Chronic Wound Telemedicine Models Before and During the COVID-19 Pandemic: A Scoping Review

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1 AMA PRA Category 1 Credit™

NCPD
ANCC
2.5 Contact Hours

GENERAL PURPOSE: To present the results of a scoping review exploring chronic wound care telemedicine before and during the pandemic, including the characteristics of the models implemented.
TARGET AUDIENCE: This continuing education activity is intended for physicians, physician assistants, nurse practitioners, and nurses with an interest in skin and wound care.
LEARNING OBJECTIVES/OUTCOMES: After participating in this educational activity, the participant will:
1. Identify the characteristics of the studies the authors examined for their scoping review of chronic wound care telemedicine.
2. Choose the electronic methods commonly used for wound care telemedicine in the studies the authors examined.
3. Recognize the implications for the patients who participated in chronic wound care telemedicine in the studies the authors examined.

ABSTRACT

OBJECTIVE: To explore different chronic wound telemedicine models and identify current research on this topic.
METHODS: The authors searched the MEDLINE and EMBASE databases on August 10, 2021 and identified 58 articles included in the analysis.
RESULTS: Included studies were published between 1999 and 2021, with more than half of the studies published between 2015 to 2019 (25.9%, n = 15/58) and 2020 to 2021 (25.9%, n = 15/58). There were 57 models identified, of which 87.7% (n = 50/57) used a blended model of care. Image assessment was the most common element in blended care (66.0%, n = 33/50), followed by video consultation (46.0%, n = 23/50), text (44.0%, n = 22/50), and telephone consultation (22.0%, n = 11/50). Purely virtual care was used in 12.3% (n = 7/57) of models, 85.7% (n = 6/7) of which were implemented during the COVID-19 pandemic. Most studies conducted a quantitative analysis (62.1%, n = 36/58); 20.7% (n = 12/58) conducted a qualitative analysis, and 17.2% (n = 10/58) conducted both. The most frequently assessed results were wound outcomes (53.4%, n = 31/58) and patient opinions (25.9%, n = 15/58).
CONCLUSIONS: Chronic wound care-related telemedicine has common elements: image assessment, video and telephone consultation, and text-based information that can be combined in a variety of ways with unique implementation barriers. Blended care models are more common than purely virtual alternatives. Heterogeneity among outcomes and reporting methods make the results difficult to synthesize.
KEYWORDS: blended, chronic wounds, COVID-19, telemedicine, telehealth, video, virtual, wound care

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INTRODUCTION

The COVID-19 pandemic has led to many new challenges in healthcare, including the management of chronic wounds. Chronic wounds encompass wounds that fail to go through the natural stages of healing, including vascular ulcers, diabetic foot ulcers, pressure injuries, and other nonhealing wounds.[1] Conventional prevention and management of chronic wounds involve a thorough history of the patient's health and lifestyle along with a visual and tactile assessment of the wound. Social distancing, quarantine, and lockdown measures have made it difficult or impossible for some healthcare practitioners (HCPs) to provide quality patient care and access outpatient wound care clinics or hospitals except in emergencies.[2–4] Patients with chronic wounds also tend to be older with many other comorbidities that put them at higher risk for severe COVID-19 infection.[5,6] In the face of these challenges, many healthcare teams have turned to virtual and blended (mixed virtual and in-person) care to maintain continuity of care, although literature on this topic is sparse.[7]

Telemedicine is the use of telecommunications technology to connect HCPs and patients to facilitate remote consultation and care.[8] Chronic wounds often require specialist consultation or care from wound care clinics and experts. Wound-related telemedicine was used prior to the pandemic to improve access to specialized wound care, especially in rural settings. Telemedicine can reduce transportation and healthcare costs, and achieve improved patient outcomes.[9–11] Recent systematic reviews and meta-analyses of telemedicine and chronic wound care outcomes have been conducted that demonstrate noninferiority in most wound outcomes compared with conventional care.[12,13]

Because the trajectory of COVID-19 remains unknown, and the possibility of new emergency circumstances is ever present, there is a need for literature that describes the implementation and challenges of past telemedicine models to guide future decision-making. Accordingly, this scoping review explored the types of published evidence available on chronic wound care telemedicine before and during the pandemic. The authors examined research results for clinical takeaways, including the characteristics of models implemented.

METHODS

This scoping review was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses checklist for scoping reviews.

Search Strategy and Eligibility

The authors conducted a search of the MEDLINE and EMBASE databases from their respective inception dates to August 10, 2021. The search strategy is available in Supplemental Table 1 (http://links.lww.com/NSW/A82). Studies were included if they involved chronic wound care, a virtual or blended model of wound care, were observational (case report, case series, etc) or experimental formats (pilot studies, clinical trials, etc), and were written in English. Studies were excluded if they were conference abstracts, reviews, opinion articles, animal studies, or did not apply to clinical practice. Study selection was conducted independently by two reviewers in duplicate. Disagreements were resolved via discussion or a third reviewer if consensus could not be reached.

Data Extraction and Coding

Data were extracted using a standardized template by two independent reviewers in duplicate. Disagreements were resolved via discussion and resolved by a third reviewer if consensus could not be reached. Study authors were contacted if reviewers required any further information not provided in the articles. Extracted data included study characteristics, patient demographics (sex, age, comorbidities, ulcer characteristics, setting), wound care model characteristics, and main study findings. Data were coded and compiled using digital spreadsheet software.

Data Synthesis

A descriptive and qualitative analysis was conducted for this review. The results of this review are presented in a combination of aggregate format and individual discussion.

Level of Evidence

Level of evidence was assessed for all included articles using the Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence. Included studies were given a level from 1 to 5 based on study type, where level 1 evidence is the highest level of evidence (eg, systematic reviews, n-of-1 trials), and level 5 is the lowest (eg, mechanism-based reasoning, case reports).

RESULTS

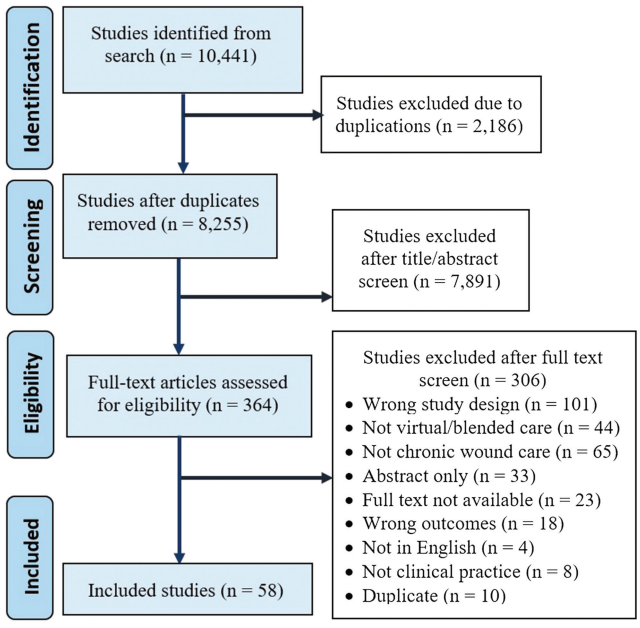
Study Characteristics

A total of 58 articles met the inclusion criteria and were analyzed (Figure). The full set of extracted data can be found in Supplemental Table 2 (http://links.lww.com/NSW/A83).

A summary of study characteristics is outlined in Table 1. The earliest included study was published in 1999, with most studies published between 2005 and 2009, 2015 and 2019, and 2020 and 2021 (each 25.9%, n = 15/58). Studies were conducted primarily in North America (41.4%, n = 24/58) and Europe (37.9%, n = 22/58). Included articles had several levels of evidence:

- Level 2: 19.0% (n = 11/58) were randomized controlled trials
- Level 3: 56.9% (n = 33/58) were cohort studies or nonrandomly sampled surveys
- Level 4: 10.3% (n = 6/58) were case series
- Level 5: 3.4% (n = 2/58) were case reports

Figure. STUDY FLOW DIAGRAM



Most studies had sample sizes between 11 and 50 (34.5%, n = 20/58) or greater than 100 (34.5%, n = 20/58). One qualitative analysis of seven nurse survey responses had an unknown patient sample size. Several studies (34.5%, n = 20/58) included multiple wound types, 24.1% (n = 14/58) examined ulcers in persons with diabetes, 20.7% (n = 12/58) documented pressure injuries, 3.4% (n = 2/58) involved vascular ulcers, 1.7% (n = 1/58) documented a chronic complex wound, and 15.5% (n = 9/58) of the articles did not report wound type.

Wound Care Model Characteristics

There were 57 different telemedicine models outlined in the 58 studies. A summary of model characteristics can be found in Table 2. One study reported two different models of care, whereas two studies were a secondary analysis of outcomes from already included studies. Home care was the most common setting (47.4%, n = 27/57), followed by outpatient care (21.1%, n = 12/57). Other settings included nursing facilities (8.8%, n = 5/57), home care with outpatient follow-up (7.0%, n = 4/57), chronic hospital care (3.5%, n = 2/57), and acute hospital care (3.5%, n = 2/57), and the remaining studies were conducted in various care settings 7.0% (n = 4/57).

COVID-19 restrictions were the reason for implementation in 24.6% (n = 14/57) of models, and poor healthcare access because of remote care for 5.3% (n = 3/57); 70.2% (n = 40/57) of models were implemented for general reasons including cost reduction, improving care outcomes, and various other indications. Most of the included models (87.7%, n = 50/57) implemented a blended model of care, using a combination of image assessment, text, video, telephone, and in-person care.

Blended Model Characteristics

Image assessment was incorporated into 66.0% (n = 33/50) of blended care models. In blended care models, HCPs conducted standard in-person care, followed by preparation and photography of the wound to send for remote specialist or expert assessment. Twelve (36.3%, n = 12/33) of the models used a digital camera for photographs, 8 (24.2%, n = 8/33) used a mobile phone, and devices were unreported for the remaining 14 models (42.4%, n = 14/33). A web-based database was used for images in 45.5% (n = 15/33) of models, and 9.1% (n = 3/33) used email.

Two models specified imaging protocols: one model used at least 3 images from various distances, and one model used 5 to 10 images of various distances and angles. The removed dressing was included in the photograph in three models (9.1%, n = 3/33). The most common use of image assessment was in conjunction with text (39.4%, n = 13/33), where photographs were sent with a written in-person assessment and/or plan from the in-person HCP. Some barriers to implementation were poor image quality, poor or unstable internet connection, lack of space in patient homes for photography equipment, patient concerns about misuse of images, and photography of the wrong wound.

Video consultation was used in 46.0% (n = 23/40) of blended care models to connect remote specialists with in-person HCPs for live remote assessment and consultation with the HCPs and patients and provide procedural guidance for treatment interventions. Of the 23 models, 34.8% (n = 8/23) used a videoconferencing system (of which 6 used a second handheld video camera), 17.4% (n = 4/23) used a smartphone, 13.6% (n = 3/23) used a videophone, 4.3% (n = 1/23) used a computer with a webcam, and 4.3% (n = 1/23) used in-room cameras. Video consultation was most frequently used with only in-person care (34.8%, n = 8/23). Barriers to implementation included hesitancy from healthcare staff, cost of equipment and installation, lack of or poor internet connection, unfamiliarity with equipment, lack of space at patient homes, and difficulties with transporting patients to consultation rooms or transporting equipment.

Telephone consultation was used in various ways as part of patient communication. Eleven models (22.0%, n = 11/50) used telephone consultation in their blended wound care model. Telephone consultation was used to follow up patients remotely in 63.6% (n = 7/11), to connect on-site HCPs with remote experts and specialists for consultation in 27.3% (n = 3/11), and as a triaging system to determine the need for in-person care or hospitalization in 9.1% (n = 1/11) of models. Telephone consultation was used with only in-person care in 36.4% (n = 4/11) of models. The one challenge reported with telephone consultation was the frequent difficulty reaching patients over telephone.

Table 1. STUDY CHARACTERISTICS (N = 58)

Characteristics	n (%)
Year of publication	
1999	1 (1.7)
2000–2004	5 (8.6)
2005–2009	15 (25.9)
2010–2014	7 (12.1)
2015–2019	15 (25.9)
2020–2021	15 (25.9)
Country	
North America	24 (41.4)
US	22 (37.9)
Canada	1 (1.7)
Mexico	1 (1.7)
Europe	22 (37.9)
Demark	5 (8.6)
Norway	4 (6.9)
UK	4 (6.9)
Italy	3 (5.2)
France	2 (3.4)
Austria	2 (3.4)
Sweden	1 (1.7)
Netherlands	1 (1.7)
Asia	8 (13.8)
Israel	3 (5.2)
India	3 (5.2)
China	2 (3.4)
Bangladesh	2 (3.4)
Korea	1 (1.7)
Australia	1 (1.7)
Levels of evidence	
2, Randomized controlled trial	11 (19.0)
3	38 (65.5)
Cohort study	33 (56.9)
Nonrandomly sampled survey	5 (8.6)
4, Case series	6 (10.3)
5, Case report	2 (3.4)
No. of patients studied	
1	2 (3.4)
2–10	10 (17.2)
11–50	20 (34.5)
51–100	5 (8.6)
100+	20 (34.5)
Not reported (seven nurses surveyed)	1 (1.7)
Type of wound examined	
Various	20 (34.5)
Diabetic	14 (24.1)
Pressure	12 (20.7)
Vascular	2 (3.4)
Chronic complex wound	1 (1.7)
Not reported	9 (15.5)

(continues)

Virtual models used several documentation methods. Text was used in 42.0% (n = 21/50) in conjunction with the other modalities as transfer and documentation of wound assessment, patient data, HCP notes, and expert recommendation via email or a web-based electronic medical record system/database. No challenges with the use of text were reported.

Virtual Model Characteristics

A fully virtual model of care was used in 12.3% (n = 7/57) models, 85.7% (n = 6/7) of which were implemented because of COVID-19. Image assessment was the most common element reported in 57.1% (n = 4/7) of models. The one model implemented prepandemic involved preinstallation of a specialized foot imaging device in patient homes, followed by the upload of foot images by the patient three times per week, and telephone follow-up if images were not uploaded. Referrals for treatment were completed as needed by remote image assessment. This model reported challenges with internet connection failures and patient nonadherence to the imaging protocol. During COVID-19, two models used telephone follow-up and online web-based consultation to monitor patients' wounds, prescribe medicines and dressings, and provide guidance on dressing changes. Another model used an institutional health record system for image assessment and a secure videoconferencing platform for physician-led physical examination and dressing changes. Other models included email correspondence with wound images; a digital instant messaging system for text, voice, video, and image consultation; and telephone-only follow-up on nonurgent outpatients.

Patient Role in Care

There was no reported role for the patient in their own care in most blended and virtual care models (71.9%; n = 41/57). Patient roles included self-surveillance for warning signs and seeking consultation as instructed by an HCP (14.0%, n = 8/57), self-care of wounds at home (7.0%, n = 4/57), and telephone/video guided home care that could include guided wound assessment, dressing changes, or other interventions (7.0%, n = 4/57).

Outcome Characteristics

A quantitative analysis was conducted in 62.1% (n = 36/58) 0f studies, and qualitative in 20.7% (n = 12/58); 17.2% (n = 10/58) of studies conducted both. Outcomes assessed among the 58 studies were wound outcomes (53.4%,

Table 2. WOUND CARE MODEL CHARACTERISTICS

Characteristics	n/N (%)
Care setting	
Home care	27/57 (47.4)
Outpatient clinic	12/57 (21.1)
Nursing facility	5/57 (8.8)
Home care with outpatient follow-up	4/57 (7.0)
Hospital—chronic care	2/57 (3.5)
Hospital—acute care	2/57 (3.5)
Various settings	4/57 (7.0)
Type of care	
Blended	50/57 (87.7)
Image assessment, text	13/50 (26.0)
Video	9/50 (18.0)
Image assessment	7/50 (14.0)
Telephone	4/50 (8.0)
Video, image assessment	4/50 (8.0)
Video, text	3/50 (6.0)
Video, image assessment, text	3/50 (6.0)
Video, telephone, image assessment	2/50 (4.0)
Telephone, image assessment	2/50 (4.0)
Telephone, image assessment, text	2/50 (4.0)
Video, telephone	1/50 (2.0)
Virtual	7/57 (12.3)
Telephone, text	2/7 (28.6)
Telephone, image assessment	1/7 (14.3)
Telephone	1/7 (14.3)
Image assessment, text	1/7 (14.3)
Video, telephone, image assessment	1/7 (14.3)
Video, telephone, image assessment, text	1/7 (14.3)
Patient role in care	
None	41/57 (71.9)
Surveillance	8/57 (14.0)
Self-care	4/57 (7.0)
Telephone-/video-guided home care	4/57 (7.0)
Reason for implementation	
COVID-19 restrictions	14/57 (24.6)
Remote care	3/57 (5.3)
Other (reduce costs, improve outcomes, increase access to care, assess feasibility) or not specified	40/57 (70.2)

n = 31/58), patient opinions (25.9%, n = 15/58), HCP opinions (24.1%, n = 14/58), cost (24.1%, n = 14/58), need for referrals/additional care (24.1%, n = 14/58), agreement between in-person and remote assessment (12.1%, n = 7/58), mortality (12.1%, n = 7/58), quality of life (10.3%, n = 6/58), amputation (8.6%, n = 5/68), and procedural issues (5.2%, n = 3/58). A summary of these findings is presented in Table 3.

Wound Outcomes and Complications. The various parameters used to determine wound outcomes included wound healing, healing rate, size reduction, time to recurrence, and percentage of wounds healed. Of the 31 studies that examined wound outcomes with telemedicine compared with standard care, 12.9% (n = 4/31) reported significantly positive outcomes in at least one parameter and no significantly negative outcome in any other parameter. One study (3.2%, n = 1/31) reported a significant increase in wound recurrence, severity, infections, and risk of amputation following the COVID-19 pandemic. Virtual care implementation was associated with significant wound outcome improvement when compared with no follow-up care at the beginning of the pandemic. Of the five studies that examined amputation outcomes, one (20.0%, n = 1/5) reported a significant increase in risk of amputation, and of the seven studies that assessed mortality, one (14.3%, n = 1/7) reported a significant increase in mortality with blended care.

Healthcare Resources and Costs. Of the 14 studies that assessed cost of care, 14.3% (n = 2/14) found significant reductions in costs of transportation. There were eight other cost-of-care studies (57.1%, n = 8/14) with nonsignificant reductions, and two (14.3%, n = 2/14) had nonsignificant increases. Referrals and/or additional care included in-person care, referrals for specialist consultation, hospitalizations, and ED visits. Of the 14 studies that examined the increased need for referrals and/or additional care, 2 studies documented a significant reduction in the need for in-person visits.

Patient and HCP Opinions. Patient opinions were gathered via quantitative or qualitative surveys. Of the 15 studies that assessed patient opinions, 20.0% (n = 3/15) reported significantly positive patient opinions, 66.7% (n = 10/15) reported generally positive impressions, and 13.3% (n = 2/15) reported neutral impressions. The HCP opinions were assessed purely qualitatively. Of the 14 studies that assessed HCP opinions, 92.9% (n = 13/14) were generally positive.

Quality of Life. These measures included direct measures of quality of life, disability, utility scores, and return to work. There were six studies that assessed the effects of telemedicine on patients' quality of life. Half of the studies (50.0%, n = 3/6) reported a significantly positive impact on quality of life, and 16.7% (n = 1/6) reported higher rates of employment after injury.

Procedural Issues. Two of the three studies that assessed procedural issues had minimal procedural issues with image quality or connection/server failures. However, there were substantial connectivity issues in one study.

Agreement. There were six studies that assessed agreement between in-person and remote wound assessment and treatment recommendations. Two studies reported substantial overall good agreement, whereas

Table 3. ANALYSIS AND OUTCOME CHARACTERISTICS

Characteristics	n/N (%)
Type of analysis	
Quantitative	36/58 (62.1)
Qualitative	12/58 (20.7)
Both quantitative and qualitative	10/58 (17.2)
Outcomes assessed	
Wound outcomes	31/58 (53.4)
Significantly positive	4/31 (12.9)
Significantly negative	1/31 (3.2)
Nonsignificant	8/31 (25.8)
Generally positive	16/31 (51.6)
Generally negative	1/31 (3.2)
Neutral	1/31 (3.2)
Patient opinions	15/58 (25.9)
Significantly positive	3/15 (20.0)
Generally positive	10/15 (66.7)
Neutral	2/15 (13.3)
Healthcare provider opinions	14/58 (24.1)
Generally positive	13/14 (92.9)
Neutral	1/14 (7.1)
Cost	14/58 (24.1)
Significantly positive	2/14 (14.3)
Nonsignificant	1/14 (7.1)
Nonstatistical decrease	8/14 (57.1)
Nonstatistical increase	2/14 (14.3)
Neutral	1/14 (7.1)
Need for referrals/additional care	14/58 (24.1)
Significantly positive	2/14 (14.3)
Nonsignificant	2/14 (14.3)
Generally positive	3/14 (21.4)
Generally negative	2/14 (14.3)
Neutral	4/14 (28.6)
Mortality	7/58 (12.1)
Significantly negative	1/7 (14.3)
Nonsignificant	5/7 (71.4)
Neutral	1/7 (14.3)
Quality of life	6/58 (10.3)
Significantly positive	3/6 (50.0)
Nonsignificant	2/6 (33.3)
Generally positive	1/6 (16.7)
Agreement	6/58 (10.3)
Generally positive	4/6 (66.7)
Conflicting	2/6 (33.3)
Amputation	5/58 (8.6)
Significantly negative	1/5 (20.0)
Nonsignificant	1/5 (20.0)
Generally positive	2/5 (40.0)
Neutral	2/5 (40.0)
Procedural issues	3/58 (5.2)
Minimal	2/3 (66.7)
Substantial	1/3 (33.3)

(continues)

Table 3. ANALYSIS AND OUTCOME CHARACTERISTICS, CONTINUED

the remaining four studies reported conflicting results based on the assessed characteristic.

DISCUSSION

This scoping review summarized virtual and blended chronic wound care models and their outcomes reported in 58 different studies. The increased use of telemedicine has been observed all over the world in the last 2 decades, although developing regions of the world are faced with far more barriers to implementation.[14] Reviews of telemedicine projects in developing countries have identified major challenges that disproportionately affect developing countries: high costs of implementation; resistance to change from clinicians; lack of infrastructure; and an aging population, especially in Asian countries.[14,15] As a result, systematic reviews of telemedicine are still predominantly based on literature from Europe and North America.[16,17]

Of the 57 different models characterized in this review, researchers identified four recurring elements in the remote delivery of chronic wound care: image assessment, video, telephone, and text communication. Image assessment was the most common, incorporated into 66.0% of models (n = 50). Among the seven virtual care models, image assessment was used in four (57.1%).

There is a significant amount of research being conducted on image assessment of chronic wounds, also known as asynchronous or store-and-forward telemedicine.[18] In a scoping review of asynchronous telemedicine, dermatology was the most represented specialty, and there have been recent advances in neural networks and machine-learning algorithms to automate the wound assessment process.[18,19] Clinical guidelines from the Institute of Medical Illustrators recommend professional to semiprofessional camera equipment, consistent lighting conditions, plain backgrounds, and color calibration for optimal imaging of wounds.[20] The use of image assessment in this review generally used simpler technology, most often using a digital camera or a mobile phone to take wound photographs that were assessed by a human wound care expert remotely. Photographs were often taken at patient homes by nursing staff, which made it difficult to set up photography equipment and caused issues with image quality consistency. There was one virtual model that used a specialized foot imaging device to simplify the imaging process for the patient, although this model had issues with internet

connectivity and patient adherence to the protocol.[21] A simple cell phone image with good lighting from more than one angle may have better pixel resolution and photographic quality for assessment than video images over the internet.

Other key elements of telemedicine models in our review were video and telephone consultation. Video and telephone consultation are forms of synchronous telemedicine, which are typically applied to intensive care, emergency medicine, and psychiatry settings.[22] However, video has many useful applications in chronic wound care, including allowing specialists to conduct live remote assessments, communicate with patients and on-site HCPs, and provide remote guidance for dressing changes and other procedures. In blended care models, video consultation was often used on its own with an on-site HCP coordinating the interaction, although it was also combined with asynchronous image assessment. There were many barriers to implementation noted including high costs, unfamiliarity with the technology, and internet connection issues.

In comparison, researchers noted no barriers with the use of telephone consultation in our review. Telephone consultation requires less technology and has been more widely accepted among older populations and minorities during the COVID-19 pandemic as documented in a cross-sectional study of more than 160,000 patients. However, a systematic review compared the two communication modalities and concluded that video consultation facilitated more accurate HCP decision-making.[23,24] Telephone HCP consultation can be combined with semiprofessional, digital, or cell phone images to enhance decision-making.

The final key element identified in this review was the use of text-based information, either in the form of email, instant messaging, or an electronic medical record. Email is an accessible system for store-and-forwarding images and accompanying information.[25] Instant messaging via social media platforms are newer additions to telemedicine identified in this review and others.[17]

Although these modes of communication are convenient and accessible, extra care must be taken to ensure patient privacy and information security.[26] An electronic medical record system should be considered a secure alternative, especially if the infrastructure already exists within the healthcare organization. Newer systems can be a one-stop shop for patients, allowing them to access the system using a variety of devices, view their own information, and receive consultation from their HCP from the same software.[27]

There were only seven studies that implemented a fully virtual model of care; six (85.7%) were implemented because of COVID-19. Under ideal conditions, even with the use of telemedicine, chronic wound care has many in-person components such as dressing changes and some aspects of the physical examination (wound drainage, edema, depth, odor) that are difficult or impossible to assess remotely, making purely virtual care less than ideal.[28] During the pandemic, however, the benefits of reducing exposure may outweigh the risks of virtual care. Careful consideration should be taken when weighing the risks; one study reported significant increases in wound recurrence, wound severity, infections, and amputation risk compared with standard care with the implementation of fully virtual care following the start of the pandemic.[3]

This review identified 10 outcome domains. The most common outcomes assessed were wound outcomes (53.4%) and patient opinions (25.9%). Most of the findings were not statistically significant, but positive findings were noted in wound outcomes, patient opinions, cost, need for referrals/additional care, and quality of life. Significantly negative findings were noted in amputation and mortality. These findings mostly align with results from a systematic review and meta-analysis of telemedicine for persons with diabetic foot ulcers that found a significantly higher mortality risk compared with standard care.[13] On the other hand, a third systematic review and meta-analysis of telemedicine outcomes in chronic wound care reported noninferiority of telemedicine in efficacy and safety, with a significant reduction in amputation risk among randomized controlled trials.[12]

Limitations of this scoping review include heterogeneity of the wound care models and reported outcomes that made it difficult to compare findings and draw conclusions among studies. Although the care models shared four common elements (video, telephone, image assessment, text) that could be easily identified, there were 11 different combinations of these among the 50 blended care models and six different combinations among seven virtual care models. Outcomes were also not consistently reported between studies, and many studies reported qualitative outcomes.

This review also did not include gray literature that could have led to the exclusion of potentially notable or innovative wound care models implemented in clinical practice. The exclusion of non-English studies may have resulted in an overrepresentation of wound care models from English-speaking countries.

CONCLUSIONS

Chronic wound care telemedicine uses a combination of image assessment, video and telephone consultation, and text-based information. Existing models mostly combine telemedicine with in-person care, although the COVID-19 pandemic may be associated with a recent increase in fully virtual models of care. There is a wide variety of outcomes assessed that makes findings difficult to compile and synthesize.

PRACTICE PEARLS

- Wound care telemedicine applies one or more of the following elements: image assessment, video/telephone consultation, and text-based communication.
- Most wound care telemedicine reports involve blended in-person/virtual combination models of care. Purely virtual models have been more common with the COVID-19 pandemic signaling a new viable alternative for patient care when in-person care is difficult.

• Patients or HCPs onsite with the patient can obtain photographs for wound assessment. Challenges include poor video image quality, lack of internet connection, and imaging of the wrong wound. Better imaging may be obtained with semiprofessional, digital, or smartphone images transmitted via secure email or alternative transmission methods.
• Video consultation can allow for live remote assessment by a specialist, but barriers to implementation include unfamiliarity with equipment and poor internet connection. Telephone consultation is easier to implement but does not facilitate visual assessment that can be enhanced with image transmission by separate secure communication methods.
• An electronic medical record, email, or (more recently) instant messaging applications can be useful for text-based communication between providers and patients. ●

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