Health and aged care enabled by information technology

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Abstract: One of the challenges facing health and welfare policy makers as well as researchers in most developed countries is the increasing demand for aging services and aged care. Low birth rates and rapid increases in the percentages of elderly people make aging and aged care one of the top priority issues among the national agenda of many countries.

The responses of governments have included initiatives to extend productive working lives and promote self-funded retirement; to promote healthy, active aging; and to encourage more care to be delivered in home and community settings. Technology will be a major enabler of these strategies.

People requiring health services are increasingly being offered more care in their own homes and community settings as an alternative to hospital admission and to delay or avoid moving into institutional care. Research is providing intelligent technology to enable care in the home as well as to monitor safety, security and quality. Innovation will provide greater independence and better access to care for the elderly, chronic illness sufferers and people with disabilities in their own homes and reduce the incidence of hospital admissions and the length of stay when admissions do occur. Technologies will support families and professional carers and are expected to reduce costs. This paper reports on developments in technology to support aged care in home and community settings.

Background

The age structure of Australia has been gradually changing from a pyramid shape in the past with large numbers in younger aged groups and few people reaching old age to more of a column or coffin shape with few people dying before reaching old age.[1] Life expectancy at birth of Australia in 2003 was 78 for males and 83 for females with a continuing reduction in mortality rates across younger age groups. As the population continues to age the incidence of dramatic disability restriction and hospital utilization spirals upward.[2] In addition the rapid increase of percentages of consumers aged 65 and over will result in the substantial gap between the availability of care providers and demand for aged care in the future.[3] There is a world-side shortage in some areas of professional carers such as nurses and there is no longer the availability of informal carers for elderly parents or others requiring support. This means we need alternative approaches to providing appropriate health and aged care for the elderly people at present as well as in the future.

In response to the challenges posed by aging populations, governments of many developed countries have taken such diverse measures as deferring retirement, promoting more self-funded retirement, increasing the provision of home care, implementation of public insurance schemes for aged care, providing research grants to academics and technologists working in aged care field, and providing more support for family carers.

Amongst these responses is recognition of the need to explore the application of information management and information technology to health and aged care. IT (information technology) can be expected to better enable older people in independent living and remaining in their own homes for longer and also will aid care delivery in an environment of a shortage of carers. This paper will address what changes might be feasible as a consequence of technology for health and aged care derived from experiences of the application of information technology to health care field. It will discuss on current research and challenges, and provide a picture of the future of health and aged care enabled by information technology.

Technology

Technology is expected to enhance the safety and independence of frail older people, enable access to quality care services and to extend their ability to remain in their own homes.[4] Intelligent systems can monitor patients' vital signs, activity levels, their safety and security. The technology can monitor indicators of their health status, provide alerts to events such as falls, and give early warnings of potential problems.

Monitors include personal alarms, motion and smoke sensors, and fall detectors. These can be supported by intelligent software that can alert carers or call centres as required. Some monitors keep track of household equipment and how it is being used. This could indicate that a person is no longer cooking for themselves or could turn off appliances that have been left on. Sensors are available to turn lights on. They can track and alert for wandering by patients with dementia, and can monitor arrivals and departures of people including the patient or authorised visiting carers. Bed pressure sensors can detect when a patient leaves their bed during the night, and will trigger an alarm if they do not return within a reasonable time. Monitors can record visits to the bathroom and how long they might spend there as well as any change in physical activity such as using the stairs. The technology can alert patients to their own levels of physical activity; it could set goals and prompt them to undertake more activity to maintain muscle, bone and mental fitness.

Older people living alone can be at risk of inadequate nutrition. Sensors on kitchen cupboards, refrigerators and other electric appliances can indicate when the patient is eating and drinking and pass this information to carers. Systems can record patterns of typical behaviour over time, note changes and alert carers when appropriate. Monitoring devices can be more accurate guides to the health risks than are the patient's own awareness of their symptoms. Devices can monitor important indicators for disease management.

Existing home security monitors in Australia use the simple landline telephones and some additional functionality can still be provided using that service. Broadband however will be required for always-on continuous monitoring, especially for image capture and transmission. RFID, Bluetooth and Wi-Fi technology will allow connectivity of devices around the home and in the community without cabling. Passive RFID tags can absorb enough power from the sensing device to perform simple functions. Devices that are powered electrically can use Ethernet Over Power.

Research

While the number and sophistication of available technologies continues to increase there is a need for research into adoption issues, return on investment, realisation of benefits, integration and interoperability. There are gaps in the range of technologies and particularly in intelligent software and interfacing.

As health information technology has developed rapidly in the past two or three decades, it is expected to have a positive impact on the access, quality, and cost of health and medical care.[5] For example, it would be easier for people living in rural area, nursing homes, and

mental institutions to receive care including consultations through telemedicine. Health information technology was also expected to help facilitate high-speed communication and transfer of patient records between distant medical centers.[6]

Information technology is expected to have diverse positive outcomes on the quality of health care, such as the reduction of "time-to-treatment, improved awareness of clinicians which means clinicians are better informed and updated with recent advances by telemedicine.[7] It is also expected to have positive impacts on the quality of health care by improving working conditions for clinicians particularly in rural and remote areas.[8]

There are analyses of the effectiveness and cost savings of information technology and reports on particular aspects of telemedicine such as teleradiology and telepathology, but not for more comprehensive networks.[9] Of particular interest are the impacts on care and the financial benefits of monitoring and management of patients in remote locations.[10]

According to recent literature which reviewed systematically the impact of health information technology on quality, efficiency, and costs of health care, health information technology has been shown to improve quality by increasing adherence to guidelines, enhancing disease surveillance, and by decreasing errors.[11] In primary and secondary care the impact of information technology on quality has been through facilitating care guidelines or protocols. Information technology enables management and analysis of massive healthcare databases that would not be feasible with paper-based systems.[12]

There are some studies on the effect of information technology applied to health care in Korea. A result of a study conducted in Korea revealed that hospitals which implemented more information technology-related strategies, for example, computerized physician order entry, picture archiving & communication systems (PACS), Enterprise Resource Planning (ERP), billing and medical data transportation by Electronic Data Interchange (EDI) and other similar systems showed a higher financial performance than those which did not.[13] Another study examined the effects of a Web-based health information service system for the elderly and revealed that users rated it very useful, relevant, convenient, and efficient for preventing disease and promoting health.[14] A study revealed that most users were comfortable and satisfied with the telemedicine in primary care.[15]

Smart homes

Efforts to apply information technology for aging and aged care are recently being made to workplaces, home, vehicles, wearable or pervasive goods, and personal care assistant. There is world-wide interest in so-called Smart Homes for both enhancing wellness as well as supporting people with disabilities and/or healthcare needs. Smart homes involve embedded assistive technologies with communication links to carers and clinicians to support the frail elderly in particular in staying in their own homes rather than institutional care.[16] A smart home is usually embedded with the following technologies: sensor networks, home networks, activity tracking, ambient displays, context aware memory aids, and location tracking and alert system.

<u>An example Smart Home environment:</u>

1. Sensor networks build environments equipped with sensors for movement, location etc. In home care settings these may use in-building location services. In aged care, it can refer to:
    a. Bed-sensors that monitor when a person is in bed, how many times they get up in the night, it will send an alert if they do not return
    b. Monitors for falls

c. and Movement detectors that build the normal patterns of movement and can provide an alert if someone deviates from their usual pattern – or can provide incentives for people to maintain physical activity

2. Home network is sensor networks in the home.

3. Activity tracking, that is tracking the activity of a patient. that will provide information on levels of physical activity, changes in their pace in, for example navigating stairs, how many times and how long someone needs to visit the toilet at night, whether they are using devices such as the cooker and refrigerator which might indicate whether they were eating and whether they were deviating from daily patterns of activity.

4. Ambient displays is lights or other indicators that provide background information – for example in aged care, the Intel project has a lamp that goes on to show the elderly person when her daughter's family are in their own home – then she knows they are there and can call them by telephone etc

5. Context Aware Memory Aids is applications that watch a user's context and proactively suggest information that may be of use - prompts or other reminders specific to what a person might be doing, for example if someone switches on the coffee machine a screen might display the steps involved in making a cup of coffee (it is common things like this that people with dementia forget how to do); (and) reminders to take medication or sensors that become aware of what someone is doing and reminds them of where they were up to and what the next step is.

Additional technology might include location and alert systems for tracking wandering patients and providing an alert to someone responsible if they were considered to be at risk.

Telehealth is the use of telecommunications to deliver care services across distances and can enhance communications between patients, their families and clinicians. Videophones have been used in tele-hospice programs for the terminally ill,[17] home telecare studies,[18] telerehabilitation support,[19] and disease-specific interventions.[20] Examples such as these indicate the feasibility of the technology and other studies have indicated cost-effectiveness.[21],[22]

Videophone technology has been found to assist communication and the participation of families in care planning when they living some distance from a family member in a nursing home. Videophones improved communication between nursing home residents and their family members, reduced isolation and increased family support.

Today, the market for smart home services for senior housing is however still essentially barely existent in many developed countries as well as Australia and Korea. This phenomenon may have resulted from the fact that providers of smart homes have been in practice very focused on the technical possibilities rather than solving the every day problems of end-users. Important reasons for this are insufficient capital, little knowledge about how to involve the user, a lacking ambition to work in a multidisciplinary way, and unprofitable market condition. This finding implies that the challenges we are facing in aging and aged care is the development of user-oriented products, education and training of users for new products and services, internal organization of the firm which consisted of multidisciplinary team, and the profitability of market, not the technology.

Aging and aged care as we know it will be transformed as technology enables extending active and productive lives and facilitates more care to be delivered according to consumer preferences for place and time. These changes will reflect the impacts of technologies that

have transformed other industries, enabled new products and services and provided delivery at the convenience of the consumer.

Just as assistive technology aids airline pilots, it will compensate for decline in physical or cognitive fitness allowing us to extend our professional lives and extend the reach of clinical care into homes. It will enable seniors to choose how long and how much they will work. Health and aged care will be observable and safe when and where you want it. The systems will provide a virtual personal care assistant; it will know how to find your records, it will assist clinicians in linking to research, and it will help you stay independent and connected. It will also support families as part of the care team for their frail elderly parents even when they live large distances apart.[23] From these perspectives, it is not unreasonable to anticipate that information technology will become the core discipline of health and aged care.

Summary

There will be many opportunities for new and imaginative research from aging of societies. Some urgent research requirements include developing standards of aged care, identifying the issues, proof of concept projects, real world testing, proving the business case,[24] promoting technology for quality care, consumer-oriented care and electronic health records. While some of the devices are emerging we do not yet know where or how to deploy technology effectively to deliver both the care and the financial benefits. Research is needed to guide changes that will be required in policy, strategy, funding, work-practices, integration of technology into care, future roles for the professions and new models of care. A multi-discipline consortium is one approach that is already being pursued to provide a platform for enhancing the scale of related research activity, stimulate and commercialize innovation, and support collaboration between researchers to increase their impact.

The Collaboration for Aging and Aged Informatics Research at the University of Southern Queensland in Australia is an example of multi-discipline consortium: that is it brings together researchers from across the Faculties of Business, Science and Engineering; as well as partners from universities across Australia and from Japan and Korea, from state and federal governments and from aged care providers and ICT companies. Current research projects include a hospital avoidance pilot and the establishment of a Smart Home as a research facility.

We are on the cusp of a major social change in healthcare delivery across the world. Technology has enabled transformation in many industries. There is interest in technology to enable societies to manage pressures of aging populations. Consequently it is not unreasonable that greater deployment of technology will result in a transformation of health care from being provider driven to consumer focused, from delivery at the provider's convenience to the time and place of convenience of the consumer, from a focus on the acute hospital care more towards community care, prevention and maintenance of wellness. Technology can be expected to enable a vision of care being more evidence-based and safe.

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