct
Assess Service Requirements	Direct
Create / Maintain Care Plans	Direct
Deliver monitoring programs – F2F	Direct
Deliver monitoring programs - Remote	Direct
Meetings, training and other indirect activities	Indirect
Complete admin tasks	Indirect

Activity Types in the CBS are defined as either Direct or Indirect activities. Direct Activities can be directly attributed to, or support the outputs of a service. Indirect Activities are activities that have no consequential relationship to the output of a service. The aim is to minimise indirect activities.

4.11.1.1 External Activities

Process maps can include the activities of external resources, for example, the time taken for a GP to create and send a referral. In this case an additional Activity 'Create referral' would be added to the beginning of the process. Incorporating external activities will assist to provide a clearer understanding of the time, complexities and costs of the full process, but can add an additional layer of complexity to the CBS model.

4.11.2 Trace Personnel to Activities

In most cases, the biggest cost in delivering a health care service is personnel, including staff, contractors, allied health, specialists and other care professionals. In the CBS costing model, personnel are traced to activities based on the estimated amount of time they spend performing each activity. To simplify the process, personnel can be grouped by their classification or role type, for example, Registered Nurse (RN), General practitioner (GP), Physiotherapist (Physio) or Admin Staff (Admin).

In this step, our aim is to calculate the # FTE performing each activity, as this will then enable the cost of personnel to be calculated for each activity. Through a guided process, representatives from each role are asked to estimate the amount of time spent performing the activities specified in the process maps per FTE equivalent.

During this process, it is most likely that additional activities will be identified, so firm guidance may be required to ensure that the model does not become too complex. A 4 week period is recommended in order to capture the variances in activities over the course of a month, as some activities will only take place at the start or end of a month. Also it is imperative to ensure that the total number of hours for each role meets the FTE requirements of the role, for example, 38 hours, unless there is a specific requirement to capture out of hours work.

Table 4-3 Sample Resource Allocation for 2 FTE RNs over a 4 week period provides a template for allocating resource time over a 4 week period, with Wk1 being defined as the first week and Wk4 as the last week of the month.

In this example, 2 FTE RNs working with a community care provider have allocated their time against a range of activities involved in the delivery of a medication monitoring program being delivered via two alternative service models, i.e. face to face (F2F) visits and remotely by video phone (Remote).

For simplicity sake, the approximate # hours taken by the RNs to complete each activity have been evenly allocated across the 4 weeks. When allocating time, it is imperative to minimise the amount of time allocated to indirect activities, as this will distort the model. Where a large percentage of time has been grouped in Admin, further analysis will usually be required to more specifically allocate Admin time to definable activities.

Table 4-3 Sample Resource Allocation for 2 FTE RNs over a 4 week period

Activities	Wk1Hrs	Wk2Hrs	Wk3Hrs	Wk4Hrs	Ave %	Ave # FTE	Role
Receive Referrals / Enquiries	4.0	4.0	4.0	4.0	5.3%	0.103	RN
Coordinate care programs	4.0	4.0	4.0	4.0	5.3%	0.103	RN
Correspond with Referee's GP	4.0	4.0	4.0	4.0	5.3%	0.103	RN
Assess Service Requirements	6.0	6.0	6.0	6.0	7.9%	0.154	RN
Create / Maintain Care Plans	4.0	4.0	4.0	4.0	5.3%	0.103	RN
Deliver monitoring programs – F2F	32.0	32.0	32.0	32.0	42.1%	0.821	RN
Deliver monitoring programs - Remote	8.0	8.0	8.0	8.0	10.5%	0.205	RN
Meetings, training and other indirect activities	10.0	10.0	10.0	10.0	10.5%	0.256	RN
Complete admin tasks	6.0	6.0	6.0	6.0	7.9%	0.154	RN
TOTAL	78.0	78.0	78.0	78.0	100%	2.000	RN

This process would be repeated for each role type involved, either directly or indirectly in the delivery of the program. NOTE: Corporate / Department overhead costs, for example, Finance, HR and Executive and other costs are traced separately to activities.

4.11.3 Calculate Activity Costs - Personnel

Personnel costs are traced to Activities based on the Cost Driver (CD) "Time spent by personnel performing an activity". The average time spent, as a % of total time is then multiplied by the # FTE involved and the annual cost of each FTE, or an hourly rate, where this is applicable.

Equation 1 - Activity Costs Calculation

- Annual Activity Cost (AC) = % Time allocated to Activities x # FTE x Annual Personnel Cost, or
- Hourly Activity Cost (AC) = % Time allocated to Activities x # FTE x Hourly rate

The more time spent performing an activity, the greater its cost and visa-versa.

Staff and other people resource costs can either be obtained from the financial accounts, or where this information is not available or inaccurate, can be calculated by taking an average of the classified annual salaries for each resource type and allocating a percentage overhead, for example, 27% to account for holiday, sick days, superannuation and other personnel costs.

Using the information from Table 4-3; assuming a total resource cost per FTE RN of $70,000, the costs of coordinating care programs would be:

Equation 2 - Calculation of Activity Costs

- 0.103 * $70,000 = $7,368 per annum. (Note rounding of # FTE)

Applying this calculation to the activities listed above is shown in Table 4-4

Table 4-4 Calculating the activity cost of personnel

Activities	Ave %	# FTE	Total Cost
Receive Referrals / Enquiries	5.3%	0.103	$7,368
Coordinate care programs	5.3%	0.103	$7,368
Correspond with Referee's GP	5.3%	0.103	$7,368
Assess Service Requirements	7.9%	0.154	$11,053
Create / Maintain Care Plans	5.3%	0.103	$7,368
Deliver monitoring programs – F2F	42.1%	0.821	$58,947
Deliver monitoring programs - Remote	10.5%	0.205	$14,737
Meetings, training and other indirect activities	10.5%	0.256	$14,737
Complete admin tasks	7.9%	0.154	$11,053
TOTAL ALLOCATED	100.0%	2.000	$140,000

To improve the results of the model, if there is any relationship between indirect personnel time and a direct activity, the Personnel's time should be allocated to that activity.

4.11.4 Trace Other Resource Costs to Activities

In addition to personnel costs there will be other (non-personnel) resource costs that need to be traced to activities in order to determine the full cost of each activity. Other resource costs may include service consumables for example; wound dressings, facility costs, technology and communication costs, plant & equipment and corporate overheads. In the costing model, these resources need to be identified as variable, fixed, or overhead costs.

Other resource costs can be traced either to activities based on the estimated consumption of those resources by the activity, or the personnel performing the activity. Where other resource costs relate to service outputs, for example, consumables, they should be traced to service outputs via the relevant activities. Where other resource cost relates to personnel, for example, payroll processing costs; they should be traced to personnel, based on the # FTE or alternatively their annual salary.

Service consumables may be traced directly to service activities, based on the # programs. Facility costs may be traced, based on the square metres of floor space consumed by an activity, or where a number of activities are performed in the same area, the #FTE personnel involved in each activity. Technology and communications and Plant & Equipment costs may be traced to activities based on their estimated utilisation by the activity. Corporate overheads, such as HR costs may be traced proportionally to staff resources, based on the #FTE, or their salary.

The example shown in Table 4-5 illustrates how other resources can be traced to activities. This example assumes non-personnel resource costs of Consumables ($15,000), Facility ($40,000), Technology ($20,000), Motor Vehicle ($30,000) and Corporate Overheads ($40,000). It is assumed that the activities shown are the complete set of activities in the model.

Table 4-5 Other Resource Costs Traced to Activities

Activities	Consumables	Facility	Technology	Travel	Total Other Cost
	$15,000	$20,000	$20,000	$30,000	
Receive Referrals / Enquiries		$345	$1,053	$0	$1,397
Coordinate care programs		$345	$1,053	$0	$1,397
Correspond with Referee's GP		$345	$1,053	$0	$1,397
Complete detailed Assessments		$517	$1,579	$0	$2,096
Create / Maintain Care Plans		$345	$1,053	$0	$1,397
Deliver monitoring programs – F2F	$7,500	$0	$0	$20,000	$27,500
Deliver monitoring programs - Remote	$7,500	$10,000	$10,000	$0	$27,500
Meetings, training and other in-direct costs		$862	$2,632	$0	$3,494
Complete admin tasks		$517	$1,579	$10,000	$12,096
TOTAL	$15,000	$13,276	$20,000	$30,000	$78,276

Equation 3 - Apportion Consumable Costs to Activities

- 100% ($15,000) (Consumables Cost / Total # Services) * # programs for each service model
- E.g. Consumables Costs for the activity 'Deliver monitoring programs – F2F' = ($15,000 / 6000) * 3000 = $7,500

4.11.4.1 Assumptions

A critical requirement in allocating costs is to clearly define the assumptions made in the model, as these will vary from service to service. In the example above, the following assumptions have been made:

- Consumables have been treated as variable costs and apportioned to activities on the basis of the # programs provided.
- Facility costs have been apportioned to activities on the basis of the resource time spent utilising the facility. Facility costs have not been allocated to the activity Deliver Face-to-Face medication monitoring as this occurs away from the facility. The total cost of facilities has been proportionally distributed across the other activities based on the average no. of hours personnel spend completing each activity.

Equation 4 - Apportion Facility Costs to Activities

- 100% ($30,000) Facility Cost / (Total FTE - F2F monitoring activity FTE) * Ave FTE for each activity, excluding F2F Monitoring activity
- Facility Costs for the activity 'Coordinate care programs' = $40,000 / (2.00 – 0.82) * 0.10 = $3,478

Equation 5 - Apportion Technology Costs to Activities

- Technology costs have been allocated 50% ($10,000) to the Deliver Remote Medication Monitoring activity as this activity accounts for approximately 50% of the technology and communication costs with the remaining 50% ($10,000) allocated across all other activities, excluding F2F monitoring activity based on the average no. of hours personnel spend completing each activity.
- 50% ($10,000) Technology costs allocated to Remote Monitoring activity; and
- 50% ($10,000) Technology costs / (Total FTE – Remote Monitoring activity FTE) * Ave FTE for each other activity, excluding Remote Monitoring activity
- E.g. Technology Costs for the activity 'Coordinate care programs' =
- $10,000 / (2.00 – 0.21) * 0.10 = $1,053
- Travel costs have been allocated two thirds to Deliver F2F monitoring, as this is the primary activity where travel is directly required, with the remaining one third allocated to Meetings, training and other indirect costs.

Equation 6 - Apportion Travel Costs to Activities

- 66% ($20,000) Travel costs allocated to F2F Monitoring activity; and
- 33% ($10,000) Travel costs allocated to Meetings, training and other indirects.

4.11.5 Trace Overheads to Activities

As previously stated, a key function of ABC is to more fairly allocate Indirect costs (Overheads) to activities. To achieve this, admin costs are proportionally allocated to direct activities, usually based on the # FTE, unless there is sound argument for an alternative method of allocation.

Equation 7 - Apportion Corporate Costs to Activities

- Corporate costs have been allocated 50% ($20,000) to the personnel involved, based on costs relating directly to staff, including HR and Training and Development, with the remaining 50% ($20,000) traced to general service overheads.
- 50% ($20,000) Corporate costs allocated direct to Personnel; and
- 50% ($20,000) corporate costs allocated to general service overhead.

Obviously the way costs are allocated will vary from service to service. Accordingly the majority of methods used should be in line with the above examples. In Table 4-6 Overhead costs have been traced proportionally to Personnel and Other Costs, shown as "Adjusted Personnel" and "Adjusted Other Costs".

NOTE: There can be rounding errors when tracing overheads as a result of circular reference issues, as one variable is dependent on another dependent and visa-versa.

Table 4-6 Total Activity Cost of Personnel and Other Resources, with Admin Activities Allocated

Activities	Personnel	Other Costs	Overheads	Total	Adjusted Personnel	Adjusted Other Costs
Receive Referrals / Enquiries	$7,179	$1,397	$1,026	$9,603	$9,794	$1,917
Coordinate care programs	$7,179	$1,397	$1,026	$9,603	$9,794	$1,917
Correspond with Referee's GP	$7,179	$1,397	$1,026	$9,603	$9,794	$1,917
Complete detailed Assessments	$10,769	$2,096	$1,538	$14,404	$14,696	$2,876
Create / Maintain Care Plans	$7,179	$1,397	$1,026	$9,603	$9,794	$1,917
Deliver monitoring programs – F2F	$57,436	$27,500	$8,205	$93,141	$77,037	$37,105
Deliver monitoring programs - Remote	$14,359	$27,500	$2,051	$43,910	$18,575	$35,796
Meetings, training and other indirects	$17,949	$3,494	$2,564	$24,006	$24,486	$4,794
Complete admin tasks	$10,769	$12,096	$1,538	$24,404	$0	$0
Corporate Overhead			$20,000	$20,000	$0	$0
TOTAL ALLOCATED	$140,000	$78,276	$40,000	$258,276	$173,969	$88,243

Equation 8 - Tracing Overheads to Activities

- OH (1) 50% Overheads ($20,000) traced to personnel based on the #FTE
- OH (1) * Activity #FTE / Total #FTE
- For Receive Referrals / Enquiries FTE =.103 (From Table 3.)
- $20,000 *.103 /2.0 = $1,020
- OH (2) 50% Overheads ($20,000) traced to total cost (including Personnel and Other Resources)

At this point, based on our assumptions, we can conclude the total cost of performing the above listed activities as:

- Personnel of $173,969 + Other resources of $88,243 = Total of $258,276

4.12 Tracing Activity Costs to Service Models

Activity costs are traced to service models based on the estimated consumption of each activity, plus any direct costs applicable, by the program/service model. Refer to Figure 4-3 Activity Based Costing Model.

The term Cost Driver (CD) is used to define what drives the costs of an activity, for example, the quantity of visits. Common CDs used in the CBS are the number of participants, number of visits, length of stay, type of intervention and the age, health and mental state of the participant.

Where two or more different programs are delivered by common resources, the activity costs are first traced to each program based on the estimated consumption of activities by each program and then traced to each service model based on the estimated consumption of activities by each service model.

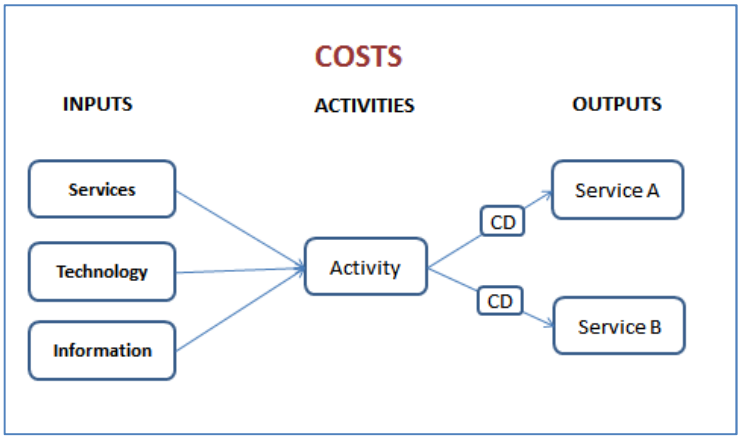


Figure 4-4 Using CDs to trace activity costs to two different programs

The tracing of activity costs to different program service models may be based on several different Cost Drivers (CDs), depending on the complexity of the model. Where most activities for each service model are the same, then it is only for the exceptions that different CDs are required. For example, a remote monitoring service using video technologies would have a CD based on the # of remote consults and a F2F monitoring service model would have a CD based on the # of home visits.

Figure 4-4 provides a template for using CDs to trace activity costs to two alternative service models. In this example it is assumed that both service models will have the same number of clients and complexity. In this scenario, the service model is a traditional home visit medication monitoring program, and the second service model is a video enabled remote (Tele-Health) medication monitoring program.

Table 4-7 illustrates the tracing of costs to Service Model 1 and Service Model 2 based on the most appropriate driver of costs (CD). In this example, the cost of the referral activity is traced equally to both service models. Usually the number of referrals to each model would differ, resulting in the costs being distributed according to the number of referrals.

Table 4-7 Activity Costs Traced to each Service Model

Activities	Cost	CD	Model 1 Value	Model 2 Value	F2F Service 1	Tele-Health Service 2
Receive Referrals / Enquiries	$11,712	# Referrals	100	100	$5,856	$5,856
Coordinate care programs	$11,712	# Participants	100	100	$5,856	$5,856
Correspond with Referee's GP	$11,712	# Participants	100	100	$5,856	$5,856
Complete detailed Assessments	$17,568	# Participants	100	100	$8,784	$8,784
Create / Maintain Care Plans	$11,712	# Participants	100	100	$5,856	$5,856
Deliver monitoring programs – F2F	$114,142	# Visits	3,000		$114,142	$0
Deliver monitoring programs - Remote	$54,372	# Consults		3,000	$0	$54,372
Meetings, training and other indirects	$29,281	# FTE	1.79	1.18	$17,647	$11,633
Complete admin tasks	$0	Fixed			$0	$0
TOTAL ALLOCATED	$262,212				$163,998	$98,214

4.12.1.1 Assumptions:

Any other assumptions in addition to those previously outlined, should be provided.

4.12.2 Conclusion

Based on the assumptions made in the model, the conclusion derived would be that the Tele-Health medication monitoring program can be delivered at a substantially lower cost than the traditional face to face medication monitoring program. On its own, cost is only one factor in the delivery of a health care service and the non-financial benefits also need to be taken into account. The next sections articulate how the benefits of a service model, can be applied.

4.13 Creating the Benefits Model

What are the benefits of an e-Healthcare model and how can they be measured?

The cost efficacy of an e-Healthcare model can fairly easily be quantified using ABC methodologies (Estabrooks et al., 2008; Shortliffe et al., 2001). For example, the use of Tele-Health to deliver remote medication monitoring may prove to be more cost effective than a traditional home visit medication monitoring program. As stated in the previous section, cost is only one dimension that needs to be considered when evaluating an e-Healthcare program.

4.13.1 Selecting the Analysis Design

As outlined in the CBS framework, there are three primary analysis tools used to evaluate the benefits:

- Cost-Benefit Analysis (CBA) methodologies require program consequences to be valued in monetary units, thus enabling the analyst to make a direct comparison of the Program's incremental cost with its incremental consequences in commensurate units of measurement, be they dollars, pounds or yen (Drummond et al., 2005Chapter 7, Pg.211.).
- Program benefits can often be intangible and subjective, and received over a period of time. Reduced future costs and improvements in health care outcomes as a result of a program are often much more difficult to quantify and can be distorted by time, secondary health issues and other factors. Additionally, benefits can be viewed from multiple Program Outcomes, and a benefit to one stakeholder may not necessarily be a benefit to another stakeholder.
- Cost-effectiveness analysis avoids the challenges of measuring benefits in monetary units and instead measures the outputs of a program (Estabrooks et al., 2008). If consideration is being given to the quantity of services that can be delivered, then Cost-Effectiveness is a valid method to use and measures that assist the researcher to quantify the outputs of a Program need to be incorporated into the CBS.
- Cost-Utility analysis (Drummond et al., 2005) requires benefits to be measured in terms of Quality of Life Years (QALYs), so where the Outcomes for a recipient of care need to be evaluated, measures that assist the researcher to quantify the Outcomes of a Program need to be incorporated into the CBS Framework.

The aim of the CBS Framework is to overcome the limitations of each of the above cost analysis approaches, by creating an evaluation form that enables all types of measures to be collated and presented.

4.13.2 Defining Outcome Benefits

In most cases, the outcome benefits of a program can be defined in terms of how well the outcomes have been achieved. In the design of the e-Healthcare evaluation framework, 5 standard program outcomes have been identified:

- Access
- Participation
- Care Outcomes
- Quality & Safety
- Cost Efficacy

As previously stated, the standard Outcomes Benefits can be changed, as required to suit the needs of the Program. If the key Benefits for a Tele-heath medication program were to offer a cost-efficient, sustainable, and effective service the key Benefits may include:

Table 4-8 Key Benefits of a Technology Enabled Tele-Health Program

Key Benefits
Improved access to Program
Reductions in re-admissions
Reductions in service costs
Increased participation rates
Improved health care outcomes
Reduction in waiting times
Improvement in QOL
Reduction in Incidents
Improved completion rates

As previously stated, the key Benefits of the technology enabled service model need to be identified and described through a consultative, or workshop process. This can be achieved through the use of the CBS Outcomes Benefits and Measures worksheet.

The CBS - Benefits module enables both the monetary and non-monetary benefits of a program to be captured and analysed. Measures are used to collect quantity, %, time, quality and other performance indicators of the service model. The Output benefits for each Program can therefore be based upon how well the Benefits have been achieved. Benefits can be benchmarked against an agreed set of values, against an existing program, for example, a Face-to-Face Program, or against No Program.

To evaluate how well the Benefits for the Program have been met, a range of measures can be used. In the Tele-Health example, for the Benefit: Improve Access to Program, the measure # Regional and remote patients referred to the service may be suitable. Table 4-9 outlines the basic terminology for measures.

Table 4-9 Measures Terminology

Measure	Name of the measure
Description / Purpose	What does the measure mean and why is it important
Data Type	The type of data collected, for example, $'s cost or (benefit), #, %, Rating, QALYs
Source	Where has the data come from, for example, system output, or research
Result	Total measure value achieved for Program 'A'
Result	Total measure value achieved for Program 'B'
Net Benefit	The improvement measured, as (A / B) or (A – B)
$ Net Benefit	The $ of the improvement measured ($A – $B)

4.13.3 Comparing Service Models

When comparing two alternative service models, the measures of Service 'A' can be directly compared against an alternative service 'B', negating the need to provide an independent control or benchmark for each measure. In this case, the column 'Result' becomes 'Service A' and the column 'Control' becomes 'Service B'.

4.13.4 Populating the Framework

In Table 4.9 on of the measures for the Benefit 'Increase the number of participants who complete the Program is the # participants completing 80% of the program.

Data collected from the CSIRO Cardiac Rehabilitation case study is outlined in Table 4-10 Benefits Module - Tele-Health Example. Column 'A' is used to record the results for Technology assisted Home based rehabilitation and the Benchmark is used to record the existing Centre based rehabilitation.

What this clearly shows, in the above example, is that there was a significant increase in the number of people completing the Home Based technology enabled program as compared to the Centre Based program.

Table 4-10 Benefits Module - Tele-Health Example

Perspective / Benefit / Measure	Description / Purpose Data Type Source	Model 'A' Home	Model 'B' Centre	% Net Benefit	$ Net Benefit
Participation					
# participant completing 80% of the program	Research demonstrates that the risk of re-admission is reduced substantially where 80% or more of a Cardiac Rehab program is completed	80%	45%		
Total Net $ benefit					

4.14 Measurement Tools

A diverse range of measurement tools can be utilised to populate the CBS. For details of the assessment tools refer to Table 3-5 CBS Measure Types.

4.14.1 Assessments

A wide range of assessments can be used to measure health outcomes, of which some are provided in Table 4-11 - Assessment Tools.

Table 4-11 - Assessment Tools

Assessment
Diets Habit Questionnaire (DHQ),
DASS21,
EQ-5D,
Kessler 10 (K10),
Seattle Angina Questionnaire (SAQ),
Morisky Medication Adherence Scale and trial specific evaluation questionnaires.

4.14.2 Surveys

Surveys are an excellent way to obtain measures on the quality of the service, user satisfaction, with Ordinal Measures, such as 1 = Poor and 5 = Excellent used to collect data for the model.

4.14.3 Calculating the Value of Benefits

Once we have collected the measures, wherever possible we need to calculate the monetary value of the measure. To assist with the calculations of benefits, wherever possible, previously identified research Outcomes must be utilised to substantiate the net benefit derived.

When calculating Benefit $Values, it is important not to double count a benefit, as this will distort the analysis. This may occur where there are two measures that could both result in a similar benefit.

4.14.4 Quality of Life (QOL) Measures

As previously stated, Cost-Effectiveness Analysis (CEA) is an appropriate method for measuring benefits delivered by a Program, where these may be difficult to translate into direct monetary benefits. CEA measures may include a wide range of clinical and other measures that can enable Program Benefits to be evaluated in terms of % improvement, or reduction in health risks, or additional years of life. **Error! Reference source not found.** illustrates how some measures have been used to evaluate selected clinical fields.

4.14.5 Quality-Adjusted Life-Year (QALY) Measures

Over the past 25 years, the quality-adjusted life-year (QALY) has become the dominant measure of benefit assessment in health economic evaluation (Torrance, 1986; Williams, 1985). Its use is now widespread, particularly in the various health

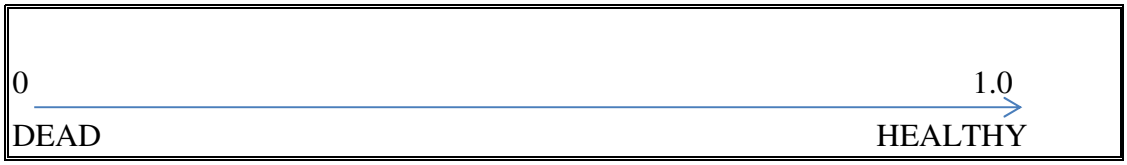
technology assessment agencies around the globe, and most notably in the UK through the assessment procedures undertaken by the National Institute for Health and Clinical Excellence (NICE) (National Institute for Health and Clinical Excellence, 2007).

Table 4-12 Examples of Effectiveness Measures used in Cost-Effectiveness Analysis

Study Reference	Clinical field	Effectiveness measure
(Logan et al., 1981)	Treatment of hypertension	Mm Hg blood pressure reduction
(Schulman et al., 1990)	Treatment of hypercholesterolemia	Percentage serum cholesterol reduction
(Hull et al., 1981)	Diagnosis of DVT	Cases of DVT detected
(Schulpher & Buxton, 1993)	Asthma	Episode-free days
(Parsons et al., 2002)	Thrombolysis	Years of life gained

Source: (Drummond et al., 2005) Page 104

As stated, Cost-Utility Analysis (CUA) is gaining popularity as an appropriate method for measuring benefits delivered by a Program in terms of QALYs (Quality Adjusted Life Years) gained as a result of the intervention. QALY measures includes physical, mental, social and other measures, that indicate the quality of well-being using a scale that describes the best state (Perfect Health) as 1 and the worst state (Dead) as 0.



If the extra years would not be lived in full health, for example, if the patient would lose a limb, or be blind or have to use a wheelchair, then the extra life-years are given a value between 0 and 1 to account for this (Coiera, 2003). A number of instruments have been developed to assist in measuring the QALY, including the:

- SF-6D (Short Form – 6 Dimensional) assessment (Longworth & Bryan, 2003) and
- EQ-5D (European Quality – 5 Dimensional) assessment (Parkin & Devlin, 2006).

NOTE: That it is possible to have a state below 0.0, as a person may be in significant pain or duress.

4.14.5.1 Use of QALY Measures

QUALYs are most appropriate for measuring the changes in a person's state or well-being, at the commencement of an intervention and during or at the conclusion of the intervention.

4.14.5.2 Valuing QALY Measures

There are many ways that the state of a person's QALY can be assigned a monetary value, so when seeking to value the change in a person's state as a result of an intervention, arriving at a figure can vary enormously, especially when economic positions are applied. To overcome this issue, again we need to turn to previous accepted studies that can assist us to arrive at a value.

It is very difficult to put a figure on the value of 1 QALY. In the UK, generally if a treatment costs more than £20,000-30,000 per QALY, then it would not be considered cost effective. (National Institute for Health and Clinical Excellence, 2007).

4.15 Framework Reporting – Comparing Service Models

In this section, our aim is to collate the Outcomes, Benefits and Measures into a format that presents the alternative service models for a Program and that can be easily understood.

Utilising the data gained from the Costing and Benefits models, a Cost – Benefits Framework can be created that enables a program, or service output to be compared against an alternative program, or service output. The structure and results of the CBS framework are shown in Table 4-13.

Table 4-13 Cost-Benefits Framework Comparing 2 Service Models

Perspective / Benefit / Measure	Description / Purpose	Result 'A' Tele-Health	Result 'B' Control
# Regional and remote patients referred to the service	Regional and remote patients have a higher risk of re-admission if they cannot access the Program # Referrals Statistics	50	25
Waiting Times	For every day spent on a waiting list, an additional 1% of patients are less likely to go onto the program # Days Survey	21	31

In Table 4-13, example data has been used to illustrate a comparison between the two service models, in this case a Tele-Health service model and a control model.

4.16 Summary

The CBS and methodology enables the costs and benefits of a program to be collated into a Framework comprising of Outcomes, Benefits and Measures. The benefits of the CBS, is that it can provide the Program Co-ordinator with a multi-perspective view of different programs, and quantifiable benefits that can be used to justify spending decisions.

CHAPTER 5 - CASE STUDY 1 – COMMUNITY WAITING LIST

The aims of this study were to evaluate the costs and benefits of a technology enabled Community Waiting List (CWL), that enabled community based providers to add, view and update older persons (Age > 65) requiring assistance at home.

This was the first case study initiated and completed in the stage 2, "Prepare, Collect and Analyse" and as such was mostly completed prior to the full definition of the CBS. As such this project only partially followed the CBS methodology; but it was considered an integral component in this study, because of its focus on provider collaboration.

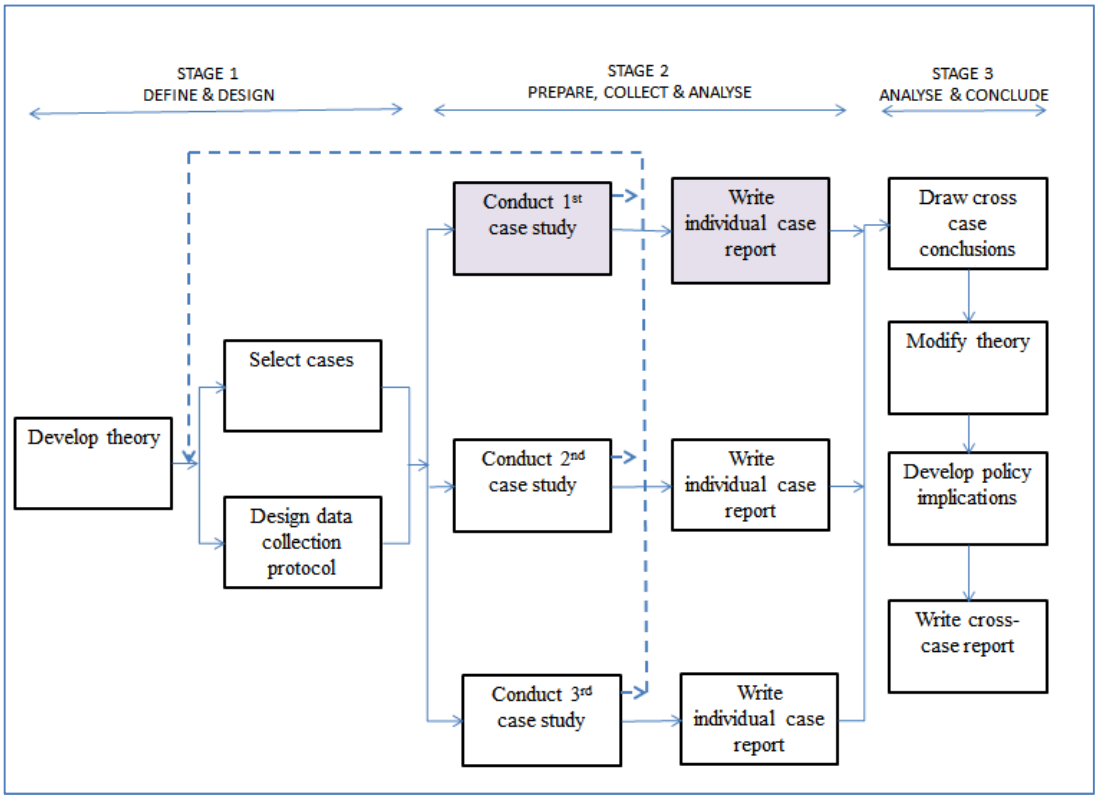


Figure 5-1 Stage 2 - Case Study 1

A key outcome from the study was how collaboration between community care providers, assisted by technology had a positive impact on the delivery of care to older persons in the Murray Mallee region of South Australia.

5.1 Definitions, Terminology & Actors

Table 5-1 Definitions, acronyms and abbreviations

Acronym	Description
ACAT	Aged Care Assessment Team
CACP	Community Age Care Packages
EACH	Extra Aged Care at Home
EACHD	Extra Aged Care at Home for people with dementia
HACC	Home and Community Care Packages
CWL	Solution developed by Nexus for the Community Waiting List (CWL)
Portal	A web site that can be accessed by authorised users
SCR	An electronic Shared Care Record
TCP	Transitional Care Package (Assists people to make the transition from hospital to home)
Nexus	Nexus Online Pty Ltd

Table 5-2 Terminology

Terminology	Definition
Community Care Access Portal	The Community Care Access Portal provides a shared interface that enables: ACAT to register and track assessed persons on the list Providers to register their program availabilities, to view and add to the waiting list record, and select persons from the list

Table 5-3 Actors

Actor	Description
Murray Mallee Aged Care Task Force	A council sponsored program aimed at coordinating care for the elderly in the Murray Mallee region of South Australia
Aged Care Assessment Team (ACAT)	Responsible for assessing elderly persons, to determine the most suitable care services, including residential care
Carers SA (CSA)	Carers SA are a part of the Commonwealth Respite &Carelink Centre, who provide a wide range of service to carers across Australia
Community Based Providers	Home care providers and other community based providers

5.2 Project Overview

Located approx. one hour from Adelaide, South Australia, the Murray Mallee is a grain-growing and sheep-farming area with one major town Murray Bridge and a number of smaller locations, including Karoonda, Lameroo and Pinnaroo. This area has a high number of older persons located on farm properties, as well as in the towns, who require additional assistance to stay at home.

Within this region, there are multiple community care organisations providing a range of services, as well as the local hospital, GPs and Family health and care services. The demand for services is greater than the supply of packages. Individual community package service providers maintain a file of client referrals but this does not constitute a waiting list as providers apply different priority criteria and are not aware of other providers' referrals and priorities.

The system of assessment, referral and management of community packages in the Murray Mallee, as in other areas of health is complex.

There are multiple service providers for the 3 types of community packages across sub regions of the Murray Mallee. The demand for services is greater than the supply of packages and so services maintain a file of referrals from which they select clients as vacancies occur. Clients are contacted by the provider when a vacancy occurs if they meet the provider's priority criteria. Where there are 2 providers clients may be contacted by both providers as vacancies occur. Each of the services maintained a file of referrals, however this did not constitute a waiting list as providers apply different priority criteria based on a complex range of factors including referral date, client need, service capacity and location. They are also unaware of who has been picked up by the second provider. The current systems inadequacies are:

- There is not a waiting list for services and what there is, is not common or complete;
- Referral and management of people "waiting" for a community package is not transparent;
- There is no way to monitor a client's progress "waiting" for a package;
- The current system does not facilitate referral of clients "waiting" for a package onto other appropriate services;
- The particular difficulties of providing services in rural and remote areas such as travel, distance management and workforce availability mean that CSP need to forward plan package provision to match capacity. The current system does not assist the CSP with forward planning;
- There is double handling of some clients by providers and exchanges of confidential information to CSP that do not end up providing a service; and
- There is not a waiting list and what there is, (referral files), does not provide an indicator of demand or regional service provision and regional variation. This is important for regional planning.

The challenge that providers face is the ability to utilise their resources to maximise the care services provided to individuals in the region. A major barrier to achieving this goal is the ability to share information collectively with other providers and to utilise Government funded care efficiently and fairly.

5.3 Project Establishment

In June 2007, a project was proposed to establish and evaluate an online community of care for the Murray Bridge region, involving Carers SA and key providers. This project, which was initiated by Carers SA, aimed to streamline the delivery of community based aged care packages, improve collaboration between providers, and generate statistical information to assist providers to better plan future services.

A Community Waiting List Steering Committee was established to develop a system to jointly manage the referral and administration of community package waiting lists. At the core of the project was the development of a web based database for community packages for the Murray Mallee. The project was managed by the Murray Mallee Ageing Taskforce through the Community Waiting List Steering Committee. The committee consists of the 3 Community Package providers the Murray Mallee Aged Care Group, ACH group and Resthaven Community Programs, the, the Commonwealth Respite & Carelink Centre and the project officer for the Murray Mallee Ageing Taskforce. All of the committee members gave in principle support to the project including a financial commitment to the development of the database.

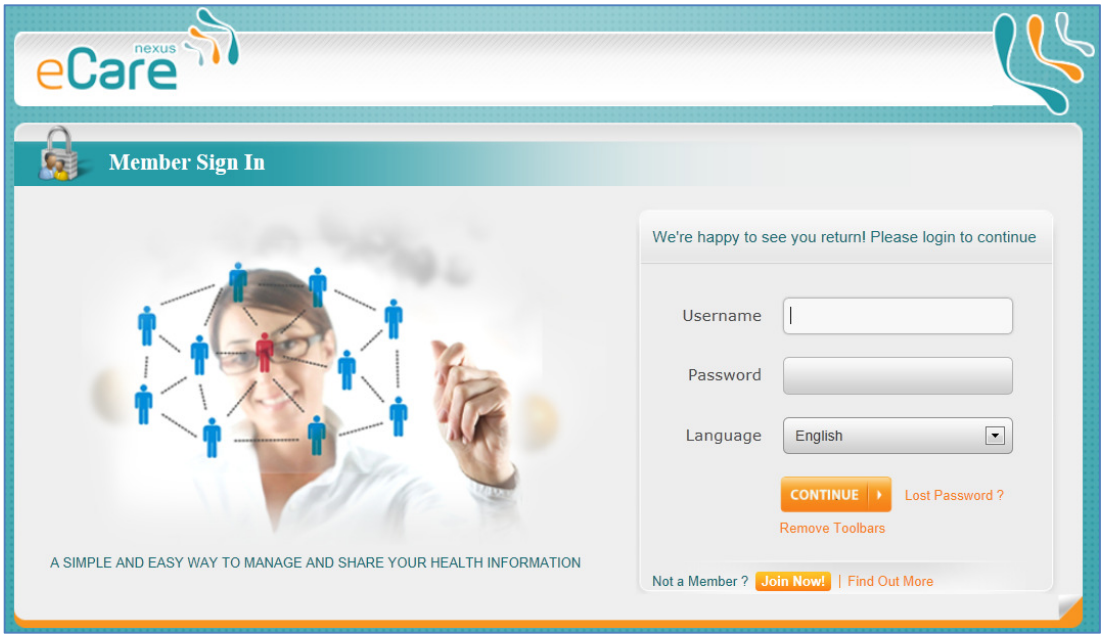


Figure 5-2 - Community Waiting List Logon

The CWL would enable individuals and their details to be added when ACAT completed an assessment, and then viewed and added to by stakeholders involved with the individual. It was hoped that this would lead to improved collaboration, greater transparency and improved access to services by the individuals in need.

The committee also realised the importance in being able to measure the success of the CWL and did it enable them to achieve their objectives. In discussions with the Researcher, who was introduced to the community providers through the developing organisation Nexus Online, it was agreed that the Researcher be engaged to evaluate the benefits of the project.

5.4 Identification of Stakeholders and their Needs

This involved:

- Meeting with key stakeholders and agreeing on a framework to engage with them; and
- Holding workshops with stakeholder to identify and clarify their needs.

The stakeholders involved in this project are outlined in Table 5-4

Table 5-4 Stakeholder Groups

Stakeholder Group	
Community Package providers	Murray Mallee Aged Care Group, ACH group and Resthaven Community Programs
ACAT	Aged Care Assessment Team
Respite	Commonwealth Respite & Carelink Centre
Coordinator and funder	Murray Mallee Ageing Taskforce
Other stakeholders	Nexus Online Pty Ltd

5.4.1 Identification of Business Needs and Objectives

The aim of establishing CWL was to provide a centralized electronic system for the referral and management of community package waiting list, with objectives to:

- Reduce administration;
- Improve transparency of the referral process;
- Reduce the potential of clients getting lost on the waiting list;
- Reduce handling of confidential information by service providers; and
- Provide accurate data on waiting lists, priorities and community package service provision across the region.

5.5 Define the Care Model(s) / Service(s) that will be evaluated

To achieve these business needs / objectives, Nexus Online was engaged to develop a secure online community waiting list (CWL) that could be accessed by the participating organisations. Nexus recognised the uniqueness and innovation of the project and offered to adapt its eCare™ coordination solution database and host and maintain the site for a 2 year pilot period.

5.6 Define the Study Design Framework

The study involved the Researcher:

- Working closely with the Project Manager (from the Murray Mallee Ageing Taskforce), attending meetings with stakeholders and contributing knowledge and feedback, on a as required basis;

- Meeting with each of the stakeholders to gain an understanding of the work they do and the issues, time delays and inhibitors to their activities;
- Calculating the costs of the current service and identifying the costs, outcomes and benefits of the proposed model;
- Translating the work flows and communications into a specification for the developer;
- Working in an advisory role to the Developer of the CWL solution to assist in the design of the solution, so that it met the needs of the stakeholders;
- On the completion of the pilot solution, oversee the testing and interim evaluation of the solution;
- Upon user acceptance, oversee the implementation of the solution; and
- At the end of the trial (December 2010) to provide an evaluation on the costs and benefits of the e-Healthcare solution.

5.6.1 Identify Limitations

Healthcare, like any other system, involves a wide range of actors and activities, linked together in a complex web of relationships between each other and with the technologies they use (Houghton, 2003). This highly fragmented environment, which incorporates a wide range of complex transactions, policies, privacy issues and funding models, presents a major barrier to the application of ICT.

5.6.2 Define Stakeholder Participants

Stakeholder participants were sought from the partner organisations.

5.6.2.1 Define Care Recipient Selection and Inclusions / Exclusions

It was agreed during the stakeholder meetings that the following criteria would be set for evaluation of participants involved in the trial.

Table 5-5 - Participant selection

Inclusions / exclusions	Details
Condition	People living at home requiring assistance
Age	>65
Assessment	Only those persons assessed by ACAT would be added to the waiting list

5.6.3 Define Care Recipient Data to be collected

Care recipient data collected included demographic and condition history, including:

- Client Name, address and demographic details;
- Assessment Type, for example, Initial, ACAT (Show last assessment);
- Status, for example, Added, Reserved, Removed;
- Current services; and
- Patient Carer

5.6.4 De-Identification of Stakeholders

Coded protection of identity was used for all statistical outputs and information was only disseminated to approved stakeholders, as advised by the project manager.

5.7 Articulating the Evaluation Construct

The original version of the e-Healthcare evaluation framework was initially used for the Community Waiting List study. This study was later re-structured to fit in with the revised evaluation model. Note though that the case only included a benefits analysis, as this is what the researcher was engaged to conduct. The Key Objectives of the project were clarified and defined as per Table 5-6.

Table 5-6 Key Objectives

Objectives	Details
reduce administration	All the tasks were manual based, from the completion of an assessment, through to distributing information of clients to providers and reporting on services provided, individually
improve transparency of the referral process	In the manual system, each of the providers did not know what clients the other providers were providing services to.
reduce the potential of clients getting lost on the waiting list	When people went onto the waiting list, this was done on a provider by provider basis, so it was unknown how long they were on the list and were sometimes forgotten in the manual process
reduce handling of confidential information by multiple service providers	In the manual system, the ACAT staff had to copy the details of all of the assessed clients and provide individual copies to each of the providers
provide accurate data on waiting lists, priorities and community package service provision across the region	To obtain additional packages for the area involves a process of explanation and the presentation of a verifiable case to Government

5.7.1 Defining Outcomes

The Outcomes identified that could be used for evaluating the implementation of the CWL were initially based on the standard Outcomes developed for the e-Healthcare framework, In further analysis of the stakeholder objectives were matched against the most likely outcomes, with additional outcomes introduced and some of the outcomes removed, as outlined in Table 5-7. The objectives were then matched against the outcomes defined.

Table 5-7 Outcomes

OUTCOME	OBJECTIVES
Access	improve transparency of the referral process
Participation	
Quality & Safety	reduce the potential of clients getting lost on the waiting list
Coordination	reduce handling of confidential information by multiple service providers
Cost Efficacy	reduce administration
Health Services	provide accurate data on waiting lists, priorities and community package service provision across the region

For this project, Health Outcomes were replaced with Coordination to reflect the focus on care providers instead of care recipients. Note at this point there were no objectives matched against participation.

5.7.2 Defining the Benefits

Through several group meetings the Researcher worked with stakeholders to:

- Map out the Key Scenarios for all Types of Providers;
- Define the processes and policies related to the identification and transfer of patients suitable for community care services; and
- Review current system capabilities against stakeholder requirements to identify any gaps.

During this process a number of inhibitors were identified that impacted on the service quality, cost effectiveness and outcomes of health and community care services in the region. Based on these inhibitors, stakeholder objectives and gap analysis, a list of benefits was identified, as outlined in Table 5-8.

5.7.3 Identifying Measures

The measures for the CWL were derived from an initial list generated by the Researcher, based on the e-Healthcare CBS and previous experience, which was then evaluated by the Stakeholders and updated as the project progressed.

Table 5-8 Outcomes Benefits

OUTCOME	BENEFITS
Access	Reduced time to obtain services
Participation	Improved collaboration between providers
Quality & Safety	Improved communications with consumers Greater choice of providers
Coordination	Streamlined management of confidential information by multiple service providers
Cost Efficacy	Reduced administration

To identify measures, each benefit was analysed to identify how it could be supported, for example, for the benefit defined as “Reduced time to obtain services” one measure was to identify the number of the number of days the individual had been on the waiting list.

Using the above information, the initial CBS model was created and agreed with the Stakeholders involved in the Program. It is important to obtain consensus from Key Stakeholders to:

- Agree on the Outcomes;
- Agree on the Benefits and what is most important to compare between the alternative systems; and
- Agree on at least some of the measures that would be used to measure the impact of the new technology on the program.

5.7.4 Inputs

In line with the CBS methodology, the providers of services, supporting technologies and information services were identified.

5.7.4.1 Health Care Providers

At the time of this study the providers consisted of ACAT, 3 Community Package providers the Murray Mallee Aged Care Group, ACH group and Resthaven Community Programs and the Commonwealth Respite &Carelink Centre.

5.7.4.2 Supporting Technologies

Nexus Online has developed an integrated care solution, called Nexus eCare™, that enables information from disparate systems to be securely shared between multi-disciplinary health care teams. Nexus eCare™ is an ASP. Net web application with an MSSQL backbone which has been implemented in both Australia and New Zealand health care settings. It was the project team's intention to use this solution as a starting base and then build in the required functionality to achieve the agreed outcomes.

For the project, a secure online community waiting list (CWL) wasa developed, that could be accessed by the participating providers and other stakeholders. The CWL was made available to all organisations registered as a Provider organisation who delivered services under specific government funding programs, including:

- CACP (Community Aged Care packages);
- EACH (Extended Aged Care at Home packages);
- EACHD (Extended Aged Care at Home for people with Dementia packages);
- HACC (Home and Community Care packages); and
- TCP (Transitional Care Packages).

In summary, the CWL:

- Provided a community provider portal through which the Aged Care Assessment Team (ACAT), could, after assessment, wait list the patients with community based providers;
- Sent notifications automatically to those providers delivering the aged care packages and also to Carers SA to alert them that a carer may require assistance;
- Enabled additional information to be added to the patient record, including assessments, personal history, social information and care plans;
- Had the ability to electronically send patient data, requests for services and messages to external providers, for example, HACC funded community care providers;
- Had the ability to electronically receive patient information, service outcomes and messages from outside sources, for example, GPs;
- Provided comprehensive audit trails of user access, data changes and transfers; and
- Provided extensive reporting and analysis capability.

5.7.4.3 Information Services

The information services, maintained by Nexus, included a Shared Care Record (SCR) that maintained all data on individuals added to the waiting list. Information on individuals could be accessed by registered providers, based on the packages of care provided

5.7.5 Service Provision

Through several meetings and informal discussions, the Researcher worked with CWL stakeholders to:

- Map out the key processes for CWL, as per Table 5-9; and
- Define the, processes and policies related to the identification and transfer of patients suitable for community care.

Table 5-9 Key Processes

Key Processes	Description
Add Individuals to CWL	Persons assessed by ACAT were added to the CWL Notification emails were automatically sent to all providers who provide the care packages as identified by ACAT
Send Notifications	Send notification to Carers SA if the person has a carer
Track Individuals	Track persons on CWL, including provision of different services by providers
Maintain Individuals details	Review and update person's details, including demographics, services provided, notes, documents and images
Report on and analyse activities and outcomes	Report on activities and provide statistical analysis

5.7.6 Add Individuals to CWL

The ACAT staff assesses older persons in the region to determine their suitability to community care packages and services. Individuals are also meant to be re-assessed after 12 months. Because of the backlog this can stretch out to 2 years. Individuals are added to the CWL.

5.7.6.1 Manual Process

The manual process involved copying the assessment multiple times and then driving to each provider, who provides the specified services and hand delivering the assessments.

5.7.6.2 Technology Enabled Process

The technology enabled process enabled the ACAT staff admin person to create a record in the CWL, specify the service types required and scan and attach the assessment. Upon completion an email was sent to each provider who provided that service type, notifying them of the referral. The provider could click on a link in the email, which would display the details of the individual added.

5.7.7 Notify Carers SA

Where the individual being added to the CWL had a carer, often the carer also required support, for example, respite.

5.7.7.1 Manual Process

In these cases ACAT may send the information through to Carers SA, under the manual process, though this was identified as rarely being done.

5.7.7.2 Technology Enabled Process

The CWL incorporated a Carer check box, which the ACAT admin person was forced to tick (Yes) or (No) to complete the referral. If Yes (there was a carer) was ticked this provided an automated email to Carers SA. When this was received, by Carers SA the admin staff could click on a link in the email, which would display the details of the individual.

5.7.8 Tracking Individuals

After an individual has been assessed, a provider might be able to offer some services.

5.7.8.1 Manual Process

Changes in an individual's status were notified to providers by ACAT if they became aware of the change, or if an individual provider became aware, they updated their own records.

5.7.8.2 Technology Enabled Process

Changes in an individual's status were changed in the CWL by ACAT, or any other provider, if they became aware of the change, which updated all records. Additionally where a provider was able to provide some services, they could also update the CWL and other providers could see what services were being provided.

5.7.9 Maintain Individuals Details

After an individual has been assessed, their circumstances may change, they become ill, or their partner dies, etc.

5.7.9.1 Manual Process

If a provider became aware of a change in details, the individual's details were updated by each provider in their own records.

5.7.9.2 Technology Enabled Process

Once a provider had received a referral from ACAT for an individual, they became part of that individual's care team in the CWL and could update the individual's details as required.

5.7.10 Analyse Activities and Outcomes

Providers need to provide a report to Commonwealth to obtain service packages and funding.

5.7.10.1 Manual Process

Each individual provider provided their own report.

5.7.10.2 Technology Enabled Process

It was still the responsibility of each provider to provide their own report; however the CWL enabled providers to provide an additional collaborative overview of the full region, supported by evidenced data from the CWL.

5.8 Costs Analysis

A cost analysis was NOT completed for this case, as it was outside of the project scope. The cost of the Technology provided was AUD 6,000 per annum, on a hosted service basis.

5.9 Benefits Analysis

There were two evaluations of the CWL, one at 6 months and one at 12 months. The first evaluation was conducted by sending out a survey to each of the participants. See Appendix E - CWL – Interim Evaluation Survey

This response to this survey was poor, with the feedback that a number of the questions were ambiguous, which was supported by strongly differing answers, even from within the same organisation.

As such, the final evaluation was conducted in a group session, where all stakeholders were asked a series of questions to assess the performance of the CWL against the anticipated outcomes (objectives) in the original project proposal. These were then incorporated into the CBS framework. The focus group as a whole were asked to rate the statement. Where the question was directed to a specific stakeholder then that stakeholders rating was given greater weighting. When consensus was not reached, the dissenting views were also noted. Some questions only required a simple Yes/No answer, however the Researcher always attempted to gain a qualitative response.

Note that methodology used to apportion responses in the final evaluation varied from the interim evaluation.

Note2. The names of individuals were de-identified for this report by using [redacted].

As an Example:

Does the CWL reduce paperwork?

- CSP – Agrees with the question
- CSA – Makes no difference
- ACAT – Disagrees with the question

	ACAT	CSA	CSP	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

NOTES:

- The providers being asked the question are indicated at the commencement of the question, as ACAT, CSP (Community Service provider), or CSA (Carers SA). In practice, what was identified is that even when a specific stakeholder was being asked a question, often other stakeholders would also want to contribute to the answer, from their perspective, even where they were not directly involved. Hence, in many of the questions, even though the question is directed at say ACAT, the other stakeholder responses were also recorded.
- The comments of the respondents are included at the end of each question under the heading Comments.

5.9.1.1 Question 1

ACAT & CSP

The CWL does the following:

- Reduces the time spent by staff on administrative work around referral and handling of paperwork

		ACAT	CSP	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

For ACAT, because this question is multi-facetted, it was unpacked into 4 segments: Dissemination of information, Screening (who is on, who is accepted), Data Entry & Assessment & Review.

5.9.1.1.1 Dissemination of Information

			ACAT	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

5.9.1.1.2 Screening

			ACAT	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

5.9.1.1.3 Data Entry

ACAT				
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

5.9.1.1.4 Assessment & Review

			ACAT	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Comments

ACAT - it was agreed that there has been an equal mix of benefits and costs, as follows:

- ACAT assessors do not have to drop off the ACAT (except urgent ACATs& in the Mid Murray).
- There is a reduction in telephone calls by the ACAT to providers on new referrals – they do not contact every provider anymore.
- [redacted]– can view who has been picked up, who has declined and therefore reduces the time spent on review of ACATs – where a client has refused the ACAT will not facilitate a review.
- There is an increase in administration tasks.
- It was agreed that overall the administrative input remains the same for ACAT because the extra time spent on data entry is offset by less time spent on assessment & review, following up on clients & liaising with providers.

CSP - there has been a definite reduction in paper – they do not write letters to clients any longer. They used to keep a thick folder of referrals and would have to wade through them to choose clients.

CSA- there has been an increase in carers therefore their workload has increased, which was seen as a positive outcome ([redacted]). There is now a feedback loop from Carers SA to ACAT around carers & contact with clients who have not received a service.

<u>Other issues and opportunities for improvement:</u>

ACATs are being put on the system about 2 to 3 weeks after the ACAT completed. This is not a problem with Murray Bridge.

Paperwork will reduce when the ACAT goes electric and if the database can be linked to the electronic ACAT then data entry would be reduced.

5.9.1.2 Question 2

CSP

Makes decision making and choosing clients from the waiting list easier

			CSA	ACAT / CSP
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Comments

CSP – the location of clients on the database & the capacity to print lists with addresses helps because you can fit clients into existing staff rounds. Priority is one basis on which to choose and that is easy to see on the database.

CSP – Still sometimes organisations receive hard copy before ACAT can put the

details on CWL and these are not always priority referrals.

ACAT - can also more easily advocate for high priority clients. ACAT - thinks that the W/L does help with choosing the clients.

5.9.1.3 Question 3

Please describe any advantages or disadvantages that the CWL has compared to the previous system of assessment, referral and waiting list management.

5.9.1.3.1 Advantages

- Collaboration – brought people around the table
- Data – a major advantage
- National focus on the region (OFTA – National conferences)
- Getting ahead of the game (e health & e ACATs) – taking the fear out of the future.
- Deeper insight into ACAT & ACAT processes
- Benefits to clients – 1) more targeted approach to referral & management of W/L. 2) More client contacts on W/L (CL) – clients appreciate contact. 3) quicker service provision 4) Better information for providers to make choices (for example, whether someone as a DVA card?)

5.9.1.4 Disadvantages

- System is not being used to its full potential (for example, one CSP not using the CWL fully results in incomplete data)
- Training – CSP need training to use fully
- Double entry of data for ACAT admin
- W/L processes works better where there is a longer waiting list. Where there is a shorter W/L different processes are in play.

5.9.1.5 Question 4

ACAT

The CWL reduces the administrative workload for ACAT staff (i.e. less time spent in administrative tasks, referral tasks and handling of paper work)?

		ACAT		**CSP**
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

This question has already been answered in question 1 in a different form, so it was excluded from the results.

5.9.1.6 Question 5

ACAT & CSP

The CWL has led to greater transparency in the management of the waiting list for example, how and where clients are accepted or not accepted.

			CL	CSP ACAT
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

ACAT – Definitely more transparent. You can see when urgent people are bypassed or picked up and usually no why.

CSP (ACH) – Disagreed with this statement, stating that transparency can be minimal, CWL is a point base where ACATs are stored collectively

CSA– If there is "cherry picking" it is more evident.

Not satisfied with the consensus, the Researcher reframed the question:

Does transparency lead to greater fairness?

Feedback: More doubtful – services have a limited budget and there are limited packages. If there is an external party – CSA that can view the W/L and so service providers are aware that their decisions are more transparent and this encourages fairness.

NOTE: ACH disagreed with the original question, which requires further clarification.

5.9.1.7 Question 6

ACAT & CSP

CWL facilitates better monitoring and tracking of people on the waiting list, particularly people who are urgent or high priority.

				CSP ACAT CL
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

ACAT – can determine where the clients are located and where on the list. BUT the list needs to be managed (kept up to date) by all users and some central oversight (ACAT).

CSP – much easier to track clients and ability to see who refuses a package. The Multi D meeting that has been established in Murray Bridge has assisted with this – a focus on client progress on the W/L especially with other services (good to have involvement of the council on this).

CSA– only look at the W/L when they get an alert. CSA could possibly manage it better in particular the use of data for their own purposes (for example, proportion of carers contacted or contacted about services).

<u>Other issues and opportunities for improvement:</u>

List is not always kept up to date.

The CWL could be linked with CL's in house system, to provide a more consolidated view and better management of carers.

5.9.1.8 Question 7

ACAT & CSP

With the CWL database, clients are less likely to get lost on the waiting list.

			ACAT CL CSP	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

ACAT – Yes but needs to be managed. The Multi D helps with this as the group can track people on the list. This needs all providers to use the database and this has not always happened with all the providers. There have been issues of commitment and training (knowing how to use the database).

ACAT & CSP - The database helps with the communication loop between ACAT & providers which reduces the risk of clients getting lost.

The Researcher reframed the question as "Does the waiting list reduce the risk of a client being lost of the waiting list" and it was agreed that it did reduce the risk.

5.9.1.9 Question 8

CSP.

The CWL reduces the administrative workload for CSP staff (i.e. less time spent in administrative tasks, referral tasks and handling of paper work).

			CSP	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

YES – This question was answered under question 1

In the forum, all participants strongly agreed. This differed from the survey returned from ACH, where it was believed there was no difference, as different work modalities are probably utilised at different sites.

As a result the response has been adjusted.

5.9.1.10 Question 9

CSP

Do you continue to maintain a paper waiting list (ACAT referrals)?

Both Yes ☒and No☒

CSP – Still maintain paper folders with the ACAT especially in the Mid Murray DC where the process is different. The W/L is small in Mid Murray and so the full ACAT is sent to providers as the W/L data does not go up until 2 – 3 weeks after the referral. In Murray Bridge urgent ACAT assessments are delivered to providers.

CSP (ACH) does not

5.9.1.11 Question 10

CSP

The CWL assists with forward planning for example, selection of clients, matching workforce capacity to clients & client need, workforce development.

		ACAT CL	CSP	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

CSP – Yes. Can match where clients live to where they have a workforce more easily. This is limited though as client priority is also considered.

ACAT – data from W/L does not help forward planning as Country Health do that centrally and they have no input.

CSP (ACH) – No difference

5.9.1.12 Question 11

All

The CWL provides accurate data on waiting lists, priorities & community package service provision.

			ACAT CSP CSA	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

ACAT – More accurate than the previous system but again needs the commitment of all the providers. ACAT provide overall management and this & it works on a limited area such as the CSP (Murray Mallee) – there would need to be different mechanisms in different areas. Local knowledge is also a bonus – if the area is small enough you can track people more easily because of local knowledge. The W/L & the systems around it have helped bring the services together and communicate better.

5.9.1.13 Question 12

ACAT & CSP

CWL enables people living in the community who are eligible for Community Packages to have choice of the provider of the Community Package.

		ACAT CL CSP		
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

ACAT – No. There is only 1 provider for a type package in some areas and none in others. Also where the client might be difficult to service (location etc.) providers do not necessarily offer a choice.

All – Agreed that where there is more than one provider then the W/L can facilitate choice but it does not necessarily enable choice.

5.9.1.14 Question 13

ACAT

Is the full ACAT only provided to community package service providers that request it?

Yes ☐ No ☒

In Murray Bridge full ACATs are provided to CSP that are rated urgent. In Mid Murray, where there is a short W/L the full ACAT is provided to all providers for that package. Normally the full ACAT is only provided to those CSP that request it.

5.9.1.15 Question 14

All

CWL assists with regional planning and advocacy by providing accurate data on waiting lists and priorities across the region.

				ACAT CSP CSA
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

ACAT – Definitely. Data from the W/L has been used to successfully advocate for more packages. Ten (10) additional community packages in Murray Bridge & Aboriginal packages.

NOTE: CSP (ACH) agreed that CWL does make a difference, but it was not always accurate, due to time delays in entering data.

5.9.1.16 Question 15

CSA

How many people were contacted via the Rural Care database waiting list and provided with information on services in the last 3 months?

In the July to September 2010 quarter: 23 information contacts including 12 new carers.

In the December quarter to date 9 information contacts including 9 new carers.

5.9.1.17 Question 16

CSA

Has the CWL facilitated the registering of Carers of persons awaiting packages?

Yes ☒ No ☐

5.9.2 Other Comments

There was a strong theme that the W/L requires a full commitment from all of the stakeholders for it to work at its full potential. Knowledge & training around using the database was important as well. Another point noted that CSP have different internal processes for selecting clients and have different experiences (at least in the recent past). Example - Resthaven have had slow turnover of clients while MMACG

have had a high turnover.

The ACATs do not go up onto the database immediately and there can be a 2 to 3 week delay. Therefore urgent ACATs have to be passed on to CSP directly. In the Mid Murray where there is not a long waiting list and where there have been vacancies the ACAT also has to be forwarded.

CSP (ACH) – CWL has been and continues to be a handy accessible tool. I believe that it could develop even more in the future. I also believe it is important to make accurate and detailed notes. I think data needs to be collected on when client/carer contacted, if they accept or decline and further information and if they are not interested.

5.10 Creating the Scorecard

Using the e-Healthcare CBS framework, 5 key Outcomes were selected for this analysis; Access, Participation, Quality & Safety, Coordination and Cost Efficacy. The Outcomes selected differed slightly from the e-Healthcare CBS to match in with the priority objectives of the project. A mixed methods approach was used to collect and analyse data which was obtained from group meetings, semi structured interviews and surveys.

NOTE: The CWL case did not involve the calculation of costs.

Based on the stakeholder objectives, the list of benefits was identified, as outlined in Table 5-10.

5.10.1 Access:

As a result of the improved statistical information provided by the CWL, the providers in the region were able to build a stronger case for additional packages which resulted in the region were awarded additional packages. This was supported by the question 14 in the evaluation: CWL assists with regional planning and advocacy by providing accurate data on waiting lists and priorities across the region with an agreed response: Definitely. Data from the W/L has been used to successfully advocate for more packages. This resulted in ten additional community packages in Murray Bridge & aboriginal packages.

Table 5-10 CWL Outcome Benefits

OUTCOME	BENEFITS
Access	Reduced time to obtain services
Participation	Improved collaboration between providers
Quality & Safety	Improved monitoring and tracking of people Increased choice
Coordination	Streamlined management of confidential information by multiple service providers
Cost Efficacy	Reduced administration

5.10.2 Participation:

Participation was defined as how often providers accessed the service and updated information. The majority of the providers were accessing and contributing to the service, although there were some providers who were hesitant in using the service. This was supported in "Other Comments" "There was a strong theme that the CWL requires a full commitment from all of the stakeholders for it to work at its full potential" What was actually being said was that not all providers were contributing.

5.10.3 Quality &Safety

A major issue prior to the CWL was that people were getting lost in the system, which resulted in a lack of follow up and provision of services in some cases. It was supported overwhelmingly by question 5 The CWL has led to greater transparency in the management of the waiting list for example, how and where clients are accepted or not accepted and question 7 With the CWL database, clients are less likely to get lost on the waiting list.

A second benefit that the CWL was to deliver was increased choice in providers. In Question 12, CWL enables people living in the community who are eligible for Community Packages to have choice of the provider of the Community Package' The unanimous answer was that it made no difference. This was clarified that on the basis that there is only 1 provider for a type package in some areas and none in others. Also where the client might be difficult to service (location etc.) providers do not necessarily offer a choice. All agreed that where there is more than one provider then the CWL could facilitate choice but it does not necessarily enable choice.

5.10.4 Coordination

Coordination of services was seen as a major benefit of the CWL, which was supported by question 5 The CWL has led to greater transparency in the management of the waiting list for example, how and where clients are accepted or not accepted and question 6 The CWL improved monitoring and tracking of people.

5.10.5 Cost Efficacy

Overall, the administration costs were shown to have reduced as a result of the CWL with different results for different types of providers. For ACAT the question was "Reduces the time spent by staff on administrative work around referral and handling of paperwork". In discussions ACAT believed this was too broad, as this question is multi-facetted. It was subsequently unpacked into 4 segments: Dissemination of information, Screening (who is on, who is accepted), Data Entry & Assessment &Review. This resulted in 3 agrees and 1 strongly disagree for Data Entry. For CSP, the result was agree and strongly agree, but for CSA, the result was that work had increased as a result of the CWL, as it had provided additional clients.

For the CWL, scorecard provides the ability to display the results of the research using a rating, or alternatively a $ value. Ideally, as per Cost-Benefits Analysis, wherever possible benefits should be calculated in monetary terms to enable the costs and benefits to be compared equivocally. For the evaluation of the CWL, this was not the case, as the Researcher was only engaged to review the benefits in non-monetary terms.

5.11 Calculating the Benefits

Then questions were rated as follows:

- Strongly Disagree 0
- Disagree 1
- No Difference 2
- Agree 3
- Strongly Agree 4

A value was provided for each group that answered collectively. Note that for the CSP group, there may be several respondents, so an average was then taken. The value for each group was added together and then divided by the maximum score to achieve a percentage. See example below:

For example, if ACAT said for a question, that the CWL made no difference and the CSP group said they strongly agreed, the score would be 2+4 = 6. This would then be divided by the maximum value that could have been achieved, for example, 8 to provide an average result of 6/8 = 75%.

Table 5-11 provides a summary of the questions and results from the workshop, by outcome and benefit. Questions have been allocated to benefits in consultation with the project manager and the scores from each provider have been added together and then divided by the total possible score to arrive at a % for each benefit.

Table 5-11 CWL Questions and Results

OUTCOME	BENEFITS	Questions	Scores	Result
Access	Reduced time to obtain services	10, 11, 13, 14	2+3+3+3+3+4+4+4	81%
Participation	Improved collaboration between providers	5, 15	3+4	88%
Quality & Safety	Improved monitoring and tracking of people Increased choice	6, 7, 12	4+4+4+3+3+3+2+2+2	75%
Coordination	Streamlined management of confidential information by multiple service providers	2, 3, 5, 6	3+4+4+2+4+3+4+4+4+4+4	91%
Cost Efficacy	Reduced administration	1, 4, 8	3+3+3.5	79%

5.12 Cost-Benefits Scorecard

The CWL CBS can now be calculated by comparing the CWL Result against the Benchmark result, which is based on there being no change, i.e. 2/4 = 50%. The percentage improvement is shown for each outcome in Table 5-12.

Table 5-12 CWL Cost Benefit Scorecard

OUTCOME	BENEFITS	CWL Result	Benchmark Result	% Improvement
Access	• Reduced time to obtain services	81%	50%	62%
Participation	• Improved collaboration between providers	88%	50%	76%
Quality & Safety	• Improved monitoring and tracking of people • Increased choice	75%	50%	50%
Coordination	• Streamlined management of confidential information by multiple service providers	91%	50%	82%
Cost Efficacy	• Reduced administration	79%	50%	58%
	•			
Cost		$6,000	$-	$-

The annual costs of the CWL, as a provided service were $6,000 (ex. GST). Unfortunately the Researcher was not asked to evaluate the cost of the service prior to the establishment of the CWL, so the benchmark cost and the change in cost have not been calculated. If a valuation had been completed, then the cost of the benchmark (previous service) would have been known and the change in cost could have been calculated.

5.13 Summary

The response from stakeholders supports the interim evaluation that the CWL was an improvement over the paper based system with respect to making decisions & choosing clients from the waiting list, transparency, monitoring and tracking of people on the waiting list. Respondents thought that clients were less likely to get lost on the "waiting list" and that the database had assisted with regional planning

and advocacy.

In this review, the statistics obtained from the database were acknowledged by stakeholders as being beneficial in achieving a higher number of packages for the region.

Carers SA also credited the CWL with identifying and connecting with a greater number of carers in the community.

All but one respondent were comfortable to phase out the paper system and the one that respondent that responded negatively did so for reasons of personal organisation. The CWL also assisted with accessing clients and carers for respite and other services.

The CWL did not significantly impact on the administrative workload or "handling paper". Given that the paper system continues to be used by providers this is not surprising.

ACAT reported an increase in administrative workload and this is also to be expected. The CWL was not generally seen to facilitate client choice or to assist with service provider forward planning. Comments by respondents suggested that choice was limited by the number of packages and providers in a region i.e. clients may only have one choice or because of the waiting lists have only one practical choice.

There were variable responses to the question on the database assisting service providers with forward planning. The availability of packages and client priorities were seen to limit forward planning for some providers.

Generally the CWL was seen positively as an example of collaboration by the stakeholders but there were comments that suggested that the "spirit" of collaboration is needed for the database to function in the future and that users needed to use the database correctly for it to be useful. There were concerns expressed that the database could lead to less communication between stakeholders in the long term and therefore have a damaging effect.

The analysis of the database identified a range of useful planning data including the number of approved clients, accepted clients, clients who had refused a package, clients who had died, entered into aged care facilities or left the district all by location and package. The database also provided data on average wait days by priority rating.

The analysis of the data revealed that only 20% of people on the waiting list received packages that year. Murray Bridge had the longest waiting lists and the longest wait times contrary to expectations. The analysis also revealed that 20% of people who were offered a package declined a service.

The analysis of the database also revealed that people rated as an urgent priority received a package significantly quicker than those with lower ratings. Often people on the database that were rated urgent but remained on the waiting list were no better off than lower rated clients. This is likely to be a function of the location of the clients (i.e. they were all from Murray Bridge). An urgent rating only facilitates access to a service if the packages are available.

The data from the CWL was useful enough to support a submission to the Aged Care Planning Advisory Committee for argue for more community packages in Murray Bridge.

CHAPTER 6 - CASE STUDY 2: ARC

This case study was an Australian Research Council (ARC) project, titled "Minimising the Inappropriate and Unnecessary Admissions of Older People to Hospital". The ARC project arose as a result of an ARC grant won by a consortium consisting of The University of Southern Queensland, Queensland Health and Nexus Online Pty Ltd.

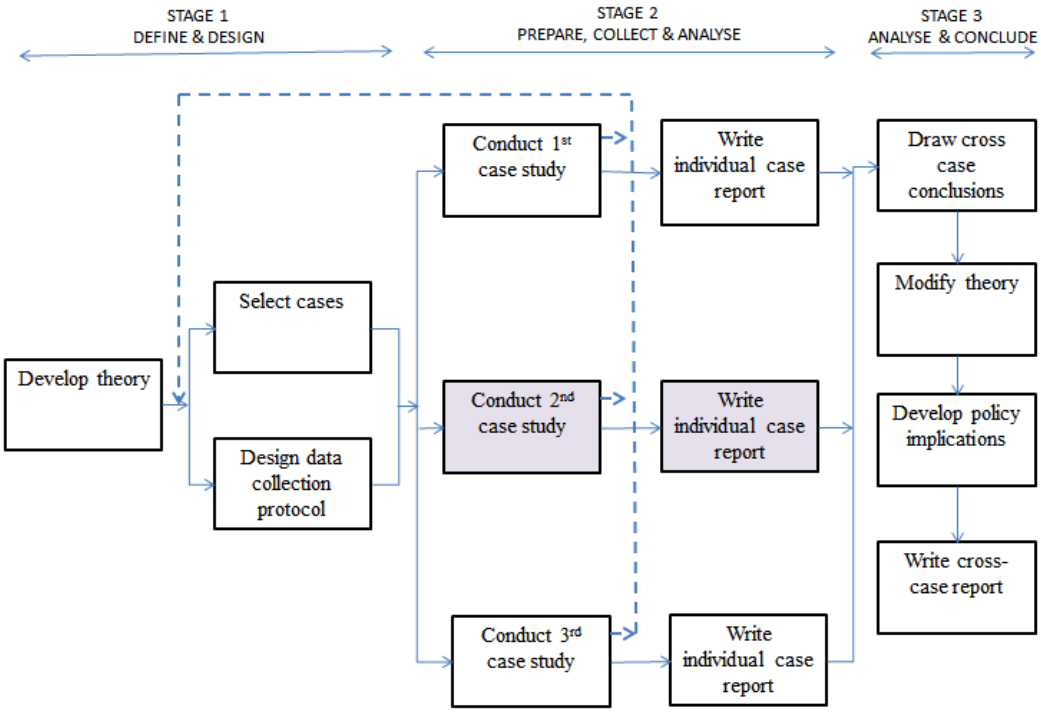


Figure 6-1 Stage 2 - Conduct Case Study 2

The aims of this project were to develop, trial and evaluate a technology platform that would minimise unnecessary, inappropriate and costly admissions to hospital of older persons. This would be achieved by using the technology platform to identify candidates for hospital redirection, map programs to patients, and automate communications between hospitals and community service providers, and tracking service delivery by agencies. Australian Research Council (ARC) LP0882189project - Minimising the Inappropriate and Unnecessary Admissions of Older People to Hospital.

Table 6-1 Definitions, Acronyms and Abbreviations

Acronym	Description
ACAT	Aged Care Assessment Team
ARC	Australian Research Council
CAAIR	Collaboration for Ageing and Age-Care Informatics Research
CACP	Community Age Care Provider
CCAP	Community Care Access Portal (ne: ACAT Community Waiting List)
Coordination server	the project technology™ Coordination server
eCare™	Solution developed by Nexus - enables Electronic Communities of Care (holistic)
eGate	Queensland Health Electronic Gateway
HL7	Health Level 7 (Internationally recognised health data standards)
Portal	A web site that can be accessed by authorised users
SCR	the project technology™ Shared Care Record
EDIS	Emergency Department Information System
HBCIS	Hospital Based Corporate Information System
Nexus	Nexus Online Pty Ltd
Queensland Health	Queensland Health
RWL	Residential Waiting List
TACCT	Targeted Assessment and Care Coordination Team

Table 6-2 Terminology

Terminology	Definition
Patient Care Team (Care Team)	The care team includes the patient, and or their carer or family members, their GP, specialists, nursing and home care providers and other providers as determined between the TACCT and the patient and or their carer or family members.
Community Care Access Portal (CCAP)	The Community Care Access Portal provides a shared interface that enables: TACCT and other providers to refer a person to ACAT ACAT to register and track assessed persons on the list Providers to register their program availabilities, to view and add to the waiting list record, and select persons from the list
eCare™	eCare™ is an asp. Net web application that enables care coordinators to receive notifications of patient admissions, select and track patients, record assessments and service details and manage all aspects of community care coordination.
eCare™ Coordination (Coordination)	eCare™ Coordination is an Electronic Gateway that: Manages HL7, XML, SMS, Email and Data exchanges between TACCS, the SCR and Community Providers Encrypts, authenticates and tracks all communications Incorporates common lists, references and interfaces
eCare™ TACCS (TACCS)	eCare™ TACCS is an eCare™ application designed to meet the needs of the Targeted Assessment and Care Coordination Team (TACCT)
eCare™ Shared Care Record (SCR)	eCare™ Shared Care Record (SCR) is an eCare™ application and database that combines information from TACCS and other members of the care team to create a comprehensive shared care record.

eCare™ Professional Portal (Professional Portal)	eCare™ Professional Portal enables Providers in the patient's care team to access the patient's SCR and share information with other members of the care team, including care plan, medications, allergies, biometric data and history
eCare™ Personal Portal (Personal Portal)	eCare™ Personal Portal provides the patient and their family members with access to their SCR, with the ability to update personal details and communicate with providers in their care team.

Table 6-3 Actors

Actor	Description
TACCT	Targeted Assessment and Care Coordination Team
Community Based Providers	GP, home care providers and other community based providers
Patients	Patients admitted, or at risk of being admitted to hospital
TACCS	a version of eCare™ designed to meet the needs of TACCT
eGate	Queensland Health Electronic Gateway
SCR	Shared Care Record
Coordination server	eCare™ Electronic Gateway
Portal	Web portal that enables providers to view and add to the SCR

6.1 Project Overview

At the time of commencing this study, in Australia the major means of communication between hospitals to and from primary care, community care and residential aged care were phone calls, paper records and faxes. In most cases the information was printed from a computer system then entered into another computer system. There is no security, no confirmation of receipt, great potential for data entry error and little feedback. In 2007, a $360K Australian Research Council (ARC) grant LP0882189 – "Minimising the inappropriate and unnecessary hospital admissions of frail older people" was won by a consortium including: Queensland Health, the University of Southern Queensland and Nexus Online. The aims of this project were to:

- Develop, trial and evaluate a tool that would support the rapid referral of GP patients and hospital ED presentations to community care services to avoid an admission and to identify and facilitate the referral of in-patients to reduce patient LOS
- Capture and analyse key statistical data, with the view of measuring and improving hospital avoidance practices
- Establish a conceptual evaluation framework and methodologies that could be used for similar evaluations
- Facilitate the development of research papers and presentations.

This project aimed to make a modest difference by providing an infrastructure through which primary, secondary and aged-care providers can communicate and coordinate services. Such a relatively simple infrastructure is absent in most health systems around the world. It is concerned with "hospital avoidance" or reducing unnecessary admissions of the elderly. It aimed to develop a model for how other projects with similar aims might work and be funded.

This project attracted substantial support from a state department of health, a software developer and several universities. It attracted a large national competitive research grant which gave the project the benefit of dedicated professional resources. The project is currently underway in a central Queensland health district with the support of primary and secondary care providers (Soar et al., 2007a).

This research involved a selection of hospitals to cover a regional Health Service District in Queensland. Researchers discussed the proposed project with a number of hospitals who expressed interest in participating in the project. Funding came from Queensland Health ($100k cash), a software developer, Nexus Online ($200k cash), and the Australian Research Council ($356k cash). The research team was led by Associate Professor Jeffery Soar from USQ, and included leading academics in the fields of health economics, hospital avoidance, privacy and security of patient data, rural health and health informatics.

The trial site chosen for this project was the Fraser Coast, with participation by the Hervey Bay and Maryborough hospitals, Wide Bay Division of General Practitioners, local community nursing, residential and home care providers and allied health professionals. This "Fraser Coast Health District" was selected by Queensland Health based on its higher percentage of persons over 65 and subsequent pressures on the existing health services. The project had the support of Hervey Bay hospital and District staff, the TACCT team, GPLinks and Blue Care community

care as well as the grant partners, Queensland Health and Nexus Online. The project aimed to minimise unnecessary, inappropriate and costly admissions of older people to hospitals, through better information communications and collaboration. At the project site, Hervey Bay and Maryborough Hospitals, this was to improve information sharing between the ED based TACCT (Targeted Assessment and Care Coordination Team), hospital clinicians and external providers. The project would provide valuable research learnings that could be applied by Queensland Health to deliver more appropriate and responsive solutions to people who could be better served through community based care, as an alternative to hospital care.

To implement this project, an experienced team was selected by the partners, comprising of a senior project manager, solutions designers, specialist engineers, software developers and ancillary contractors. Members of this team worked through a process to identify the needs of the Health District, meet with stakeholders, present options and identify local issues. The team then worked as a collective, to build upon an existing information technology platform, provided by project partner Nexus, that facilitates information sharing and service coordination between acute and primary care providers and also with patients and their families and home based monitoring devices.

This project aimed to improve the flow of information between the emergency departments of Hervey Bay and Maryborough Hospitals, the transition care staff at Hervey Bay ('TACCT'), several participating General Practitioners, Community Health staff and Blue Care, the largest aged care provider in the area. The objective was to reduce unnecessary admissions (and possibly presentations to ED) through early identification of candidates for community care and 'real time' sharing of current clinical and social patient information. Strong support was received from the Fraser Coast Queensland Health medical and administrative executives, from the local Division of General Practice and from Blue Care. All were represented on the expert reference group that designed the project. Key stakeholders were invited to participate in the evaluation at each stage of the study, which was provided on a voluntary basis.

Older people commonly present to hospitals with multiple, complex conditions. Because of the bottlenecks in Accident and Emergency departments and for expedience they tend to be admitted because clinicians have insufficient time to explore other options or there may be a lack of available options (Soar et al., 2007b). Internationally, governments are considering strategies to reduce demand on hospital systems by providing e-Healthcare for the aged and chronic ill where they reside. Because of a paucity of research, the effectiveness of these strategies is unknown.

The project ran significantly behind schedule and was finally closed when funds were exhausted at the end of 2010. The delays were primarily due to ethics approval and the process of working through the Information Security Division's procedures to ensure that the solution provided met the privacy and security requirements of Queensland Health. It was considered by the project team that the proposed solution was ready for implementation and final audit by an independent third party.

In December 2010, the project cane to a completion in terms of ARC funding. There was considerable interest on the part of participants to continue to work on the project with the aim of making the system available for use and completing the research component. Unfortunately due to budget restraints the project did not continue.

6.2 Project Establishment

At the commencement of the project, the following was initiated:

1. A Project Manager with substantial experience in hospital avoidance initiatives was appointed.
2. A Project Steering Committee of key stakeholders was constituted, consisting of the partner organisation CEO, Queensland Department of Health; the Wide Bay Division of General Practice and other stakeholder organisations.
3. An Expert Reference Group (ERG) that represented health providers and administrative disciplines (for example, Emergency Department, RACF, home care providers) was constituted and the health service district was engaged to obtain their perception of safety and their satisfaction with the model. This Group reviewed and advised on the design and implementation of the project and communications with constituents groups.
4. The Project Management Team of the CIs and project staff met monthly and were responsible for monitoring progress against plan, quality of deliverables, project risk management and sign-off completed stages.
5. The Researcher appointed to undertake the evaluation and the author of this study.

As per the following table, stakeholders included Queensland Health; Fraser Coast Health, the Wide Bay Division of General Practice, Blue Care and other stakeholder organisations. This including the Targeted Assessment and Care Coordination Teams (TACCT) and the Emergency Departments from the Hervey Bay and Maryborough hospitals, the Wide Bay Division of GP and representatives from Blue Care, Oz Care and other selected providers from the Hervey Bay and Maryborough districts and the solutions partner Nexus Online.

Table 6-4 Stakeholder Groups

Stakeholder Group	ARC Project
Care Recipients	Older persons (>65) identified as at risk of unnecessary hospitalisation, by GPs, selected aged care providers, and triage staff in the Hervey Bay and Maryborough Hospitals
Government	QLD Health corporate including: Policy and ICT Fraser Coast Health Service District
Hospitals	Hervey Bay Hospital Maryborough Hospitals
Clinicians / Nursing / Allied Health Staff	The Targeted Assessment and Care Coordination Team (TACCT)
Practitioners	Wide Bay Division of General Practice Selected GPs as directed by the division
Community Nursing / Residential Aged Care Facilities	Blue Care
Allied Health Professionals	None currently specified
Other stakeholders	University of Southern Queensland, Nexus Online

In meetings with stakeholders, key areas were identified that could reduce inappropriate and unnecessary admissions to the Hervey Bay and Maryborough hospitals, and in addition improve the opportunity to discharge suitable patients earlier than may otherwise be achieved.

In the discussions, a recurring issue raised by all stakeholders was the almost total lack of communication between all of the disparate segments of the health service across the region. The most raised reason was as a result of the isolated silos that had been created in response to the existing funding models, State vs Federal vs Local and the lack of integration between health systems.

Integration presupposes what Conrad and Shortell (1996) denote compatibility standards, i.e. negotiated agreements about what and how to share and exchange information across multiple local settings and systems (Ellingsen & Monteiro, 2006). Unfortunately, the term "Integration", is more often than not, perceived as being predominantly technical and excludes the socio-political aspects of integration. Winthereik and Bansler (2007) highlight that information systems for health care have so far primarily been developed to support the computerization of patients' records and work flows within individual health care organizations.

This was certainly true in the Hervey Bay health region. An example raised by clinicians was when an 80 year old person presented at the ED at 10pm on a Sunday evening with severe chest pain and was vague about the medications they were taking, for example, the red pill and the blue pill and 3 white pills to help them sleep. The clinician would try to contact their GP and if successful then try to get the GP to travel to their office, open up their patient management solution, look up the medications for the patient and then call the clinician back and hope they were reasonably correct. And, in many cases, the GP would be away, or could not or would not travel to their office, etc. This was further complicated by the high level of tourism, where the visitor's GP was in another state or country and GP hoppers, a term given to people who visit multiple GPs.

In the meantime the clinician would attempt to stabilise the patient and take the necessary tests to determine the diagnosis and guess at the medications being taken. Statistics were vague, but it was mentioned by a Queensland Health staff member that there were more than 10,000 serious reportable adverse medication incidents each year in Queensland hospitals, resulting in a substantial number of deaths (figure unknown).

In a report on patient safety From Learning to Action IV Fourth Queensland Health Report on Clinical Incidents: Incidents and Sentinel Events in the Queensland Public Health System reported in 2008/09, for 2007-08 of the more than 71,305 thousand reportable incidents, there were 15,590 'harm' incidents, with 318 (2%) resulting in death or likely permanent harm, 3,313 (21%) resulting in temporary harm, and 11,959 (77%) resulting in minimal harm (ABS, 2003).

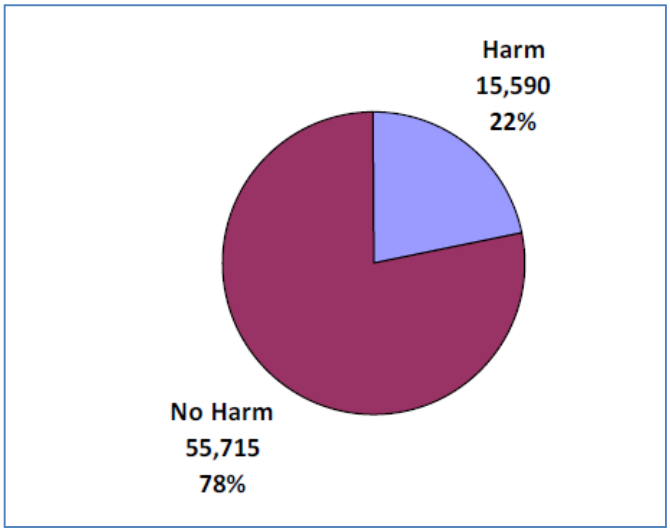


Figure 6-2 Total incidents (SAC 1, 2 and 3) 2008-09: Total incidents by harm

It was agreed by the stakeholders, that as part of the ARC project, tools would be developed by the ARC team in consultation with the key stakeholders and Queensland Health to investigate solutions to address the above requirements. Note that after these initial meetings the electronic discharge letter was scheduled to be implemented by Queensland Health.

6.3 Identification of Stakeholders and their Needs

This involved:

- Identifying key stakeholder groups and agreeing on a framework to engage with them; and
- Holding workshops with key stakeholder groups to identify and clarify their needs using "Story boarding".

6.3.1 Identification of Business Needs and Objectives

In meetings held with key stakeholders, the key business needs identified were to:

- Minimise unnecessary time spent in hospital by people over the age of 65;
- To make best use of community resources through better coordination; and
- Demonstrate an e-health coordination solution which addresses the business needs through improved communication between hospitals General Practitioners and Community aged care providers.

To achieve these business needs / objectives, five key strategies were identified that could reduce inappropriate and unnecessary admissions to the Hervey Bay and Maryborough hospitals, and in addition improve the opportunity to discharge suitable patients earlier than may otherwise be achieved. These were:

- Improve the identification of patients presenting at ED or in wards for referral to community care;
- Immediately upon the discharge of a patient provide an electronic discharge

letter to their GP and community or residential providers;

- Automatically notify GPs when one of their patients is admitted to hospital, with a request for current medications;
- Improve the coordination of care and information sharing between hospital based discharge planners and community based providers; and
- Enable referrals to the Aged Care Assessment Team (ACAT) to be placed on a Community Waiting List that can be electronically accessed by community providers.

It was agreed by the stakeholders, that as part of the ARC project, tools would be developed by the ARC team in consultation with the key stakeholders and Queensland Health to deliver the above priorities. The role of the Researcher was defined as "Assisting in the design of the technology solution and in evaluating the impact the technology solution would have on the above strategies and the overall service". The outcomes from the meetings were distributed by the project manager to stakeholders.

6.4 Define the Care Models that will be Evaluated

In order to achieve these outcomes, it was proposed by the ARC project team to work with the TACCT (Targeted Assessment and Care Coordination Team) and to provide them with a solution that would:

- compliment and integrate with the Electronic Discharge Summary;
- be populated, real-time, with patient data from the hospital systems;
- enable TACCT and other authorized staff to add to the patient record;
- enable TACCT to securely exchange data with external providers; and
- provide the basis for the evaluation of the TACCT program.

6.5 Define the Study Design Framework

The study would involve the Researcher:

- Working closely with the Project Manager, attending meetings with stakeholders and contributing knowledge and feedback, as required;
- Working closely with the TACCT staff to gain an understanding of the work they do and the issues, time delays and inhibitors to their activities;
- Calculating the costs of the current service and identifying the costs, outcomes and benefits of the proposed model;
- Translating the work flows and communications into a specification for the developer;
- Working in an advisory role to the Developer of the TACCT solution to assist in the design of the solution, so that it met the needs of the TACCT staff, other users and other stakeholders;
- On the completion of the pilot solution, oversee the testing of the solution;
- Upon user acceptance, oversee the implementation of the solution; and

- Over a 12 month period, evaluate the impacts of the solution on the TACCT activities and service.

Note: Due to the cancellation of the project, the last 3 points were not completed.

6.5.1 Identify Limitations

The health service, like any other e-Healthcare system, involves a wide range of actors and activities, linked together in a complex web of relationships between each other and with the technologies they use (Houghton, 2003). This highly fragmented environment, which incorporates a wide range of complex transactions, policies, privacy issues and funding models, presents a major barrier to the application of ICT. The following constraints applied to this project:

- Time – The research grant was for the period Jan 2008 to Dec 2010;
- Cost – Costs could not exceed the budget of the ARC grant;
- Resources – Availability of community resources were limited due to workloads; and
- Technology – The technology solution had to comply with the comprehensive standards set for enterprise wide solutions.

6.5.2 Define Stakeholder Participants

Stakeholder participants were sought from the partner organisations, including the Queensland Health; Fraser Coast Health, the Wide Bay Division of General Practice, Blue Care and other stakeholder organisations. This including the Targeted Assessment and Care Coordination Teams (TACCT) and the Emergency Departments from the Hervey Bay and Maryborough hospitals, the Wide Bay Division of GP and representatives from Blue Care, Oz Care and other selected providers from the Hervey Bay and Maryborough districts.

6.5.2.1 Define Care Recipient Selection and Inclusions / Exclusions

It was agreed during the stakeholder meetings that the following criteria would be set for evaluation of participants involved in the trial.

Table 6-5 Participant Selection

Inclusions / exclusions	ARC Project
Selection and Qty.	Opportunistic purposive selection of up to 50 participants will be undertaken by the TACCT
Condition	People with chronic and acute conditions
Age	>65
Speak English	Yes
Dementia	No

6.5.3 Define Care Recipient Data to be Collected

Care recipient data collected included demographic details and condition history, including:

- Facility, for example, HBH (Codes are used to reduce the field size, i.e. HBH is Hervey Bay Hospital) For people at Home the Facility is defaulted to "Home" For people in a facility an abbreviation of the name of the facility is used (Max 10 characters);
- Patient Name – Age (Gender) - UR for example, Henderson, Sarah – 68 (F) - UR00845678 (Name shown as LastName, FirstName);
- Area – Bed, for example, ICU - Bed 10, Ward A – Bed 12, For people receiving care in the community the area is defaulted to the Suburb;
- LOS, for example, 2 days;
- Triage level, for example, 2;
- Primary Diagnosis, for example, Cardiac Arrest;
- Assessment Type, for example, Initial, ACAT (Show last assessment);
- Status, for example, Admitted, Referred, Discharged; and
- Additional Patient information, (Displayed in RH Frame) including:
- Address and contact details
- Patient GP
- Patient Carer.

6.5.4 De-Identification of Stakeholders

Coded protection of identity was used for all statistical outputs and information was only disseminated to approved stakeholders, as advised by the project manager. Formalise research protocols, confidentiality and ethics requirements.

This included:

- Completion of documentation incorporating solution functionality outputs, confidentiality, key performance measures, service level standards and costing and invoicing clauses.
- Establishment of an overall management plan with the project Steering Committee that included critical timeframes, and resource responsibilities.
- Ethics approval by the Redcliffe-Caboolture Health Service District Ethics Committee (EC00170) and the University of Southern Queensland.
- Obtain access to data, financial accounts and other information relevant to the project

Data, financial accounts and other information relevant to the project evaluation was obtained from Queensland Health, the hospitals involved, system outputs, observation, semi-structured interviews, focus groups and surveys. Qualitative data was primarily obtained from stakeholders, through workshops, interviews, surveys and forums.

Quantitative data for the ARC case study was primarily obtained from Qld Health. Refer to Appendix G - Statistical Data Sources

The original version of the e-Healthcare evaluation framework was initially used for the ARC study. It was during the CSIRO project that the initial construct was renamed to the Cost Benefits Scorecard (CBS) and revised to meet the needs for evaluating comparative service models. Upon this change the ARC case was re-structured to fit in with the revised framework and methods.

Note that the 2 comparative service models were articulated as the current manual service model and the proposed service technology enabled model. In line with the initial e-Healthcare evaluation methodology, the objectives of the TACCT service were agreed in meetings held with key stakeholders, as shown in Table 6-6.

Table 6-6 Key Objectives

Objectives	Details
Improve information flow	Improve information flow between the emergency departments of Hervey Bay and Maryborough Hospitals, the transition care staff at Hervey Bay ('TACCT'), several participating General Practitioners, Community Health staff and Blue Care, the largest aged care provider in the area.
Reduce Unnecessary Admissions	Reduce Unnecessary Admissions (and possibly presentations to ED) through early identification of candidates for community care and 'real time' sharing of current clinical and social patient information

In terms of the e-Healthcare construct, these objectives were redefined as outcomes, in order to provide a neutral definition against which the new technology solution could be evaluated.

6.5.5 Defining Outcomes

In further analysis of the stakeholder objectives, the Outcomes identified that could be used for evaluating the implementation of an e-Healthcare model were initially based on the standard Outcomes developed for the e-Healthcare framework, with the descriptions changed to reflect the project, as outlined in Table 6-7.

For this project, Health Outcomes were replaced with Coordination to reflect the focus on care providers instead of care recipients.

Table 6-7 Outcomes

OUTCOME	OBJECTIVES
Access	Increase access to the service through the better Identification of patients
Participation	Enable different providers to connect into the solution and sharing of information
Coordination	Streamline the coordination of patients to community based services
Quality & Safety	Ensure that the quality of the service is safe and offers choice
Resource Utilisation	Improve the effectiveness of TACCT staff

6.5.6 Defining the Benefits

Measuring the costs and benefits of an e-Healthcare model has its challengers and the valuation of outcomes, for example, hospital days avoided can be difficult to prove. This is especially true where the occupancy of the hospital is greater than 95% and patients are being diverted to other facilities.

This was demonstrated by the Advanced Community Care Association – Hospital avoidance project in South Australia (Soar et al., 2007b). In this case, even though the project demonstrated success in redirecting patients away from hospitals to community care services, because the hospitals involved were over stretched and there were no reductions in occupied bed numbers the service was discontinued as savings could not be demonstrated.

Through informal discussions, observations and the use of storyboarding, the Researcher worked with TACCT staff to:

- Map Out the Key Scenarios for TACCT;
- Define the processes and policies related to the identification and transfer of patients suitable for community care as an alternative to hospital care; and
- Review current system capabilities against stakeholder requirements to identify any gaps.

During this process a number of inhibitors were identified that impacted on the service quality, cost effectiveness and outcomes of the TACCT service. Based on these inhibitors, stakeholder requirements and gap analysis, a list of benefits was identified, as outlined in Table 6-8.

Table 6-8 Outcomes Benefits

OUTCOME	BENEFITS
Access	Increased identification of people presenting to ED that may be suitable for care in the community Increased identification of people in wards that may be suitable for care in the community
Participation	Improved information sharing between the hospitals and community care services
Coordination	Improved coordination of patients to community based services
Quality & Safety	Reductions in reportable incidents that may result in harm to patients
Resource Utilisation	Improve effectiveness of TACCT

6.5.7 Identifying Measures

The measures for the TACCT e-Healthcare model were derived from an initial list generated by the Researcher, based on the e-Healthcare framework and previous experience, which was then evaluated by the TACCT and updated as the project progressed.

To identify measures, each benefit was analysed to identify how it could be supported, for example, for the benefit defined as “Increased identification of people presenting to ED that may be suitable for care in the community” one measure was to identify the number of patients presenting at ED, by triage and age.

In working through this process, the Researcher was constantly frustrated by the lack of measurable data available from the hospital system. For example, for the above measure, as well as the triage and age, we also wanted to obtain the primary diagnosis, co-morbidities, and location from where the person had come from, but this data was either not available, or only available in notes added inconsistently by different staff.

This inability to obtain substantive data caused the Researcher to spend substantial amounts of time manually reviewing patient data and having to settle for less than adequate data in many cases. Using the above information, the initial CBS model was created and then agreed with the Stakeholders involved in the Program. It is important to obtain consensus from Key Stakeholders to:

- Agree on the Outcomes;
- Agree on the Benefits and what is most important to compare between the programs; and
- Agree on at least some of the measures that would be used to measure the impact of the new technology on the program.

6.5.8 Inputs

In line with the CBS methodology, the providers of services, supporting technologies and information services were identified.

6.5.8.1 Health Care Providers

At the time of this study, the TACCT (Targeted Assessment and Care Coordination Team) was a small unit consisting of 5 staff working out of the Emergency Departments in the Hervey Bay and Maryborough Hospitals. Their primary task of TACCT was to identify patients arriving at ED, or inpatients in wards that may be better suited to receiving care in the community rather than in an acute care setting, and to then coordinate the discharge of those patients, ensuring that adequate supports were in place to reduce the risk of re-admission.

6.5.8.2 Supporting Technologies

Nexus Online, the industry partner has developed an integrated care solution, called Nexus eCare™, that enables information from disparate systems to be securely shared between multi-disciplinary health care teams. Nexus eCare™ is an ASP. Net web application with an MSSQL backbone which has been implemented in both Australia and New Zealand health care settings. It was the project team's intention to use this solution as a starting base and then build in the required functionality to achieve the agreed outcomes.

At the heart of proposed solution was a consumer centric Shared Care Record (SCR) that could seamlessly and securely link to disparate provider systems and devices, to create a virtual electronic health record (EHR). Unlike an EHR, where information for a consumer is aggregated, the design incorporates a hub and spoke architecture that connects multiple provider databases together, similar to a network.

Figure 6-3 Electronic Community of Care

As illustrated in Figure 6-3 a hospital based integrated care solution was developed that incorporated the tools necessary to achieve the outcomes agreed with key stakeholders. For the purposes of this project this solution, was called TACCT-ICT (Targeted Assessment and Care Coordination Team - Integrated Care Solution).

The TACCT-ICT:

- Was based on the Nexus eCare™ - Hospital Refer interface developed for the Royal Adelaide Hospital Transitional Care Team;
- Incorporated the systems, functions, assessments and procedures currently being utilised by TACCT;
- Was hosted on a server in the Hervey Bay Hospital data centre. The server was provided by the project, in line with specifications proposed by the Hervey Bay ICT Officer, and supported by Nexus Online via VPN access;
- Was populated with patient information obtained via EGate. The data obtained, at least initially, mirrored that of the electronic discharge summary;
- Used advanced algorithms to provide TACCT with lists and alerts of potential patients, for example, frequent flyers that may be suitable for alternative to hospital care;
- Enabled additional information to be added to the patient record, including assessments, personal history, social information and care plans;
- Had the ability to electronically send patient data, requests for services and messages to external providers, for example, HACC funded community care providers;

- Had the ability to electronically receive patient information, service outcomes and messages from outside sources, for example, GPs;
- Provided comprehensive audit trails of user access, data changes and transfers;
- Provided extensive reporting and analysis capability;
- Provided an admissions notification tool that scanned all admissions to either the Hervey Bay or Maryborough hospitals and where possible identified the patient's GP and automatically sent them a notification message of admission and request for current medications;
- Provided a coordination tool that assisted TACCT staff to electronically coordinate community and transitional services with providers. This tool was pre-populated with patient information, including medications and observations; and
- Provided a Community Waiting List tool that enabled electronic referrals to the Aged Care Assessment Team (ACAT), who could then, after assessment, wait list the patients with community based providers.

6.5.8.3 Information Services

The information services, maintained by Nexus, included a Shared Care Record (SCR) that maintained all data on individuals added to the database. Information on individuals could be accessed by registered providers, based on their access permissions. Figure 6-4 ARC - Technology Infrastructure, shows the flows of information from the Hospital Based Corporate Information System (HBCIS) and the Emergency Department Information System (EDIS) through eGate (the Queensland Health electronic gateway) to the eCare™ Hospital database, through the firewall to an externally hosted coordination server to the shared care record. From the shared care record, GPs and Providers would have access to patient data via a secure internet connection.

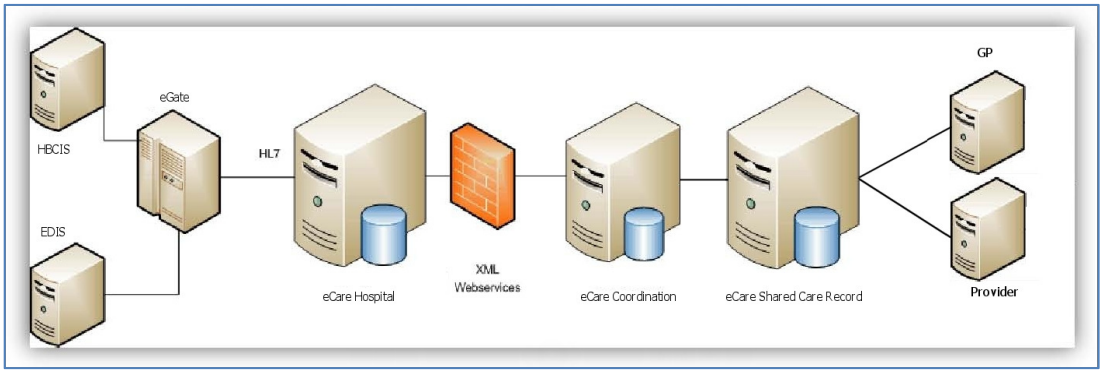


Figure 6-4 ARC - Technology Infrastructure

6.5.9 Outputs

The initial analysis of the activities undertaken by the TACCT staff was mapped out by the Researcher with the staff. The Researcher then shadowed the TACCT staff as they performed their tasks across several days to gain a hands' on understanding of the activities and issues involved.

Through informal discussions, observations and the use of storyboarding, the Researcher worked with TACCT staff to:

- Map out the key processes for TACCT;
- Define the, processes and policies related to the identification and transfer of patients suitable for community care as an alternative to hospital care; and
- Review current system capabilities against stakeholder requirements to identify any gaps.

Table 6-9 Process Outlined

Process	Description
Monitor patient admissions, updates and discharges	Manually identify patient admissions, updates and discharges
Track patients	Track patients admitted who may be suitable for transfer to community care as an alternative to hospital care. Patients are filtered, based on age, triage, admissions history and other indicators as determined between TACCT, clinicians, and other key stakeholders.
Maintain patient details	Record and review additional patient details, including referral details, patient demographics, personal, medical and social information, assessments, care plans, car team, interventions, notes, documents and images
Assess patient's suitability for home care	Assess a patients potential to be transferred to home care as an alternative to hospital care
Coordinate home based care	Coordinate home based care for patients to be delivered by a combination of internal (TACCT) resources, and or community based providers. The coordination process continues after discharge until the requested services have been completed for the patient.
Report on and analyse activities and outcomes	Report on activities and provide statistical analysis

For full details of the processes defined, refer to Appendix F - ARC – Business Processes

The following expands on the key activities undertaken by TACCT staff.

6.5.10 Patient Identification

The TACCT staff continuously monitored the Emergency Department (ED) of the Hervey Bay hospital in an attempt to identify potential candidates for community care.

6.5.10.1 Manual Process

The manual process involved walking around the ED, checking the white board and chatting with clinicians on the ED floor to ask about potential patients. The TACCT staff also received referrals from clinicians, but this was more on an ad hoc basis, depending on the clinicians on duty. TACCT staff also scanned through the hospital computer system, seeking out information on patients.

6.5.10.2 Technology Enabled Process

The e-Healthcare solution being implemented provided TACCT with a consolidated patient list from both the Hervey Bay and Maryborough hospitals and flagged potential candidates for community care, using a set of algorithms, based on age, triage, sex, prior admissions data and length of stay. This was the same process as had been implemented at the Royal Adelaide Hospital (RAH) two years earlier.

6.5.11 Assessments

The coordinator had the option of visiting the patient to personally assess their eligibility for Community care and gather additional information for the referral process, i.e. carer details, where services would be provided, OH&S issues and other relevant information. During the assessment phase, TACCT would identify persons that require additional care services to better assist them to remain in their home and potentially reduce the number of hospital visits.

6.5.11.1 Manual Process

All information was gathered on paper, which was then entered into the TACCT access database.

6.5.11.2 Technology Enabled Process

The e-Healthcare solution being implemented enabled an assessment to be completed on a laptop. The assessment module incorporated a Home Care Indicator to assist clinical staff in determining whether a patient was eligible for hospital alternatives and which services were available.

6.5.12 Care Planning

Subject to assessment, where the TACCT staff, considered a patient as suitable for transfer to community care, they created a care plan with any relevant patient and medical conditions, current medications and other information relevant to the patient.

6.5.12.1 Manual Process

Information on the patient was manually obtained from the hospital computer system and entered into a pre-formatted spread-sheet. There were observed to be many gaps, as the data in the hospital system was not current.

6.5.12.2 Technology Enabled Process

The e-Healthcare solution being implemented created a pre-populated care plan with any relevant patient and medical conditions, current medications and other information obtained from the hospital system. The TACCT staff could add too, delete from or otherwise alter the details contained in the care plan and then to select the service (s) required for the patient which are added to the care plan. If the patient had received a previous service, this data was automatically added to the existing patient record.

6.5.13 Service Coordination

Upon a patient being accepted for community care, in the majority of cases, the TACCT staff set about organising community services to ensure the patient could safely return home, with supports in place to assist them, or for the transfer to a residential care facility, where they could be taken care of, either on a respite or permanent basis.

6.5.13.1 Manual Process

The coordination of care involved contacting, predominantly by phone, different community care agencies, for example, Blue Care to arrange supports, as well as family or personal carers, and also the Aged Care Assessment Team (ACAT) if the TACCT staff believe that the patient required permanent residential placement. Observations of this process showed that it often took several hours and multiple phone calls to coordinate services for one person. In one instance it took eight hours to coordinate residential care for a patient.

6.5.13.2 Technology Enabled Process

The e-Healthcare solution being implemented enabled patients to be placed onto a Community Care Access Portal (CCAP) that could be accessed by external providers who can provide HACC, CACP or EACH packages, ACAT, Carers Australia and other agencies. When a person was placed on the CCAP, relevant providers could be automatically notified by encrypted email or SMS. The e-Healthcare solution being implemented also provided a list of service providers with the most suitable service provider (s) selected for each service.

6.5.14 Service Tracking

The TACCT staff had the responsibility of following up on patients returned into the community, to ensure that the care organised was initiated correctly and that the risks of a return to hospital were minimised.

6.5.14.1 Manual Process

Each patient was followed up by a phone call and or in many cases where a patient had returned to their home, a visit to the person's home.

6.5.14.2 Technology Enabled Process

The e-Healthcare solution being implemented provided a service tracking form that displayed all active services that had not been completed, with timestamps for each event in the life of the referral, including receipt of referral, contact with patient and services provided.

6.5.15 Providers Portal

The e-Healthcare solution being implemented provided a Provider's portal, that enabled providers to access information, receive notifications of events, communicate with other members of a care team and access referrals on the waiting list.

Waiting List Referral – This places the referral on a Community Waiting List, for example, An ACAT waiting list, or a RCF waiting list. Patients placed on a waiting list can only be viewed by those organisations, or users that have appropriate permissions to view the patient.

Where selected, and if details are available, the GP is notified of the referral, either by electronic data transfer, or email, depending on the system used within the practice.

6.5.16 Reporting

Each month TACCT provided a report on their activities.

6.5.16.1 Manual Process

This was manually generated from the sheets of paper, access database and spread-sheets

6.5.16.2 Technology Enabled Process

The e-Healthcare solution being implemented provided a comprehensive set of reports, based on the information obtained from the hospital systems and the daily activities of the TACCT staff.

When a patient is assessed by TACCT as being suitable for transfer to home care, as an alternative to hospital admission, the episode is assigned to TACCT. After the patient is discharged from hospital to home care the episode continues until it is closed by TACCT.

Note: There are multiple time components (LOS) that must be considered for reporting and analysis purposes:

- The total hospital component - based on visit/admit and discharge time;
- The ED component - based on visit/admit and assigned dates;
- The In-Patient component - based on assigned and discharge dates;
- The community component - based on discharge and completed dates; and
- The TACCT component - based on the assigned and competed dates.

6.6 Costs Analysis

Direct and indirect costs related to the TACCT service were calculated for the existing manual service and the technology enabled (e-Healthcare) service. Costing data for the Hervey Bay and Maryborough hospitals was obtained from the Qld Health ARC project manager. The data collected did not include accommodation and IT infrastructure costs or overheads.

6.6.1 Identify Activities

Through a consultative approach, TACCT staff members were asked to define the core activities involved in the program, commencing with the identification process, through to the coordination and reporting. Then the differences for each model, the manual service and the technology enabled service were identified.

Table 6-10 Core Activities Involved in Delivering the TACCT Service

Activities
Monitor patient admissions, updates and discharges
Identify potential Patients for home care
Track patients through the hospital system
Assess patients suitability
Coordinate care services
Correspond with Patients GP
Create / Maintain Care Plans
Complete admin tasks

In addition to the above activities, the e-Healthcare model included the activity, "Provide technology service".

6.6.2 Trace Personnel Costs to Activities

TACCT staff members were traced to activities based on the estimated amount of time they spent performing each activity. Through a guided process, TACCT staff members were asked to estimate the amount of time spent performing the activities specified. This process enabled the # FTE to be calculated for each activity. During this process, some additional activities were identified, and added to the model. Table 6-11 outlines how time was traced to each of the different activities over one month. It was considered that a one month evaluation would provide a reasonably accurate analysis, as the activities each day were reasonably similar, with a report provided at the end of each month.

Table 6-11 Allocation of Personnel to Activities

Resource	Activity	% Time	# FTE	Hrs per Month
	Monitor patient admissions, updates and discharges	15	3	67.5
	Identify potential Patients for home care	15	3	67.5
	Track patients through the hospital system	5	3	22.5
	Assess patients suitability	5	3	22.5
	Coordinate care services	25	3	112.5
	Correspond with Patients GP and other providers	5	3	22.5
	Create / Maintain Care Plans	5	3	22.5
	Complete admin tasks	25	3	112.5
	TOTALS	100	3	450

6.6.2.1 Assumptions:

The above calculations ignore holidays when there are only 2 FTE staff on as the staff are still being paid. The above allocations were made prior to the implementation of the TACCT ICT.

6.6.3 Calculate Staff Costs

Other resource costs were not considered in costing model as the area occupied by the staff and travel would remain unchanged for both service models. The resource costs were calculated for each activity based on the advised hourly rate of $75, including all overheads, as advised by the TACCT manager.

NOTE: No other corporate costs were allocated, or taken into account.

Table 6-12 - Calculate Staff Costs

Resource	Activity	Hrs per Month	Hourly Rate	$ Value
	Monitor patient admissions, updates and discharges	67.5	75	$5,062.5
	Identify potential Patients for home care	67.5	75	$5,062.5
	Track patients through the hospital system	22.5	75	$1,687.5
	Assess patients suitability	22.5	75	$1,687.5
	Coordinate care services	112.5	75	$8,437.5
	Correspond with Patients GP and other providers	22.5	75	$1,687.5
	Create / Maintain Care Plans	22.5	75	$1,687.5
	Complete admin tasks	112.5	75	$8,437.5
	TOTALS	450	75	$33,750

6.6.4 Calculate Other Resource Costs

Other resource costs were not considered in costing model as the area occupied by the staff and travel would remain unchanged for both service models.

6.7 Calculate Technology Costs

Table 6-13outlines the TACCT technology costs and method of estimation.

Table 6-13 Estimated Technology Costs

Technology Item	Value	Apportionment	Monthly Cost
Software as a service	$36,000	12 Months	$3,000
QH Connectivity	$12,000	12 Months	$1,000
Portal and database maintenance	$12,000	12 Months	$1,000
Training	$6,000	12 Months	$500
TOTAL			$5,500

6.7.1.1 Assumptions

- PC and laptop equipment will be supplied by the hospital.
- There would not be any costs in relation to GPs accessing the service.
- The solution, hosting and support will be provided as a software as a service by the technology partner.

6.7.2 Summarise Costs

Costs common for both models of care were apportioned based on the estimated consumption by each model. Costs directly related to one model, were traced to that model, as provided in Table 6-14.

Table 6-14 Summary of Costs

Cost Elements	Manual	e-Healthcare
Monitor patient admissions, updates and discharges	$5,063	$5,063
Identify potential Patients for home care	$5,063	$5,063
Track patients through the hospital system	$1,688	$1,688
Assess patients suitability	$1,688	$1,688
Coordinate care services	$8,438	$8,438
Correspond with Patients GP	$1,688	$1,688
Create / Maintain Care Plans	$1,688	$1,688
Complete admin tasks	$8,438	$8,438
Technology Costs		$5,500
TOTAL	$33,750	$39,250

What can be clearly seen is that, excluding the technology cost, there were no other cost differences in the total costs of activity between the manual and technology enabled service, as in discussions with the TACCT manager, she identified that no matter what system was being used the staff numbers would remain the same and all of the activities would remain the same, but perhaps just alter slightly.

It was anticipated that the number of patients identified and coordinated to community care would increase as a result of the service and so the cost per patient would reduce substantially.

6.8 Development of the Technology Platform

The technology platform provided by the partner “Nexus” was upgraded and enhanced to ensure that it met required Queensland Health security standards and incorporated the necessary functionality required to ensure that the objectives of the project could be met. This was achieved through a formal development and delivery approach that utilised the IBM® Tivoli® Unified Process (ITUP), which incorporates the ISO 27000 series of standards, Use Cases methodology, Agile Software Development Process and Prototyping.

The role of the Researcher was to contribute his skills and knowledge of the TACCT service to assist in the design of the solution and its testing.

6.8.1 Development / Upgrade Process

The development / upgrade process is included the following 5 steps:

This involved:

- Completion of documentation incorporating solution functionality outputs, confidentiality, key performance measures, service level standards and

costing and invoicing clauses; and

- Establishment of an overall management plan with the project Steering Committee that included critical timeframes, and resource responsibilities.

6.8.2 Identification of Stakeholder Needs- Technology

This involved:

- Identifying key stakeholder groups and agreeing on a framework to engage with them;
- Holding workshops with key stakeholder groups to identify and clarify their needs using "Use Case" scenarios; and
- Developing a detailed functional specification that incorporated stakeholder needs and their deployment priorities.

6.8.3 Identify Gaps

This involved:

- A review of current system capabilities against stakeholder requirements to identify any gaps.

6.8.4 Development Plan and Specification

This involved:

- Developing a project development plan and specification plan based on the stakeholder requirements and gap analysis that enabled the core functions of the technology Platform to be developed in a staged process.

This plan was subsequently changed due to the Business and Technical requirements of Queensland Health. NOTE: Due to confidentiality clauses, the information exchanged with Queensland Health cannot be included.

6.8.5 System Testing and Acceptance

As components of project technology Platform were upgraded, each component was subsequently tested by the project staff and Researcher. This included:

- Setup core organisation structures;
- Setup of user roles and views;
- Setup of community elements;
- Setup of data libraries and documents;
- Setup of pages and lists;
- Setup of services and assessments; and
- Setup of communications and protocols

6.9 Security Testing

As per the Queensland Health Information security Policy, the solution was fully tested, firstly in-house and was due to be tested by a third party consultant, to ensure that it complies with all Queensland Health standards, when the project came to a conclusion.

6.10 Calculating the Benefits

The benefits defined for this project were based on the gap analysis and inhibitors identified in the first part of the study.

6.10.1 Benefits Model

The benefits model was commenced for:

- Collecting measures / indicators;
- Calculating changes in QALYs; and
- Calculating the $ Value of benefits.

This section was not completed due to the suspension of the project.

6.11 Project Evaluation

In conjunction with the development and implementation of the Nexus eCare™ solution an evaluation framework was also being developed in conjunction with a CSIRO initiated project titled CAP (Care Assessment Platform), which was focused on evaluating the costs and benefits of home based cardiac rehabilitation.

This framework was reapplied to the ARC project to try and create at least some overlap that could be used to validate the constructs.

6.12 Project Challenges

The technical challenges of creating a SCR that links disparate data from multiple sources together, combined with secure messaging and personalised interfaces, were complex and challenging, and resulted in a significant delay in implementation.

The greatest challenge in implementing the project technology developed by the project for the Fraser Coast was in meeting the detailed security and privacy policies and procedures, which are inherently embedded in health care.

6.13 Barriers to Implementation

The project delivered a robust technology that could facilitate the secure exchange of patient information between hospitals and community based providers. The e-Healthcare solution promised to deliver significant improvements to the existing service model, including care coordination, cost efficiencies, patient outcomes, quality & safety, participation and access to community based services.

The next step was for Queensland Health to appoint a third Party ICT security

specialist, to ensure the safety, security and functionality of the system and to implement it, as proposed. The technical challenges of implementing an e-Healthcare solution that links disparate data from multiple sources together, combined with secure messaging and personalised interfaces, were complex and challenging, and resulted in a significant delay in implementation. The greatest challenge in implementing the project technology developed by the project for the Fraser Coast was in meeting the detailed security and privacy policies and procedures, which are inherently embedded in health care.

6.13.1 Data Security

Security is considered the most important issue facing the implementation of electronic integrated health systems. Paul et al. (2005) points out the following threats: a sniffer, software like a phone tap, monitors network traffic to intercept; unauthorised Internet users and unauthorised intranet users intrude the network; and spoofing can take place (i.e. someone pretends someone else).

The project acknowledged that data security was paramount and the development team had taken all known steps to ensure that a participating patient's information could not be compromised in any way. Encrypted electronic data, that can be tracked, controlled and audited is arguably more secure than sending faxes, emails or making phone call. Data security standards were implemented for this project in accordance with both the Queensland Health Information Security Standards and also the International Organization for Standardization / ISO/IEC 27002:2005.

The Queensland Health Information Security Standards incorporate a comprehensive set of policies and procedures that must be met prior to a solution being adopted into the Queensland Health environment.

ISO 27002 is an information security standard published by the (ISO), that provides best practice recommendations on information security management for use by those who are responsible for initiating, implementing or maintaining Information Security Management Systems (ISMS).

Note that there is a considerable overlap between the two sets of standards, to ensure best practice for information security management and to safeguard the security and privacy of health data.

6.13.2 'Who Will Have Access To What Information?'

The SCR, which enables information from multiple data sets to be linked together, has the potential to enable providers to access information that is not required by them in delivering their services to the participant. To ensure that providers only see information that is relevant to their needs, procedures that match the access rights of providers with the services required have been incorporated. Nexus has also implemented policies in line with The National E-Health Transition Authority (NEHTA)'s Individual Electronic Health Record (IEHR) Privacy Blueprint and more recently the Personally Controlled Electronic Health Record (PCEHR) protocols (National E-Health Transition Authority (NEHTA), 2008).

For this project to move to the next phase, these barriers needed to be overcome, which involved the participation, cooperation and support of all stakeholders including Queensland Health, the Fraser Coast health region, the Wide Bay of General Practitioners and community providers.

6.13.3 Custodianship of Patient Clinical Data

A major challenge was enabling access to patient clinical data across the sectors of care and consequently across the Queensland Health secure firewall; whilst complying with Queensland Health policies, standards and processes to ensure the protection of patient information.

In meetings between the project representative and Queensland Health, the configuration of the SCR was discussed and who would be responsible for the data. In the initial design of the solution, it was intended by the Nexus representative that the SCR would be held external to Queensland Health, so that it could be accessed by both Queensland Health staff and external providers, for example, the patient's GP.

This posed a critical issue for Queensland Health who stated that as the custodians of the patient record they would be responsible for the SCR and therefore it must be maintained by Queensland Health. In a meeting between the project representative and Queensland Health including, Peter Lloyd, representatives of Information Division and Research, it was agreed that the server and databases for the solution would all be contained within the Queensland Health firewall and that any data transfers would only be provided on an authorised basis, by Queensland Health.

The project representative clearly indicated that this posed a significant challenge for enabling external providers to access the SCR and would make it impractical for participating consumers to access their information via a secure web portal. Queensland Health has stated that they are working towards enabling GPs and other registered providers to access information from within the Queensland Health firewall. It is hoped that this would overcome the barriers to exchanging data through the firewall.

CHAPTER 7 - CASE STUDY 3 – CAP2

The third study undertaken by the Researcher was a CSIRO Australia e-Health Research Centre randomised controlled trial, called CAP2. As this study ran for longer than the other 2 studies, it contributed substantially to the redefinition of the e-Healthcare CBS framework, and it was the study that the CBS methodology was ultimately finalised.

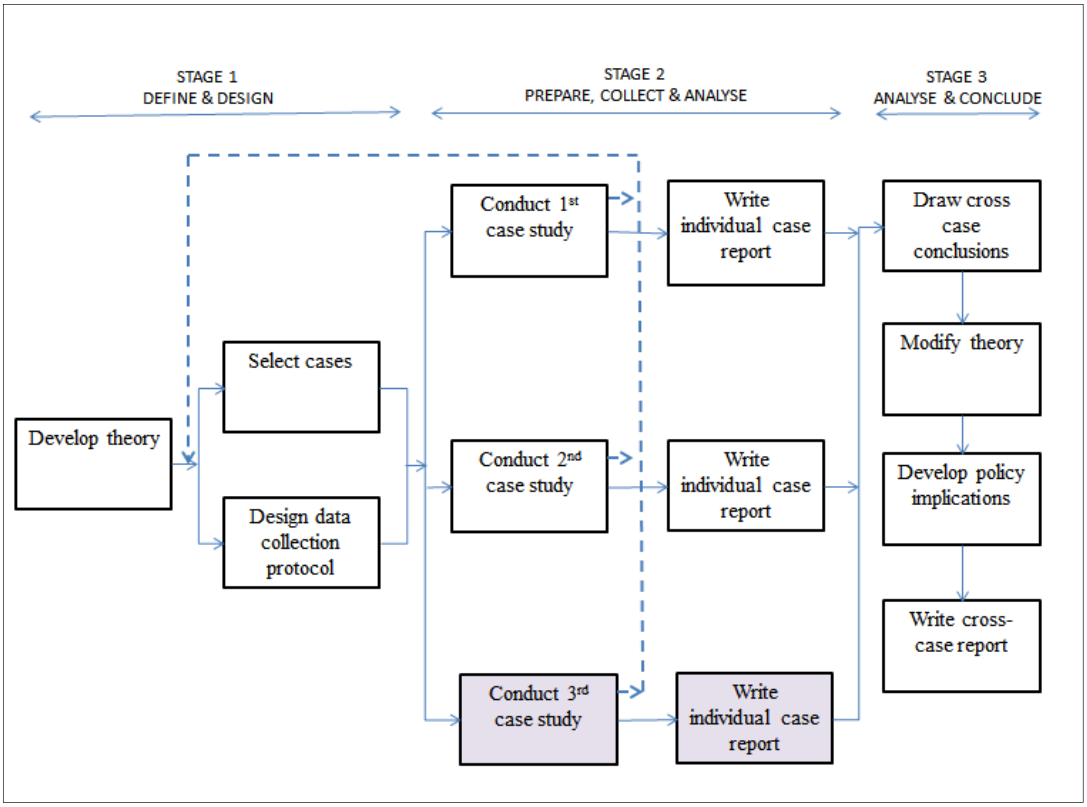


Figure 7-1 Stage 2 - Case Study 3

The aim of CAP2 was to demonstrate the effectiveness of home based care combined with ICT intervention for people suffering from cardiac disease, as compared to traditional processes (Sarela et al., 2009a). A randomised controlled clinical trial was conducted that focused on finding evidence on using Information Technology, specifically Tele-Health systems, to support alternative care models within outpatient cardiac rehabilitation programs. This proposal extends the work and utilises the knowledge derived from the clinical trials undergone in North Lakes during 2007.

The trial incorporated the randomised selection of 120 cardiac rehabilitation patients from the Prince Charles, Caboolture and Redcliffe hospitals, to evaluate if their technology enabled home based care model (CAP2) is a cost effective and a viable alternative for cardiac rehabilitation. The CAP2 trial involved the delivery of a six week program for a total of 120 patients, with 60 patients receiving a traditional gym based program (Program A) and 60 patients receiving the technology enabled home based program (Program B). Randomization was carried out through permuted block randomization to ensure a balance in the patients allocated to each group.

7.1 Technology Enabled, Home Based, Cardiac Rehabilitation - Measuring The Benefits!

7.1.1 Project Overview

This study explored the costs and benefits of CAP2 and the potential for a rollout of the platform across Queensland Australia. The CAP2 project arose through an enquiry from CSIRO, seeking the input of a PhD student, whose research incorporated the evaluation of the costs and benefits of technology enabled care models. A mixed methods approach was used to provide qualitative and quantitative data from observation, semi-structured interviews, focus groups, surveys, system outputs and statistical reports.

Cardiac rehabilitation (CR) programs are comprehensive life-style programs that have been found to be effective in reducing the recurrence of a cardiac event. Globally current programs have significantly low levels of uptake 16-20% in OECD countries (Thomas, 2007). Reasons cited include low levels of service provision and lack of referrals by providers (Scott et al., 2003), and poor uptake by Patients including physical barriers, such as lack of transport, or financial cost, and personal barriers, such as embarrassment about participation, or misunderstanding the reasons for onset of CHD or the purpose of CR (Neubeck et al., 2012). In discussions with Stakeholders, it was suggested that a range of different models for rehabilitation programs should be available for the Patients, according to their own preferences and needs to overcome some of the underlying barriers. Technology enabled care models could provide a viable alternative to centre-based programs for cardiac rehabilitation, potentially increasing participation and quality of life and reducing service costs and secondary events.

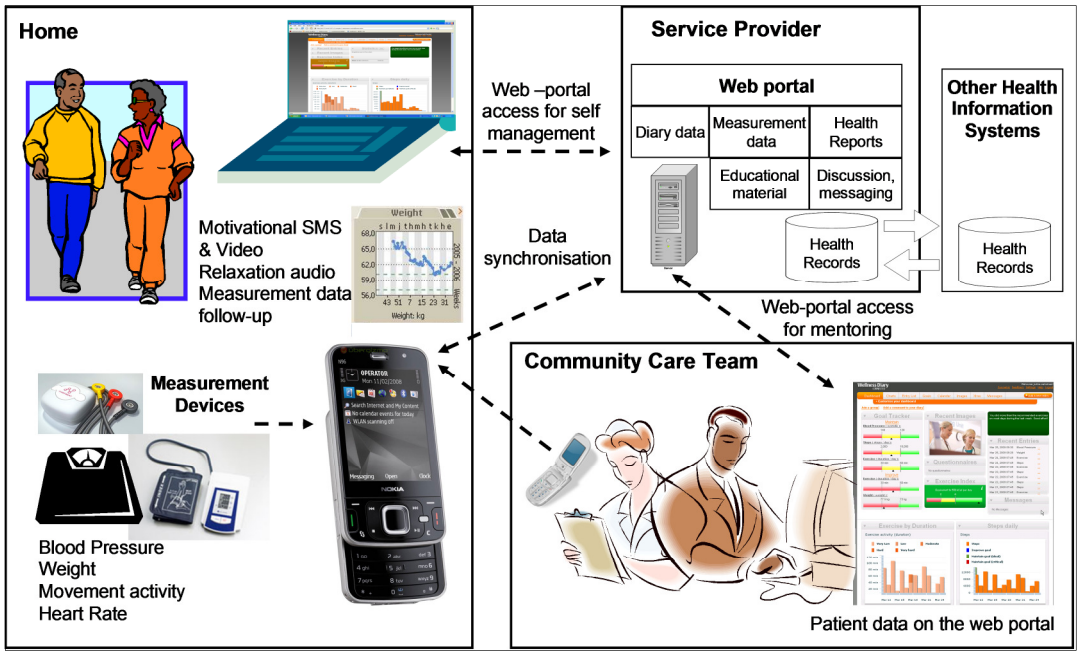


Figure 7-2 CAP2 Model

CSIRO's E-Health Research Centre (EHRC), in collaboration with (Finland) and Nokia have developed a technology enabled home based cardiac rehabilitation model, which seamlessly integrates mobile phone and Internet based technologies

and software in program delivery and patient empowerment. AEHRC hypothesize that the developed model offers a cost-efficient, sustainable, and effective alternative to overcome the limitations and barriers that exist in traditional cardiac rehabilitation programs, including facility provision and access, travel time, time away from work, and patient commitment to the program. AEHRC's model, called CAP (Care Assessment Platform), aims to overcome some of these barriers by providing Patients with an alternative technology enabled home based cardiac rehabilitation program.

CAP is a novel model for a home-based cardiac rehabilitation program, which efficiently uses personal health technologies (mobile phone, Internet technologies, sensors, monitoring devices, and software) in program delivery and patient empowerment (Sarela et al., 2009a). It was hypothesized that the developed care model offers a cost-efficient, sustainable, and effective alternative to overcome the limitations and barriers that exist in traditional cardiac rehabilitation programs.

The personal health system market is rapidly developing but the market place is still immature. Lack of existing business models and limited understanding of the associated costs and stakeholder requirements increase the complexity and risks of creating and especially employing new and alternative models of care in large scale. These factors may create a significant barrier in introduction and long-term uptake of novel care models that may require completely new organizational structures, technology infrastructure, or just new ways of working.

7.1.2 Definitions, Terminology, Actors and References

Table 7-1 Definitions, Acronyms and Abbreviations

Acronym	Description
CSIRO	The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is Australia's national science agency
KPI	Key performance Indicator used to measure the benefit of the service
Data Type	The type of data collected, for example, $'s cost or (benefit), #, %, Rating
Source	Where has the data come from, for example, system output, or research
Result	Total KPI value achieved
Benchmark	The KPI value against which the Result can be compared
Rating %	Result / Benchmark as a %

Table 7-2 Terminology

Terminology	Definition
CAP	Care Assessment Platform
Myocardial Infarction	A heart attack occurs when blood flow to a part of your heart is blocked for a long enough time that part of the heart muscle is damaged or dies
CR	Cardiac Rehabilitation
WD	Wellness Diary
Wellness Web Portal	Portal through which Participants could access and update their activities and other information

Table 7-3 Actors

Actor	Description
Providers	Caboolture, Redcliffe and Chermside hospitals / health centres
Participants	People referred to the service after having a myocardial infarction
CSIRO (EHRC)	The Commonwealth Scientific and Industrial Research Organisation (CSIRO) E-Health Research Centre

7.1.3 Project Establishment

At the time that the researcher joined the CAP2 project was already established, ethics approval had already been obtained and the first candidates were enrolled in the trial. The Researcher was engaged to undertake a Cost-Benefits Analysis of the CAP2 model. Stakeholders included staff from the Cardiac Rehabilitation teams at the Caboolture, Redcliffe and Prince Charles hospitals, GPs enrolled in the CSIRO trial and selected community providers.

Table 7-4 Stakeholder Groups

Stakeholder Group	CSIRO Project
Care Recipients	Cardiac rehabilitation patients, as identified and assessed by the participating hospital clinicians
Government	QLD Health corporate including: Policy and ICT Redcliffe-Caboolture Health Service District The Prince Charles Hospital Health Service District
Hospitals	Prince Charles Hospital, Chermside Caboolture Hospital, Caboolture Redcliffe Hospital
Clinicians / Nursing / Allied Health Staff	Clinicians / Nursing / Allied Health Staff involved in the cardiac rehabilitation programs
CSIRO	Providers of the technology and project management
Allied Health Professionals	None currently specified
Other stakeholders	CSIRO – E-Health Research Centre (EHRC) in collaboration with (Finland) and Nokia

7.1.4 Identification of Project Key Objective (s)

The key objective of the Researcher's study was to evaluate the costs and benefits of an innovative home based technology enabled cardiac rehabilitation care model, known as the Care Assessment Platform2 (CAP2) (Sarela et al., 2009a) and determine if it is a cost-efficient, effective and viable alternative for traditional centre-based cardiac rehabilitation care model.

NOTE: As the project had already commenced prior to the appointment of the Researcher, the Researcher had limited opportunity to provide input on the initial selection of key objectives for the project.

7.1.5 CAP2 Study Design Framework

The CAP study was an un-blinded, randomised controlled trial (RCT), involving cardiac rehabilitation patients enrolled from Primary & Community Health Services of Metro North Health Service District of Queensland Health, Australia from 2009 to 2011. Referrals for clients, who indicated intention to participate in rehabilitation, were screened by a project officer (PO) to determine exclusion criteria for the trial. Clients who were deemed appropriate for and indicated interest in the trial were seen face-to face by the PO for the purpose of obtaining consent and for randomisation.

Patients post myocardial infarction (heart attack), who were cleared to participate in cardiac rehabilitation (CR), were eligible. These criteria were decided to avoid individuals with only a minimal need for cardiac rehabilitation. Subjects were excluded if they had high medical care needs (i.e. unable to participate in self-management program), no experience with mobile phone usage because the intervention was mobile phoned supported), inability to operate mobile phone for purposes of trial (for example, vision or hearing impairment, cognitive impairment, poor dexterity) or current involvement in, or consent to participate in, any other medical trial involving clinical interventions.

The protocol was approved by Redcliffe-Caboolture Ethics Committee, Northside Health Service District and was registered in the Australian New Zealand Clinical Trials Registry (ANZCTR) with number ACTRN12609000251224. The study was supported by the management of the Primary & Community Health Services of Metro North Health Service District of Queensland Health and the Australian e-Health Research Centre.

From 861 referrals, 843 participants were assessed for eligibility, from which 120 participants consented to participating in the trial (average age 55.6 ±10 and 83% male). The study population ultimately consisted of 120 individuals, of whom 100 were male, with 60 participants allocated to each program. There were no significant differences in age, gender or cardiac event for participants allocated to the home and centre-based.

Participants allocated to the home-based group (Group 1) did not attend gym classes, and instead received a Nokia Mobile phone with Wellness Diary and a Wellness Web Portal, daily SMS and mentoring. Participants enrolled to the centre-based group (Group 2) received the traditional 6 week hospital based Outpatient Cardiac Rehabilitation services, including Gym sessions.

Figure 7-3 Process flow of participants through each program shows the flow of patients through both programs

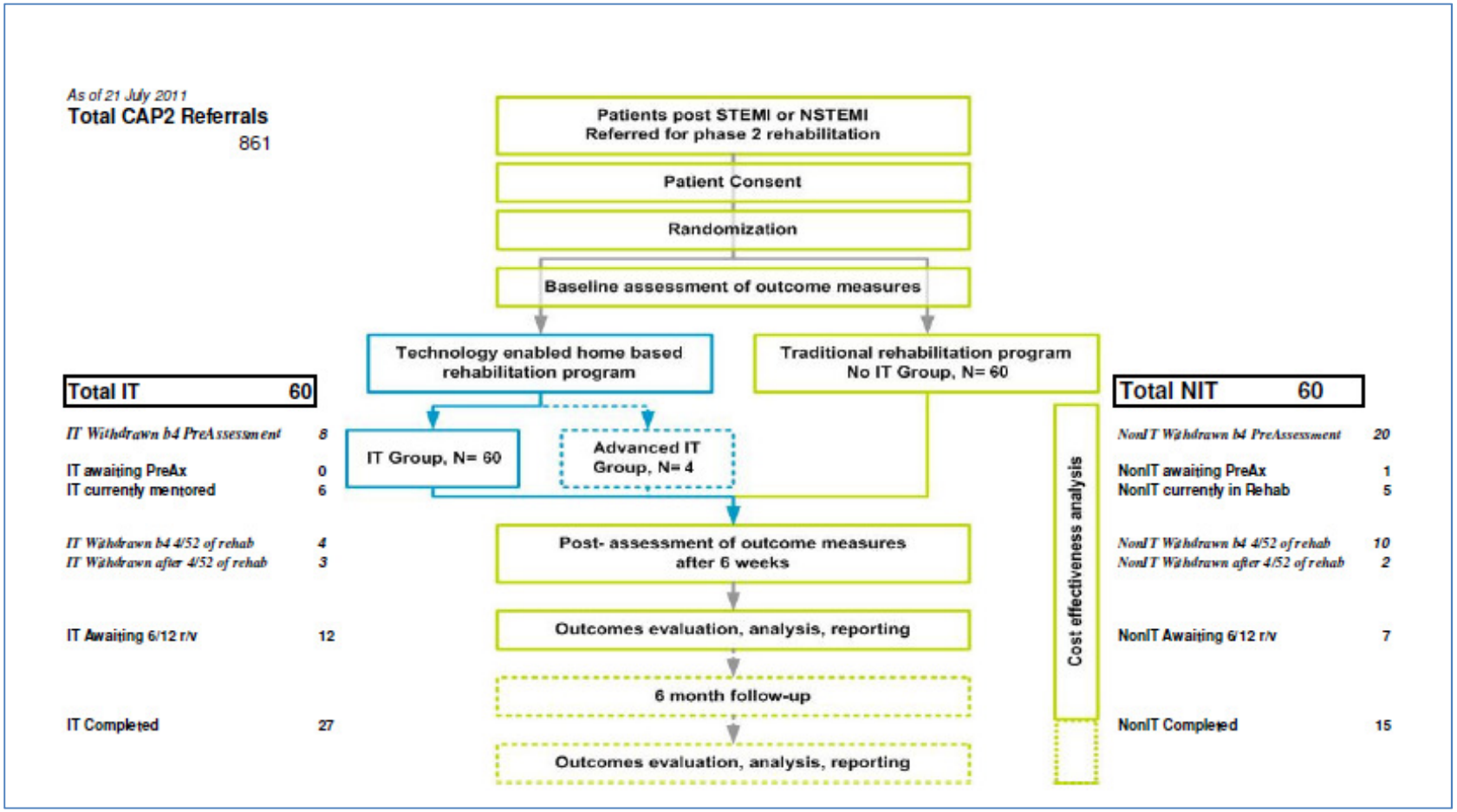


Figure 7-3 Process flow of participants through each program

7.1.6 Group 1 - CAP Model

Each patient was assigned a dedicated mentor and received regular telephone support and counselling via weekly phone/video calls from the mentor. They also received daily supportive text messaging including education, motivation and reminders, integrated video and audio files on their mobile phone, including relaxation scripts and educational information. The CAP CR program structure was developed according to the National Heart Foundation of Australia to address all the components of a comprehensive cardiac rehabilitation program (National Heart Foundation of Australia, 2004). The mentors accessed the patient's recent data which were daily synchronised to a Wellness Diary portal, prior to phone consultation, to facilitate and personalise feedback. The mentor discussed the patient's progress in comparison to set goals and assisted in setting new goals on exercise and behavioural modifications for the following week. The mentoring phase of the rehabilitation program ended after 6 weeks with a post-assessment meeting at the community centre.

All patients received a "My heart, my life" booklet published by Australian Heart Association which included information on benefits of regular exercise, activity recommendations, nutrition and mental wellbeing.

7.1.7 Group 2 - Traditional Program

The traditional care group received traditional Phase 2 community outpatient rehabilitation care comprising of individual assessment, low or moderate intensity physical activity in a supervised group program and education, discussion and face to face counselling sessions at the community centre. The centre programs varied in length with an objective of 2-3 times weekly over a six/eight week period. Patients were booked into a baseline assessment for involvement in the education and exercise sessions as appointments became available. At the end of the CR program a post-assessment meeting was booked at the centre. Patients in the traditional program also received a "My heart, my life" booklet.

7.1.8 Data Collection / Sampling

Data for the Cost-Benefits study was obtained from government agencies, system outputs, observation, semi-structured interviews, focus groups and surveys. Qualitative data was primarily obtained from stakeholders, through workshops, interviews, surveys and forums. Quantitative data for the case study was primarily obtained from CSIRO and the Project Manager. Refer to Appendix G - Statistical Data Sources and system outputs.

7.1.9 Research Protocols, Confidentiality and Ethics Requirements

These were completed prior to the Researcher joining the study. The Researcher was asked to sign a contract that set out the rules of engagement.

7.1.10 Care Recipient Selection and Inclusions / Exclusions

Participants were sought from the partner organisations, including CSIRO, Queensland Health; Caboolture, Redcliffe and Chermside hospitals / health centres, as per Table 7-5. This involves generating a random number to select the block.

Varying block sizes of 4, 6, and 8 were used. Random number generation was done through: http://www.random.org/integers/?mode=advanced.

Table 7-5 Participant Selection

Inclusions / exclusions	Details
Selection and Qty.	Randomised selection of 120 cardiac rehabilitation patients from the Prince Charles and Caboolture Hospitals
Condition	Cardiac rehabilitation patients
Age	No age limit
Speak English	No restriction
Dementia	No

7.1.11 Care Recipient Data Collected

Care recipient data collected included demographic details and condition history, assessments, statistical data and surveys. A range of assessments and surveys were conducted for each patient. Refer to Appendix H - Cardiac Rehabilitation Assessment

Coded protection of identity was used for all statistical outputs and information was only disseminated to approved stakeholders, as advised by the project manager.

7.2 CAP2 – Cost Benefits Evaluation

As discussed previously it can be a given, that every health care service provided, no matter where it is provided or what is provided, is subject to cost constraints. The provision of cardiac rehabilitation is no different, with the demand for services far outstripping the supply. In Queensland it has been estimated that less than 20% of patients recovering from a myocardial infarction (heart attack) complete an approved rehabilitation program. This study utilised the CBS framework and methodologies to compare the costs and benefits of the Care Assessment Platform (CAP2) with the traditional centre-based cardiac rehabilitation care model. The results obtained from the study have been used to determine if the CAP2 model is a cost-efficient, effective and viable alternative for CR.

7.3 Cost Benefits Evaluation Framework

It was during the CSIRO project that the original CBS framework evolved substantially from the initial framework and was renamed to the Cost Benefits Scorecard (CBS) framework. This resulted in the original CSIRO study being repackaged to fit with the revised framework.

As noted earlier the results of the CAP2 study were re-structured to fit in with the revised evaluation model. Subsequently, the methodology for collecting and displaying data also evolved, and as a result there were differences in the way data was captured and displayed in the model for the different case studies. The most noticeable change was in the Benefits dimensions, with the inclusion of the impacts dimension and the Scorecard dimension to distinguish this framework as a comparative framework that could be used to compare similar service models.

7.3.1 Populating the CBS

Following the CBS framework and methodology each of the eight dimensions for both service models were defined, commencing with Outcomes, Outputs and Inputs, as follows.

NOTE: As the primary purpose of this evaluation focused on comparing the Costs and Benefits between two alternative care models, the quality aspects of the service have not featured strongly in this study.

7.4 Input Dimensions

The three Input dimensions (Health Care Services, Technology Services and Information Services), combine together to enable technology enabled health care (e-Healthcare) services to be provided. Note that any of these services could be provided on its own, or as a collation.

7.5 Input Dimension - Health Care Services

Health Care Services are defined in the CBS framework as the health care services provided by professionals / organisations and the processes, protocols and methods utilised. It also incorporates the physical facilities, equipment, overheads and indirect supporting services needed for the provision of health care services. The health care services were provided, initially by three cardiac rehabilitation centres, Chermside, Redcliffe and Caboolture community health services. Later these providers were expanded to include other centres in the Northern Health Service.

7.6 Input Dimension - Technology Services

Technology services are defined in the CBS framework as specific technologies that either assist in the delivery of physical health care services, or are in themselves part of the service, for example, a health & wellbeing web portal. Technology services can incorporate systems, connectivity, devices, web portals, messaging services, mobile apps, data, images, documentation, media and other items that are used in the direct provision of services.

7.6.1 Service Model 1 (Technology Enabled)

The technology provided for the Tele-Health service model was provided and maintained by CSIRO's E-Health Research Centre (EHRC), in collaboration with (Finland) and Nokia, which seamlessly integrates mobile phone and Internet based technologies and software in program delivery and patient empowerment. Participants in Group 1 were provided (at no cost) with a Nokia N64 mobile phone, which incorporated a health & wellbeing app called the Wellness Diary and provided $10 worth of data and calls per month. They were also provided with a Wellness web portal which enabled them to set goals and track their progress as well as access information on food ideas and nutrition.

7.7 Input Dimension – Information Services

Information Services, as defined in the CBS framework relates to the data, documentation, messages, communications, dictionaries, images, videos and other forms of media that are used in the provision of services.

7.8 Output Dimension - Service Provision

7.8.1 Program Outputs

This case study was a controlled CR trial, where two different service models were compared, as follows.

7.8.1.1 Service Model 1 (Technology Enabled)

Participants allocated to the home-based program (Group 1) did not attend gym classes, and instead received a Nokia Mobile phone with Wellness Diary and a Wellness Web Portal, daily SMS and mentoring.

7.8.1.2 Service Model 2 (Not Technology Enabled)

Participants enrolled to the centre-based program (Group 2) received the traditional Phase 2 community outpatient rehabilitation care comprising of individual assessment, low or moderate intensity physical activity in a supervised group program and education, discussion and face to face counselling sessions at the community centre.

7.9 Measuring Quality

The quality aspect of the service was measured through:

Assessments completed at baseline, 6 weeks and 6 months to obtain feedback on the services provided, surveys and statistics obtained from the services.

7.10 Measuring Costs

Direct and indirect costs related to the delivery of a six week CR program, with re-assessment after 6 months were evaluated. Based on an average sized facility providing rehabilitation to 160 Patients per annum, the cost per participant receiving the centre-based model were compared with the costs per participant receiving the CAP model. Both the centre-based and CAP modes of delivery offer comprehensive rehabilitative care by encompassing exercise, risk modification and mentoring.

7.10.1 Obtain Costing and Associated Data

Costing data was obtained from the participating cardiac rehabilitation centres and their respective hospitals, as well as from Qld Health. The data collected from Chermside Rehabilitation Centre included costs relating to staff, and general expenses, but did not include costs relating to facilities, gymnasium, utilities, insurances and overheads.

7.10.2 Define Activities

Through a consultative approach, selected CR centre staff members were asked to define the core activities involved in delivering the CR program, commencing with the intake process, through to service delivery, discharge and reporting. Then the differences for each model, the centre-based and the home-based models were identified as set out in Table 7-6.

Table 7-6 Core Activities involved in a Cardiac Rehabilitation Service

Activities	CAP	CENTRE
Receive Referrals / Enquiries	X	X
Coordinate care services	X	X
Correspond with Referee's GP	X	X
Assess Service Requirements	X	X
Create / Maintain Care Plans	X	X
Provide gym sessions		X
Deliver mentoring services – F2F		X
Deliver mentoring services - Remote	X	
Provide equipment for CAP	X	
Meetings, training and other indirect activities	X	X
Complete admin tasks	X	X

7.10.3 Trace Resources to Activities

In the Cardiac Rehab unit (CR) staff member costs were traced to activities based on the estimated amount of time they spend performing each activity. To simplify the process, personnel were grouped by their classification or role type, for example, Registered Nurse (RN), Physiotherapist (Physio), Occupational Therapist (OT) and Admin Staff (Admin).

Through a guided process, representatives from each role were asked to estimate the amount of time spent performing the activities specified. This process enabled the # FTE to be calculated for each activity. During this process, some additional activities were identified, and added to the model.

Table 7-7 outlines how time was traced to different activities for 1 day. This was replicated across a 2 week period, as this was considered by staff to provide an accurate reflection of the activities undertaken. It was considered that a 6 week evaluation may have provided a slightly more accurate activity analysis, as this would cover the time of the rehabilitation program. For this case this was not completed, as it was not considered to have a material impact on the costs.

Estimated times were calculated in minutes, instead of a percentage as this process was easier for the CR staff to calculate. Minutes were then converted to hours and into a percentage of resource time based on an FTE of 37 hours

Lost time spent performing activities, due to interruptions, has been estimated for each activity. In the case of prepare Gym, 90% of the staff time has been allocated to this activity, with the remaining 10% allocated to undefined time. Undefined time was allocated to the activity Admin.

Table 7-7 Allocation of Personnel to Activities - CR

Week 1									
	Staff Resources								
Activity by Resource Type	CNC	CN	PHY	RN	RBH	MD	OT	%'Share	Qty
FTE	1.0	1.0	0.7	0.2	0.2	0.1			
Monday									
Prepare Gym		20	20					90%	30
Exercise		140	140					90%	15
Education		60	60					90%	20
Assessments		75	75					80%	2
Healthy Hearts									
CCS	30	45	45					80%	2

The (Quantity (Qty) column specified the maximum number of participants involved in the differing sessions. For example, 15 participants would be catered for in an exercise session, although perhaps only 10 may turn up for the class.

7.10.4 Calculate Activity Costs

The resource costs for the total fortnight were calculated, based on the financial accounts provided by the Prince Charles Hospital. These costs were apportioned on a participant by participant basis, based on the number of participants. The cost per participant can be calculated based on the following formula.

Equation 9 - Calculate Activity Costs

Cost per participant = Resource (x) $ Hourly Rate x # Minutes / 60 x #FTE x %Share / # concurrent Patients

Using the above formula and an hourly rate of $75 (inc.: OH), the cost per participant to set up the Gym = (20/60 x $75 x 2 FTE) x 90% / 30 = $1.50 per participant, or $45 in total.

7.10.4.1 Assumptions:

The maximum number of participants at the Chermside CR centre, at any given time was estimated at 30. Therefore where there was no defined number of participants for an activity, costs were apportioned to participants based on the 30 participants. Where the number of participants could be calculated for an activity, this number was used in the calculation.

For the Activity Assessments, 2 personnel were involved, a CN and a Physio. The time allocated for each of these staff was based on 75% of the CN's time and 25% of the Physio's time on 1 assessment and the opposite on the next assessment.

The costing model was populated based on the Chermside CR centre, with the intention that the model will then be interrogated, adjusted and populated with data from the other centres.

7.10.5 Mentoring

Participants were provided with mentoring to encourage them to adhere to their program, as follows:

- Group 1: Participants were provided with regular mentoring calls and daily text messages.
- Group 2: Participants were provided with group and some one-on-one mentoring at the gym sessions.

Group 1 mentoring was treated as a separate activity, as it could be clearly defined. Group 2 mentoring was treated as a part of the gym session and could as it could not be clearly defined. Table 7-8 outlines the additional mentoring costs and method of estimation for CAP:

Table 7-8 Mentoring Activities

Activity	Explanation	Group 1	Group 2
Calls by Mentors	30 calls per mth per mentor to call 5 Patients for 15mins per week	$9	$0
Mentoring in Gym Sessions	Mentoring provided as part of the gym sessions	$0	Inc.

7.10.5.1 Assumptions

- Mentoring was based on the delivery of mentoring services to all participants and did not account for drop outs.
- Often multiple calls were required to make contact with participants. The time spent making unanswered calls was not recorded.

Management services includes the infrastructure, facilities, buildings, corporate costs, server networks, PC's, laptops, phones, internal management systems, and general overheads. The technologies that are primarily aimed at enabling the service to operate are included in Management services. Technologies that are used specifically to deliver a service are included under Technology services.

In addition to assessments, education sessions, administration, Service model 2 provided twice weekly gym sessions, which were not available to participants in group 1.

7.11 Calculate Management Services Costs

The facilities utilised by the Chermside CR team where estimated at a total of 180 sqm (Square Metre) divided into 30 sqm general use and 150 sqm dedicated to the Gymnasium. The 150 sqm utilised by the Gymnasium was estimated at $36,000 based on a floor cost of $240 per sqm. The floor cost was calculated based on comparative rental charges, as advertised in the local real-estate advertisements in the nearby area. Costs estimates were agreed with the Prince Charles Finance officer who provided the accounts and additional information. Table 7-9 outlines other resource costs involved in the delivery of the CR program:

Table 7-9 Management Services Costs

Service model	Explanation	Group 1	Group 2
Facility costs	A commercial rate has been estimated based on floor space and divided between gymnasium and other areas	$45	$270
Gym Equipment / Maintenance	The gym equipment was regularly serviced and updated with a budget figure agreed with the finance officer of $40k per annum	$0	$250
Equipment	Equipment and internal infrastructure costs, for example, PC and phone were considered to be used equally by both the IT and non IT program	$75	$75
		$120	$595

The gym equipment was regularly serviced and updated with a budget figure agreed with the finance officer of $40k per annum. Note that there were no records available to confirm this figure and the staff within the centre believed that it was too high and the cost per participant was calculated, by dividing the costs by the total number of participants over the course of a year.

7.11.1.1 Assumptions

- It was anticipated that an alternative usage for the premises could be identified.
- All utilities, insurances, cleaning and security have been included in the above costs
- The internal hospital system was ignored, as it only acted as an input facility and did not services.

7.12 Define and Trace Technology Partner Resources to Activities

The same process, of defining activities and then tracing resources to those activities to arrive at a time and cost per activity was followed for the technology partner CSIRO. These resources traced to the technology (CAP) model are shown in Table 7-10.

Table 7-10 Technology Staff Resource Time Traced to Activities

Resource	Activity	% Time	# FTE	Hrs per Wk.
CSIRO - Technology Partner	Provide Technical support if PO/Mentor unable to resolve	10	0.5	2
	Develop and update technology tools and electronic material	40	0.5	8
	Host web and messaging services. This service was provided by Nokia	0	0	0
	Source devices, software, mobile communications plans, messages and educational materials for the program	10	0.5	2
	Train new Project Officers and Mentors to use Web-portal and home care devices	5	0.5	1
	Setup Electronic material	15	0.5	3
	Setup Mobile phone and plan	5	0.5	1
	Setup Web Portal account	5	0.5	1
	Source and Purchase Devices	10	0.5	2
		100%	0.5	20

The cost of the IT resource was based on an estimated annual pay rate of $75,000 for an appropriately qualified IT resource.

Equation 10 - Calculation of IT Resource Costs

Cost per participant = (Resource $ Annual Rate x %Time x #FTE) / # Patients

= ($75,000 x 0.4 x 0.5 FTE) / 60 participants = $250.

7.12.1.1 Assumptions:

During the course of the trial the Technology provider #FTE was estimated at 1FTE. It was considered that in normal operation, this would reduce to 0.5 FTE, based on the following assumptions:

- Activity 2 - Develop and update technology tools and electronic material is a once of cost and so has been included in the costs of infrastructure.
- All other activities would reduce by at least 50% once the model was established.

The resource time was based on 5 concurrent participants completing the CAP at any one time, with 5 new participants every 6 weeks.

During the course of the trial, the number of concurrent participants varied substantially, as a result of the SARS outbreak and other contributing factors. Therefore a percentage of time was unutilised

7.12.2 Calculate Technology Costs

The CAP program included the provision of technology services to participants, including the provision of a mobile phone and phone credit, devices for measuring weight, BP, heart rate, Glucose and exercise steps. Table 7-11 outlines the CAP specific technology costs and method of estimation:

Table 7-11 Technology Costs

Technology Item	Value	Apportionment	Annual Cost	6 Week Program	Participant $ Cost
Mobile technology	$1,150	2 years	$575	0.12	$66
Patient devices	$400	5 years	$80	0.12	$9
Portal and database maintenance	$200,000	3 years	$66,667	0.12	$118
Hosting and support	$50,000	1 Year	$50,000	0.12	$89
TOTAL			$117,322		$283

7.12.2.1 Assumptions

- Mobile technology phones will require replacement every 2 years.
- Patient devices will only apply to a limited number of participants and will require replacement every 5 years.
- Maintenance of the portal and associated database will be charged on an annual or monthly basis and not as an upfront license fee.
- Hosting and support are provided by the technology partner.

7.12.3 Technology Driven Mentoring

Participants were provided with daily text messages designed to encourage them to adhere to their program. Table 7-12outlines the additional mentoring costs and method of estimation for CAP.

Table 7-12 Mentoring Activities

Activity	Explanation	Group 1	Group 2
Patient Phone plan	Have the phone for 6 months with most calls in first 6 weeks - data only counted @ $10 per month per unit	$60	$0
SMS	120 per patient * $0.15 for 6 weeks	$18	$0

7.12.3.1 Assumptions

It was assumed that all 60 participants in Group 1would receive their full quota of mentoring activities and texts.

7.12.4 Service Model Cost Summary

As per the ABC model, costs common for both models of care were apportioned based on the estimated consumption by each model and costs directly related to a model were traced to that model. Direct and indirect costs related to the delivery of a six week CR program, with re-assessment after 6 months were evaluated. Based on an average sized facility providing rehabilitation to 160 Patients per annum, the cost per participant receiving the centre-based model were compared with the costs per participant receiving the home-based model. Costs were broken down by Program and activity, as provided in Table 7-13. These calculations showed that the home-based CR model could be delivered for a marginally lower cost of AUD 1,630 per patient, compared to AUD 1,845 for the existing centre-based group.

Table 7-13 Summary of Comparative Costs

Cost Elements	Group 1	Group 2	$ Difference
Education	$130	$35	$95
Assessment	$195	$195	$0
Coaching / Mentoring	$380	$225	$155
Gymnasium	$0	$180	($180)
Communications	$195	$125	$70
Facility	$120	$595	($475)
Technology	$280	$40	$140
Administration	$485	$450	$35
Program Costs	$1785.00	$1845.00	($60)

7.12.5 Sensitivity Analysis:

Increasing the number of Patients utilizing the home-based program by 100% was calculated to reduce the above stated costs per participant in group1 by approximately $80. Additionally, because the home-based program is not restricted by the limitations of the gym size, it has the potential to benefit from economies of scale.

7.13 Output Dimension - Service Usage

The study population ultimately consisted of 120 individuals, of whom 100 were male, with 60 participants allocated to each program. There were no significant differences in age, gender or cardiac event for participants allocated to the home and centre-based. See Table 7-14.

Table 7-14 Uptake of Services for each Program

Model	Accepted	Uptake	Completion	Adherence
Definition	Consented	Completed initial baseline assessments	At 6 weeks, participated in ≥80% of CR mentor consults for IT, and attended ≥80% centre sessions for non-IT Patients respectively	Adherence to physical exercise at 6 months. 2 Patients from both models lost.
Home Based (Group 1)	n = 60	n = 53 / 88%	n = 48 / 80%	n = 46
Centre Based (Group 2)	n = 60	n = 40 / 67%	n = 28 / 47%	n = 26

Both groups received the initial education sessions and assessments at the commencement of the program and after 6 weeks. Usage of the services took place over a period of time (approx. 18 months), with only five participants on average at a time as there were a number of impacting factors, including the swine flu epidemic that caused the project to stall several times.

Outcome Benefits Dimension

Benefits obtained through the delivery of a more cost effective care model can fairly easily be quantified using ABC methodologies, as outlined in the previous section. Cost-Benefit Analysis (CBA) methodologies require program consequences to be valued in monetary units, thus enabling the analyst to make a direct comparison of the Program's incremental cost with its incremental consequences in commensurate units of measurement, be they dollars, pounds or yen (Drummond et al., 2005).

Where ever possible, monetary values were assigned to the benefits in line with Cost-Benefit theory. The monetary value of benefits were estimated based on a meta-analysis of studies focused on the role of both centre-based and home-based CR programs and their impacts on reducing the risks of secondary CR events and hospital re-admissions.

When estimating the monetary value of benefits, either the most conservative value, or an average value was selected. Where the monetary value of benefits could not be reasonably accurately estimated, for example, additional time spent with family, the benefit was assigned an AUD 0 value and CEA has been used to identify a numerical or percentage based benefit.

Program benefits can often be intangible and subjective, and received over a period of time. Reduced future costs and improvements in health care outcomes as a result of a program are often much more difficult to quantify and can be distorted by time, secondary health issues and other factors. Additionally, benefits can be viewed from multiple Outcomes, and a benefit to one stakeholder may not necessarily be a benefit to another stakeholder.

As defined by the steering group, the key objectives for CAP were to offer a cost-efficient, sustainable, and effective alternative to overcome the limitations and barriers that exist in traditional cardiac rehabilitation programs, including facility provision and access, travel time, time away from work, and patient commitment to the program (Walters et al., 2010).

Table 7-15 - CAP2 Program Objectives

Program Objectives	Description
Cost-efficient & sustainable	CAP can be provided at the same or a lower cost than the traditional centre based model and provide an effective alternative to the centre based program
Effective outcomes	Health outcomes for patients and the quality of the service will be at least as good as those experienced with the centre based program
Improved access to Program	More people can access the program within an acceptable time, irrespective of income, physical location or cultural background
Reduced travel time and time away from work	Patient Travel costs and time away from work can be reduced
Improved participation	participants will remain on the program for longer and have a higher level of participation than the centre based program

In most cases, the benefits of a program can be defined in terms of how well the key objectives of the program have been achieved. Program Objectives were identified, as shown in Table 7-15.

In consultation with key stakeholders, involved in the CAP trial and in line with the updated framework, the following five outcomes were drawn from the key objectives, as provided in Table 7-16.

This change reflected the need to remove the bias created by using the term Objective and instead, to reflect a neutral term that could be either positive or negative. It was argued by the Researcher that this change, although subtle, would provide greater validity of the framework.

Note that the "Health Services" sub dimension was not included in this study, but was subsequently added to the CBS framework to take into account the specific elements of the other case studies.

Table 7-16 CAP2 Program Outcomes - Redefined

Outcomes	Description
Access:	This was a measure of program accessibility, as evidenced by referrals that did not take up the program and also by participants who did not complete the program due to location, travel costs, work commitments, or delays on the waiting list.
Participation:	This was a measure of involvement in the program, as evidenced by the number of participants that completed the program, based on an 80% completion rate.
Health & Wellbeing:	This was a measure of the impact of the program on participant's health and wellbeing outcomes, based on assessments using the EQ-5D assessment and reported in terms of changes in Quality Adjusted Life Years (QALYs).
Quality & Safety:	This was a measure of the quality and safety of the program in terms of complaints, feedback, errors and reportable incidents
Resource Effectiveness	This was a measure of how effective resources were being used to deliver the program and also the costs to participants

The Outcome benefits for both the IT and non IT program were identical although there were some variations in the measures used to determine the value of the benefits. These changes are identified in the relevant sections.

7.13.1 Define Program Benefits

The CBS enables both the monetary and non-monetary benefits of a program to be analysed and grouped by perspective. Where ever possible, monetary values were assigned to the measures in line with Cost-Benefit theory, with other benefits being measured in terms of QALYs, Qols, or comparative percentages or ratings.

Through a consultative process, the proposed benefits of the technology enabled service model were identified and described for each outcome. This included reviewing each outcome to determine the key benefits that could be attributed to that outcome. For example, under the Outcome Access, a benefit for the CAP2 project was identified as 'Reduced Waiting Time'. As stated in the e-Healthcare framework, benefits are closely aligned with objectives.

7.14 Measuring the Benefits

To evaluate the benefits of CAP, A range of tools have been used to obtain quantity, %, time, quality and other performance measures of the service model. A list of measures is included in Appendix J - Cap2 Outcomes Benefits and Measures.

Where possible, the measures collected have been used to assist in the calculation of monetary values for benefits in line with Cost-Benefit theory. Alternatively the tools have been utilised to calculate QALYs or to provide a comparative % or rating.

Measures data was obtained from the statistical outputs of each model, interviews, financial reports, assessments, surveys and feedback from stakeholders involved in the program and from unstructured discussions and secondary evidence. For the ongoing evaluation of the CAP service model, it was imperative to systematise the collection of measures data, to reduce the ongoing impost on personnel time, and also to improve the accuracy and consistency of the data. This can be achieved through the use of internet solution and systemised data collection processes.

To assist with the calculations of benefits, wherever possible, previously identified research outcomes have been utilised to substantiate the net benefit derived.

7.14.1 Dimension - Access

This was a measure of program accessibility, as evidenced by referrals that did not take up the program and also by participants who did not complete the program due to location, travel costs, work commitments, or delays on the waiting list.

Program accessibility was evidenced by the number of drop-outs from the program, that were attributable to participant-level barriers, and additionally by the average number of days from time of referral to acceptance on program.

Substantiating evidence indicates that barriers to commence, attend and remain on the CR program were significantly reduced for the home-based participants, as evidenced by the dropout rates of 8 compared to 21 for the centre-based participants in the first week and 28 compared to 48 prior to completing 80% of the program. Cost barriers were reduced as a result of a lower number of visits to the centre, equating to AUD 80 for the home-based participants compared with AUD 400 for the centre-based participants, based on AUD 20 per visit. Other barriers to participation included transport availability, time, health and mental state, employment commitments and distance from programs. Benefits achieved by reducing these barriers have not been considered in this paper, as they are not specifically related to the program.

7.14.1.1 Referrals / Enquiries

There were 834 referrals during the time of the trial, which took place over 2 years. Note that the take up of patients was substantially impacted as a result of the swine flu epidemic.

Of significance was the percentage of males as compared with females. This percentage was similar in both programs, as shown in Table 7-17.

This compares with a ratio of approximately 3:1, Males to Females reported in a variety of studies conducted on Caucasian populations. One study of 2273 patients hospitalized with a first acute myocardial infarction (MDC 1, 2, 3 or 9), 1710 (75-

2%) were male and 563 (24-8%) female. Women developed acute myocardial infarction at a later age than men (/><0001, Table 2), with a mean (standard deviation) age of 60-4 (7-9) years for the former and 56-4 (8-6) years regarding the latter (Herman et al., 1997).

Table 7-17 Gender Breakdown

Participant Breakdown	Centre Based	Home Based
% Male	81.67%	85.00%
% Female	18.33%	15.00%

7.14.1.2 Ability to Access Services

The significant difference between the 2 programs was the ability of participants in Group 1 to access services remotely, via their mobile phone and web portal. Access by regional, remote and indigenous persons was not clearly articulated in the study and was not included in the trial, as the patients, selected for the trial, were only selected where they could attend a centre. Immediately this ruled out the inclusion of persons from regional and remote locations.

Table 7-18 Participant Breakdown

Participant Breakdown	Centre Based	Home Based
% CALD	0%	0%
% Indigenous / TSI	0%	0%
# Participants living more than 25 kms from where services are provided	??	??

Table 7-18 shows that there were 0 indigenous / TSI or CALD participants. It was considered, however, by the Researcher and in discussions with stakeholders that if the technology enabled service were made available, that there would be uptake by persons who otherwise would not have participated in the program.

There were 4 participants whom participated in either of the programs that were more than 25 kilometres away from a centre. The details of which service model they participated in is unknown at this time.

7.14.1.3 Reduced Waiting Times

The average number of waiting days was 49.792 days for the home-based program compared to 63.875 days for the centre based program. In a study by Russell et al. (2011) it has been established that for every day spent on a waiting list, an additional 1% of patients are less likely to go onto the program. Based on 834 referrals during the time of the trial and a reduction of 14 days for the home-based program would equate to an additional 12 participants commencing rehabilitation with potentially cost savings of AUD 46,397, based on an 80% completion rate, or $3,866 per participant. This assumes that CR places would be available. These benefits have not been included in the CB model, but should be taken into account in the development of a business model.

7.14.2 Dimension - Participation

The original primary endpoint to the CAP2 study was adherence to physical exercise, but recruitment was lower than had been predicted and the study could not be completed with the sample size and power originally planned. The steering committee therefore decided to adopt co-primary endpoints of uptake (the primary endpoint), together with adherence to CR (the pre-specified secondary endpoint).

The primary endpoint with respect to CR uptake was confined to the proportion of patients who started a cardiac rehabilitation program and was determined by number of individuals who attended at least the baseline assessment in each group. Adherence to CR for each participant was defined as the proportion of individuals who attended baseline assessment and participated in ≥80% of CR mentor consultations for IT, and attended ≥80% centre sessions for no-IT patients respectively.

7.14.2.1 Adherence to Plan / Program

The level of adherence was evidenced by the number of participants that participated in ≥80% of CR mentor consults for IT, and attended ≥80% centre sessions for non-IT Patients respectively, within the 6 week program, as shown in Table 7-19: The number of participants completing the home-based CR program (80%) proved to be 33% higher than that of the centre-based program.

The statistical data obtained from the Project Coordinator showed that the most significant time of drop off was within the first week of the program.

- Group 1: Drop Offs in first week n = 8 / 13%
- Group 2: Drop Offs in first week n = 21 / 35%

Several theories were put forward why this was the case and some feedback was received. The difficulty was that when people dropped of the program, often they were difficult to follow up on.

Table 7-19 Process Flow of Participants through each Program

Model	Accepted	Uptake	Completion	Adherence
Definition	Consented	Completed initial baseline assessments	At 6 weeks, participated in ≥80% of CR mentor consults for IT, and attended ≥80% centre sessions for non-IT Patients respectively	Adherence to physical exercise at 6 months. 2 Patients from both models lost.
Home Based (Group 1)	n = 60	n = 53 / 88%	n = 48 / 80%	n = 46
Centre Based (Group 2)	n = 60	n = 40 / 67%	n = 28 / 47%	n = 26

7.14.3 Readmission Costs

Evidence suggests that the completion of a formal rehabilitation program may significantly reduce the risk of a secondary event and re-admission. Table 7-19 Process Flow of Participants through each Program" shows the uptake, adherence and completion, based on an 80% completion rate, of the two program models.

In a review by Oldridge (1998) and O'Conner et al. (1989) of 20 randomised trials conducted throughout the world, they concluded that all-cause mortality, cardiac mortality and non-fatal infarction decreased by 20-25% over 3 years where substantiative exercise-based rehabilitation takes place. The cost of one cardiac readmission is estimated at $39,670 Canyon and Meshgin (2008) reported a significantly smaller number of total readmissions in patients participating in a community based program compared to those patients that did not attend the program (8% and 28% respectively).

In a Western Australia trial by Canyon (2008), it was shown that the average cost of a secondary re-admission for a person who had a myocardial infarction was calculated at $25,051.

Using the more conservative figures from these studies, it can be concluded that for every person who had a myocardial infarction, and did not attend rehabilitation, the secondary costs were on averaged 28% x $25,051 = $7,014.28 compared with 8% x $25,051 = $2,004.08 for a person who completed 80% of a recognised program.

Table 7-20 Participation Benefits

Benefit Estimation	Home Based	Centre Based
Completed 80% of Program	48	28
Total Participants	60	60
% Completed	80%	47%
Risk of Re-admission	8%	8%
Cost of re-admission	25,051.00	25,051.00
Cost per Unit	2,004.08	2,004.08
Total Cost (Completed)	96,195.84	56,114.24
Did not Complete Program	12	32
Total Participants	60	60
% NOT Completed	20%	53%
Risk of Re-admission	28%	28%
Cost of re-admission	25,051.00	25,051.00
Cost per Unit	7,014.28	7,014.28
Total Cost (Uncompleted)	84,171.36	224,456.96
Total Cost (60 Participants)	180,367.20	280,571.20
Ave Cost per Participant	3,006.12	4,676.19
Net Benefit compared to No Program	4,008.16	2,338.09
COST Of Program	$1,633	$1,845
% ROI	145%	27%

Based on the above mentioned studies, this would result in a benefit of $7,014.28 - $2,004.08 = $5,010.20 per person on the program. Based on the cost of the CAP model $1,785, the return on investment (ROI) of $5,010 equates to 280%. Table 7-20 shows the potential re-admissions benefit calculations for both home based and centre based service models.

Table 7-21 Readmissions within 12 months of Commencing Rehabilitation

Readmissions	Data Type	Home Based	Centre Based
Readmissions within 12 months	# Patients	8	12
Readmissions within 12 months	# Admissions	13	17

In the data provided to date, the home based (IT) readmissions were lower than the home based readmissions, which would support the other studies. Because it could not be fully established if these readmissions were representative of the true situation, they were ignored for this study.

7.14.4 Dimension - Health Outcomes

Demographic and clinical characteristics of participants who commenced CR were measured at the time of commencement (Baseline), and again at 6 weeks. Anthropometric measures included weight, height, blood pressure and waist circumference. Functional exercise capacity was measured using the 6 Minute walk test (Balke, 1963) and leisure-time physical activity was measured by the Active Australia Survey (AAS) (AIHW, 2006). The following questionnaires, as set out in Table 7-22 were also completed:

In this study the primary analysis used the EQ-5D value set developed from a valuation of key health states using the Time Trade-Off derived EQ-5D Weights for Australia (Viney et al., 2011). A blood sample was obtained to determine total cholesterol concentration, triglycerides, high-density lipoprotein (HDL) cholesterol and low-density lipoprotein (LDL) cholesterol.

There was clear evidence that the health outcomes achieved by participants in Group 1 were higher than those participants in Group2. This was based on five indicators selected for the study; Physical limitation, Angina stability, Angina frequency, Treatment satisfaction, and Disease perception which were used to calculate the Quality of Life (QoL).

Table 7-22 CR Assessments and Descriptions

Assessment	Description
Diets Habit Questionnaire (DHQ),	The Diet History Questionnaire (DHQ) is a food frequency questionnaire (FFQ) developed by staff at the Risk Factor Monitoring and Methods Branch (RFMMB). This FFQ consists of 124 food items and includes both portion size and dietary supplement questions. It takes about 1 hour to complete and was designed, based on cognitive research findings, to be easy to use (National Cancer Institute, 2012).
DASS21,	The DASS 21 is a 21 item self-report questionnaire designed to measure the severity of a range of symptoms common to both Depression and Anxiety(Lovibond & Lovibond, 1995).
EQ-5D,	The EQ-5D is a standardised measure of health status to provide a simple, generic measure of health for clinical and economic appraisal. Applicable to a wide range of health conditions and treatments, it provides a simple descriptive profile and a single index value for health status that can be used in the clinical and economic evaluation of health care as well as in population health surveys (EuroQol Group, 1990).
Kessler 10 (K10),	The K10 comprises ten questions about psychological distress. It is designed to quantify the frequency and severity of anxiety- and depression-related symptoms experienced in the four weeks prior to screening (Kessler et al., 2003).
Seattle Angina Questionnaire (SAQ),	Measures functional status of patients with coronary artery disease. Each of the 5 dimensions are scored by assigning each response an ordinal value, beginning with 1 for the response that implies the lowest level of functioning, and summing across items within each of the 5 scales. Scale scores then transformed to 0-100 range by subtracting the lowest possible scale score, dividing by the range of the scale and multiplying by 100. No overall scale score is generated (Spertus JA et al., 1995).
Morisky Medication Adherence Scale and trial specific evaluation questionnaires.	Morisky's Medication Adherence Scale (MMAS) was designed to distinguish poorly adherent patients from those with medium-to-high adherence to their antihypertensive (Morisky et al., 1986).

There were no significant differences in baseline characteristics between patients allocated to the home-based and centre-based arms.

7.14.5 Change in Risk Factor Status over 6 Week CR Program

In the post assessment at 6 week, participants within the home-based arm of the trial had significant improvements in their mean, weight/BMI, Waist circumference, 6 MWT, DASS (Depression and Anxiety) scores, K10, EQ5D-Index, EQ5D-VAS, DHQ (fat, fibre and salt) and triglycerides. Significant changes were also seen in the participants in the centre-based arm in, 6MWT, DASS (Depression), DHQ (fat, fibre and salt) as well as total cholesterol and triglycerides.

7.14.6 Measuring QoLYs and QALYs

Quality of Life Years (QoLYs) enable the health state of a person prior to an intervention to be compared against the health state after the intervention. Note that health state includes physical and mental state. Quality Adjusted Life Years (QALYs) measure the impact of the program on participant's health and wellbeing outcomes. There are various assessments that can be used to measure QoLYs. For this case study the QoL calculations were based on assessments using the EQ-5D assessment and reported in terms of changes in Physical & Mental Wellbeing.

The primary analysis used the EQ-5D value set developed from a valuation of key health states using the Time Trade-Off derived EQ-5D Weights for Australia (Viney et al., 2011).

- EQ-5D - Index: calculated using Australian weights
- EQ-5D – Visual Analogue Scale: 1-100 QoL scale

The impact of each program model on participant's health and wellbeing outcomes were calculated based on the EQ-5D assessment completed at the commencement of the program and again at six weeks, as provided in Table 7-23.

Changes in health states over the six week period showed a mean improvement of 0.08 in the Quality of Life (QoL) per participant in the home-based group compared with a slight reduction of 0.01 for participants in the centre-based program.

Table 7-23 Change in QoL GMean

Cost Elements	Group 1	Group 2	Difference	$ Net Benefit
QoL: EQ-5DGMean (CI) Baseline	0.84 (0.79-0.89)	0.83 (0.77-0.90)	0.01	
QoL: EQ-5DGMean (CI) 6 Weeks	0.92 (0.88-0.96)	0.82 (0.72-0.94)	0.100	
QoL: EQ-5DGMean (CI) Change	0.08	-0.01	0.09	

Cost-utility analyses (CUAs) has been used in conjunction with the EuroQol five-dimensional (EQ-5D) questionnaire, which is one of the most widely used generic preference-based instruments for measuring health-related quality of life. Based on the research Review of Australian health economic evaluation – 245 interventions: what can we say about cost effectiveness (Dalziel et al., 2008) have calculated the median cost-effectiveness ratio of 1 QALY (0.01) at AUD18,100.

Using Cost-Utility Analysis (CUA) an Australian study estimated that, among patients who have experienced an acute coronary syndrome, cardiac rehabilitation costs approximately $42,535 per quality-adjusted life year saved (allowing for the effect on survival), compared with standard care (Briffa et al., 2005). Based on the increase in QoL of 0.08 for the home-based group this would provide a health benefit of AUD 3,388 per participant.

7.14.7 Sub-Dimension - Safety & Quality

This sub-dimension provides a measure of the quality and safety of the program including choices in service, complaints, feedback, errors and reportable incidents. Reportable, as provided in Table 7-24 incidents were defined as an incident that could have a material impact on a participant or staff member.

Table 7-24 Incidents

Event	Explanation	Group 1	Group 2
Reportable incidents	The number of reportable incidents during the course of the trial. A reportable incident was defined as an event that may have a material impact on the health & wellbeing of the participant	10	7

7.14.8 Satisfaction

A survey was conducted at baseline, 6 week and 6 months to establish service model preferences. The six month results were used as the surveys were inconsistent for the other periods. Refer to Table 7-25.

Table 7-25 Participant Preference for Service Model

	Preference for CR			**Preference for Exercise**		
	Baseline	6 Week	6 Month	Baseline	6 Week	6 Month
IT						
Home based	31	31	35	23	31	35
Centre based	1	0	2	3	0	2
No preference	9	7	4	15	6	4
	41	38	41	41	37	41
NIT						
Home based	NA	NA	3	NA	NA	10
Centre based	NA	NA	15	NA	NA	6
No preference	NA	NA	5	NA	NA	6
			23			22

7.14.9 Sub-Dimension - Resource Effectiveness

The results show that at the end of six months Participants in the IT group preferred the home based service n = 35 out of a total response of n = 41 (85%);. Participants in the Non IT group were mixed in their preference, with those preferring the centre based service n = 15 out of a total response of n = 23 (65%).

This sub-dimension provides a measure of how effective resources were being used to deliver the program and also the costs to participants Outputs.

7.14.9.1 Provider Costs

As per the cost analysis shown in Table 7-26 Cost Efficacy Cost Comparison for IT and Non IT Service Models, it was calculated that the IT enabled home based service could be delivered marginally more cost-effective for AUD 1785 than the centre based program AUD 1845. From the preliminary analysis, the costs of each program are similar, with a small savings identified for the CAP technology option. Sensitivity analysis indicated that further savings, in the range of AUD 80 per participant, could be achieved through an increase in the number of participants in the home based model, with only minor savings possible in the centre based model as a result of the restrictions in scalability of the gym.

Table 7-26 Cost Efficacy Cost Comparison for IT and Non IT Service Models

Cost Elements	Group 1	Group 2	Difference	$ Benefit
Education	$130	$35		($95)
Assessment	$195	$195		$0
Coaching / Mentoring	$380	$225		($155)
Gymnasium	$0	$180		$180
Communications	$195	$125		($70)
Facility	$120	$595		$475
Technology	$280	$40		($140)
Administration	$485	$450		($35)
Program Costs	$1785.00	$1845.00		$60

7.14.9.2 Participant Costs

Patients with the TEHBC program will only be required to visit the Rehabilitation Centre 4 times, twice at the commencement of the program, after 6 weeks and after 6 months. This compares with 20 visits for Gym-based Patients. Patient travel costs were based on the average distance that participants were required to travel multiplied by number of visits required. For simplicity sake, the cost per trip was estimated at $20, based on an average 25 kms @ $0.80 per km.

- Group 1: Travel n = 4 x $20 = $80
- Group 2: Travel n = 20 x $20 = $400

Table 7-27 Participant Costs

Participant Costs	Explanation	Group 1	Group 2
Travel	Travel costs were estimated at $20, based on an average round trip of 25 kms @ $0.80 per km	$80	$400

Savings identified for the CAP technology option, patient travel costs for the home-based program were lower than the gym-based program (calculated at $20 per trip).

7.15 Populated CBS

Table 10 combines Key Objectives and Measures into a Cost-Benefits Scorecard that enables the value of Benefits for both the Home Based (CAP) and Centre Based Rehabilitation service models to be compared and evaluated.

Using a combination of Cost Benefits Analysis (CBA), Cost-Utility Analysis (CUA) and Activity Based Costing (ABC) methodologies, the Costs and Benefits of each Perspective were calculated per Participant for the home-based CR (Group 1) and the centre–based CR (Group 2), as outlined in Table 7-28.

7.15.1A Warning:

Note that in calculating Benefit $Values, it is important not to double count a benefit, as this will distort the analysis.

Table 7-28 Cost Benefits Scorecard

Outcomes	Group 1	Group 2	Difference
Cost Efficacy	$1,630	$1,845	-$60
Participation	($4,008)	($2,335)	-$1,673
Health Outcomes	($3,388)	$0	-$3,388
Quality & Safety	$0	$0	$0
Access	$80	$400	-$320
Net Cost / (Benefit)	(5,686)	(90)	-$5,596

7.16 Projected Cost Benefits Based on 3,000 Participants

The Researcher was asked by the AEHRC to extrapolate the cost-benefits model to provide services to a wider number of patients, so that this could be taken to Queensland Health with the view of implementing the CAP2 service model across the state. It was estimated, based on the trial results that the Technology enabled program could attract an additional 20% (3000) of the over 15,000 patients/year discharged with cardiac diagnosis in Queensland, Australia (Sarela et al., 2009b).

Table 7-29 – Extrapolated Cost-Benefits Scorecard

Total Participants	**No Program**	**Centre Based**	**CAP**	**Centre 50% CAP 50%**
Total Participants	60	60	60	3000
Program Cost per Participant	$0	$1,845	$1,785	$1,815
Total Cost (60 Participants)	$0	$110,700	$107,100	$5,445,000
% Completed	0%	47%	80%	64%
Est. Risk of Re-admission (2 Yrs)	8%	8%	8%	8%
% NOT Completed	100%	53%	20%	37%
Risk of Re-admission	28%	28%	28%	28%
Est Total # Re-admissions (2 Yrs)	16.80	11.16	7.20	459.00
Est. Cost of re-admission	$25,051	$25,051	$25,051	$25,051
Est. Total Re-admission Costs	$420,857	$279,569	$180,367	$11,498,409
Est. Cost of No Program	$420,857	$420,857	$420,857	$21,042,840
Net Cost / Benefit	$0	$141,288	$240,490	$9,544,431
Net Cost / Benefit per Participant	$0	$2,355	$4,008	$3,181
% ROI	0%	128%	225%	175%

The costing model was based on a total of 3,000 participants, with:

- 50% (n=1500) of participants completing a centre based program; and
- 50% (n=1500) of participants completing a CAP program

The benefits were based on:

- A reduction in re-admissions from 28% to 8% for patients who have completed a formal rehabilitation program (National Heart Foundation of Australia, 2010); and
- A Cost of separation of $25,051 per separation (Access Economics, 2009), Participant costs have been ignored
- A 5% incremental reduction in technology costs, from economies of scale

The evaluation model returns the following result, as shown in Table 7-29

7.17 Summary

CAP provides many benefits, including:

Increased participation – CAP can either be used as a stand-alone program, or more likely in conjunction with an existing gym-based program, increasing patient options and participation;

Scalability – With increasing demand on skilled resources the home-based model provides an excellent opportunity to leverage existing cardiac rehabilitation resources on an incremental cost basis;

Flexibility – CAP enables cardiac rehabilitation teams to integrate and coordinate service delivery in conjunction with appropriately qualified, community based providers;

Visibility – CAP enables other members of the care team, for example, the patient's GP, Physiotherapist and Dietician to access and contribute to the care plan and outcomes;

Patient involvement – CAP enables patients to actively interact with and contribute to their rehabilitation program via a personal web portal;

Research – CAP provides rich data that could be used by researchers to improve rehabilitation models;

Implementation – CAP is a Turn-key solution that can be implemented as an additional service at low cost, with minimum infrastructure and training requirements;

Service Model - CAP could be offered as an inclusive service, so that all technology and support costs are provided on a usage basis, minimising up-front investment;

Technology improvement – CAP offers vendors and service providers an open ended opportunity to deliver new technologies and solutions to cardiac rehabilitation.

7.18 Barriers to Uptake

The care and business model developed for home-based cardiac rehabilitation programs may have extremely high impact by increasing the uptake of currently underused cardiac rehabilitation services and more importantly by introducing a new evidence-based model for businesses providing services for health care organizations. The business model could be extended to multiple clinical domains to enable urgent transition from hospital and care centre based treatments to sustainable home-based care.

To date, even with the substantiation of this study and other complimentary studies, this option has not gained traction. CR is predominantly a public health service run through community care services and like many other services the stance taken is usually to continue with the current service.

Participation rates in cardiac rehabilitation following myocardial infarction (MI) remain low. Studies investigating the predictive value of psychosocial variables are sparse and often qualitative.

CHAPTER 8 - KEY FINDINGS & DISCUSSION

In accordance with Stage 3 of the Case Study construct, see Figure 8-1, this chapter brings together the outcomes for each case study, both individually and collectively. It then provides insight into the constructs and processes leading to the final framework, policy implications and concludes with a summary discussion of the major findings.

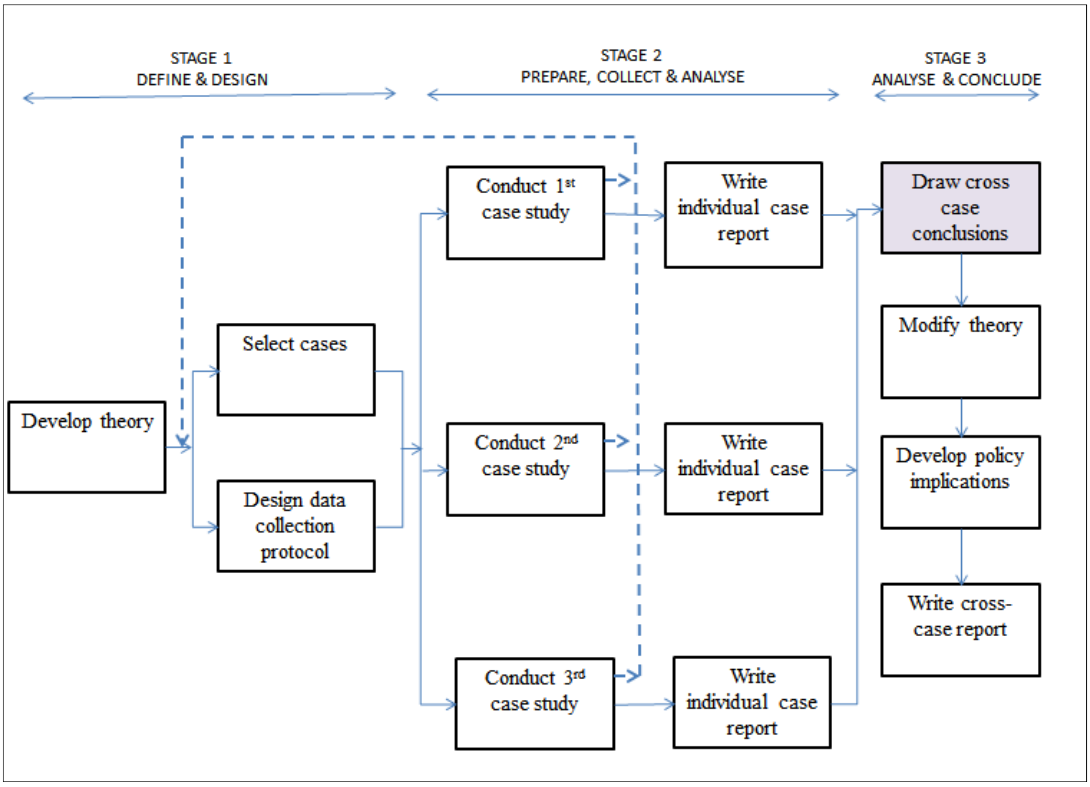


Figure 8-1 Case Study Construct

8.1 Summary of Major Findings

The purpose of this study was to evaluate the impact of collaborative technologies on the provision of community based care to older persons and persons with acute and disabling conditions.

Reflecting on the research question:

Question 1 "How will the e-Healthcare model provide more cost-effective services and better care outcomes for older persons and persons with chronic and disabling conditions?"

AND

Question 2 "What are the barriers that will inhibit its uptake?"

Both parts of the research question have been covered in each of the case studies, which are summarised below.

The Community Waiting List (CWL) is an online database for community packages

that has been trialled in the Murray Mallee region of South Australia since late 2008. The Researcher was engaged to complete an interim evaluation of the trial in October 2009 and a final evaluation in December 2010, to determine the impact of CWL on the delivery of packages and associated services.

Using the e-Healthcare CBS as a framework, 5 key Outcomes were incorporated to create a multidimensional measuring model with interdependencies between the different Outcomes. Outcomes selected for this analysis were Access, Participation, Quality & Safety, Collaboration and Cost Efficacy. The perspectives selected differed slightly from the e-Healthcare CBS to match in with the priority objectives of the project. A mixed methods approach was used to collect and analyse data which was obtained from semi structured interviews, workshops and surveys.

The e-Healthcare CBS provides the ability to display the results of the research using a rating, or alternatively a $ value. Ideally, as per Cost-Benefits Analysis, wherever possible benefits should be calculated in monetary terms to enable the costs and benefits to be compared equivocally. For this study, the Researcher was engaged to review the benefits only, in non-financial terms. As a result the ranking methods approach was used as outlined in the CBS framework and methods. A summary of the benefits from the CWL are outlined in Table 8-1. The cost of the service was $6,000 per annum. Although the benefits have not been measured in monetary terms, from the results of the evaluation, the benefits have been substantial at very little cost.

Table 8-1 CWL Benefits Scorecard

OUTCOMES	CWL Result	Benchmark Result	% Improvement
Access	81%	50%	62%
Participation	88%	50%	76%
Quality & Safety	75%	50%	50%
Coordination	91%	50%	82%
Cost Efficacy	79%	50%	58%
Cost	$6,000		

8.1.1 Access:

The analysis of the data revealed that only 20% of people on the waiting list received packages that year. Murray Bridge had the longest waiting lists and the longest wait times contrary to expectations. As a result of the improved statistical information provided by the CWL, the providers in the region were able to build a stronger case for additional packages which resulted in the region being awarded additional packages. This resulted in ten additional community packages in Murray Bridge & aboriginal packages.

8.1.2 Participation:

It was confirmed that the majority of the providers were accessing and contributing to the service, but there were some providers who were hesitant in using the service. Generally the CWL was seen positively as an example of collaboration by the stakeholders but there were comments that suggested that the “spirit” of

collaboration is needed for the database to function in the future and that users needed to use the database correctly for it to be useful. There were concerns expressed that the database could lead to less communication between stakeholders in the long term and therefore have a damaging effect.

8.1.3 Quality and Safety

A major issue prior to the CWL was that people were getting lost in the system, which resulted in a lack of follow up and provision of services in some cases. The CWL led to greater transparency in the management of the waiting list for example, how and where clients are accepted or not accepted which resulted in clients being less likely to get lost on the waiting list.

In terms of choice, it was unanimous that the CWL made no difference. This was clarified that on the basis that there is only 1 provider for a type package in some areas and none in others. Also where the client might be difficult to service (location etc.) providers do not necessarily offer a choice. All agreed that where there is more than one provider then the CWL could facilitate choice but it does not necessarily enable choice.

8.1.4 Coordination

Coordination of services was seen as a major benefit of the CWL, as it led to greater transparency in the management of the waiting list for example, how and where clients are accepted or not accepted and improved monitoring and tracking of people.

8.1.5 Cost Efficacy

Overall, the administration costs were shown to have reduced as a result of the CWL, but there were different results for different types of providers. For ACAT there was an increase in data entry, which then resulted in a decrease down the line for Service Providers. Importantly, the CWL did not significantly impact on the administrative workload or “handling paper” given that the paper system continued to be used by some providers.

8.1.6 Conclusion:

In conclusion, the CWL seems to provide a more effective process for coordinating the provision of home care services in a rural region where there are multiple providers. In turn the improved collaboration has resulted in greater access to older persons living in the region, reduced the number of persons requiring services from being forgotten, increased transparency between providers and assisted in gaining additional care packages for the region. The CWL reduced the administration for providers, but was also responsible for increasing some of the administration for ACAT.

In the longer term the increase in administration for ACAT is anticipated to cause a barrier to the use of the CWL, as ACAT is not funded to provide this service and since the time of the review, have expressed their concern over an increasing work load. Again this highlights the barriers faced in the health system when implementing almost any type of initiative to improve the system.

8.1.7 Recommendations / Feedback Loop

The evaluation pointed to a number of issues that needed addressing. They were as follows:

1. There is a significant workload on the ACAT entering data and managing the database. The steering committee recommended that we explore the incorporation of the Aged Care Client Electronic Record with the CWL. The ACCR includes 90% of the information collected by the CWL database. The electronic ACCR was not expected to be implemented in Murray Bridge until mid-2011.
2. There continued to be a significant administrative workload for the CSP because the paper system referral system is still in use. Given that the survey indicated that stakeholders were happy to phase out the paper system it is recommended that we do so.
3. The trial period exposed a high level of people declining packages when offered. As the causes of this are largely outside the influence of the steering committee it was recommended that we provide this data to the Office for the Ageing and the Department of Health & Ageing as well as local service providers.
4. The success of the CWL is dependent on the knowledge of the users. New staff should be trained in the database and the processes around referral management. The process manual should be updated and be made available to all users and any new users should be inducted into the database and its procedures.
5. Finally the steering committee believes that the long term success of the CWL is contingent on maintaining stakeholder commitment beyond the 2 year project phase. With that in mind the steering committee will review the Memorandum of Understanding and consult with the stakeholders around the future management of the CWL and Community Packages.

   The greatest barrier is "**Who will pay for it?**"

The aims of the second case study project were to develop, trial and evaluate a technology platform that would minimise unnecessary, inappropriate and costly admissions to hospital of older persons. This was to be achieved by using a technology platform to identify candidates for hospital redirection, map programs to patients, and automate communications between hospitals and community service providers, and tracking service delivery by agencies.

A hospital based integrated care solution was developed that incorporated the tools necessary to achieve the outcomes agreed with key stakeholders. This included improving the identification of patients suitable for home care services as an alternative to hospital care, coordinating community care services for these patients, improving collaboration and information sharing between the hospitals and community providers, reducing manual tasks and paperwork and providing evidence for the effectiveness of the service.

Using the e-Healthcare CBS as a framework, 5 key perspectives were incorporated to create a multidimensional measuring model with interdependencies between the

different perspectives. Outcomes selected for this analysis were Access, Participation, Health Outcomes, Quality & Safety and Health Service Impacts. The perspectives selected differed slightly from the e-Healthcare CBS to match in with the priority objectives of the project. A mixed methods approach was used to collect and analyse data which was obtained from workshops, semi structured interviews, financial reports and trial statistics.

Table 8-2 ARC Benefits

OUTCOME	BENEFITS
Access	Increased identification of people presenting to ED that may be suitable for care in the community Increased identification of people in wards that may be suitable for care in the community
Participation	Improved information sharing between the hospitals and community care services
Coordination	Improved coordination of patients to community based services
Quality & Safety	Reductions in reportable incidents that may result in harm to patients
Resource Utilisation	Improve effectiveness of TACCT

In the pre-implementation trials the e-Healthcare solution appeared that it would meet all of these objectives. The project delivered a robust technology that could facilitate the secure exchange of patient information between hospitals and community based providers. The e-Healthcare solution promised to deliver significant improvements to the existing service model, including care coordination, cost efficiencies, patient outcomes, quality & safety, participation and access to community based services.

Even when the technical challenges of implementing an e-Healthcare solution that enables data from the hospital to be shared with community based providers were, in most cases, addressed, the political challenges were insurmountable.

8.1.8 Data Security

The project acknowledged that data security was paramount and the development team had taken all known steps to ensure that a participating patient's information could not be compromised in any way. The concerns about data security standards were onerous and too substantial for the project to overcome in the time frame allowed.

8.1.9 Who Will Have Access to the Data?

The SCR, which enabled information from multiple data sets to be linked together had the potential to enable providers to access information that was not required by them in delivering their services to the participant. This created a range of privacy issue discussions, which in most cases were centred on a few examples and did not take into account the overall benefit.

8.1.10 Custodianship of Patient Clinical Data

A major challenge was enabling access to patient clinical data across the Queensland Health secure firewall, whilst complying with Queensland Health policies, standards and processes to ensure the protection of patient information. During the later course of the project the electronic sharing of data between hospital clinicians and different health providers was ruled out, as there was disagreement on "Who owned the data?"

This decision unfortunately spelled the end of the project, after 3 years work.

8.2 CAP2 Cost Benefits Analysis

A cost benefits analysis was completed to support the hypothesis that the CAP Home-Base cardiac rehabilitation (CR) model offers a cost-efficient, sustainable, and effective alternative to overcome the limitations and barriers that exist in traditional cardiac rehabilitation programs.

Using the e-Healthcare CBS as a framework, 5 key perspectives were incorporated to create a multidimensional measuring model with interdependencies between the different perspectives. Outcomes selected for this analysis were Cost Efficacy, Participation, Health Outcomes, Quality & Safety and Access. The perspectives selected differed slightly from the e-Healthcare CBS to match in with the priority objectives of the project. A mixed methods approach was used to collect and analyse data which was obtained from semi structured interviews, financial reports, trial statistics, assessments and surveys.

Using a combination of Cost Benefits Analysis (CBA), Cost-Utility Analysis (CUA) and Activity Based Costing (ABC) methodologies, the Costs and Benefits of each Perspective were calculated per Participant for the home-based CR (Group 1) and the centre–based CR (Group 2), as outlined in Table 8-3.

Table 8-3 CAP2 Cost Benefits Scorecard

OUTCOMES	GROUP 1	GROUP 2	DIFFERENCE
Cost Efficacy	$1,630	$1,845	-$60
Participation	($4,008)	($2,335)	-$1,673
Health Outcomes	($3,388)	$0	-$3,388
Quality & Safety	$0	$0	$0
Access	$80	$400	-$320
Net Cost / (Benefit)	(5,686)	(90)	-($5,596)

Cost Efficacy: Direct and indirect costs related to the delivery of a six week CR program, with re-assessment after 6 months were evaluated using ABC methodologies. Based on an average sized facility providing rehabilitation to 160 Patients per annum, the cost per participant receiving the centre-based model were compared with the costs per participant receiving the home-based model. These calculations showed that the home-based CR model could be delivered for a marginally lower cost of AUD 1,630 per patient, compared to AUD 1,845 for the existing centre-based group.

Participation: Participation was evidenced by the number of participants that completed each program, based on an 80% completion rate. Significantly, the number of participants completing the home-based CR program (80%) proved to be 33% higher than that of the centre-based program. Secondary research suggests that the completion of a formal rehabilitation program may significantly reduce the risk of a secondary event and re-admission from 28% to 8% (National Heart Foundation of Australia, 2010). Using Cost Benefits Analysis (CBA) and supporting studies (Access Economics, 2009), the resulting cost savings were estimated at AUD 4,008 per participant for the home-based group and AUD 2,335 for the centre-based group.

Health Outcomes: The impact of each program model on participant's health and wellbeing outcomes were calculated based on the EQ-5D assessment completed at the commencement of the program and again at six weeks. Changes in health states over the six week period showed a mean improvement of 0.08 in the Quality of Life (QoL) per participant in the home-based group compared with a slight reduction of 0.01 for participants in the centre-based program. Calculated based on a valuation of key health states using the Time Trade-Off derived EQ-5D Weights for Australia (Viney et al., 2011). Using Cost-Utility Analysis (CUA) an Australian study estimated that, among patients who have experienced an acute coronary syndrome, cardiac rehabilitation costs approximately $42,535 per quality-adjusted life year saved (allowing for the effect on survival), compared with standard care (Briffa et al., 2005). Based on the increase in QoL of 0.08 for the home-based group this would provide a health benefit of AUD 3,388 per participant.

Quality & Safety: No supporting evidence of quality or safety issues, including complaints, errors or reportable incidents were provided for either program.

Access: Program accessibility was evidenced by the number of drop-outs from the program, that were attributable to participant-level barriers, and additionally by the average number of days from time of referral to acceptance on program.

Substantiating evidence indicates that barriers to commence, attend and remain on the CR program were significantly reduced for the home-based participants, as evidenced by the dropout rates of 8 compared to 21 for the centre-based participants in the first week and 28 compared to 48 prior to completing 80% of the program. Cost barriers were reduced as a result of a lower number of visits to the centre, equating to AUD 80 for the home-based participants compared with AUD 400 for the centre-based participants, based on AUD 20 per visit. Other barriers to participation included transport availability, time, health and mental state, employment commitments and distance from programs. Benefits achieved by reducing these barriers have not been considered in this paper, as they are not specifically related to the program.

The average number of waiting days was 49.792 days for the home-based program compared to 63.875 days for the centre based program. In a study by Russell et al. (2011) it has been established that for every day spent on a waiting list, an additional 1% of patients are less likely to go onto the program. Based on 834 referrals during the time of the trial and a reduction of 14 days for the home-based program would equate to an additional 12 participants commencing rehabilitation with potentially cost savings of AUD 46,397, based on an 80% completion rate, or $3,866 per participant. This assumes that CR places would be available. These benefits have not been included in the CB model, but should be taken into account in the development of a business model.

Conclusion: In conclusion, the CAP home-based model seems to provide an efficient lower-cost approach to cardiac rehabilitation, with additional flexibility, improved access and potentially may significantly reduce the risks of secondary re-admissions and related costs. Table1 illustrates the significant benefits that may be able to be achieved by the CAP model, as calculated using CBA.

Because a significant proportion of participants indicated their preference for the centre-based program, the CAP home-based model would seem to be an alternative model and not a replacement for the centre-based rehabilitation.

To date, even with the substantiation of this study and other complimentary studies, at the date of the submission of this thesis, CAP2 has not gained traction. CR is predominantly a public health service run through community care services and like many other services the stance taken is usually to continue with the current service.

8.3 Collective Findings√

On first glance the three case studies were in different settings and certainly ended in different states. A more objective analysis illustrates that each of the projects were very similar in their focus:

- The CWL study was primarily focused on measuring the impacts of collaborative technologies in facilitating the coordination of care services in a rural community setting and the benefits this has for both older persons in the community and the health services involved.
- The ARC study was primarily focused on measuring the impacts of collaborative technologies in facilitating the identification and coordination of patients to community care in a regional setting and the benefits this has for both older persons in the community and the health services involved.
- The CAP2 study was primarily focused on measuring the impacts of collaborative technologies in facilitating the delivery of home based cardiac rehabilitation and the benefits this has for both persons who have suffered a cardiac event and the health services involved.

In general the empirical findings of each the case studies confirm the e-Healthcare CBS construct as outlined in Chapter 3, Figure 3-8, and the first part of the question posed by this study; **"How can technology enabled collaborative health care (e-Healthcare) service models provide more cost-effective services and better care outcomes for older persons and persons with chronic and disabling conditions?"** This was demonstrated by the CWL which resulted in the gain of additional care packages for the region and by CAP2, where the value of the benefits was calculated to provide a 240% return on investment, and partially by the ARC study, were unfortunately the outcome benefits from the trials listed below were not realised.

- Improved access to services
- Increased participation by the service users
- Improved health or service outcomes
- Improved quality and safety
- Improved use of resources (lower costs – less admin)
- Better outcomes for health services.

In the CWL and CAP2 case studies, collaboration, aided by information technologies was shown to be the key factor that contributed to their success.

There were also influences which impacted on each study, which were answered by the second part of the question; **"What are the barriers that will inhibit its uptake?"**

This was most clearly shown by the ARC study, where even when the benefits could be clearly articulated and a system had been built and tested and ready to implement, the project was held up repeatedly by policy and politics and finally failed, after three years commitment by the stakeholders.

It was also illustrated by the CWL that even though the benefits may be clearly realised, they may not be sustainable. Unfortunately, 18 months after the December 2010 review, the CWL came to a standstill, as a result of insufficient resourcing for ACAT and their inability to commit time to entering persons assessed into the database.

And the CAP2 case, which shows so much promise, gives consumers better choices and potentially can deliver a significant return on investment, and yet more than 12 months after the trial has ended, still has not been taken up as an alternative to the centre based service.

These cases, like so many other cases, both in Australia and across the world, that have shown so many benefits and yet do not get past the trial stage, or fail soon after implementation.

The question is **WHY???**

The Researcher's conclusion is that the barriers to uptake are many and the enablers to uptake are few, or short term, are hampered by government funding models and cuts, or rely on people volunteering their time and so are not sustainable in the long term.

8.4 Research Framework

In this section, the processes that led to the selection of the research framework and scorecard are discussed.

The research question that this study has sought to answer is:

Question 1 "How will the e-Healthcare model provide more cost-effective services and better care outcomes for older persons and persons with chronic and disabling conditions?"

AND

Question 2 "What are the barriers that will inhibit its uptake?"

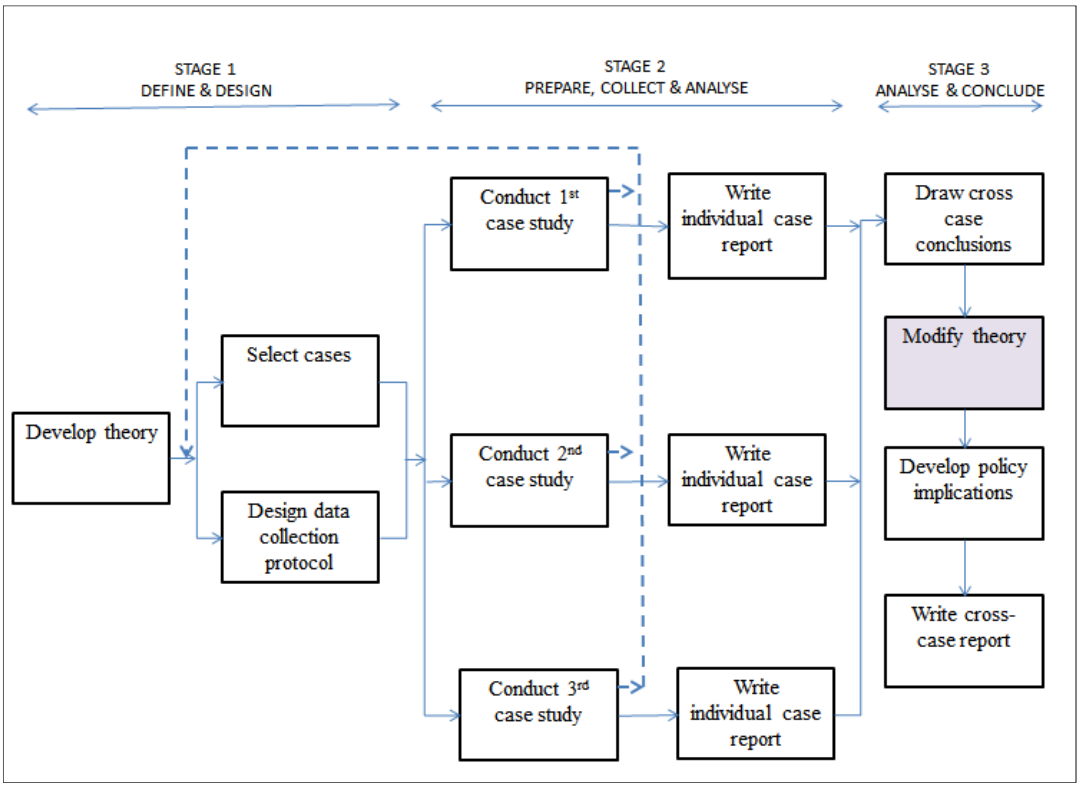


Figure 8-2Case Study Construct - Modify Theory

To answer these questions, the Researcher investigated a range of frameworks, most of which could assist in answering part of the question, but none specific to technology enabled, community based, health care (e-Healthcare) service models, where the technology is an integral component in the delivery of the service.

After much deliberation, the Researcher selected the updated Delone and McLean IS Success model as a starting framework, as shown in Figure 8-3.

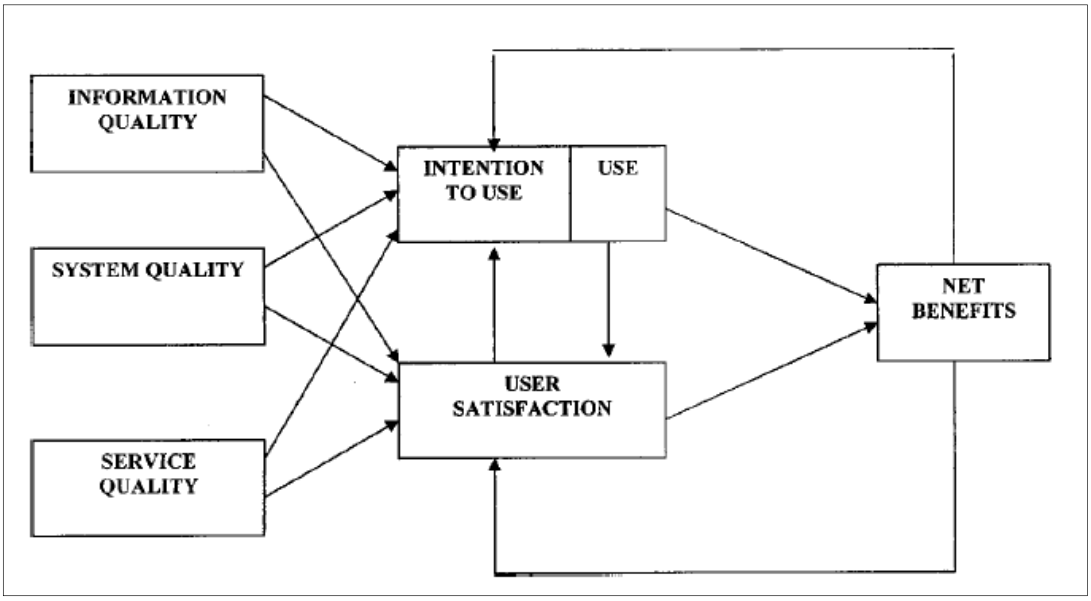


Figure 8-3: Updated D&M IS Success Model

Research was then undertaken to see how other researchers / evaluators had adapted the IS model to suit their particular needs, with a focus on e-Health and Tele-Health studies. See Table 3-1 e-Health Frameworks Investigated. There were many variations identified, some with simple changes and some with complex changes, they all had one common theme; that is the quality of the technology, services and information can impact on the use of the service and the use of the services would impact on the benefits achieved.

8.4.1 Adapting the IS Success Model to Suit the Needs of the Study

The Researcher added groups "Inputs', 'Outputs' and 'Outcomes' to the model, to reflect the overarching dimensions of a health service.

8.4.2 Inputs Dimensions

The Researcher altered the meanings of the Input dimensions to reflect those required for a technology enabled health care service. This was on the basis that the IS model was focused on internal operational systems, whist the e-Healthcare service was focused on the use of technology in partnership with providers to deliver community based services. In the e-Healthcare model:

- Health Care Services relates to the providers of the services;
- Technology Services relates to the enabling technologies used in delivery of the services; and
- Information Services relates to the information flows in the service, including data, messaging, templates and other media.

8.4.3 Outputs Dimensions

The next adaptation was in respect to the outputs dimensions, where the Intention to Use, Use and User Satisfaction dimensions in the IS model, were merged into one dimension called Service Usage and an additional dimension was created called Service provision. It was argued that in an e-Healthcare service model, services would be either provided, or accessed and that there would be a symbiotic relationship between the two, where each would impact upon the other.

8.4.4 Outcomes Dimensions

The Researcher introduced 6 Benefits as sub-dimensions that were designed to reflect the key outcome benefits of a health care service. The Researcher also incorporated health economics measurement tools including Cost Benefits Analysis (CBA), Cost-Utility Analysis (CUA) and Activity Based Costing (ABC) methodologies into the model.

8.4.5 Updated e-Healthcare Evaluation Model

These changes are reflected in Figure 8-4

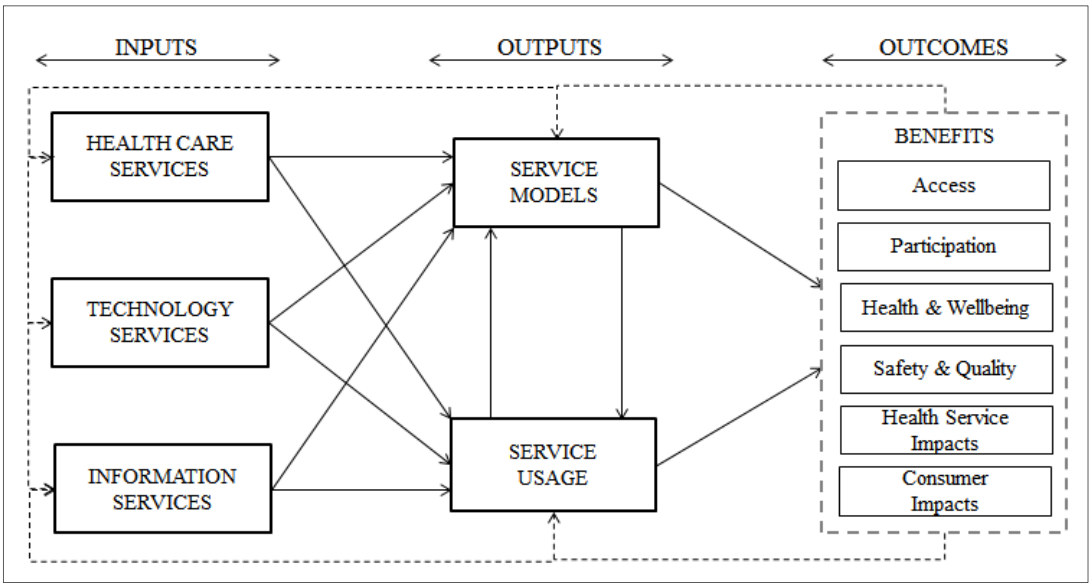


Figure 8-4 Adapted Version of the McLean IS Success Model

This model was used for both the CWL and ARC studies and also for the start of the CAP2 study. It was during the CAP2 study that the Researcher realised a weakness in the model. What the Researcher considered was the IS success and variations of the model had been designed to evaluate a whole of organisation, or whole of service implementation. What was required for the CAP2 evaluation was to compare one service model against another service model, i.e. the home based Tele-Health CR model against the centre based CR model.

The Researcher commenced reviewing other frameworks, models and studies, and had discussions with various colleagues, but could not identify any frameworks that facilitated the comparison of two or more different health care service models. As such the Researcher fell back on his experience and other research to develop a comparative Cost Benefits model, incorporating Balanced Scorecard methodologies. This was later named the Cost Benefits Scorecard (CBS).

Using Activity Based Costing (ABC) service activities could be traced to distinct outputs, for example, Service Model 'A' or service model 'B'. The impacts and benefits of each service model can be identified through analysis. Then the costs and benefits for each service model A and B can be combined into a scorecard that provided a comparison between the two alternative service models and provides feedback to improve the service.

8.4.6 Cost Benefits Scorecard (CBS)

A Google Internet search identified a number of usages of the abbreviation CBS, but only provided one study that related the term CBS to Cost Benefit Scorecard, which involved research on the expenditure of sports for females in the USA compared to that of males.

In summary, the CBS, as depicted in Figure 8-5is a multi-dimensional framework that enables Inputs (Providers, Technology and Information) to be traced to Outputs (Service Provision and Service Usage) based on the consumption of inputs by each service model. The services provided or used by each model are traced to Outcomes (Impacts and Benefits) for providers, consumers and or other stakeholders. The

Costs and the Benefits are then incorporated into a scorecard that groups benefits into perspectives, according to the needs of the study. In the centre of Outputs is a nebulous dimension called Collaboration, which impacts on and is impacted by service provision and usage and is at the core of this study.

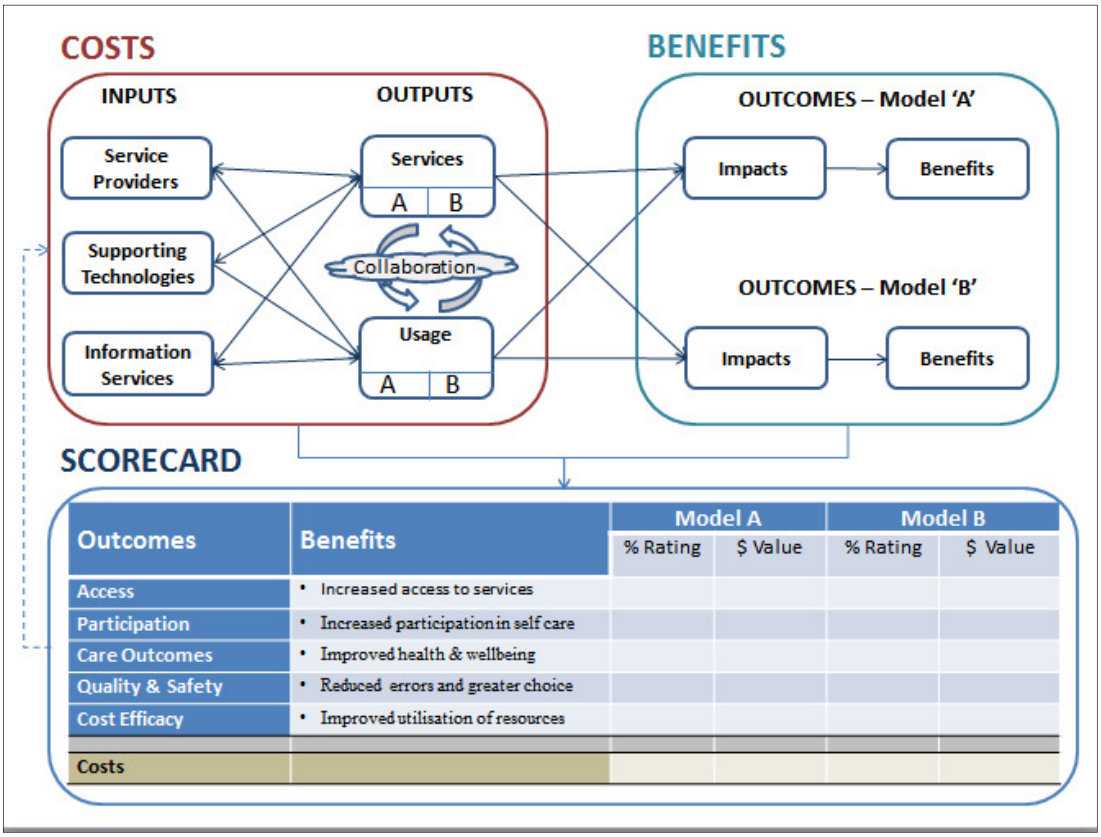


Figure 8-5 Cost Benefits Scorecard

The constructs of the CBS are adequately explained in Chapter 3 "Research Frameworks".

This model was used for each of the three case studies, with differing perspectives, based on the needs of the case.

The cases CWL and ARC were later re- structured to fit in with the newly defined CBS, with some variation in the methodology due to the type of evaluation required.

8.5 Cross Case Report

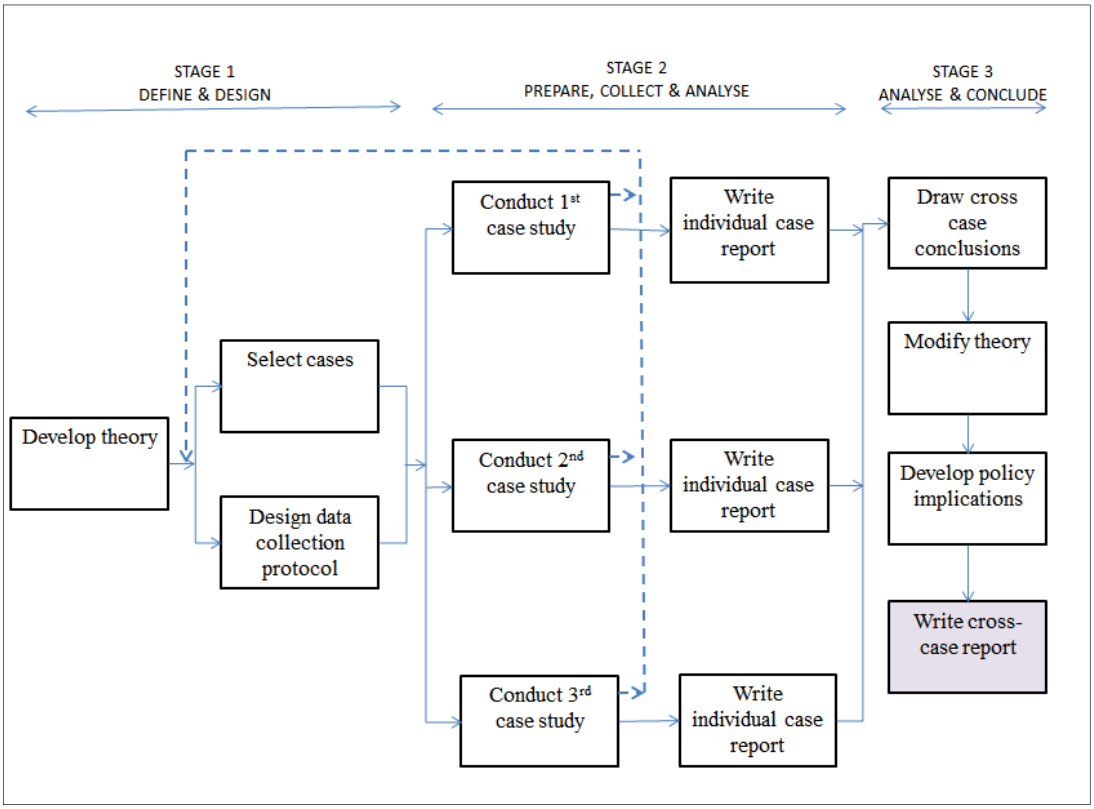


Figure 8-6Case Study Construct - Cross Case Report

An ageing population, combined with a rapid increase in chronic disease is placing unprecedented demand on limited health resources, with more than half of all potentially preventable hospitalisations from selected chronic conditions. The Centres for Disease Control and Prevention (CDC) estimated that, in the United States, the number of people diagnosed with diabetes increased from 5.8 million in 1980 to 15.8 million in 2005; and as of 2009, 23.6 million people have diabetes (National Center for Health Statistics, 2011).

This unprecedented increase is dealing governments across the globe a huge fiscal blow, which for many countries has come on top of the 2008 economic crisis and is unsustainable in the longer term. One of the primary justifications for undertaking new initiatives in health care practices revolves around the economic benefits that will arise as a result of implementation. New initiatives in health policy, care practices and advances in technologies are driving changes in costs and benefits to participants including providers, consumers and other stakeholders. Health economics analysis suggests that changes to existing practices or the initiation of new practices, should only proceed if the benefits exceed the costs. This theory has in many instances influenced providers and governments to focus mainly on changes which can lead to cost reductions regardless of changes to patient care or the potential for initiatives to increase overall system efficiencies. These changes are often as a result of short-term thinking and do not take into account a holistic approach.

Home care, which has been identified as a less costly alternative to institutional care and is often preferred by patients, is becoming more acceptable and a part of the total

health care package (Melby, 2005; Robinson, 1999). Unlike hospital care, where systems, process and resources are centralised, the delivery of home and community based care requires providers from multiple disciplines, with different systems and cultures to converge together in the delivery of care. Governments and providers across the globe are implementing and encouraging the uptake technology assisted health care (e-Healthcare), including e-Health, eCare, Tele-Health, Tele-Care, Telemedicine and centralised electronic health records.

To date there have been some successes, and there has also been some spectacular failures. In an article recently published in the Huntington Post, "Don't Repeat the UK's Electronic Health Records Failure" the UK's pathway to implementing electronic health records (EHRs) commenced in 2008, is estimated to exceed 30 Billion Pounds by 2014. Yet despite expectations that the system would increase efficiency and reduce medical errors, to their efforts neither improved health nor saved money -- in fact in some cases, they may have led to patient harm (Soumerai & Avery, 2013).

This is why; "As e-Healthcare initiatives are implemented across the world and new technology enabled models of care emerge, it will become imperative for program funders and evaluators to employ an array of quantitative and qualitative methods and techniques to answer the many efficiency and effectiveness questions that various stakeholders are likely to pose."

Question 1 "How will the e-Healthcare model provide more cost-effective services and better care outcomes for older persons and persons with chronic and disabling conditions?"

AND

Question 2 "What are the barriers that will inhibit its uptake?"

8.6 The Benefits

Collaborative technologies, combined with health care services and information services can not only deliver economic benefits, but can also deliver a wide range of other benefits that can significantly improve the care provided. Using the CBS framework, the Researcher has identified the costs and barriers for three cases. These include:

- Providing better access to health care services for older persons, persons with chronic and disabling conditions and regional and indigenous communities;
- Improving the participation and adherence to programs, and encouraging consumers to take a greater role in the self-management of chronic conditions;
- Delivering better, more sustainable care outcomes, mentally, physically and personally;
- Reducing the risks of incidents and providing greater choice in the selection of providers and services;
- Improving information sharing and accuracy and service coordination between providers and with recipients; and
- Reducing costs and administration tasks and improving the utilisation of scarce resources.

8.7 The Barriers

The second part of the question addressed in this study was **AND - What are the barriers that will inhibit its uptake?**

The benefits were compelling in each of the three cases, but the barriers can be overwhelming. This was most clearly shown by the ARC study, where even when the benefits could be clearly articulated and a system had been built and tested and ready to implement, the project was held up repeatedly by policy and politics and finally failed, after three years commitment by the stakeholders.

To date, the CWL which was so successful has withered due to a lack of resourcing and even the CAP2 project, which has shown outstanding results, has not yet gained traction. There are many similar stories, which have occurred across the globe, including the UK Electronic Health record, down to the localised initiatives which start out full of enthusiasm but then fail over time due to a lack of resourcing or policy changes.

CHAPTER 9 - CONCLUSION

This chapter provides concluding remarks for the study and briefly revisits the practical use of the framework and suggested future research opportunities; the contribution of the study, its applicability, limitations and implications for theory, theory and practice.

9.1 Concluding Remarks

This study responds to the needs of health care providers, funders and government, seeking to address the rapidly rising demand in health care, with limited resources, by providing a "how to" evaluate alternative health care service models. This study and other related works have demonstrated the benefits that can be achieved by combining technology, service provision and information to:

- Deliver interactive services that engage care recipients and assist them to stay motivated, to complete a rehabilitation program and as a result achieve better health outcomes;
- Identify hospital patients and to more efficiently coordinate community based care, so that the hospital can be freed up to service more acute patients; and
- Enable different service providers in regional Australia to communicate and work as a team and in doing so provide more responsive services and to increase the number of services provided to people in are in great need.

This study has enabled a comprehensive e-Healthcare evaluation framework and methodologies to evolve, that can be used by to compare different service models, i.e. technology enabled home based care versus hospital based care, and to present the results using both monetary and non-monetary measures.

This study shows the difficulties facing e-Healthcare service models, how hard they are to establish and how easy they can unravel. In 2010, the Australian Government created a funding item to encourage the uptake and use Tele-Health consults by GPs and specialists. This has resulted in Tele-Health being used to deliver an increasing range of services that can be provided at a distance, including psychiatric and dermatology consults, consultations with remotely based organisations, for example, mining companies, consultations between specialists and GPs, and many other services. In September 2012, effective from 1 January 2013, the rules governing the boundaries in which Tele-Health consults could be claimed, changed. This was based on a financial decision to reduce the budget deficit, and as a result a number of successful service models were decimated.

It has been said that the only way to change the future is to change the things we are doing today, but to do that we need to think differently (unknown quote). Health thinking needs to take into account a wider perspective than providers and/or government and incorporate overall system changes, both financial and non-financial, to enable rational decisions to be made, that will in turn impact on future health outcomes. Advances in technology are having major impacts into the way health is delivered, with breakthroughs occurring almost daily on new treatments and a better understanding of what causes disease.

This study may assist providers and consumers to present a better case to Government and other funders, as it has assisted CSIRO, the cardiac rehabilitation centres and the other stakeholders involved in the CAP2 trial, to argue for their Cardiac Rehabilitation service model to be implemented across the state.

9.2 Research Contributions

This study contributes to the available knowledge in theoretically, methodologically, and practically.

9.2.1 Theoretical Contributions

The literature review and empirical findings of this study highlighted the challenges facing the health care services, with rising demand from an ageing population with higher instances of chronic disease, complex and antiquated funding models and increasingly restrictive privacy and security policies.

Home care has been identified as a less costly alternative to institutional care and is often preferred by patients (Melby, 2005; Robinson, 1999). Unlike hospital care, where systems, process and resources are centralised, the delivery of home and community based care requires providers from multiple disciplines, with different systems and cultures to converge together in the delivery of care. Collaborative technologies are breaking down these barriers by enabling care providers and recipients to interact together in a virtual community of care, in which real-time communications and information sharing encourages consumers to take a greater role in the management of their health and wellbeing.

The question asked was

Question 1 "How will the e-Healthcare model provide more cost-effective services and better care outcomes for older persons and persons with chronic and disabling conditions?"

AND

Question 2 "What are the barriers that will inhibit its uptake?"

This study focused on evaluating the impact of collaborative technologies, firstly through the literature review and then through the search for and development of a theoretical framework to guide the research. An initial framework and methodologies, based on an adaptation of the updated Delone and McLean (2003) IS Success framework and the researchers previous experience, was refined through multiple case studies using e-Healthcare technologies. Through an extensive process, the research framework evolved to enable alternative service models to be evaluated and compared and then presented in a Cost-Benefits Scorecard (CBS). This framework will contribute to the efforts of Researchers, either in the evaluation of other e-Healthcare service models, or by serving as an illustration that they can follow as they evolve their own frameworks.

9.2.2 Methodological Contributions

This study combined several different disciplines, including health services, technology, information management and health economics together with non-financial measures, to provide a comprehensive methodology that could be used to complete evaluations of alternative care models.

The processes provided by this study will provide understanding of the many forces at play in the development, implementation and ongoing success of e-Healthcare service models, and how the framework can be articulated to suit the particular needs of a project. It is believed by the Researcher that the methodology evolved through undertaking this research will contribute to the efforts of other Researchers, either in the evaluation of other e-Healthcare service models, or by serving as an illustration that they can follow as they evolve their own methodologies.

9.2.3 Practical Contributions

As a result of the Researchers involvement in this study, there have been a number of practical contributions, including:

- The gain of additional care packages for the Murray Mallee region;
- A well-constructed cost-benefits paper with supporting evidence that has been used to argue a case for CAP2 to be adopted throughout Queensland;
- Contributions to the ARC partner and provider of the CWL, Nexus Online, with input on systems design, implementations and evaluations;
- Providing new methodologies for evaluating ICT based health services and the evidence for these services to be rolled out on a larger scale than is currently the case;
- Using the model to evaluate other studies, for their effectiveness in providing safe, appropriate and cost effective care to patients in their place of residence; and
- Further work with other researchers from Universities and other research organisations to improve on the total knowledge of evaluating health technologies. This includes the Adelaide University - Unicare Tele-Health project, the Canterbury Community Trust for their hospital avoidance project and the Mental Illness Fellowship of SA in their provision of mental health services to people in South Australia.

9.3 Limitations of the Study

The research project included the involvement of different stakeholder groups, exposure to multiple perspectives, and responsive evaluation as each stakeholder was confronted with other stakeholder views. The involvement of stakeholder groups from different backgrounds, both added a diversity of perspectives to the research project, and also confined some of the outcomes of the evaluation. A key learning from discussions with different groups of providers is how differently they see the world. This became most obvious in the priorities, concerns, and issues that were most important to each group of Providers, even within the same organisation. For example, the clinicians at Hervey Bay Hospital stated that they fully supported what

TACCT was achieving, but then expressed concerns over the safety of the process, with comments like “In the hospital you can keep an eye on the patient, whereas in the community this is much harder”.

Ideally, each case study would have been represented by similar groups of providers in order to gain a balanced perspective of the claims, concerns, and issues of delivering quality care outcomes, and the strategies and technologies being used to overcome these. In most communities, it is likely that perhaps only two or possibly three Provider groups collaborated together to optimise the delivery of care. This created a risk that the studies would be biased towards the perspectives offered by the contributing Providers, who are most likely to be organisational type providers.

Each case had limitations. The Researcher was not engaged at the commencement of the trial and as such did not have the opportunity to assist in guiding the initial objectives and constructs. As a result some critical data was not obtained. Secondly, the trial was substantially interrupted by the Swine Flu epidemic, which caused the trial to come to a standstill for a considerable number of months. During this time momentum was lost and not regained. There were also limitations on the Researchers side. The costs of undertaking studies of cases in different locations caused a significant burden in terms of travel and time away from home. This was especially so with the ARC case, which involved a 2 ½ hour flight, followed by a 4 ½ hour drive, each way, plus accommodation. As a result trips were minimised, which the Researcher believes impacted on the project.

9.4 Further Research Areas

The Researcher is already involved in new research projects, which have arisen as a result of this study. One of the projects is a Tele-Health project being undertaken by Unicare E-Health, a development project of Adelaide Unicare, which involves:

- Tele-Health education
- continuing professional development to clinicians, and education sessions and practical workshops to health students.
- Tele-Health support
- profession-specific support and advice on Tele-Health to clinicians.
- Clinical Tele-Health services
- a range of specialist medical services via video consulting to Tele-Health eligible areas and health services.
- Technical Tele-Health network
- a network for the delivery of video consulting and other Tele-Health services.
- Evidence for Tele-Health
- academic evidence and an "ask us a question" enquiry service about Tele-Health.

The role of the researcher is to provide expertise, supported by research and system development in the delivery of coordinated Tele-Health services. A key component of this work is to provide substantiated benefits and costs, using the e-Healthcare framework and methodologies.

This project will enable the Researcher to further refine the CBS framework and related methods, which can then be used for further evaluations. Additionally the CBS will hopefully, provide a relevant framework for other researchers, who can add value to the framework.

The Researcher is seeking additional research projects that complement the research undertaken through this study and previous works. Through these projects, the Researcher is seeking to further refine the evaluation framework and methodologies and to have the opportunity to evaluate larger projects.

A further research area that the Researcher is keen to pursue, and has had some interest in over the past decade is the contribution to the design of web and phone app interactive self-help services, that can be used to engage older people and people with chronic disease, mental health, disabilities whom may otherwise become isolated in their homes.

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APPENDICES

Appendix A - Letter to Participants

Hi xxxx,

My name is Frank Whittaker and I am conducting PhD research with Assoc. Professor Jeffrey Soar as my supervisor at the University of Southern Queensland (USQ).

Over the past 10 years I have worked with a range of health and community care organisations, predominantly in the use of technologies for coordinating care and the transfer and sharing of information. During this time, I, like many others, have been frustrated at my inability to clearly link the use of technology to care outcomes, and so have decided to undertake this PhD research

The purpose of my research is to better understand how inter-active technologies are enabling new models of care for persons with acute and chronic conditions, and how this results in more cost-effective services and better outcomes for both recipients and providers

To do this I am collecting the perspectives and opinions from a range of different people; those who are providing care (providers), for example, a GP and those who are receiving care (recipients), for example, a person with diabetes.

Your participation in this study is voluntary and you are able to withdraw at any time, without any implications. Information provided by you will remain de-identified and will be used for research purposes only. Please let me know if there is any information that you would like to remain confidential, now or later.

To participate in this study, you will require internet access and will need to register with our research web site at www.ecare.com.au/phdresearch. This site will provide additional information on my project and includes surveys, forums, blogs and feedback on the research.

I thank you for your time and interest.

Yours Truly

Frank Whittaker

Appendix B - Consent Form

Research Title: Electronic Communities of Care

Researcher's name **Frank Whittaker**

Supervisor's name Professor Jeffrey Soar (USQ, School of Management)

- I have read the Participant Information Sheet, and the nature and the purpose of the research project have been explained to me. I understand and agree to take part.
- I understand that I may not directly benefit from taking part in the project.
- I understand that I can withdraw from the study at any stage and that this will not affect my status now or in the future.
- I confirm that I am over 18 years of age.
- I understand that the information provided will only be used for research purposes.
- I understand that all data and information provided by me will be securely stored and will not be released in its identifiable form to any third parties without my written consent.

Name of participant...

Signed .....

Dated .....

Appendix C - AT Solutions Investigated

Seon-Woo Lee et al. (2007), explored the assisted living domain surveying the elderly in their own homes. Architecture was created with sensors for detecting movement and a gateway in the home for sending the data to a central server. They focussed primarily on analysing the data. The system appears to be rather monolithic by nature, and does not seem open. This might be a good strategy to solve the particular scenario they are aiming at and have set as their objective, but what if the system is later adapted by a regional care centre and the need arises for the system to talk with several back-end systems, or they need to support a range of hardware sensors from another vendor. Whether there is access to the source code and whether this is open source is not discussed, but this appears not to be the case, and thus not allowing for modifications or adaptations of the system.

Huang and L. (2007) also looked into establishing an architecture for the home, but focuses on the conversion of signals in the home to a known format. The converted data is placed in a middleware where the format from for example, a webcam or an ECG is formatted to the DICOM format from NEMA (NEMA, 2008). Due to the limited amount of information on the middleware in relation to the use of technologies, this work is again deemed rather closed and limited on features. The use of standards (DICOM and NEMA) seems quite relevant, and using a middleware could be promising, if the middleware was itself heterogeneous with regards to programming languages and operation system platforms. This is not possible to deduct from the text, as is neither code availability nor licensing issues.

Varshney (2007) writes about the infrastructure for monitoring the elderly at home. The research focuses on how sensors should communicate with the outside world, but does not specify a complete solution. This is again deemed a prototype project – exploring a single case, rather than providing a complete infrastructure for assisted living solutions.

Bamis et al. (2008) discusses the possibility of monitoring the elderly in their homes and tracking their movement and providing a scalable framework for interpreting their movement data and a state model of their behaviour. This includes an API for asking whether the person is getting enough sleep, where the person currently is, number of visits to the toilet etc. The system allows for third party movement and tracking sensors, but it does not include for example, ECG or blood pressure sensors. The system appears modularized and scalable, but it does not appear to be open for third party software systems, as it does not appear to be available for source code download. The system share many similarities with the Open Care Project discussed in this paper, but appear as being rather monolithic and closed.

Kirovski et al. (2007) from Microsoft Research introduces the Health-OS system. It is a system, apparently dedicated for the Microsoft Windows and Windows CE platforms (even though it is claimed it will run on any suitable real time OS based device), which integrates different commercial sensor types, collects and stores the data on standard Windows and Windows CE devices. The system appears somewhat open, including an SDK for accessing the data and functionality. Unfortunately, the source code does not appear to be available, again keeping the system closed for most extensions or modifications.

Schwiebert et al. (2001) discusses some issues regarding biometric sensors where they point out a number of important points including problems with power supply,

interruption of the elderly etc. The project is deemed more relevant for providing requirements for sensor manufacturers than it is relevant to infrastructure discussions.

Rodrig and LaMarca (2005), presents a P2P architecture for collecting and distributing data from sensors. In our opinion, the complexity of an infrastructure tends to increase when using a P2P architecture, and Rodrig and LaMarca does not convince us otherwise with their system. This does not mean that it might not have its validity in some scenarios, just that a pervasive e-Healthcare infrastructure not seems to gain anything from being P2P based.

Bardram et al. (2005) discusses the transition from ordinary visits at a physician to the use of telemedicine, where the patients themselves performs the measurements and collects the data. The paper does not focus on infrastructure or architecture, but on the usage of systems suitable for home use.

(Telcomed) is a commercial company based in Ireland, producing a range of telemedicine and pervasive e-Healthcare products. Including sensors for monitoring heart rate, 1 lead ECG, body temperature, weight, blood pressure, blood sugar and more. They provide a complete infrastructure, from the patient's home to the web-based Telcomed monitoring centre. They use proprietary communication protocols, and the solution appears not to be open for third party solutions.

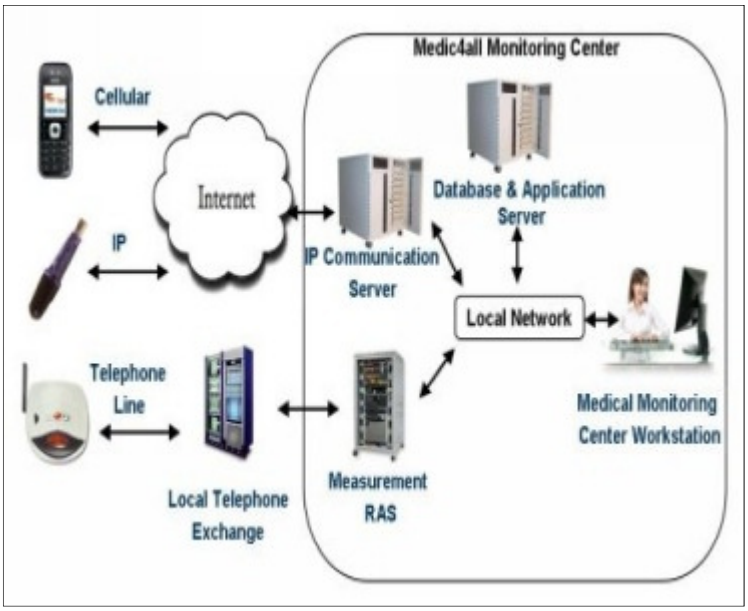

Figure A0-1 Overview of the Telcomed Telemedicine surveillance system and Medical Monitoring Centre

(Corscience) is likewise a commercial company, based in Germany. They also provide a complete vertical monolithic solution including sensors for ECG, blood pressure (both 1-lead and 3, 6 or 12-lead), a weight sensor as well as an Asthma sensor device. The Corscience system can send data from either a stationary gateway, or a small mobile gateway, to a central database, and provides web-access to these data, including alert functionality and more. The Corscience system is closed like Telcomed, but they do use Bluetooth for most sensor devices, and they do share their communication protocol with partner companies, signing an NDA. The Open Care Project is supporting several Corscience sensors devices at present, incl. ECG, blood pressure and weight. Corscience is not open source, and not much more open

than is the Telcomed solution. Again, choosing Corscience requires a full solution, and it may not work with for example, Telcomed products.

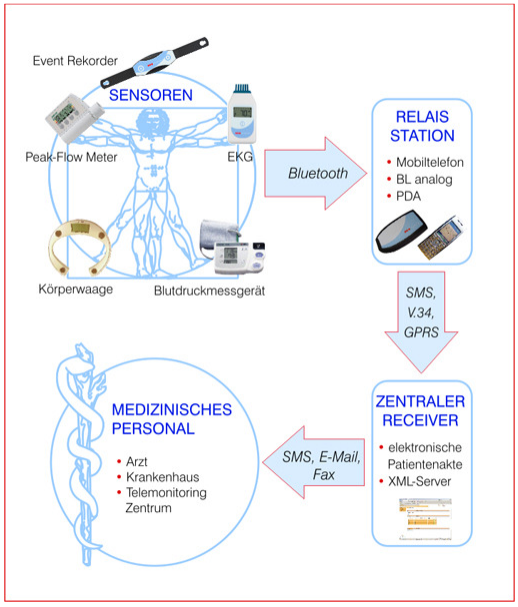

Figure A0-2 Overview of the Corscience Deployment

Sensors communicate with relay stations to a central server, and then on to EPR's and other systems.

Yet another private company is (Tunstall). Tunstall has a wide range of sensor products, incl. pressure mats and movement sensors, as well as blood pressure, ECG, temperature and more. Tunstall utilizes an interactive base station at the user's home, sending the data directly to the relevant clinic. Again, the sensors are Bluetooth based, and by signing an NDA, it is possible to partner with them. Again, we see a semi open solution, which is not open source.

Figure A0-3 Tunstall Tele-Health Monitor

(similar to the Open Care Base station) - here working with a Bluetooth based blood pressure device

Intel has recently released the Intel Health Guide PHS6000(Intel), which is an interactive mobile computer with a touch screen, camera and more. According to Intel, a whole range of sensor types has been certified for use with it, which sensors exactly has not been revealed yet. The solution appears somewhat monolithic in nature, but might be open for third party sensors, as long as Intel will certify them. There is no mention of whether the system is open for external systems, including Electronic Patient Record systems, clinical systems and others. Also, there is no mention of whether the source code is available for modifications, or whether the hardware platform might be changed to something else than an Intel based machine.

Figure A0-4 Intel Healthguide

The Intel Healthguide is a touch screen based computer for easy access to data.

The (Continua Alliance, 2010) is a non-profit, open industry alliance of e-Healthcare and technology companies that has realized that "broad interoperability has yet to be achieved" (Hospital peer review, 2000) within the field of pervasive healthcare. They conclude that "Much of the technology that can improve e-Healthcare already exists in some form. For example, medical devices that monitor health and fitness – blood pressure cuffs, glucose meters, medication trackers, weight scales and pedometers – are on the market. These pieces cannot be integrated into full personal Tele-Health systems that can send data from multiple vendors' medical devices to a health care provider or fitness coach. No standards exist that fully define interoperability among these devices, thus the market is unable to invest in interoperable solutions." (Vestn Akad Med Nauk SSSR, 1950).

The Continua Alliance has the goal of achieving interoperability between different e-Healthcare related technologies and solutions. The Continua Alliance plan on using the ISO/IEEE 11073 family of Medical Device Connectivity standards and Bluetooth and the USB Personal e-Healthcare Device Class Specification as the glue to tie e-Healthcare sensors and computing hardware together with Remote Patient Monitoring and Electronic Health Record systems (Dis Manag Advis, 2001). The Continua Alliance is dedicated to provide developer resources (including access to some free reference source code) as well as guidelines and a certification process. The Continua Alliance is as such in many respects closely related to the mission of the Open Care Project. It is considered that they are more concerned with device interoperability than providing a complete and freely available end-to-end infrastructure.

Nexus eCare™ is a client centric, online collaborative care platform, through which multi-disciplinary providers can collaborate with recipients and other members of their care team to deliver interactive, face-to-face, online and remote services.

Built on the Microsoft.NET platform, eCare™ incorporates web portals and a mobile app through which providers can interface and communicate with their clients and other members of the care team. eCare™ can interface with Assistive Devices via blue tooth and wireless, and incorporates video technologies and alerts (Nexus eCare).

Appendix D - Measurement Tools used to measure Costs and Benefits

TERM	DEFINITION
ABMIS	A powerful online analysis solution that enables feedback from multiple stakeholders to be combined with statistical data to create a 360 view of process and service efficiency.
ACCNA	Australian Community Care Needs Assessment (ACCNA) and http://chsd.uow.edu.au//documents/accna_cena_fact_sheet_dec06.pdf
CENA	Carers Eligibility and Needs Assessment (CENA) http://chsd.uow.edu.au//documents/accna_cena_fact_sheet_dec06.pdf
InteRAI	Assessment Instrument http://www.interrai.org/section/view/
NVIVO	An analysis solution used for classifying, sorting and arranging information, exploring trends, building and testing theories and ultimately arriving at answers to questions.
ONI	ONGOING NEEDS IDENTIFICATION http://www.health.qld.gov.au/hacc/ONIUpdatedfiles06/ONI%20Tool%20v2.00%20-%20Request%20Form_1.pdf`

Appendix E - CWL – Interim Evaluation Survey

Survey for the Evaluation of the Rural ECare Community Waiting List

CWL is a pilot project to develop and evaluate an online common and jointly managed database for community packages in the Murray Mallee.

A centralized system for the referral and management of community package waiting list is expected to:

- reduce administration,
- improve transparency of the referral process,
- reduce the potential of clients getting lost on the waiting list,
- reduce handling of confidential information by multiple service providers and
- provide accurate data on waiting lists, priorities and community package service provision across the region.

The purpose of this survey is to assess the performance of the CWL against the anticipated outcomes in the original project proposal.

Anticipated Outcomes from the CWL database from the original CWL project proposal.

- More streamlined approach to the assessment, referral and management of community packages.
- Greater transparency of referral process
- Less likelihood that clients get lost in the system.
- Administrative work for CSP is reduced and greater potential for CSP to concentrate on core business.
- CSP do not have to maintain independent referral files.
- CSP have a tool that will assist with forward planning (for example, identify workforce gaps, flag future clients)
- Full ACAT information is only provided to the CSP that will provide the service
- There is a greater likelihood that clients could receive other services while on the waiting list for Community Packages
- Clients will only have to deal with one CSP and will have a contact for all information on health & community services through Carelink.
- Accurate data would be available on waiting lists & priorities across regions. Demand for and supply of packages across the region will be more transparent which will assist with regional planning and advocacy.
- The promotion and enhancement of Carelink as an access point for services and information.
- Reduce handling of confidential information by multiple service providers;
- Provide accurate data on waiting lists, priorities and community package service provision across the region; and
- Enable people living in the community who are eligible for Community Packages to have choice of the provider of the Community Package.

Question 1

This question was asked of ACAT &CSP

The CWL does the following:

- Reduces the time spent by staff on administrative work around referral and handling of paperwork

Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 2

This question was asked of CSP

- Makes decision making and choosing clients from the waiting list easier

Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 3

Please describe any advantages or disadvantages that the CWL has compared to the previous system of assessment, referral and waiting list management.

Question 4

This question was asked of ACAT.

The CWL reduces the administrative workload for ACAT staff (i.e. less time spent in administrative tasks, referral tasks and handling of paper work)?

Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 5

This question was asked of ACAT & the CSP

The CWL has led to greater transparency in the management of the waiting list for example, how and where clients are accepted or not accepted.

	1	2	4	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 6

This question was asked of ACAT &CSP

CWL facilitates better monitoring and tracking of people on the waiting list, particularly people who are urgent or high priority.

		1	5	2
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 7

This question was asked of ACAT &CSP

With the CWL database, clients are less likely to get lost on the waiting list.

	1		5	2
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 8

This question was asked of CSP.

The CWL reduces the administrative workload for CSP staff (i.e. less time spent in administrative tasks, referral tasks and handling of paper work).

	2	3	5	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 9

This question was asked of CSP

Do you continue to maintain a paper waiting list (ACAT referrals)?

Yes ☐ No ☐

Question 10 This question was asked of CSP

The CWL assists with forward planning for example, selection of clients, matching workforce capacity to clients & client need, workforce development.

2		4	1	
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 11

This question was asked of CSP, Carelink and ACAT

The CWL provides accurate data on waiting lists, priorities & community package service provision.

	2	1	5	1
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 12

This question was asked of ACAT &CSP

CWL enables people living in the community who are eligible for Community Packages to have choice of the provider of the Community Package.

1	1	6		1
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 13

This question was asked of ACAT

Is the full ACAT only provided to community package service providers that request it?

☐

Question 14

This question was asked of CSP, Carelink& ACAT

CWL assists with regional planning and advocacy by providing accurate data on waiting lists and priorities across the region.

	1	1	4	3
Strongly Disagree	Disagree	No Difference	Agree	Strongly Agree

Question 15

This question was asked of Carelink

How many people were contacted via the Rural Care database waiting list and provided with information on services in the last 3 months?

Question 16

This question was asked of Carelink

Has the CWL facilitated the registering of Carers of persons awaiting packages?

Yes ☐ No ☐

Question 17

This Question was asked of all stakeholders

- Are there any additional comments you would like to make on the CWL database?

Appendix F - ARC – Business Processes

Business process:	Reduce unnecessary hospital admissions and LOS	Monitor patient admissions, updates and discharges
Description:	Manually identify patient admissions, updates and discharges	
Roles:	TACCT, Patients	
Triggers:	Patient presents to ED Referral created by ED staff Manually searching for patients	
Pre-conditions:	Non Indigenous Patients ≥ 65 and Indigenous Patients ≥ 50	
Process description:	Scan HBCIS and EDIS to identify potential patients Scan ED to identify potential patients Receive referrals	
Post-conditions:	Assessment required to determine capacity to be transferred to home care	
Current supporting applications / tools	HBCIS EDIS Access database ED white board	
Current forms / templates:	N/A	
Supporting documents:	N/A	
Business rules:	N/A	
Data entities:	HBCIS EDIS Access database	
Issues:	This process is predominantly manual	
Notes:	The process could be improved by implementing an automated system that incorporates algorithms to identify potential patients for home care and provides alerts to TACCT on a real-time basis	

Track patients

Business process:	**Reduce unnecessary hospital admissions and LOS**	**Track patients:**
Description:	Track patients admitted who may be suitable for transfer to community care as an alternative to hospital care. Patients are filtered, based on age, triage, admissions history and other indicators as determined between TACCT, clinicians, and other key stakeholders.	
Roles:	TACCT, Patients	
Triggers:	Patient admitted	
Pre-conditions:	Non Indigenous Patients ≥ 65 and Indigenous Patients ≥ 50	
Process description:	1.1 Scan HBCIS and EDIS to identify potential patients 1.2 Scan ED to identify potential patients	
Post-conditions:	Assessment required to determine capacity to be transferred to home care	
Current supporting applications / tools	• HBCIS • EDIS • Access database • ED white board	
Current forms / templates:	• N/A	
Supporting documents:	• N/A	
Business rules:	• N/A	
Data entities:	• HBCIS • EDIS • Access database	
Issues:	• This process is predominantly manual	
Notes:	• The process could be improved by implementing an automated system that incorporates algorithms to track potential patients for home care after they are admitted	

Maintain patient details

Business process:	**Reduce unnecessary hospital admissions and LOS**	**Maintain patient details**
Description:	Record and review additional patient details, including referral details, patient demographics, personal, medical and social information, assessments, care plans, car team, interventions, notes, documents and images	
Roles:	TACCT, Patients	
Triggers:	Patient identified by TACCT as a potential candidate for home care	
Pre-conditions:	Non Indigenous Patients ≥ 65 and Indigenous Patients ≥ 50	
Process description:	1.1 Assess patient 1.2 Record additional details	
Post-conditions:	N/A	
Current supporting applications / tools	• HBCIS • EDIS • Access database • Spreadsheets and manual documents	
Current forms / templates:	• N/A	
Supporting documents:	• N/A	
Business rules:	• N/A	
Data entities:	• HBCIS • EDIS • Access database	
Issues:	• Information maintained on the patient, outside of HBCIS is predominantly kept manually	
Notes:	• The process could be improved by implementing an system that enabled information pertaining to TACCT to be recorded and accessed by either TACCT, or another member of the patient's care team	

Assess patient's suitability for home care

Business process:	**Reduce unnecessary hospital admissions and LOS**	**Assess patient's suitability for home care**
Description:	Assess a patients potential to be transferred to home care as an alternative to hospital care	
Roles:	TACCT, Patients	
Triggers:	Patient identified by TACCT as a potential candidate for home care	
Pre-conditions:	Non Indigenous Patients ≥ 65 and Indigenous Patients ≥ 50	
Process description:	1.1 Assess patients 1.2 Record assessments 1.3 Determine patient's potential to be transferred to home care as an alternative to hospital care	
Post-conditions:		
Current supporting applications / tools	• Paper based –	
Current forms / templates:	• Assessment tools	
Supporting documents:	•	
Business rules:	•	
Data entities:	• N/A	
Issues:	• This process is predominantly manual	
Notes:	• The process could be improved by recording the assessment results into a database for future comparisons	

Coordinate home based care

Business process:	**Reduce unnecessary hospital admissions and LOS**	**Coordinate home based care**
Description:	Coordinate home based care for patients to be delivered by a combination of internal (TACCT) resources, and or community based providers. The coordination process continues after discharge until the requested services have been completed for the patient.	
Roles:	TACCT, Patients, external Providers	
Triggers:	Patient transferred to home care	
Pre-conditions:	Non Indigenous Patients ≥ 65 and Indigenous Patients ≥ 50 Care plan determined	
Process description:	1.1 Determine what resources are required to provide care 1.2 Either Schedule services internally, or refer services to external organisation	
Post-conditions:	Care completed	
Current supporting applications / tools	• Phone, fax and email • Paper, excel	
Current forms / templates:	• Referral forms	
Supporting documents:	•	
Business rules:	•	
Data entities:	• Access database • Manual paper	
Issues:	• This process is predominantly manual	
Notes:	• The process could be improved by making it easier to coordinate services and share patient data with external providers	

Report on and analyse activities and outcomes

Business process:	**Reduce unnecessary hospital admissions and LOS**	**Report on and analyse activities and outcomes:**
Description:	Report on activities and provide statistical analysis	
Roles:	TACCT	
Triggers:	Patient transferred to home care and services completed	
Pre-conditions:	Non Indigenous Patients ≥ 65 and Indigenous Patients ≥ 50	
Process description:	1.1 Generate statistical reports	
Post-conditions:	N/A	
Current supporting applications / tools	• Access database • Excel	
Current forms / templates:	•	
Supporting documents:	•	
Business rules:	•	
Data entities:	• Access Database • Excel	
Issues:	• Limited statistical analysis	
Notes:	• The process could be improved by developing / incorporating a more comprehensive set of statistics	

Appendix G - Statistical Data Sources

AIHW

http://www.aihw.gov.au

The Australian Institute for Health and Welfare is an Australian government agency responsible for health and welfare information and statistics. The AIHW manages a range of national data collections covering health, housing and community services. Its data management role includes the promotion of consistency among national, state and territory statistics, and the production of comprehensive national data.

Key publications

- the biennial *Australia's Health* and *Australia's Welfare* reports to the Australian Parliament.
- working papers and reports covering topics by disease, population group, health service area etc.

Data sets

Online data at the AIHW website includes:

- METEOR, the national online metadata registry for health, community services and housing assistance.
- Data standards - National Health Data Dictionary, National Community Services Data Dictionary, National Housing Assistance Data Dictionary.
- data cubes with an interactive, "build-your-own data table" facility. Topics covered include: Alcohol and other drug treatment; cancer; chronic disease; disability; expenditure; general practice; hospital morbidity; mortality; mental health; and risk factors.

Additional data at: http://www.aihw.gov.au/publications/index.cfm/title/10015

- Introduction (148K PDF)
- Overview of Australian hospitals (234K PDF; 181K XLS tables and figures) Note 8
- Public hospital establishments (203K PDF; 85K XLS tables and figures) Note 6
- Hospital performance indicators (352K PDF; 369KXLS tables and figures)
- Waiting times for elective surgery (195K PDF; 153K XLS tables and figures)
- Administrative data for admitted patients (317K PDF; 238K XLS tables and figures)
- Demographic profile for admitted patients (307K PDF; 302K XLS tables and figures)
- Principal diagnoses for admitted patients (309K PDF; 598K XLS tables and figures)
- Procedures for admitted patients (439K PDF; 389K XLS tables and figures) Note 3

- External causes for admitted patients (249K PDF; 151K XLS tables and figures)
- Australian Refined Diagnosis Related Groups for admitted patients (317K PDF; 286K XLS tables and figures) 9

ABS

http://www.abs.gov.au/

ABS health-related information includes the results of the triennial National Health Survey, which collect information about the health status of Australians, their use of health services and facilities, and health related aspects of their lifestyle. In addition to the summary publications, the ABS releases topical health "snapshots" covering disease areas or population subgroups.

Australian DoHA

http://www.health.gov.au/internet/wcms/publishing.nsf/Content/Statistics-1

The department manages a number of data sets, relating to Casemix, covering hospital activity in both the public and private sectors.

- National Admitted Patient Care Dataset
- Elective Surgery Waiting Times Additions and Removals
- Elective Surgery Waiting Times Census
- Non-admitted Patient Emergency Care
- Public Hospital Establishment Collection
- National Hospital Cost Data Collection (NHCDC)
- The Hospital Casemix Protocol (HCP) data collection
- Private Hospital Data Bureau (PHDB)

OECD

http://www.oecd.org/

Health information from the OECD includes:

- country reports (submitted by country government agencies)
- statistics from OECD countries
- a range of research projects, working papers, and other publications.

These contain health, mortality and morbidity data, health system policy, expenditure and use information, and historical comparison for the countries considered. *OECD Health Data 2006: Statistics and Indicators for 30 Countries*

WHO

The WHO's health statistics and information program accessed online at

http://www.who.int/whosis/en/index.htmlincludes:

- Core Health Indicators
- Mortality and health status
- Disease statistics
- ICT statistics
- Health system statistics
- Risk factors and health service coverage

Appendix H - Cardiac Rehabilitation Assessment

Queensland Government Queensland Health Metro North Health Service District Primary and Community Health Services **Cardiac Rehabilitation Assessment**	(Affix patient identification label here) URN: Family Name: Given Names: Address: Date of Birth: Sex: ☐ M ☐ F

Recent Cardiac Event/Procedure:	
Date:	Hospital:

Summary of Risk Factors:			
☐ Smoker	☐Diabetes	☐ Lipids	☐ Hypertension
☐ Overweight	☐ Family History	☐ Physical Inactivity	☐ Depression

Date: / /	**Pre Assessment**	**Post Assessment**	**6 month review**
Lipid Profile			
Test Date:	/ /	/ /	/ /
TC< 4			
LDL< 2			
HDL> 1			
TG < 1.5			
HbA1C			
Parameters			
BP (resting)			
HR (resting)			
Weight (kgs)			
Height (cms)			
BMI 18.5 -24.9kg/m2			
Waist circumference (at the umbilicus) <94cm Males <80cm Females			
Risk Assessment			
Smoking (cigs/day)			

Alcohol (drinks/day)			
HealthwiseDHQ			
Quiz			
K 10			
Exercise (>150mins/wk.)			
Return to usual ADLs			
RTW			

Appendix I - CSIRO Resource Allocation

CSIRO CAP2 Research Team			
CSIRO CSIRO - Technology Partner			
1. Provide Technology Support - Provide technology support		**% of Time**	**Hours**
Provide Technical support	Provide Technical support if PO/Mentor unable to resolve	10	4
Start Messaging services		0	0
2. Maintain Technology - Maintain Technology			
Develop and update Technology tools	Develop and update technology tools and electronic material	40	16
Host Web and Messaging services	Host web and messaging services	0	0
Source Technology	Source devices, software, mobile communications plans, messages and educational materials for the program	10	4
Train New Project Officers	Train new Project Officers and Mentors to use Web-portal and home care devices	5	2
3. Source and Provide Technology - Technology			
Setup Electronic material		15	6
Setup Mobile phone and plan		5	2
Setup Web Portal account		5	2
Source and Purchase Devices		10	4
TPCHCR The Prince Charles Hospital Cardiac Rehab			
Cardiac Rehab - Cardiac Team			
4. Run Education Sessions - Education			
Run Education sessions		10	24
5. Screen Referrals - Screen referrals for suitability			
Identify clients with high medical needs	Identify clients with high medical needs	0	0

Internet 100%

Appendix J - Cap2 Outcomes Benefits and Measures

The following table outlines the Outcomes, Objectives and Measures used in the CAP2 evaluation.

OUTCOMES
OBJECTIVES
MEASURES

1. ACCESS - People can access the program within an acceptable time, irrespective of income, physical location or cultural background

1.1. Improved referral processes will increase the number of people accessing the program

Measures	Question / Description	Purpose	Data Type	Source
# patients referred to the service	Has there been a change in the # patients referred to the service as a result of the trial?	This aims to identify if CAP has made it easier for clinicians to refer patients to the program	#	Statistical Data
% of patients referred who commenced a program	Of the patients referred to each program, what % commenced a program?	This aims to identify if CAP has provided an alternative to patients, who may otherwise not have participated in the Hospital based program	%	Statistical Data
# patients deemed unsuitable for a program	Of the patients referred to the service, how many were deemed unsuitable for the program. Perhaps because they could not access the facilities, or they were not competent with using the CAP technology?	This aims to identify if CAP is any more or less likely to exclude referrals than the hospital based program	#	Statistical Data
Waiting List transparency	How transparent is the management of the waiting list for example, how and where clients are accepted or not accepted	This aims to identify if CAP provides greater transparency in the management of the waiting list for example, how and where clients are accepted or not accepted	Rating	Stakeholder Feedback
Program choices	Are participants people living in the community provided with options to participate in rehabilitation programs	This aims to identify if CAP improves the range of choices for people living in the community	Rating	Stakeholder Feedback

1.2. Reduced waiting times will result in more people enrolling in the program

Measures	Question / Description	Purpose	Data Type	Method
# Days waiting time	What was the Ave. # Days waiting time, after being referred from hospital, to gain access to each program,	This aims to identify if CAP reduces the waiting times to access a program by removing the limitations on access to Gym sessions	Days	Statistical Data

1.3. Patients living in regional and remote communities will have greater access to the program

Measures	Question / Description	Purpose	Data Type	Method
% Regional and Rural Patients	What was the % of regional and remote patients enrolled in each program?	This aims to identify if CAP offers an option to regional and remote patients, who otherwise may not have been able to access the service	#	Statistical Data
% Indigenous participants	What was the % of indigenous participants enrolled in each program?	This aims to identify if CAP offers an option to indigenous participants, who otherwise may not have been able to access the service	#	Statistical Data

2. PARTICIPATION - Service is client focused. Participants are treated with dignity, confidentiality and encouraged to participate in choices that relate to their care

2.1. Improved interactivity between Providers and Recipients will result in higher Participation involvement in their care

Measures	Question / Description	Purpose	Data Type	Method
Access to personal health and wellbeing information	How easily can Participants access their personal information in relation to the program / service?	This aims to identify if CAP enables participants to more easily access their personal health data	Rating	Stakeholder Feedback
Interactivity between providers and participants	What is the level of interactivity between provider staff and participants?	This aims to identify if CAP improves the level of interactivity between providers and participants	Rating	Stakeholder Feedback

2.2. Increased patient involvement in their care will result in improved long-term outcomes and a reduction in secondary attacks and re-admissions

Measures	Question / Description	Purpose	Data Type	Method

Recording of Vital Signs	How often are participants taking and recording their vital signs (# / Wk.)	This may be interpreted as patients taking greater ownership over their health and thus relying less on external providers	Qty	Statistical Data
Recording of activities and personal measures	How often are participants recording their activities and other personal measures ((# / Wk.)	This may be interpreted as patients taking greater ownership and thus relying less on external providers	Qty	Statistical Data
Medication Management	Have participants improved on the management of their medications?	This may be interpreted as patients taking greater ownership and thus relying less on external providers	Qty	Survey
Participant tracking	Are participants easily tracked through the rehabilitation process, from referral to waiting list to services	This aims to identify if CAP enables better monitoring and tracking of people on the program, particularly people who are high priority	Rating	Stakeholder Feedback
2.3. Increased participant satisfaction will result in higher retention rates				
Measures	Question / Description	Purpose	Data Type	Method
Meets needs of participants	How well does the service meet the individual needs of participants	This aims to identify if CAP better meets the needs of some participants	Rating	Stakeholder Feedback
Satisfaction levels	How would you rate your satisfaction with the service?	This aims to identify if CAP better provides improved satisfaction to some participants	Rating	Stakeholder Feedback
3. HEALTH OUTCOMES- An effective program with care interventions that are flexible and relevant to the participant's needs will improve retention rates and health care outcomes and reduce secondary attacks and re-admissions				
3.1. Improved retention rates will result in more people completing the program				
Measures	Question / Description	Purpose	Data Type	Method
Participant selection	% people referred to the service who were later deemed to be unsuitable	This aims to identify if CAP makes decision making and choosing clients from the waiting list easier	%	Statistical Data
# of patients who completed more than 80% of the program	Of the patients who commenced the program, what % completed 80% of the program?	This aims to identify if CAP participants encountered less barriers to staying on the program	Qty	Statistical Data

% of patients who completed the full program	Of the patients who commenced the program, what % completed 100% of the program?	This aims to identify if CAP participants encountered less barriers to staying on the program	Qty	Statistical Data
# Patients who dropped out of the program due to logistical reasons	# Patients who dropped out of the program due to logistical reasons, for example, access to public transport, time and cost of travel, travel interstate / overseas, change in personal circumstances	This aims to identify if CAP is a more flexible program, that can better cater for participant changes in circumstances	Qty	Statistical Data
# Patients who dropped out of the program due to health reasons	# Patients who dropped out of the program due to a deterioration in health or changed medical requirements	This aims to identify if CAP had any greater or less drop outs due to health issues	Qty	Statistical Data

3.2. Improved Quality of Life and physical health outcomes for Participants

Measures	Question / Description	Purpose	Data Type	Method
Change in QOL Rating over the course of rehabilitation	What was the ave. change in the QOL Rating for participants that completed a minimum of 80% of their program	This aims to identify if CAP has contributed in some way to improving participants quality of Life	Rating	Assessment Data
Change in QOL Rating over the course of rehabilitation	What was the ave. change in the QOL Rating for participants that completed a minimum of 100% of their program	This aims to identify if CAP has contributed in some way to improving participants quality of Life	Rating	Assessment Data

Change in QOLY Rating over the course of rehabilitation	What was the ave. change in the QOLY for participants that completed a minimum of 80% of the program	This aims to identify if CAP has contributed in some way to improving participants quality of Life years	Rating	Assessment Data

3.3. Improved Physical health outcomes for Participants

Measures	Question / Description	Purpose	Data Type	Method
Fitness	What was the average distance walked by participants in the 6wk&6month assessments?	This aims to identify if CAP has contributed to improving a participant's fitness level	Qty	Assessment Data - 6minute walk test
Weight	What was the ave. Weight loss/change of participants at the 6wk&6month assessments?	This aims to identify if CAP has contributed to improving a participant's weight loss	Qty	Assessment Data
BP	What was the ave. reduction/change in BP of participants at the 6wk&6month assessments?	This aims to identify if CAP has contributed to improving a participant's BP	%	Assessment Data
Stress	What was the ave. reduction/change in stress of participants at the 6wk&6month assessments?	This aims to identify if CAP has contributed to improving a participant's stress levels	%	Assessment Data - DASS21 / K10 questionnaires

3.4. Reduced Secondary attacks and Re-Admissions

Measures	Question / Description	Purpose	Data Type	Method
# Readmissions during trial	What was the # readmissions for a related event during the trial	This aims to identify if CAP has contributed to reducing secondary attacks and hospital re-admissions	Qty	Statistical Data
# Readmissions within 12 months of commencement	What was the # readmissions for a related event within 12 months of commencing a program	This aims to identify if CAP has contributed to reducing secondary attacks and hospital re-admissions	Qty	Statistical Data

4. Quality & Safety - The highest quality services provided with actual or potential harm from health care management or the environment in which health care is delivered avoided or reduced to acceptable limits

4.1. Adverse events minimised

Measures	Question / Description	Purpose	Data Type	Method
# Adverse events	What were the number of adverse clinical events during the trial, for example, Heart failure, chest pain, investigations	This aims to identify if CAP is at least as safe as the traditional program) - NOTE The definition for an adverse event is any event that either did, or could have resulted in serious harm to a participant	Qty	Statistical Data - SAE/hospital admission data
# Medication Management events	What % of adverse events were medication related	This aims to identify if CAP reduces medication related problems / events	Qty	Statistical Data - subgroup of SAE
4.2. Reduced adverse consequences resulting from a lack of services available in regional or rural communities				
Measures	Question / Description	Purpose	Data Type	Method
% Regional and Rural participants re-admitted due to lack of services	What was the % Regional and Rural participants re-admitted within 12 months, as compared to participants living in a metropolitan location	This aims to identify if CAP offers an option to regional and remote patients, who otherwise may not have been able to access the service	#	Statistical Data
% Indigenous participants re-admitted due to lack of services	What was the % Indigenous participants re-admitted within 12 months, as compared to participants living in a metropolitan location	This aims to identify if CAP offers an option to regional and remote patients, who otherwise may not have been able to access the service	#	Statistical Data
4.3. Reduced missing data on orders and requests				
Measures	Question / Description	Purpose	Data Type	Method
# Administrative errors	Administrative errors for example, missing data and mixed-up appointment times	This aims to identify if CAP reduces administrative errors	Qty	Statistical Data - variance forms?
# Technology errors	Technology errors for example, SMS not being received, phone break downs, etc.	This aims to identify if CAP has substantive technology issues that could impact on the quality of service provided	Qty	Statistical Data - technology issues log
4.4. More effective care provided in the community due to clear information provided in a timely manner to all providers involved in the care of a participant				
Measures	Question / Description	Purpose	Data Type	Method

Communication between staff directly involved in the program	How easily can the staff involved in the services delivered to a participant access common information and coordinate services?	This aims to identify if CAP improves communications and information sharing between staff involved in the delivery of services	Rating	Stakeholder Feedback
Communication between Program staff and Participants	How easily can the staff involved in the services share information and communicate with participants?	This aims to identify if CAP improves communications and information sharing between staff and participants	Rating	Stakeholder Feedback
Communication with General practitioners	How easily can the staff communicate and share information with a Participant's GP and other providers in their care team?	This aims to identify if CAP improves communications between staff involved in the delivery of services and the participant's care team	Rating	Stakeholder Feedback
Communication with Family and other carers	How easily can the staff communicate and share information with a Participant's family and other carers?	This aims to identify if CAP improves communications between staff involved in the delivery of services and the participant's family and other carers	Rating	Stakeholder Feedback

5. Service Efficacy - Resources are applied in the most cost effective way to achieve the lowest costs for both the service provider and the participants

5.1. Increased service capacity, better resource utilisation and more flexible options will reduce the unit cost per Participant

Measures	Question / Description	Purpose	Data Type	Method
# of participants enrolled at any one time	What were the maximum number of participants that could concurrently be managed by each program	This aims to identify if CAP could enable more participants to be enrolled in the program	Qty	Stakeholder Feedback
Resource Utilisation	What were the minimum # FTE resources required for each program	This aims to identify if CAP could improve the utilisation of resources	Qty	Stakeholder Feedback
Workforce planning	How well is the workforce matched to the needs of the service and participants?	This aims to identify if CAP assists with forward planning for example, selection of clients, matching workforce capacity to clients & client need, workforce development	Rating	Stakeholder Feedback

Accurate information	What is the quality of data on participants & service provision	This aims to identify if CAP assists with the provision of accurate data on participants & service provision	Rating	Stakeholder Feedback
5.2. Reduced service delivery costs				
Measures	Question / Description	Purpose	Data Type	Method
Education sessions	How much time (In Hrs / Week) is spent in delivering education sessions to each program	This aims to identify if CAP decreases service costs	Hrs	Stakeholder Feedback
Assessments	How much time (In Hrs / Week) is spent in delivering assessments	This aims to identify if CAP decreases service costs	Hrs	Stakeholder Feedback
Coaching Mentoring	How much time (In Hrs / Week) is spent in mentoring participants	This aims to identify if CAP decreases the mentoring costs	Hrs	Stakeholder Feedback
Gymnasium	How much time (In Hrs / Week) is spent in preparing and maintaining the Gymnasium	This aims to identify if CAP decreases service costs	Hrs	Stakeholder Feedback
Exercise sessions	How much time (In Hrs / Week) is spent in delivering exercise sessions	This aims to identify if CAP decreases service costs	Hrs	Stakeholder Feedback
Communications	How much time (In Hrs / Week) is spent in communications with participants and their care teams	This aims to identify if CAP decreases service costs	Hrs	Stakeholder Feedback
5.3. Reduced administration costs				
Measures	Question / Description	Purpose	Data Type	Method
Information dissemination	How much time (In Hrs / Week) is spent in providing participants with information?	This aims to identify if CAP technologies decrease the time and cost of providing participants with information	Hrs	Stakeholder Feedback
Receiving and screening referrals	How much time (In Hrs / Week) is spent receiving and screening referrals	This aims to identify if CAP technologies decrease the time and cost of receiving and screening referrals	Hrs	
Finding and confirming information	How much time (In Hrs / Week) is spent in finding and confirming participant information?	This aims to identify if CAP technologies decrease the time and cost of finding and confirming information	Hrs	Stakeholder Feedback

Coordinating activities	How much time (In Hrs / Week) is spent in coordinating activities / services?	This aims to identify if CAP technologies decreases the time and cost of coordinating activities	Hrs	Stakeholder Feedback
Data entry	How much time (In Hrs / Week) is spent in recording activities, for example, phone contacts, checking on participant progress, assessments, etc.?	This aims to identify if CAP technologies decreases the time and cost of recording activities	Hrs	Stakeholder Feedback
Other Administration tasks	How much time (In Hrs / Week) is spent on other administration tasks, not included above?	This aims to identify if CAP technologies decrease the time and cost of other administration costs	Hrs	Stakeholder Feedback

5.4. Reduced infrastructure costs

Measures	Question / Description	Purpose	Data Type	Method
Facilities	What was the est. SQM of facility space required for each program and What was the cost	This aims to identify if CAP technologies reduces infrastructure costs	SQM	Costing Model
Communication costs	What was the estimated cost of communications, for example, phone bills for each program	This aims to identify if CAP technologies reduces infrastructure costs	$	Costing Model
Provision and maintenance of Gym Equipment	What was the est. cost for provision and maintenance of Gym equipment	This aims to identify if CAP technologies reduces infrastructure costs	$	Costing Model
Provision and support of technologies	What was the cost of technology services, systems and infrastructure for each program	This aims to identify if CAP technologies reduces infrastructure costs	$	Costing Model

5.5. Reduced patient costs

Measures	Question / Description	Purpose	Data Type	Method
Patient travel	What was the average distance for participants to travel over the course of the program	This aims to identify if CAP technologies reduces patient costs	KMs	Statistical Data

5.6. Increased recovery of funding from external sources through better identification of patient and statistical reporting

Measures	Question / Description	Purpose	Data Type	Method

Statistical reporting	What was the average distance for participants to travel over the course of the program	This aims to identify if CAP technologies reduces patient costs	KMs	Statistical Data

6. Learning & Growth - Processes, systems and responses are constantly being improved to provide a higher quality, more effective service

6.1. Feedback is constantly obtained from participants, staff and other stakeholders

Measures	Question / Description	Purpose	Data Type	Method
Feedback from participants	What is the quality of the feedback received from participants?	This aims to identify if CAP enhances the level of feedback received	Rating	Stakeholder Feedback
Feedback from staff	What is the quality of the feedback received from staff?	This aims to identify if CAP enhances the level of feedback received	Rating	Stakeholder Feedback
Feedback from other stakeholders	What is the quality of the feedback received from other stakeholders?	This aims to identify if CAP enhances the level of feedback received	Rating	Stakeholder Feedback

6.2. Journals, papers and presentations are delivered as a result of the service

Measures	Question / Description	Purpose	Data Type	Method
# Journals, papers and presentations delivered as a result of the service	How many Journals, papers and presentations have been delivered as a result of the service over the past 12 months	This aims to identify if CAP leads to new learnings and dissemination of results	Rating	Stakeholder Feedback

Appendix K - Cap Technology Questionnaire

1. How often have you been using the following devices and technologies?

	Daily	Several times / week	Weekly	Several times / month	Sometimes	I have tried but I do not use regularly	Never
Mobile phone							
Scale							
Blood pressure monitor							
Step Counter (in mobile phone)							
Wellness Diary (in Mobile phone)							
Wellness Diary (in internet)							

2. How often have you carried your mobile phone along during the day?

( ) Daily

( ) Several times / week

( ) Weekly

( ) Several times / month

( ) Sometimes

( ) Seldom

( ) Never

3. In those days when you have carried your mobile phone with you, when and how often during the day did you carry your phone?

	Always	Often	Sometimes	Seldom	Never
While awake					
While working					

While at home					
While out of home					
While exercising					

The following are some statements regarding technologies and methods related to the rehabilitation program. Choose how well do you agree with these statements. If you have not used the technology or method, you may skip that part.

4. Step Counter

If you used a Step Counter, you may skip this question and go directly to answer to the questions below on the table. If you did not use the Step Counter, why? You can choose one or several options)

( ) I do not consider it as useful

( ) It is difficult to use

( ) I did not remember to use it

( ) It is uncomfortable to use

( ) Other reason. If yes, please specify:
_____

Step Counter	Fully agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Completely disagree
The Step Counter in the mobile phone motivated me in reaching my exercise goals					
The Step Counter was easy to use					
The Step Counter was useful for me					
I am going to continue to use the Step Counter in the mobile phone					
I would prefer a separate step counter over one in the mobile phone					

Using the Step Counter caused me stress					
Long-term follow up of physical activity with the Step Counter was important for me					
I have learned to better understand my daily activity with the Step Counter					
The feedback from the Step Counter was not sufficient					
I am fed up with the Step Counter use					
I would recommend the Step Counter for the other users like myself					

5. Wellness Diary (mobile phone application)

If you used a Wellness Diary, you may skip this question and go directly to answer to the questions below on the table. If you did not use the Wellness Diary, why? (You can choose one or several options)

( ) I do not consider it as useful

( ) It is difficult to use

( ) I did not remember to use it

( ) It is uncomfortable to use

( ) Other reason. If yes, please specify:
_____

Wellness Diary in the mobile phone	Fully agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Completely disagree
The Wellness Diary in the mobile phone motivated me in meeting the goals of the rehabilitation program					
The Wellness Diary was easy to use					
Wellness Diary was useful for me					
I am going to continue to					

use the Wellness Diary in the mobile phone					
Making entries manually on the health parameters on the Wellness Diary required a lot of effort					
Using the Wellness Diary caused me stress					
Long-term follow up of health parameters with the Wellness Diary was important for me					
I have learned to better understand my health with the Wellness Diary					
The feedback from the Wellness Diary was not sufficient					
I am fed up with the Wellness Diary use					
I would recommend Wellness Diary for other users like myself					
I had often technical problems with the Wellness Diary					
I had problems remembering to use the Wellness Diary					
I had problems remembering to synchronise the Wellness Diary data					
I had often technical problems (error messages) while trying to synchronise the Wellness Diary data					

6. Wellness Diary Portal (Internet application)

If you used a Wellness Diary Internet Portal, you may skip this question and go directly to answer to the questions below on the table. If you did not use the Wellness Diary Portal, why? (You can choose one or several options)

( ) I do not consider it as useful

( ) It is difficult to use

( ) I did not remember to use it

( ) It is uncomfortable to use

( ) I do not have Internet access

( ) I did not receive or I lost my user account information

( ) Logging in was too slow or complex

( ) Its use required too much effort

( ) Other reason. If yes, please specify:
_____

Wellness Diary Portal in the internet	Fully agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Completely disagree
Wellness Diary Portal in the Internet motivated me in meeting the goals of the rehabilitation program					
Wellness Diary Portal was easy to use					
Wellness Diary Portal was useful for me					
I am going to continue to use Wellness Diary Portal in the internet					
Making entries manually on the health parameters on Wellness Diary Portal required a lot of effort					
Using Wellness Diary Portal caused me stress					
Long-term follow up of health parameters with the Wellness Diary Connected was important for me					
I have learned to better understand my health with the Wellness Diary Portal					
The feedback from Wellness Diary Portal was not sufficient					
I am fed up with the Wellness Diary Portal use					
I would recommend Wellness Diary Portal for other users like myself					

I prefer to use Wellness Diary Portal on the internet over the mobile phone application					
I prefer using both mobile and Internet versions of the Wellness Diary together					

7. When you received motivational text messages how often did you read them?

( ) Always

( ) Most of the time

( ) Sometimes

( ) Seldom

( ) Never

8. Text messages

If you received and read the text messages at least sometimes, you may skip this question and go directly to answer to the questions below on the table. If you did not use them, why? (You can choose one or several options)

( ) I do not consider them as useful

( ) They were too difficult to use

( ) I did not remember to read them

( ) They were uncomfortable to read

( ) Other reason. If yes, please specify:
_____

Text messages	Fully agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Completely disagree
Text messages motivated me in meeting the goals of the rehabilitation program					
Text messages were easy to read and understand					
Text messages were useful					

for me					
I would like to continue to receive motivational text messages in the future					
There were too many text messages in the cardiac rehabilitation program					
Reading text messages caused me stress					
Motivational text messages were important for me					
I have learned to better understand my health with the text messages					
The information content in the text messages was not sufficient					
I am fed up with receiving text messages related to cardiac rehabilitation					
I would recommend text message service like this for the other users like myself					

9. When you received a SMS reminding you to view educational multimedia videos (animations) stored on your phone how often did you view them?

( ) Always

( ) Most of the time

( ) Sometimes

( ) Seldom

( ) Never

10. When you watched educational multimedia videos (animations) how did you view them? You may choose one or several options.

( ) Always entirely

( ) Mostly entirely but sometimes just partly

( ) Mostly just partly

( ) I tried to view them at first but gave up later

( ) I never finished any

11. Multimedia videos (animations)

If you watched multimedia videos at least sometimes, you may skip this question and go directly to answer to the questions below on the table. If you did not use them, why? (You can choose one or several options)

( ) I do not consider them as useful

( ) They were too difficult to use

( ) I did not remember to watch them

( ) They were uncomfortable to use

( ) Other reason. If yes, please specify:
_____

Multimedia videos (educational animations on your phone)	Fully agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Completely disagree
Videos on the mobile phone motivated me in meeting the goals of the rehabilitation program					
Videos were easy to watch					
Videos were useful for me					
I would like to continue to watching these kind of videos in the future					
There were too many videos in the cardiac rehabilitation program					
Watching videos caused me stress					
Educational videos were important for me					
I have learned to better understand my health with the videos					
The information content in the videos was not sufficient					
I am fed up with watching videos related to cardiac rehabilitation					
I would recommend viewing videos like this for					

the other users like myself					
The phone screen was too small to watch videos					
It was difficult to hear the video sounds					
I often experienced technical problems while trying to watch videos					

12. Relaxation audio

If you used relaxation audio at least sometimes, you may skip this question and go directly to answer to the questions below on the table. If you did not use them, why? (You can choose one or several options)

( ) I do not consider them as useful

( ) They were too difficult to use

( ) I did not remember to use them

( ) They were uncomfortable to use

( ) Other reason. If yes, please specify:
_____

Relaxation audio (on mobile phone)	Fully agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Completely disagree
Relaxation audio on phone motivated me in meeting the goals of the rehabilitation program					
Relaxation audio was easy to use					
Relaxation audio was useful for me					
I would like to continue to use relaxation audio in the future					
Listening relaxation audio caused me stress					
Relaxation audio was important for me					
I have learned to better understand my health with relaxation audio					

I am fed up with listening to relaxation audio					
I would recommend relaxation audio like this for the other users like myself					
It was difficult to hear the relaxation audio on the phone					
I faced often technical problems while trying to listen to relaxation audio					

13. Mentoring

Mentoring	Fully agree	Somewhat agree	Neither agree or disagree	Somewhat disagree	Completely disagree
Phone consultations with the Mentor motivated me in meeting the goals of the rehabilitation program					
Mentoring was easy to receive					
Mentoring was useful for me					
I would like to continue to receive Mentoring in the future					
Mentoring caused me stress					
Mentoring was important for me					
I have learned to better understand my health as a result of Mentoring					
I am fed up with Mentoring					
I would recommend a Mentor like mine to other users like myself					
Agreeing and finding the phone consultation time was difficult for me					
I prefer phone consultation over video consultation					
Video consultation with a mobile phone was useful (leave empty if you did not use it at all)					

Reviewing and discussing my own health data for example, exercises and steps, collected by mobile phone, improved the Mentoring.					
Mentoring could be carried out as efficiently without any technology					
I had often problems with mobile phone coverage (bad reception or poor voice quality) during Mentoring phone calls.					

14. Rank the following elements of the cardiac rehabilitation program. Give “1” to the most important, “2” to the second most important, “3” to the third most important element etc. Use numbers 1-7.

( ) Wellness Diary

( ) Step Counter

( ) Mentoring

( ) Motivational text messages

( ) Educational multimedia videos

( ) Relaxation audio

( ) Wellness Diary Connected Internet service

15. If you were given two options: home-based cardiac rehabilitation program (such as you have participated) or a hospital based program with similar goals but weekly education and group exercise sessions for 6 weeks, which would you choose.

( ) Home-based

( ) Hospital-based

( ) No preference

16. What is your preference for exercising?

( ) I prefer exercising at home or on my own

( ) I prefer guided group exercising

( ) No preference

	Angina stability	64.13±25.08 (n=46)	59.46±22.32 (n=37)
	Angina frequency	89.13±16.44 (n=46)	90.00±15.60 (n=38)
	Treatment satisfy	92.95±10.33 (n=44)	89.64±15.76 (n=36)
	Disease perception	71.61±23.93 (n=45)	68.95±25.54 (n=38)
Lipid profile mean±SD	Total Cholesterol	3.37±1.12 (n=47)	3.73±1.03 (n=34)
	LDL	1.71±0.78 (n=47)	2.01±0.84 (n=33)
	HDL	0.98 ±0.33 ((n=47)	1.02±0.25 (n=33)
	Triglycerides	1.34± 0.78 ((n=47)	1.50±0.95 (n=34)
	HbA1C	5.73 ± 1.23 (n=21)	6.65±2.33 (n=11)

Appendix L - Conference Presentations

- eCommunities of Care - Measuring the Benefits - HITH conference (Nov 2010)
- GPs at the Centre of an eCare community – NGP conference (Aug 2010)
- Improving the journey from hospital to home – Catholic Health Conference (June 2010)

Appendix M - Journal Articles / Conference Papers

eCommunities of Care – Measuring the Benefits!

Whittaker, F. (2010), eCommunities of Care - Measuring the Benefits - HITH conference (Nov 2010) Sydney

Abstract— Information Technology and Communications are rapidly transforming the health care sector, enabling new models of care to emerge where many previously centre based services can now be delivered safely and cost effectively to people in their own home or community setting.

One example is a Technology Enabled and Home-based Cardiac Rehabilitation program developed by CSIRO which utilises mobile technologies to offer patients recovering from a myocardial infarction, a cost-efficient, sustainable, and effective alternative to the traditional gym based program.

GPs at the hub of an eCare community

Whittaker, F. and Wisdom-Hill, K. ((2010), GPs at the Centre of an eCare community – NGP conference (Aug 2010)

Abstract— Achieving improved outcomes for people with mental health, by enabling General Practitioners, Mental Health Services and Social Services to share information and pro-actively collaborate in the delivery of care.

The Adelaide Hills Division of General Practice (AHDGP), in collaboration with Nexus eCare have implemented a Mental Health referral solution, that is currently being trailed with a select group of GPs using Medical Director and Mental Health specialists using MHagic. Practitioners, using Medical Director, have been provided with a 2710 Mental Health template that enables them to quickly generate and send a referral via email, secure message or fax, to the AHDGP's Mental Health team. The Nexus eCare solution intercepts the referral, synchronizes the information with the AHDGP's MHagic database and generates an alert to members of the AHDGP MH team. The aims of this project are to make it easier for Practitioners to make MH referrals, reduce the risk of errors and minimise manual input.

This paper looks at the challenges and successes of implementing a communications system that enables patient data to be shared between multiple care professionals and the impact this has on the delivery of care services to people with mental health.

Improving the journey from hospital to home

Whittaker, F. (2010), Improving the journey from hospital to home – Catholic Health Conference (June 2010)

PowerPoint presentation

Service and Business Model for Technology Enabled and Home based Cardiac Rehabilitation Programs

Sarela, A Whittaker, F and Korhonen, I., (2009) "Service and Business Model for Technology Enabled and Home-based Cardiac Rehabilitation Programs", 31st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'09), Minneapolis, USA, 2009.

Abstract— Cardiac rehabilitation programs are comprehensive life-style programs

aimed at preventing recurrence of a cardiac event. However, the current programs have globally significantly low levels of uptake. Home-based model can be a viable alternative to hospital-based programs. We developed and analysed a service and business model for home based cardiac rehabilitation based on personal mentoring using mobile phones and web services. We analysed the different organizational and economical aspects of setting up and running the home based program and propose a potential business model for a sustainable and viable service. The model can be extended to management of other chronic conditions to enable transition from hospital and care centre based treatments to sustainable home-based care.

Technology Enabled Cardiac Rehabilitation Program, Care Assessment Platform (CAP)

Sarela, A Whittaker, F Ding, H and Karunanithi, M. (2009) "Technology Enabled Cardiac Rehabilitation Program, Care Assessment Platform (CAP)" CSIRO ICT Centre Conference (ICTCC'09), Sydney, Australia, 2009

E-community of care – a community care information model

Soar J and Whittaker F (2008), Australian Ageing Agenda - E-community of care – a community care information model

Appendix N - Other Presentations

CAP2 Cost Benefits Analysis (Provided as support to Queensland Health for the Uptake of the CAP2 CR service model.

Abstract— A cost benefits analysis was completed to support the hypothesis that the CAP Home-Base cardiac rehabilitation (CR) model offers a cost-efficient, sustainable, and effective alternative to overcome the limitations and barriers that exist in traditional cardiac rehabilitation programs.

Using an adaptation of the updated Delone and McLean (2003) as a framework, 5 key perspectives were incorporated to create a multidimensional measuring model with interdependencies between the different perspectives. Outcomes selected for this analysis were Cost Efficacy, Participation, Health Outcomes, Quality & Safety and Access. A mixed methods approach was used to collect and analyse data which was obtained from semi structured interviews, financial reports, trial statistics, assessments and surveys.