

ORIGINAL RESEARCH OPEN ACCESS

Bridging Distances: A Retrospective Study of Virtual Wound Care to Reduce Travel Burden in Rural Healthcare

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Received: 29 April 2025 | **Revised:** 30 August 2025 | **Accepted:** 8 September 2025

Funding: The authors received no specific funding for this work.

Keywords: healthcare | remote | rural | telehealth | virtual | wound care

ABSTRACT

Introduction: This study assessed the Virtual Wound Consultancy Service (VWCS) in reducing travel burden and lowering travel costs for rural patients requiring wound care. With one-third of Australians in regional or remote areas facing limited healthcare access, this study examined how virtual care could overcome geographical barriers, focusing on travel time and cost. **Methods:** A retrospective analysis compared service utilisation and travel savings between patients using the VWCS and those receiving traditional in-person care. Data from chronic wound patients across inpatient, outpatient and residential aged-care settings in a large rural health district (July 2018 to March 2024) were reviewed. Key outcomes included travel time, travel costs and travel distance.

Results: The VWCS significantly reduced travel burdens. Patients living more than 201 km from specialist centres saved an average of 444 min per round trip. Financially, patients saved up to AU\$507.49 per trip, with the highest savings for those farthest away. The VWCS also provided timely access to wound care, with an average wait time of 3.7 days from referral to consultation. Most services involved audio/visual assessments (40%), case management (27.5%) and email consultations (18%). Over the study period, the VWCS serviced 384 patients, averaging 2.6 consultations per patient.

Conclusion: The VWCS significantly improves access to wound care for rural populations by reducing the time burden. These results support expanding virtual care models in rural areas. Future research should assess long-term clinical outcomes and refine virtual care delivery for greater quality and cost-effectiveness.

1 | Introduction

Accessing specialised healthcare services for chronic wound management in rural and remote areas presents substantial challenges that significantly impact patient outcomes [1–3]. These challenges include a shortage of healthcare professionals, the long distances that patients must travel to receive care

and the financial burden of such travel. This combination often results in delays or limitations in receiving timely care, which is particularly detrimental for individuals with chronic wounds who need prompt and specialised intervention to achieve optimal healing [4–6]. Chronic wounds, often associated with conditions such as diabetes and vascular diseases [7, 8], not only reduce the quality of life due to pain and decreased mobility but

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Summary

- What is already known about this subject
- Rural and remote Australians experience significant barriers to accessing specialist healthcare services, including wound care.
- Travel distance, time and costs are major obstacles for rural patients requiring ongoing management of chronic wounds.
- Virtual healthcare models are increasingly recognised as a strategy to improve access, but evidence quantifying their travel and cost benefits for wound care patients has been limited.
- What this study adds
- Virtual models of care can significantly reduce travel-related burdens, including time and costs, for rural and remote patients requiring specialist wound care.
- Improved access through virtual care may lead to earlier intervention, better continuity of care and reduced risk of complications associated with delayed treatment.
- Virtual healthcare services have the potential to enhance equity, patient experience and system efficiency in rural and remote healthcare delivery

also increase healthcare utilisation [6, 8–10]. In Australia, the economic burden of wound care is immense, costing the healthcare system over AU\$3 billion annually [4, 11]. This financial strain further exacerbates the challenges faced by rural patients, who must shoulder additional costs related to transportation, accommodation and time away from work or family. In response to these issues, virtual care models, notably telehealth, have emerged as promising solutions. By facilitating remote consultations and monitoring, telehealth services (such as telephone and video call) reduce the necessity for patient travel, thereby improving access to specialised wound care [12, 13]. Initiatives like the Virtual Wound Consultancy Service (VWCS), which commenced in 2018 in New South Wales (NSW) exemplify how virtual care can bridge the gap between patients and specialists, ensuring that individuals in remote areas receive timely and effective care. This approach alleviates patients' logistical and financial burdens and enhances their healthcare outcomes by enabling continuous monitoring and timely interventions without extensive travel. As virtual care continues to evolve, it holds the potential to transform wound management practices in rural and remote locations, ultimately improving patients' quality of life and reducing healthcare disparities across regions. The aim of this study was to investigate the efficiency of the VWCS in improving healthcare by assessing the travel burden, specifically, distance, cost and time savings for patients with chronic wounds.

2 | Methods

2.1 | Study Design

This study utilised a retrospective analysis of patients receiving wound care through the VWCS and face-to-face care from July 2018 to March 2024. The aim was to assess the efficiency of the

VWCS compared to face to face care in improving healthcare access by examining differences in distance, cost and travel burden between the two groups. This analysis spans the six-year period during which the VWCS has been operational.

2.2 | Study Population

The study population consisted of patients treated for chronic wounds in inpatient, outpatient and residential aged-care settings within Western New South Wales Local Health District from July 2018 until March 2024. Chronic wounds were identified using 18 International Classification of Diseases 10th Revision (ICD-10AM) codes relevant to conditions, including diabetes, venous, cutaneous abscess, cellulitis, infection, ulcer rad, gangrene, pressure injury, granuloma, lupus, vasculitis, foot ulcer, chronic ulcer, obstetric, skin tear, procedure and complication open [14, 15]. Patients included in the analysis received either VWCS care or traditional face-to-face wound care during this period. These codes were chosen as they were stipulated as chronic wound codes by the NSW Government within the Leading Better Value Care (LBVC) chronic wound initiative [14]. This study does not include the high-risk foot service initiative, as it falls under a separate LBVC tranche [14].

2.3 | Setting

The health district spans a geographical area equivalent to the size of the United Kingdom, delivering healthcare across a large regional, rural, remote and very remote population. It operates 38 hospitals and 50 community health centres. With many individuals living far from major centres, the district faces limited specialist access, extensive travel requirements and resource limitations. In 2023–2024, the district recorded 49,027 patient admissions, 212,307 emergency department admissions, 962,445 outpatient consultations and 97,136 patients received virtual care [16]. The health district employs 8674 staff members and 3669 of those are nurses [16]. In 2021–2022, the district recorded 642 separations for patients with chronic wounds [17]. A separation occurs when a patient leaves the facility's care because they are discharged, transferred to another facility or passed away.

2.4 | Intervention: Virtual Wound Consultancy Service

The VWCS was established in July 2018 after a Clinical Nurse Consultant in wound management identified a significant gap in patient's accessing wound care services due to travel. Of the 38 hospitals and 50 community health centres in the district, 36 hospitals and 48 centres lacked access to wound specialist expertise. In response, the nurse-led VWCS was created to bridge this gap, providing expert, nurse-led virtual support for chronic wound management across rural and remote areas of NSW.

This service provides (a) specialised virtual wound care expertise directly accessible to patients and clinicians; (b) training opportunities to enhance clinicians' proficiency in advanced wound assessment and management; (c) individually tailored

treatment plans developed by wound care experts; and (d) clinical guidance to help healthcare providers promptly identify signs of wound deterioration and initiate appropriate escalation pathways. The VWCS utilises Cisco videoconferencing systems, laptops or desktops, telephones and Microsoft Teams for image uploads and communication. These technologies enable the service to deliver virtual care efficiently and effectively. This service facilitates real-time consultations, advanced assessments, case planning and ongoing support, thereby overcoming geographical barriers. It improves patient outcomes by enabling timely assessments, accurate treatment recommendations and ongoing guidance for wound care teams. The VWCS clinician guides the patient's care team to conduct advanced assessments and deliver advanced wound management skills such as conservative sharp wound debridement and ankle-brachial index readings.

2.5 | Standard Usual Care

Standard face-to-face care for chronic wounds typically involves in-person consultations where clinicians assess the wound and provide treatments like dressing changes. Access to specialised wound care in rural and remote communities typically requires patients to travel to the nearest regional centre between 35 and 450 km away. Due to the absence of specialised outpatient wound clinics, these individuals must present themselves to emergency departments for care. Generalist health practitioners primarily handle wound management in these areas, with some services being nurse-led and supported by virtual allied health and medical officers. Patients seeking follow-up care with their general practitioners, outpatient clinics or surgeons frequently face long waiting periods between appointments. For specialised consultations, such as with vascular surgeons for a wound, travel distances may range from 175 km to 755 km to metropolitan centres, causing significant delays in receiving specialised wound services.

2.6 | Outcome Measures

The outcome measures for this study include evaluating the effects on travel time, travel distance and travel costs for patients accessing wound care via the VWCS compared to traditional face-to-face consultations.

2.7 | Inclusion and Exclusion Criteria

The inclusion criteria encompassed all patients with chronic wounds based on 18 International Classification of Diseases 10th Revision (ICD-10 AM) codes who received care within one local health district from July 2018 until March 2024. The exclusion criteria were patients with acute wounds and those treated outside the local health district.

2.8 | Ethics Statement

This study was approved by the Greater Western Human Research Ethics Committee (Protocol number 2024/ETH00339)

and Charles Sturt University Human Research Ethics Committee (Protocol number H24094). Two ethics governance committees were required because the study involved a local health district (covered by the Greater Western Human Research Ethics Committee) and an academic institution (Charles Sturt University), each with separate oversight responsibilities.

2.9 | Data Collection

Each participant was assigned a unique identifier to ensure patient confidentiality during data collection. Re-identified coded data was stored on a secure local health district database and was accessible only to the Health Intelligence Unit team. De-identified data was stored on a password-protected NSW health portal and was only accessible to the study investigators. The data collected for this study included patient demographics (age, gender, Aboriginality), clinical details (principal diagnosis) and hospital-related information (encounters, average wait time). Additionally, the study tracked the time between referral and consultation, readmissions and the number of patients. This data was sourced from the electronic medical record and coded health data between July 2018 and March 2024 and was used to compare outcomes between the VWCS and standard care.

2.10 | Data Analysis

Statistical analysis was conducted using Excel (Microsoft Corporation). Descriptive statistics were calculated to summarise the data. The results were presented in two main formats: categorical data was expressed as counts accompanied by their corresponding percentages (%), while numerical data was summarised using means and standard deviations (SD). Chi-square tests were applied to categorical variables to assess statistical significance between groups and *p*-values were calculated. For comparisons of numerical data, *t*-tests were used and *p*-values < 0.05 were considered statistically significant.

2.11 | Encounters

Encounters represent any clinical service, such as assessment, evaluation or intervention provided by a healthcare professional within a specific setting. Tracking the number of encounters for each participant enables a quantitative view of non-admission interactions with the healthcare system. This is particularly valuable for the VWCS, where traditional admission data does not apply. Wait time was determined by calculating the number of days between the date of referral and the first day of consultation.

2.12 | Travel Distance

Travel distances were determined using Google Maps. Participants were categorised by postcode into three groups: 0–50 km, 51–200 km and over 201 km from the closest care facility with a wound specialist.

2.13 | Travel Time and Costs

Travel time and travel cost analyses were conducted exclusively for patients who used the VWCS from July 2018 to March 2024. Average travel time and costs were calculated per group, following Australian Taxation Office guidelines [18]. These estimates excluded additional financial burdens, such as lost wages or accommodation expenses, providing exclusive insights into travel efficiency during this study period.

3 | Results

During the study period, 384 patients received care via the VWCS, totalling 1600 encounters. As shown in Table 1, the patient population consisted of 199 (52%) females and 185 (48%) males, with an average age of 67. The average number of visits per patient was 2.6 virtual encounters. Patients over 65 constituted 70% of the cohort and 13% of the patients identified as First Nations.

3.1 | Standard Care

From July 2018 to March 2024, there were 22,613 distinct hospital admissions for patients with a wound identified by specific ICD-10-AM codes. 57% of these admissions were for males and 43% for females. The average length of stay for these admissions was 16.2 days. Among these, 1924 admissions included a readmission flag, indicating the patient was readmitted within 28 days, though not necessarily for wound-related reasons, as depicted in Table 1.

3.2 | Principal Diagnosis

The top four principal diagnoses for hospital admissions from July 2018 to March 2024 were Diseases and Disorders of the Skin, Subcutaneous Tissue and Breast (33.5%), Injuries,

Poisoning and Toxic Effects of Drugs (10%), Diseases and Disorders of the Musculoskeletal System and Connective Tissue (9.4%) and Infectious and Parasitic Diseases (8.5%) (Table 2). Notably, these categories were also substantial, with patients who engaged with the VWCS and skin-related conditions showing the highest use, comprising 33% of virtual service admissions from 2018 to 2020 and 24% from 2020 to 2024. Statistically significant differences were observed across these categories, with p -values < 0.05 for most comparisons, highlighting the substantial alignment between the principal diagnoses and VWCS use, as per Table 2.

3.3 | Virtual Wound Consultancy Service Usage

The VWCS was allocated a unique clinic identification in July 2020, allowing for further data collection and analysis of service patterns. The following data is specific to July 2020 until March 2024. The most common services provided by the VWCS were audio and audio-visual assessments (40%), case planning, management and review (27.5%) and email (18%). Three hundred eighty-four patients received an initial consult only and 196 patients received subsequent consults. Patients averaged 2.6 consultations during their treatment course. The average wait time from referral to appointment was 3.7 days.

3.4 | Potential Savings due to Reduced Travel

3.4.1 | Travel Distance

The VWCS demonstrated considerable benefits in reducing travel distance for rural patients. Patients could avoid lengthy round-trip journeys to centres with wound specialists by minimising the need for in-person consultations.

3.4.2 | Travel Time

The service significantly reduced patients' travel time based on their proximity to a specialist centre. Patients within 0–50 km saved an average of 65 min per round trip. Those travelling 51–200 km saved an average of 186 min, while individuals residing more than 201 km from a specialist centre saved an average of 444 min per round trip.

3.4.3 | Travel Cost

Travel cost reductions were also significant for patients who used the VWCS. The average saving for those living within 0–50 km of a specialist centre was AU\$59.67 per round trip. Patients travelling 51–200 km saved an average of AU\$199.66, while those over 201 km away saved an average of AU\$507.49 per round trip.

Table 3 provides a detailed breakdown of these economic and logistical benefits, highlighting the VWCS's role in improving healthcare access for rural populations.

TABLE 1 | Characteristics of patients involved in the study July 2018–March 2024. Demographic and clinical characteristics of patients receiving standard care versus VWCS care, including gender, age and First Nations status, among those admitted to the LHD between July 2018 and March 2024. The data reflects distinct patient counts for each group, with statistical significance indicated for relevant variables.

Characteristic	Standard care	Virtual wound consultancy service care	P
Total number (n)	22613	384	–
First Nations (n)	3715 (16%)	51 (13%)	0.109
Female (n)	9766 (43%)	199 (52%)	0.00086
Males (n)	12847 (57%)	185 (48%)	< 0.001
Mean age (SD)	59 (19)	67 (12)	< 0.001

TABLE 2 | A range of diagnoses for the admitted patients involved in the study July 2018–March 2024. Principal diagnoses for patients admitted across the LHD and those utilising the VWCS during admission from July 2018 to March 2024. The table compares the distribution of diagnoses between standard care patients and VWCS patients, who were admitted for care. Statistically significant differences in diagnosis frequencies between the two groups are indicated by the *P*-value.

Principle diagnosis	Count (%) Virtual Wound Consultancy Service	Count (%) Standard Care	<i>P</i>
Skin, subcutaneous tissue & breast	63 (28.6%)	7867 (33.5%)	0.126
Factors influencing health status	29 (13.2%)	1052 (4.5%)	<0.0001
Musculoskeletal system & connective tissue	23 (10.5%)	2196 (9.4%)	0.575
Nervous system	18 (8.1%)	1002 (4.3%)	0.005
Circulatory system	18 (8.1%)	1719 (7.3%)	0.644
Infectious & parasitic diseases	17 (7.7%)	1988 (8.5%)	0.665
Injury, poison & toxic effect drugs	13 (5.9%)	2246 (10%)	0.043
Endocrine, nutritional & metabolic	12 (5.5%)	1285 (5.5%)	1
Digestive system	8 (3.6%)	845 (3.6%)	1
Respiratory system	7 (3.2%)	1151 (4.9%)	0.26
Kidney & urinary tract	7 (3.2%)	559 (2.4%)	0.44
Neoplastic disorders	3 (1.4%)	81 (0.3%)	0.004
Blood, blood form organs, immunological	2 (0.9%)	153 (0.7%)	0.76
Pre major diagnostic category	0	56 (0.2%)	0.003
Eye diseases & disorders	0	55 (0.2%)	0.003
Ear, nose, mouth & throat	0	218 (0.9%)	0.0001
Hepatobiliary system & pancreas	0	211 (0.9%)	0.0001
Male reproductive system	0	56 (0.2%)	0.003
Female reproductive system	0	49 (0.2%)	0.004
Pregnancy, childbirth & puerperium	0	203 (0.9%)	0.0001
Newborns & other neonates	0	41 (0.2%)	0.004
Mental, behavioural and neurodevelopmental disorders	0	218 (0.9%)	0.0001
Alcohol/drug use disorders	0	72 (0.3%)	0.003
Injury, poison & toxic effect drugs multiple trauma	0	38 (0.2%)	0.006
Burns	0	22 (0.09%)	0.02
Gastrointestinal unrelated to principal diagnosis	0	77 (0.3%)	0.003
Total	222	20 551	—

4 | Discussion

The findings of this study demonstrate that the VWCS provides significant financial advantages by reducing travel-related expenses for geographically isolated patients. The model addresses access barriers by facilitating timely interventions and positions virtual care as a cost-effective, patient-centred solution [19, 20]. Virtual care minimises in-person visits and travel

costs, benefiting patients and health systems [10, 21, 22]. It enhances wound care efficiency, reduces mortality, readmissions and costs and improves patient quality of life [23, 24]. However, economic evaluations of virtual care are challenging due to evolving technology and the complexity of assessing health outcomes accurately [21, 25]. These findings advocate for expanding virtual wound care, highlighting its role in delivering equitable and cost-efficient healthcare in rural settings.

TABLE 3 | Estimated savings in private travel distance, time and cost. Estimated savings in private travel distance, time and cost for patients accessing specialist care through the VWCS. The table illustrates the average travel distance, time saved (in minutes) and travel cost saved (in AU\$) for different distance categories, based on VWCS utilisation. These estimates highlight the potential efficiencies and cost savings associated with virtual care in reducing the need for physical travel to specialist facilities.

Distance from Specialist Facility (km)	Average Travel Time Saved (minutes)	Average Travel Cost Saved (AU\$)
0–50 km	65	59.67
51–200 km	186	199.66
Greater than 200 km	444	507.49

In this study, we evaluated the impact of the VWCS on reducing the travel burden for patients in rural and remote areas. Our results highlight substantial time and financial savings for virtual wound care patients, which aligns with previous findings. Specifically, patients within 0–50 km of a specialist wound care facility saved an average of 65 min and AU\$59.67 per round trip. For those residing 51–200 km away, the average time saving was 186 min, with a cost saving of AU\$199.66. Patients living more than 200 km from a wound specialist saved an average of 444 min and AU\$507.49 per round trip. These findings demonstrate that virtual wound care provides the required care without the travel burden, especially for rural populations with limited access to specialised services.

Approximately one-third of Australians live in regional or remote regions for various reasons, including lifestyle preferences, economic opportunities and a solid connection to their land and community [22]. However, these regions often face challenges in healthcare access and resource availability, adversely affecting quality of life [26, 27]. Centralised healthcare models exacerbate these issues by forcing patients in rural communities to travel long distances for wound care, which can delay treatment and result in poorer outcomes [6, 28, 29]. Additionally, financial burdens are significant, with studies reporting travel costs ranging from AU\$379 to AU\$739 per trip, while government reimbursements cover only AU\$182 to AU\$297 [22].

As demonstrated by the VWCS, virtual care offers a solution by enabling rural healthcare providers to consult with specialists without requiring patients to travel. By leveraging technology, services like VWCS improve access to care while reducing travel time and costs. Our findings align with previous studies that have reported similar benefits from the virtual care model. For instance, studies by de Mello-Sampayo [30], Hickey et al. [31], Patel et al. [32], Yilmaz et al. [33] highlighted the effectiveness of virtual care in reducing travel burdens globally.

In addition to the travel-related outcomes, this study explored service utilisation trends. The most common diagnoses for hospital admissions were skin and musculoskeletal disorders, injuries and infectious diseases, with skin-related conditions being the most prevalent among those accessing both traditional and virtual care. Notably, while skin-related conditions accounted

for 33% of VWCS consultations from 2018 to 2020, this proportion decreased to 24% in the following period, potentially reflecting changes in patient need, enhanced local management capabilities, or referral and service utilisation patterns. Barakat-Johnson et al. [20] reported that virtual wound services addressing pressure injuries saw increased consultations for chronic conditions over time, driven by heightened awareness and strategic referrals. Similarly, Caffery et al. [34] highlighted that telehealth services often initially focus on conditions requiring specialist input, such as wound and dermatological care, before broadening their scope as clinicians gain confidence in managing these cases locally. This transition aligns with findings from Hickey, Gomez [31], who noted that an initially high percentage of rural telehealth consultations for specific conditions, including skin disorders, declined as local clinicians acquired new skills through virtual care programmes.

The VWCS data further revealed that the most common services provided in the encounters were audio and audiovisual assessments, case planning, management and reviews. Three hundred and eighty-four patients received initial consultations and 196 patients received follow-up care. The average wait time for VWCS consultations was 3.7 days, underscoring the service's accessibility.

Beyond addressing immediate care needs, virtual care empowers patients and clinicians in rural areas. Patient education on wound prevention and management supports better self-care practices, while upskilling local clinicians enhances the quality of care delivered within communities, reducing reliance on centralised facilities [35–37]. However, expanding virtual health services requires sustained economic, ethical and regulatory support to ensure long-term success and equitable patient access [7, 22, 28]. This study reinforces the transformative potential of virtual care models like the VWCS in mitigating the challenges of geographic isolation and addressing systemic inequities in healthcare access for rural populations [2, 34, 38].

Overall, these results emphasise the critical role of virtual care in reducing travel time and travel costs for people living with wounds. The VWCS model has proven to be an effective solution for overcoming the geographical barriers faced by rural patients, ensuring timely access to specialised wound care.

5 | Study Strengths and Limitations

This study had several limitations. The retrospective nature restricted the availability of specific critical data points and relied on existing records, which may lack consistency or completeness. However, the study's strengths lie in its comprehensive data collection over six years and its focus on a novel service model specifically tailored to the needs of rural populations. While travel costs were estimated using generalised methods, which introduced some imprecision due to the lack of individualised travel data, the approach still provided valuable insights into overall cost trends, even if the accuracy of specific travel-related savings was affected. The exclusion of factors like wound types, healing progress and emergency department visits is another limitation that could have further allowed for the analysis of healthcare utilisation and costs. Nevertheless, future studies could address the identified gaps by incorporating prospective

designs and more granular data, such as individualised travel distances and wound-specific healing data. More precise travel cost estimates using actual data would enhance the reliability of the reported cost savings.

6 | Conclusion

This study emphasises the VWCS's role in alleviating travel burdens for rural patients needing specialised wound care. It shows that virtual care effectively reduces travel time, distance and costs, addressing logistical barriers. A key strength is quantifying travel challenges, providing insights for future research on virtual care and patient satisfaction. Future studies should refine these models and evaluate long-term outcomes to improve healthcare delivery for rural populations.

Author Contributions

Catherine Leahy: conceptualisation, methodology, investigation, data curation, writing – original draft, reviewing and editing. Michelle Barakat-Johnson: conceptualisation, methodology, writing – reviewing and editing, supervision. Linda Deravin: conceptualisation, methodology, writing – reviewing and editing, supervision. Erik Biros: validation, writing – reviewing and editing. Rachel Kornhaber: conceptualisation, methodology, formal analysis, writing – reviewing and editing, supervision.

Acknowledgements

The authors extend their sincere gratitude to the Health Intelligence Unit and the Digital Health Information Services teams of the local health district for their invaluable support. Their expertise and assistance in sourcing and providing access to the data were critical to the successful completion of this study. Open access publishing facilitated by Charles Sturt University, as part of the Wiley - Charles Sturt University agreement via the Council of Australian University Librarians.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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