



# Use of Telehealth for Chronic Wound Care: A Case Study

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Use of telehealth in wound care continues to expand as technology is enhanced and clinicians become more familiar with use of the new technology as a supplement to usual care. This article describes the Telehealth Wound Care Program implemented at Mount Sinai Hospital Home Health Agency and Mount Sinai Hospital Wound Care Center. Results of the wound care provided for one patient are included in the case study described in this article. The authors note the many benefits of telehealth as an adjunct to usual therapy in wound care. (J WOCN 2001;28:89-95.)

This article describes a case study in which telehealth was used to coordinate the care of a challenging patient with a complex wound. Use of telehealth made a significant improvement in coordination of care for this particular patient.

Telehealth involves use of telecommunications equipment and communication networks for the purpose of transmitting health care information among health care practitioners at different sites. First introduced in the 1950s, telehealth initially was the focus of minimal use and experimentation.<sup>1</sup> Reasons for this minimal use included expense of the equipment, lack of ability to transmit color images, and poor image resolution. In addition to these general drawbacks in the use of telehealth technology, a limited number of wound care specialists were familiar with the technology. Recent advances in technology, specifically the advent of high-speed and wide-band width communications equipment, as well as an increase in the number of wound care specialists, have resulted in an expansion in use of telehealth. Costs of telehealth technology, including personal computers, video monitors, and digital cameras, have decreased substantially in the past 5 years, providing a more cost-effective and efficient means of communication between practitioners. Furthermore, the images transmitted now have sharp resolution, which is important for accurate diagnosis.<sup>2</sup>

Use of telehealth technology has expanded into the wound care arena during the past few years, with an emphasis on

both video conferencing and “store-and-forward” technology to enhance communication between professionals who care for the patient with wounds. Video conferencing involves use of 2-way interactive real-time computer communication. The store-and-forward technology involves photographing a wound with a digital camera. The image is captured on a disk and can be forwarded by the computer to another location.

Telehealth can be potentially beneficial in management of home care patients with chronic wounds whose treatment is coordinated by multiple specialists. Chronic wounds, those that fail to proceed through a normal, orderly, and timely sequence of healing, affect nearly 2.6 million people in the United States. Furthermore, such wounds are responsible for 50% to 70% of amputations and result in annual health care costs measured in billions of dollars.<sup>3</sup> Chronic wounds include pressure ulcers, venous ulcers, arterial ulcers, diabetic ulcers, and connective tissue disorders.

Important to the use of telehealth in care of wounds is the accuracy with which technology can represent the clinical situation. Using both MEDLINE and PubMed, the authors conducted a search of the literature from 1995 to the present to determine the existing research on use of digital photography as a component of telehealth in wound care. Results can be grouped into 2 categories: (1) evaluation of the adequacy of the technology (ie, reliability and validity compared with other methods of wound assessment), and (2) clinical outcomes.

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## EVALUATIONS OF THE TECHNOLOGY

Two groups of researchers specifically evaluated the accuracy of diagnosis using store-and-forward digital imaging. The accuracy rate using still-image store-and-forward technology ranged from 85% to 90% in studies reported by Burdick and colleagues.<sup>2</sup> Wirthlin and colleagues<sup>4</sup> noted 66% to 95% agreement for wound description and 64% to 95% agreement for wound management between on site and remote physicians using still-image photography for vascular surgery patients with nonhealing wounds. Houghton and colleagues<sup>5</sup> evaluated the reliability and validity of the photographic wound assessment tool for chronic pressure and leg ulcers compared with results using a bedside assessment tool. They determined that the photographic wound assessment tool had interrater reliability (intraclass correlation coefficient = 0.73) and good concurrent validity ( $r = 0.70$ ). Mathewson and colleagues<sup>6</sup> reported use of digital photography with a single case study and demonstrated the potential efficacy of use of this intervention. Despite the positive results in use of photographic wound assessments, authors noted the need for continued evaluation of the technology and cautioned about using photographic assessment as a supplement to a more holistic patient assessment.<sup>5</sup>

## CLINICAL OUTCOME EVALUATIONS

Wirthlin and colleagues<sup>4</sup> compared clinical outcomes for patients evaluated with digital imaging and those evaluated with conventional methods. They determined that diagnostic and treatment decisions were influenced by wound type but not by level of surgical training of the physicians doing the evaluations, nor by method of evaluation.<sup>4</sup> Buntic and colleagues<sup>7</sup> determined that digital photography was highly effective in emergency department assessments. From their case study, they concluded that use of this technology could potentially eliminate unnecessary and expensive transfer of patients.<sup>7</sup>

## SETTINGS

The Mount Sinai Hospital Wound Care Center (MSHWCC) is an outpatient, surgi-

cally oriented program devoted to treatment of nonhealing wounds. The MSHWCC opened in August 1999, and to date approximately 1500 patients have been evaluated. Of these patients, approximately 300 have been involved in the telehealth program. Wounds seen most commonly at the MSHWCC are foot ulcers in patients with diabetes, venous stasis ulcers, and pressure ulcers. The medical staff has an interdisciplinary approach to wound care with expertise in vascular, plastic, and orthopedic surgery as well as gene therapy. The specialist nursing staff consists of 2 nurses who are board certified in wound care by the Wound Ostomy and Continence Nurses Certification Board and one diabetic educator. Through an integrated team approach, patients receive the most appropriate treatment to help heal wounds in the most cost-effective and timely manner. The Mount Sinai Hospital Home Health Agency (MSHHHA) is the largest hospital-based home health agency in the New York Metropolitan area. For its specialized wound care program, the agency employs 2 full-time registered nurses who are board certified in wound care by the Wound Ostomy and Continence Nurses Certification Board. These specialists are responsible for planning, implementing, and evaluating educational systems, programs, projects, and policies that relate to management of acute and chronic wounds. In addition, they perform direct consultations in the patient's home to evaluate the status of wounds and develop a plan of care in collaboration with the patient and physician.

A Telehealth Wound Care Program was developed as a collaborative endeavor between the certified wound care nurses at MSHHHA and staff at MSHWCC. The intent of this program is to: (1) establish continuity of treatment for patients with wounds by coordinating hospital, outpatient settings, and home care agency efforts; (2) enhance communication between physicians and nurses regarding wound care; (3) reduce the number of wound complications and resulting hospital stays; and (4) provide optimal healing in the shortest length of time for the patient. Overall, use of telehealth is expected to improve quality of care, reduce healing time, improve documentation, and decrease the number of patient visits required. Thus the Wound Care Program is designed to provide both quality of care and cost-saving dimensions.

In establishing the Wound Care Program, several components of an effective telehealth program were recognized to exist in the wound care arena. These included physicians and nurse specialists who understand the values and constraints of home care, are cognizant of the technology and willing to implement its use within their standard practice, and are interested and willing to partner in delivery of health care. In addition, all professionals who participate must understand the security of patient-sensitive data.

## METHODS

Photographic images of the wounds are taken with a Sony Mauica Digital camera (Model MVC FD 81, Sony Corporation, Tokyo, Japan; resolution 640 × 480/1024 × 768 pixels in 24-bit color) in the patient's home at the time of home visits by the MSHHHA wound care nurse specialists or during the patient's visit to the MSHWCC. Photographs are collected at the initial assessment phase, during each home visit by the wound care nurse specialist, following debridements at the MSHWCC, and at wound closure. The image is stored on a disk and forwarded, along with the nurse's detailed assessment and recommendations, to the MSHWCC physician.

One of the advantages of this technology is that no additional software is required to download the image from the camera to the computer. The high-resolution images are stored on a formatted 3.5-inch, 2HD floppy diskette, with each diskette holding 10 to 16 images. The image can be sent to the physician simply by removing the floppy disk from the camera, inserting the disk into the computer, and forwarding the image as an e-mail attachment. This process requires that both the sending and receiving computers be equipped with a Web browser (Microsoft Internet Explorer 4.0, Netscape Navigator), or some form of photo editor software. Most modern computers are equipped with one of these packages, eliminating the need to purchase additional software. For this program, images are then transmitted over the Hospital's intranet (cc:mail) system. All cc:mail applications restrict access to cc:mail data by requiring users to submit a log-in name and password before applications can run. All cc:mail database transactions are encrypted before leaving the workstation. No situation ever occurs in which the message con-

tents are available outside of the workstation in an unencrypted format. Two separate algorithms are used for encrypting the data: (1) a primary layer of encryption remains in effect even when files are transmitted to a remote cc:mail post office, and (2) data sent by e-mail are secured through this encryption process. To ensure patient confidentiality, no records are transmitted outside of the Hospital system (ie, through Internet access); only the Hospital's intranet system is used. Informed written consent of the patient, family, or both is required to use this system.

## CASE HISTORY

The patient is a 79-year-old widow who is responsible for the care of 2 young children. She was referred to MSHHHA on March 1, 1999, from an out-of-state rehabilitation facility following surgery for spinal fusion with Harrington rod placement. This surgery was secondary to a fall that occurred on January 1, 1999. The patient had a number of chronic health conditions, including hypertension, bilateral carotid stenosis (75% stenosis of the left carotid artery, 85% stenosis of the right carotid artery), chronic ischemic heart disease, atrial fibrillation, bilateral cellulitis of the lower extremities, and depression. The patient was receiving several medications, including 2 antihypertensive drugs (furosemide [Lasix], omeprazole [Prilosec]), a calcium supplement, and multivitamins.

The patient, who was first seen by a home care nurse from MSHHHA, presented with a stage IV sacral ulcer with clearly exposed bone. The ulcer was necrotic with copious purulent drainage from the site. On initial assessment, the patient appeared cachexic, unkempt, and was incontinent of urine and stool. The patient was able to ambulate only a few steps with a walker and had poor endurance. She complained of general malaise and fatigue. Wound measurements were as follows: length, 16 cm; width, 12.8 cm; depth, 2.8 cm; and undermining, 1.8 cm. The nutritional assessment completed by the home care nurse disclosed that the patient had a poor appetite and limited oral intake, as well as severe protein and calorie deficiencies in her diet. Supplements and a nutritional consult were recommended. After consultation with the patient's primary physician, the decision was made to refer the patient to MSHWCC for evaluation and

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**Figure 1.** Initial assessment on March 8, 1999.



**Figure 2.** Extensive necrosis on March 16, 1999.

treatment of the wound. A comprehensive treatment plan was developed that addressed pressure relief, topical management, physical therapy, nutritional consultation, and use of telehealth technology.

The patient was seen by a plastic surgeon at the MSHWCC on March 8, 1999, and debridement of the wound was completed (Figure 1). She agreed to daily dressing changes by the home care nurse. To address the extensive necrosis, initial topical management included use of high-pressure irrigation, wet-to-dry dressings with  $\frac{1}{4}$  strength Dakins solution and Mesalt packing. The patient refused pressure-relieving devices as well as nutritional supplements. When she returned to the MSHWCC the following week, the wound

had deteriorated significantly (Figure 2). Blood was drawn for tests at the MSHWCC. Laboratory results were as follows: white blood cell count, 22.2; hemoglobin, 9.5; hematocrit, 28.5; albumin, 2.6 (normal value, 3.5 to 5.5); and transferrin, 15 (normal value, 200 to 450). The patient was determined to be septic, anemic, and severely malnourished. At this time, she was admitted to the hospital for sharp debridement and wide excision of the wound and intravenous antibiotic therapy (Figure 3); this hospital admission was for 6 days (March 17-23). After discharge, the patient was again monitored by the MSHWCC and certified wound care nurses from MSHHHA. She agreed to pressure-relief measures and dressing changes but



**Figure 3.** After debridement on March 29, 1999.



**Figure 4.** Granulating wound on September 23, 1999.

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continued to refuse to follow recommendations regarding nutritional supplements.

The patient was not compliant with nutritional recommendations, and on April 9, 1999, she was admitted to the hospital with a wound infection, urinary tract infection, and fecal impaction. She was treated with intravenous antibiotics and again provided with instructions regarding the importance of nutritional supplements. Her oral intake continued to be inadequate, and after several consultations among practitioners and with the patient, the decision was made to insert a percutaneous endoscopic gastrostomy (PEG) so she would have adequate nutritional intake that would support wound healing. The PEG was inserted on April

19, 1999, and the patient was discharged from the hospital to an immediate care facility. Primary reasons for this discharge to an immediate care facility were the patient's nutritional status, her inability to care for herself and her young children, and her noncompliance with overall treatment plans. She remained in the immediate care facility for 6 weeks before being discharged to her home.

After being discharged from the immediate care facility, the patient was too weak to travel to the MSHWCC on a weekly basis, so the decision was made to have her evaluated at the MSHWCC every 3 to 4 weeks. After each visit, a photograph of the wound was transmitted to the wound care nurses at the MSHHHA along with



**Figure 5.** Decreased wound volume on October 16, 1999.

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*High-resolution images allowed the physician and home care staff to communicate frequently and monitor the wound's progress continuously.*

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any changes in the plan of care. During the weeks the patient was not evaluated at MSHWCC, her status was monitored by the certified wound care nurse from MSHHHA. A digital image and detailed assessment and recommendations for treatment were transmitted to the staff at the MSHWCC (Figures 4 and 5).

During this time, the patient's oral intake improved and the PEG was removed. In addition, she had become more compliant with pressure-relief measures. When the last photograph was taken (October 16, 1999), the patient's wound had shown considerable improvement with a significant decrease (96%) in wound volume (calculated by multiplying length of the wound by width by the depth).

During the 7-month period reported here for which telehealth was used, the patient experienced a considerable reduction in wound volume. In addition, the patient also experienced significant improvements in her nutritional and mobility status. Through the use of telehealth, the physicians and home care staff were provided with nearly real-time images of the wounds. This form of communication allowed for timely adjustments to the plan of care. In addition, all participants agreed that both the equipment and technology were easy to use. The overall benefits included improved communication, collaboration, and documentation.

## **DISCUSSION**

This case study demonstrates that digital wound imaging can enhance management of care of patients with complex wounds.

The high-resolution images allowed the physician and home care staff to communicate frequently and monitor the wound's progress continuously. Transmitting the digital images by way of the hospital's intranet system provided the physician and wound care nurses with nearly real-time images of the wound. After viewing the images, decisions regarding modification to the treatment plan could be communicated by e-mail, eliminating time-consuming "phone tag" communication. According to the self-report of physicians and nurses participating in the care of this complex and challenging patient, availability of this form of telehealth greatly improved communication and coordination of care among the various health care professionals. Both physicians and nurses participating in the patient's care had immediate access to the digital images and quickly responded to each other's requests for viewing the images. When necessary, they viewed the images together and discussed treatment options. MSHWCC staff (physician and nurse) and MSHHHA staff (home care nurses and wound care nurse specialists) documentations were done separately, according to the protocols established by each agency. MSHHHA wound care specialist nurses documented their assessments alongside color copies of the photographs in a wound care consultation note that become part of the patient's MSHHHA permanent record. Often, all or part of this documentation was shared by e-mail; that is, the detailed assessments of the wound by MSHHHA staff and photographs of the wound, along with narratives describing the wound, were sent by e-mail to the MSHWCC staff. All communications by

e-mail and records of telephone contact were documented in the patient's charts both at the MSHWCC and MSHHHA.

## CONCLUSIONS

In this case study, telehealth provided increased communication and collaboration among team members—especially those at different sites—and enhanced documentation, specifically documentation related to the wound. Use of digital photography and e-mail transmission of images added to the usual documentation by making a visual record of the patient's healing progress available. In addition, documentation included narrative descriptions of the wounds that accompanied the images by e-mail. The photographs also were printed and kept as a component of the patient's MSHHHA chart.

From this case study, it was concluded that telehealth potentially facilitated continuity of care, more accurate assessment, better wound management, and improved evaluation. Both staff at the MSHWCC (physicians and nurses) and MSHHHA (home care nurses and wound care nurse specialists) concurred that the visual images were an important supplement to the usual care and documentation for this patient's course of treatment and wound healing. Also important was that use of digital photography in the patient's home reduced the number of visits the patient had to make to the MSHWCC. Initially, the physicians wanted to see the patient in the MSHWCC every week. The wound care nurse specialist's judgment was that this would be extremely difficult for this patient, given her personal situation and previous lack of follow-up with recommendations regarding care. With the use of digital photography in the home, the MSHWCC visits were scheduled for every 3 weeks. Thus, over the course of this patient's 7-month wound care treatment, approximately one to two visits per month

were saved, for a total of approximately 10 MSHWCC visits during the course of treatment.

Specific data relating to costs of treatment were not collected for this case study, leaving an area for further study. It also is expected that this form of enhanced documentation will lead to fewer denials of payment by third-party payers. Also, under the impending prospective pay system for home care, it will be important to evaluate whether the time allotted to care of wounds would be decreased through the use of telehealth. To the extent that telehealth can shorten the length of treatment, it will prove to be a cost-effective technology.

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