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Application of Telemedicine in Wound Management and Follow-up after Discharging of Patients from Hospital

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Abstract

The increasing physical, mental, societal, and financial challenges posed by wounds and their care for individuals, families, and society underscore the urgent need for attention from the healthcare sector. Various factors contribute to the shifting landscape of healthcare provision for patients dealing with chronic wounds, including managed care dynamics, the scarcity of wound care specialists, a growing elderly and disabled population, regulatory concerns, and legal liabilities. Physicians also grapple with complex issues in managing chronic wound cases due to their time-intensive nature, high-risk profile, lack of profitability, and legal implications. Telemedicine emerges as a valuable tool to facilitate communication between physicians and specialized wound care experts. Utilizing digital imaging for skin lesions offers a safe, precise, and cost-efficient means of referral. Telemedicine employs two primary modes—store and forward (asynchronous transfer) and real-time transmission (synchronous transfer, such as video conferencing)—in the wound care context. In the hands of experienced clinicians, telemedicine technology can streamline the management of challenging wounds. While apprehension about technological change persists, the evolution of telemedicine in wound care has demonstrated a foreseeable process of advancement. In this case report, we have reported a case of 8 year old male child who sustained electrical burns over scalp, and was discharged later following wound healing. The child later developed pustule over the scalp which was picked up immediately and attended to, because of serial follow up everyday following discharge, because of telemedicine.

Keywords: Telemedicine; Wound management; Follow-up after discharge.

INTRODUCTION

The World Health Organization (WHO) defines telemedicine (TM) as the delivery of healthcare services using information and communication technologies by healthcare professionals, aimed at overcoming geographical barriers to exchange valid information for diagnosis, treatment, and prevention of diseases and injuries. Additionally,

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it serves purposes such as research, evaluation, and continuing education of healthcare providers, all with the goal of improving individual and community health. In 2001, the Indian Space Research Organization (ISRO) initiated a TM pilot project to introduce TM services to rural populations as part of a proof-of-concept technology demonstration. This initiative aims to connect remote district hospitals and health centers with specialized hospitals in urban areas via INSAT satellites, facilitating expert consultations for underserved communities. Currently, ISRO's TM Network extends its services to 382 hospitals, comprising 306 remote, rural, and district hospitals/ health centers and 16 mobile TM units linked to 60 super specialty hospitals in major cities. Mobile units play a vital role in providing tele-ophthalmology, diabetic screening, mammography, child care, and community health services.

MATERIALS AND METHODS

An 8 year old male child who sustained accidental electrical burns over scalp (*Fig. 1*) was admitted in burns ICU in JIPMER. Various regenerative wound healing modalities were performed, and the child was later discharged after wound healing. After discharge, daily follow-up of the wound status and general condition of the child was followed up through telemedicine. The child developed a pustule over the scalp which was picked up immediately due to the serial follow up (*Fig. 2*), and was immediately called back for admission and management. After serial dressing the wound condition again improved and became better (*Fig. 3*). Immediate identification of any deviation in the normal course of the patient can be done to an extent through serial follow up via telemedicine.

Fig. 1: Scalp wound of the child at time of admission

Fig. 2: Scalp wound sent by parent of the child during telemedicine follow up which revealed a pustule over the scalp

Fig. 3: Scalp wound after admission and serial dressings and application of various regenerative wound healing modalities, showing improvement of condition of the wound

RESULTS

The utilization of telemedicine was noted to be a very beneficial method to follow up patients after being discharged from hsopital facility. It has proven to save time and expenditure of the patients, as well as increased the compliance between the doctor and the patient, even after discharge of the patient.

DISCUSSION

History of telemedicine

The first telephone transmission, made by Alexander Graham Bell to his assistant Mr. Watson, consisted of the message: "Watson, come here, I need to see you." This call for medical assistance remotely marked the initial event in modern telemedicine[1].

Types of Telemedicine[2]

1. **Store and Forward (SAF) or Pre-recorded (Asynchronous) Telemedicine:** This method involves acquiring and storing information about the wound before transmitting it for expert interpretation through appropriate means. Store and forward (SAF) entails the transmission of digital images with asynchronous evaluation, eliminating the need for simultaneous presence of healthcare professionals. It is widely used due to its affordability and ease of implementation.
2. **Real-time or Video Conference (Synchronous) Telemedicine:** Real-time interaction allows for immediate transmission and display of information about the wound, enabling interactive communication between individuals at the site. It requires the availability of an expert for consultation. Video consultation (VC) connects patients, often with their General Practitioner (GP) or nurse present, to a distant consultant. Although initial studies deemed it expensive, recent advancements in technology and reduced hardware costs have made it economical. Diagnostic accuracy ranges between 67% and 80% compared to face-to-face consultations.
3. **Hybrid Telemedicine:** Hybrid telemedicine combines SAF telemedicine in the initial step with VC telemedicine in the subsequent step, saving time, clarifying doubts, and minimizing misinterpretations from both ends. This approach enhances physician and patient satisfaction in wound care.
4. **Mobile or Cellular Telemedicine:** Portable devices like cellular phones and Personal Digital Assistants (PDAs) equipped with cameras and networking capabilities allow for capturing and transmitting digital images of wounds for remote consultation. Quality and speed of image transmission have significantly improved, with diagnostic agreement reaching up to 90% compared to face-to-face consultations. These devices facilitate immediate access to experts and enable periodic evaluation of wounds in remote areas.
5. **Integration Model:** The integration model involves the systematic incorporation of electronic devices and software to capture, transfer, store, measure, and deliver follow-up wound care. It provides immediate access to visual parameters, facilitates routine follow-up care in remote areas, and enables rapid and precise measurements. Computerized graphs track wound healing progression, minimizing variations in observation and enhancing consultant and patient satisfaction. This approach maximizes the utility of SAF telemedicine centers and ensures standardized care delivery across healthcare professionals.

Classification of Telemedicine Centers:

Telemedicine centers for wound care are broadly categorized as:

1. Primary Telemedicine Center (PTC)
2. Secondary Telemedicine Center (STC)
3. Tertiary Telemedicine Center (TTC)

These categories can further be subdivided into three major levels, L1, L2, and L3, based on size and available facilities, with L1 representing the smallest level.

Infrastructure and Hardware

The hardware platform in most telemedicine systems typically consists of a desktop Personal Computer (PC). Depending on the specific application and spatial constraints, alternative platforms such as mobile systems, handheld devices, or home-use systems may also be utilized. These alternative platforms can include laptop computers, palmtop computers, PDAs, or dedicated boxes (set-top boxes) with processors. Minimum specifications for a typical PC include those of a standard desktop.

Positive Impact of Telemedicine on Triage and Management of Problem Wounds[3]

Telemedicine applications in wound care settings utilize two primary modes: Store and Forward (SAF) for asynchronous transfer, and real-time transmission (synchronous transfer, e.g., VC). Studies, such as one conducted by Dobke *et al*. in 2006, have assessed the impact of telemedicine on triaging and developing management plans for patients with chronic, problematic wounds in various care settings. Telemedicine has also been found useful in improving communication

with surgical wound care specialists[4]. Referral by digital image for skin lesions has been confirmed as a safe, accurate, and cost-effective pathway[5]. Dobke *et al*. retrospectively analyzed a database of 120 patients to determine the concordance of management plans established through telemedicine consultations alone compared to those established by multidisciplinary teams with direct patient contact. They found a 93.6% concordance with the management plan established by the surgeon based on telemedicine consultation alone. This study highlights the potential of telemedicine technology, in the hands of experienced physicians, to streamline the management of problem wounds[6]. Telemedicine has shown promise in mitigating the challenges posed by the limited availability of wound care specialists and facilitating rapid treatment[7].

Technical Considerations

When selecting a camera for telemedicine-based wound care, several factors and features must be taken into account. Key optical parameters such as color bit depth, white balance, focus, and macro capabilities are crucial considerations. Image quality must strike a balance—not excessively low, which could compromise clinical assessment, nor impractically high, leading to lengthy downloading and transfer times, especially when dealing with multiple high-resolution files. Therefore, effective compression techniques to reduce image file size while retaining pertinent details are essential[8]. There are two primary types of image compression: "lossy" and "lossless." Lossless compression preserves the image without any alteration but offers relatively modest compression rates, typically 2:1. In contrast, lossy compression achieves higher compression rates by discarding some image information, usually insignificant color differences between pixels. For wound care applications, it is vital to test compression ratios to determine the optimal balance between image compression for speedy transfer and maintaining sufficient image quality for accurate clinical decision-making by the recipient[9].

Patients' Perceptions

Literature reports indicate that telemedicine for wound care is well-received by patients. Concerns about patients rejecting "anonymous" electronic communication between themselves and healthcare providers are unfounded. Telemedicine consultations offer accurate assessments for treating problematic wounds and are welcomed by patients, potentially expediting and streamlining care for those with chronic wounds. Incorporating telemedicine as an initial or intermediate communication step with patients appears to educate patients and foster stronger bonds with specialist consultants[10,11].

Surveys of physicians utilizing telemedicine services reveal overall high satisfaction rates and suggest that telemedicine could prompt earlier initiation of wound treatment compared to conventional care delivery[12]. Concerns about telemedicine consultants overtaking patient management or negatively impacting primary healthcare practitioners' practices are unsubstantiated. Issues with continuity of care or follow-up processes have not been widely experienced[4,10,12,14]. Physician acceptance and willingness to utilize telemedicine depend on prior experiences and attitudes toward telemedicine. Exposure to telemedicine enhances physicians' inclination to integrate it into their practice and expand its implementation across various facets of healthcare. Providing support from sponsoring organizations, ensuring structural legitimacy, and establishing cohesive networks can further enhance physician acceptance of telemedicine[15].

Video Conferencing as an Operational, Research, and Educational Tool in Wound Care

Studies demonstrate that videoconferencing in educational settings results in increased interaction between students and faculty compared to traditional in-person settings. Feedback indicates that students derive greater educational value from telemedicine experiences than from physical presence in the operating room. Telemonitoring serves as a sustainable method to connect mentors and trainees in regions lacking specialized expertise, educators, and organizers of wound care[16].

Assessing Outcomes and Providing Long-term Wound Care

Ongoing research in telemedicine focuses on evaluating its efficacy in assessing outcomes in wound care practice. Telemedicine appears to be a safe and effective method for delivering wound care to medically underserved populations or unsupervised settings, such as rural or wilderness areas. Remote management of certain aspects of wound care does not negatively impact outcomes and meets the needs of diverse patient populations[17.]

Limitations

One significant limitation may stem from the lack of telemedicine facilitation centers in rural areas, alongside insufficient training on data transfer for

both rural and urban populations, contributing to apprehension regarding technology-based devices. Additionally, challenges such as poor image quality, pixelation, and perspective distortion could lead to clinically significant disparities between electronically transmitted photos and direct examinations, potentially resulting in inaccuracies in proposed diagnoses and management plans[4].

Future Prospects:

As telemedicine technologies continue to evolve and improve, they will play a crucial role in advancing wound care into the digital age and facilitating its globalization. Telemedicine holds promise in addressing both basic wound care needs in medically underserved areas and complex surgical requirements by enabling expert consultations. With ongoing technological advancements and increasing physician exposure, telemedicine for wound care is expected to expand its applications significantly. Ultimately, telemedicine will be indispensable for remotely guided or assisted wound procedures, whether robotic or traditional, performed by healthcare professionals. Moreover, the development of home telemedicine programs for direct communication between wound care specialists and patients at home, facilitated by simple devices like cellular phones with cameras, has the potential to enhance postoperative follow-up and improve the quality of wound care[7].

Medicolegal Aspects of Telemedicine:

Several legal and ethical concerns surround telemedicine, including healthcare professionals' responsibilities and liabilities, patient record confidentiality, jurisdictional issues in cross-border consultations, and reimbursement for telemedicine services. While cross-border telemedicine services have commenced, questions regarding jurisdiction and registration remain unresolved. However, healthcare professionals who practice telemedicine prudently can mitigate potential medicolegal complications[19].

Email-Based Telemedicine:

Email-based telemedicine has applications across various medical specialties, including primary and second opinion consultations, telediagnosis, and administrative roles such as e-referral. It is particularly beneficial in low-bandwidth, image-based specialties like dermatology, pathology, wound care, and ophthalmology, where attached digital camera images facilitate telediagnosis. Although regarded as underutilized, email-based telemedicine has significant potential to enhance outpatient services' efficiency and improve patient care[22].

CONCLUSION

Wound care, being a visually oriented specialty, heavily relies on images for diagnosis and treatment. The prolonged treatment duration and frequent monitoring necessitate numerous follow-up visits, often accompanied by travel expenses and extended waiting times. These factors underscore the suitability of telemedicine applications for wound care, offering a convenient and effective means of addressing the specialty's unique challenges. Through this case report we can understand the benefits of telemedicine, and how newly arising problems can be picked up and treated at the earliest, by frequent follow-up through telemedicine consultations, as it is a more convenient method for the physicians and the patients.

REFERENCES

1. Perednia D.A., Allen A. Telemedicine technology and clinical applications. *JAMA.* 1995;273:483–8.
2. Chittoria R.K., Singh U., Muralidhar A. *Telemedicine for Doctors*. 1st ed. New Delhi (India): AITBS Publishers; 2009.
3. Meyer B.C., Friedman L.S. Telemedicine-closing in on distance medicine. *San Diego Physician.* 2010; 97:36–9.
4. Dobke M.K., Renkielska A., De Neve J., Chao J., Bhavsar D. Telemedicine for problematic wound management: Enhancing communication between long-term care, skilled nursing, and home caregivers and a surgical wound specialist. *WOUNDS: A Compendium of Clinical Research and Practice.* 2006; 18:256–61.
5. Tadros A., Murdoch R., Stevenson J.H. Digital image referral for suspected skin malignancy - a pilot study of 300 patients. *J Plast Reconstr Aesth Surg.* 2009; 62:1048–53.
6. Dobke M.K., Bhavsar D., Gosman A.A., De Neve J., De Neve B. Streamlining the management of patients with problematic wounds: Must a multidisciplinary team formulate all patient management plans? *WOUNDS: A Compendium of Clinical Research and Practice.* 2007; 19:340–4.
7. Terry M., Halstead L.S., O'Hare P., Gaskill C., Ho P.S., Obecny J., *et al*. Feasibility study of home care wound management using telemedicine. *Adv Skin Wound Care.* 2009; 22:358–64.

8. Patricoski C., Ferguson A.S., Brudzinski J., Spargo G. Selecting the right digital camera for telemedicine. *Telemed J E Health.* 2010; 16:1–8.
9. Jones S.M., Banwell P.E., Shakespeare P.G. Telemedicine in wound healing. *Int Wound J.* 2004; 1:225–30.
10. Dobke M.K., Bhavsar D., Gosman A., De Neve J., De Neve B. Pilot trial of telemedicine as a decision aid for patients with chronic wounds. *Telemed J E Health.* 2008; 14:245–9.
11. Berguist T.F., Thompson K., Gehl C., Muno Pineda J. Satisfaction ratings after receiving Internet- based cognitive rehabilitation in persons with memory impairments after severe acquired brain injury. *Telemed J.E. Health.* 2010; 16:417–23.
12. Bridgen M., Minty A., Pilatzke S., Vidova L.D., Sherrington L., McPhail K. A survey of recipient client physician satisfaction with teleoncology services originating from Thunder Bay Regional Health Sciences Centre. *Telemed J.E. Health.* 2008; 14:250–4.
13. Hanson D., Calhoun J., Smith D. Changes in provider attitudes toward telemedicine. *Telemed J.E. Health.* 2009; 15:39–43.
14. Loera J.A. Generational differences in acceptance of technology. *Telemed J.E. Health.* 2008; 14:1087–90.
15. May C., Harrison R., MacFarlane A., Williams T., Mair F., Wallace P. Why do telemedicine systems fail to normalize as stable models of service delivery? *J. Telemed Telecare.* 2003; 9 (suppl 1):25–6.
16. McIntyre T., Monahan T., Villegas L., Doyle J., Jones D.B. Teleconferencing surgery enhances effective communication and enriches medical education. *Surg Laparosc Endosc Percutan Tech.* 2008; 18:45–8.
17. Nesbitt T.S., Hilty D.M., Siefkin A. Development of a telemedicine program. *Western J. Med.* 2000; 173:169–74.
18. Stanberry B. Legal and ethical aspects of telemedicine. *J TelemedTelecare.* 2006;22:166–74.
19. Nijland A., Julia E.W., Pinjen G.V. Increasing the use of e-consultation in primary care: Results of an online survey among non-users of e-consultation. *Int J. Med Inform*. 2009; 78:688–703.
20. Xiao Y., Gagliano D., LaMonte M., *et al*. Design and evaluation of a real-time mobile telemedicine system for ambulance transport. 2000;9:47–56.
21. Foltynski P., Ladyzynski P., Wojcicki J.M. Telemonitoring of diabetic foot ulcers being managed in the outpatient setting. *The Diabetic Foot Journal.* 2012; 15:74–82.
22. Caffery L.J., Smith A.C. A literature review of email-based telemedicine. *Stud Health Technol Inform.* 2010; 161:20–34.
23. Turk E., Karagulle E., Aydogan C., Oguz H., Tarim A., Karakayali H., *et al*. Use of telemedicine and telephone consultation in decision-making and follow-up of burn patients: Initial experience from two burn units. *Burns.* 2011; 37:415–9.
24. Waran V., Selladurai B.M., Bahuri N.F., George G.J., Lim G.P., Khine M. Teleconferencing using multimedia messaging service (MMS) for long-range consultation of patients with neurosurgical problems in an acute situation. *J. Trauma.* 2008; 64:362–5.