

Fast resuscitation and care of the burn patients by telemedicine: A review

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Background: In Iran, burns are the second most common cause of death, after traffic accidents in individuals under the age of 15 years. Many burned patients die or suffer injury due to lack of immediate care, so we need to use an alternative resuscitations to cure them immediately. Telemedicine describes the use of medical information exchanged from one site to another via electronic communications to improve patients' health status and care. The aim of this study was to express the advantages of Telemedicine to resuscitate and care burn patients. **Materials and Methods:** This study was a narrative review. The literature was searched on fast resuscitation and care of the patients' burn by telemedicine with the help of libraries, databases, and also searches engines available at Google, Google scholar, books and conference proceedings. In our searches, we employed the following keywords and their combinations: Telemedicine, Telecare, Burn, Burn patient, Air transport, Triage and Health Information Management in the searching areas of titles, keywords, abstracts and full texts. **Results:** In this study, more than 78 articles and reports were collected and 30 of them were selected based on their relevancy. **Conclusion:** Acute evaluation of burn patients can be performed by the telemedicine and it plays an important role in improving access to the required expertise, and raises physician confidence in treating burn patients. This can reduce under-triage or over-triage for air transport and finally lead to saving time and cost.

Keywords: Air transport, burn, patient, telemedicine, telecare, triage

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INTRODUCTION

Burns have significant short- and long-term consequences for patients and their families, and are one of the most serious injuries to mankind. Outcomes for burn patients have improved dramatically over the past 20 years; however, burns still cause substantial morbidity and mortality.^[1-3] Morbidity and mortality rise with the increasing burned surface area. It also rises with the increasing age so that even small burns may be fatal in elderly people.^[4] The depth of a burn wound and/or its healing potential are the most important determinants of the therapeutic management and of the residual morbidity or scarring. So it is important to estimate the depth of the burn to assess its severity and to plan future wound care.^[5] Fire is the fifth leading cause of unintentional injury and the third leading cause of fatal home injury in the United States.^[6] Also, burns are the major cause of death and disability worldwide, particularly in developing countries. In Iran, burns are the second most common cause of death, after traffic accidents, among individuals under the age of 15 years.^[7] Also, many burned patients die because of lack of immediate

care, due to which injury becomes more severe and patients become more compromised.^[1] Hence, we need to use an alternative resuscitate and care to treat them immediately.

The patients' care should be a high priority at the emergency department (ED) for acute patient situations. The ED provides urgent clinical and para-clinical care (such as lab test, radiology, electrocardiogram) for patients that injured in accidents and incidents. The injured patients need urgent treatment according to their injury circumstances and injury rather than situations. These patients should receive resuscitative treatments in the shortest time.^[8] Therefore, adequate and effective emergency management of the burn patient during the first few hours postburn can prevent the burn wound from progressing and becoming infected, and facilitate faster healing and rehabilitation and long-term functionality.^[1,9] Telemedicine means use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or healthcare provider and for the purpose of improving patient care.^[10]

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Telemedicine is one of the solutions that is useful. Recent developments in information and communications technology have the potential to revolutionize health care. The telemedicine is one of the most successful techniques in this rapidly expanding field.^[11]

Of course, all technologies have weaknesses but in order to reduce them we need to recognize their weaknesses. In health management systems, information has a special role in planning, evaluation, and managing.^[12] In fact, the first distinctions between developed and developing countries are the production, application, distribution and utilization of information. In this way, new technologies should help healthcare providers.^[13-15]

It is a rapidly expanding technology involving the exchange of medical information to assist diagnosis and treatment at a distance.^[16] The aim of this study was to express advantages of the Telemedicine to resuscitate and care burn patients.

MATERIALS AND METHODS

This study was a narrative review. The literature was searched for the telemedicine applications for fast resuscitation and care of the patients' burn. Our study was divided into three phases: Literature collection, assessing, and selection. Researchers identified studies that denoted advantages of applying the telemedicine for burn patients. The literature search was conducted with the help of library search engines available at Google, Google scholar, books, and conference proceedings. The search was performed in early May in 2012 until March 2013 to ensure that our literature review is most up-to-date. In our searches, we employed the following keywords and their combinations: Telemedicine, telecare, burn, burn patient, air transport, triage, and health information management in the searching areas of titles, keywords, and abstracts from 1999-2013. Search results were reviewed for relevance to burn patients. Studies that did not report an application of telemedicine for burn patients were excluded. More than 78 articles were collected and assessed 30 of them were selected based on their relevancy.

The last phase followed our proposed research framework and conducted detailed analysis with regard to the literature. We studied how the telemedicine was applied for fast resuscitation and care of the patients' burn by analyzing the research prototypes, pilot studies and case studies in our collected literature; we identified the benefits of telemedicine adoption for burn patients. These implications can be used to guide future research in this field.

RESULTS

Although Rafii *et al.* mentioned that to date, few studies have been conducted on this subject in Iran, and the findings of these studies rather inconsistent.^[7] According to Tehrantimes News, in 2012, 2,026 people lost their lives from burns in Iran out of which 1033 were women and 993 were men.^[17] Burn injuries in Iran are much more common than in the United States and Europe.^[18] Although, Iran has a well-developed system of rural health workers and clinics, covering most border areas, they need to consult with specialists for resuscitating burn patients.

It appears that telemedicine can be useful for burn patients. For example, telemedicine increases the effectiveness of treatment, and it is also involved in the training of less experienced surgeons and follow-up of burned patients.^[19]

In these reviewed papers, we have included several other studies that bring additional viewpoints and use cases for this article [Table 1].^[5,15,20-30]

The telemedicine is beneficial for assessment of burn depth and burn wound healing potential that it is especially important in the early hours after burns in accident and emergency department, where decision for treat or refer needs to be made.^[5] Telemedicine can encourage appropriate measures to respond to minor and major burns.^[23]

Saffle *et al.* mentioned, 'The ability to evaluate burn patients by telemedicine may have the potential to assist decisions regarding transfer'.^[29]

'For patients with major burns, the telemedicine evaluation helped speed preparation of appropriate critical care and justify the expense and risks of air transport; patients with lesser burns were quickly identified for economical ground transport or given definitive local care'.^[23] For example one study by Shokrollahi *et al.* showed that 'Camera phones appear to be reliable for the assessment of Total Burn Surface Area (TBSA) and burn depth in mirror burns. Although not assessed directly in this study, it is likely that major burns can also be estimated successfully in this way'.^[25] But, how can evaluate and treatment of burns patient by telemedicine be done?

The telemedicine plays an important role in improving access to the required expertise for the burn patients. Nowadays the telemedicine is important within the field of plastic surgery. It can improve access to a highly demanded specialty and facilitate the provision of expertise at remote sites.^[16] Wallace *et al.* expressed in their article 'we observed improved access, earlier and more frequent senior clinician involvement by the use of the telemedicine in burn treatment'.^[31]

Table 1: Telemedicine and burn patients at a glance in some countries

Authors	Year	Name of article	Short description	Region	Participation	Duration
Gardiner and Hartzell ^[16]	2012	Telemedicine and plastic surgery: A review of its applications, Limitations and Legal pitfalls	It is comprehensive literature review of twenty-nine articles met the variance criteria such as trauma and burn, hand, wound-care, digital re-plantation etc. that 28 (96%) manuscripts reported a benefit of telemedicine such as increased access to expertise and cost saved through reduction of unnecessary transfers and others reported on adverse effects such as misdiagnosis, time consumption, training, technical and cost issues.	UK	-	1993-2010
Holt <i>et al.</i> ^[20]	2012	Telemedicine Use Among Burn Centers in the United States: A Survey	The Telemedicine used in U.S burn centers for evaluation of acute burns for consultation, for help in determining the need for transfer, or for remote clinic follow-up. Significant interest in learning more about telemedicine suggests strongly that telemedicine should be included in the annual program at the American Burn Association.	USA	126 burn centers	-
Wallace <i>et al.</i> ^[22]	2012	A systematic review of the evidence for telemedicine in burn care: With a UK perspective	It is a comprehensive systematic review of 24 studies that published between 1993 and 2010, and concluded that patients can benefit from increased convenience and substantial cost and time savings.	UK	-	1993-2010
Saffle <i>et al.</i> ^[23]	2009	Telemedicine evaluation of acute burns is accurate and cost effective	In the research, created a telemedicine network linking their burn center to tree hospital located 298 to 350 air miles away in the United States, and proved that telemedicine is beneficial to reduce under-triage or over-triage for air transport and improve resource utilizations.	USA	Three hospitals	July 2005 to August 2007
Wallace <i>et al.</i> ^[31]	2008	Telemedicine for acute plastic surgical trauma and burns	The telemedicine is important method for preliminary information on the referral process for injured patients and it is valuable for managing patients.	UK	973 patients	10 weeks
Shokrollahi <i>et al.</i> ^[25]	2007	Mobile phones for the assessment of burns: We have the technology	We can use the mobile phone technology in hospital and for the management of minor burns, but quality (size and resolution) of the display is as important as the camera resolutions.	-	31 patients	-
Wallace <i>et al.</i> ^[26]	2007	A cohort study of acute plastic surgery trauma and burn referrals using telemedicine	The telemedicine improved accuracy of triage and have a valuable role in planning of acute plastic surgery referrals.	UK	11 units (eight hospitals and three minor injury units)	12 weeks
Saffle ^[28]	2006	Telemedicine for acute burn treatment: The time has come	This study investigated two cases of reported from the authors' practices that show the need for the routine use of telemedicine in the evaluation of burns. It also shows that telemedicine is beneficial to facilitate burn treatment and bring increasingly centralized, state-of-the-art burn care expertise within reach of every patient in America.	USA	-	-
Saffle <i>et al.</i> ^[29]	2004	Regional air transport of burn patients: A case for telemedicine?	This study examined the use of air transport and the feasibility of using alternative methods such as telemedicine to assist in evaluation and treatment of burn patients within our region. This ability has assisted to decision regarding transfer, avoiding errors in initial care, and reduces cost.	USA	All burn patients transported by air	2000-2001
Roa <i>et al.</i> ^[30]	1999	Digital imaging in the remote diagnosis of burns	The aim of this study is working toward the development procedures for the remote transmission of clinical information for the diagnosis and treatment of patient with burns.	Spain	22 consecutive patients	-

As a result, the telemedicine raises physician confidence in treating patients.

It permits other members of the burn team, including therapists and psychologists, to participate, as well as their counterparts at the remote centre.^[32]

Telemedicine images provide the qualitative benefit of confidence in the referring clinical information, as the receiving clinician seems to validate (or not) information by viewing the images, which allows greater certainty in management decisions and priority of triage.^[22]

Consequently, the telemedicine reduces the need to air transport burned patient and have an important role in the triage and planning for management of patients.

Acute evaluation of burn patients by the telemedicine can reduce under-triage or over-triage for air transport.^[23]

For example, in a study performed in Denmark in the duration of 3 months 97 burn patients were transferred to treatment at the national burn center. Thirty percent of these referrals were unnecessary according to the guidelines. The using of digital image transfers before admission of burn patients reduces both over-and under-triage and have a beneficial effect on the economy.^[31] Also, Saffle *et al.* argued that 'we created a telemedicine network between our center and three other hospitals in Idaho and Montana located 300-400 miles from the Salt Lake City. During the period of the project, 10 patients were seen by the telemedicine, while 10 were referred directly, compared to 28 patients who had all been transported by air during a prior 2-year period, overall the telemedicine has been effective in reducing patient transfers'.^[23]

Mobile Tele-dermatology is as a triage system for individuals with skin lesions. It may be useful for travelers or people living in under-served areas such as rural patients.^[22]

Therefore, the telemedicine helps to burn patients or patients who are in deprived areas.

Saffle findings showed that rural patients are at increased risk of death from burns that many of these problems with access to health care that the telemedicine could do much to solve.^[28]

These finally lead to saving time and expense, through the reduction of inappropriate patient transfer and face-to-face follow-up.^[16]

According to another study by Saffle *et al.* 'The ability to evaluate burn patients by the telemedicine may have the

potential to assist decisions regarding transfer, avoid errors in initial care, and reduce cost'.^[29]

CONCLUSION

Acute evaluation of burn patients can be performed by the telemedicine and it plays an important role in improving access to the required expertise, and raises physician confidence in treating burn patients. This can reduce under-triage or over-triage for air transport and finally lead to saving time and cost. Therefore, telemedicine is effective in fast resuscitation and care of the patients' burn and we should specially use of this technique for rural and inaccessible areas.

RECOMMENDATIONS

In many countries, including Iran, there are no accurate statistics of burn patients. Therefore, the researchers recommend that information of burn patients and damaged areas collect and transfer to academic centres to recognize required equipment and facilities and screen victims. Then this information through portable equipment can transfer to healthcare centres and other care organizations.

Public education about these technologies is necessary in order to know how to report critical information to health workers and policymakers.

REFERENCES

- Grobler RC. Emergency management of the patient with severe burns in the emergency unit. *Prof Nurs Today* 2012;16:37-45.
- Mirmohammadi SJ, Mehrparvar AH, Kazemini K, Mostaghaci M. Epidemiologic characteristics of occupational burns in yazd, Iran. *Int J Prev Med* 2013;4:723-7.
- Fatemi MJ, Salehi H, Akbari H, Alinejad F, Saberi M, Mousavi SJ, *et al.* The effect of levamisole on mortality rate among patients with severe burn injuries. *J Res Med Sci* 2013;18:795-800.
- WHO. Management of Burns. World Health Organization. 2007; Available from: http://www.who.int/surgery/publications/Burns_management.pdf. [Last accessed on 2012 Dec 15].
- Monstrey S, Hoeksema H, Verbelen J, Pirayesh A, Blondeel P. Assessment of burn depth and burn wound healing potential. *Burns* 2008;34:761-9.
- Ortiz-Pujols SM, Thompson K, Sheldon GF, Fraher E, Ricketts T, Cairns BA. Burn care: Are there sufficient providers and facilities? *Bull Am Coll Surg* 2011;96:33-7.
- Rafii MH, Saberi HR, Hosseinpour M, Fakharian E, Mohammadzadeh M. Epidemiology of Pediatric Burn Injuries in Isfahan, Iran. *Arch Trauma Res* 2012;1:27-30.
- Ajami S, Ketabi S, Yarmohammadian MH, Bagherian H. Wait time in Emergency Department (ED) Processes. *Med Arch J* 2012;66:34-8.
- Burns. *MedlinePlus Medical Encyclopedia*. 2012; Available from: <http://www.nlm.nih.gov/medlineplus/ency/article/000030.htm>. [Last accessed on 2012 Dec 15].
- WebMd. Webster's new world medical dictionary: Webster's new world. 2008.

11. Benger J. A review of telemedicine in accident and emergency: The story so far. *J Accid Emerg Med* 2000;17:157-64.
12. Ajami S, Torabian F. Mobile technology in healthcare. *J Inform Tech Soft Engg* 2013;S7:e006.
13. Ajami S, Arzani-Birgani A. The use of telemedicine to treat prisoners. *J Inform Tech Soft Engg* 2013;7:2.
14. Ajami S, Mohammadi-Bertiani Z. Training and its Impact on Hospital Information System (HIS) Success. *J Inform Technol Soft Engg* 2012;2:1-7.
15. Ajami S, Lamoochi P. Applying Telemedicine During Disasters. *J Inform Tech Soft Engg* 2013;S7:e005.
16. Gardiner S, Hartzell TL. Telemedicine and plastic surgery: A review of its applications, limitations and legal pitfalls. *J Plast Reconstr Aesthet Surg* 2012;65:e47-53.
17. TEHRANTIMES. 2,000 burn deaths recorded in Iran last year. Tehran2013; Available from: <http://www.tehrantimes.com/society/107791-2000-burn-deaths-recorded-in-iran-last-year>. [Last accessed on 2012 Dec 15].
18. Hasani L, Aghamolei T, Boushehri E, Sabili A. Analysis of hospitalized burned patients in Bandar Abbass, Iran. *J Res Health Sci* 2009;9:50-3.
19. 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.
20. Holt B, Faraklas I, Theurer L, Cochran A, Saffle JR. Telemedicine Use Among Burn Centers in the United States: A Survey. *J Burn Care Res* 2012;33:157-62.
21. Wallace D, Pickford M. The role of telemedicine in the management of acute trauma referrals to a regional Plastic and Hand Surgery unit in the South East of England. Telemedicine techniques and applications, InTech. 2011.
22. Wallace D, Hussain A, Khan N, Wilson Y. A systematic review of the evidence for telemedicine in burn care: With a UK perspective. *Burns* 2011;38:465-80.
23. Saffle JR, Edelman L, Theurer L, Morris SE, Cochran A. Telemedicine evaluation of acute burns is accurate and cost-effective. *J Trauma* 2009;67:358-65.
24. Ebner C, Wurm EM, Binder B, Kittler H, Lozzi GP, Massone C, *et al*. Mobile teledermatology: A feasibility study of 58 subjects using mobile phones. *J Telemed Telecare* 2008;14:2-7.
25. Shokrollahi K, Sayed M, Dickson W, Potokar T. Mobile phones for the assessment of burns: We have the technology. *Emerg Med J* 2007;24:753-5.
26. Wallace DL, Smith RW, Pickford MA. A cohort study of acute plastic surgery trauma and burn referrals using telemedicine. *J Telemed Telecare* 2007;13:282-7.
27. Jones S, Milroy C, Pickford M. Telemedicine in acute plastic surgical trauma and burns. *Ann R Coll Surg Engl* 2004;86:239-42.
28. Saffle JR. Telemedicine for acute burn treatment: The time has come. *J Telemed Telecare* 2006;12:1-3.
29. Saffle JR, Edelman L, Morris SE. Regional air transport of burn patients: A case for telemedicine? *J Trauma* 2004;57:57-64.
30. Roa L, Gomez-Cia T, Acha B, Serrano C. Digital imaging in remote diagnosis of burns. *Burns*. 1999;25:617-23.
31. Wallace D, Jones S, Milroy C, Pickford M. Telemedicine for acute plastic surgical trauma and burns. *J Plast Reconstr Aesthet Surg* 2008;61:31-6.
32. Latifi R. Telemedicine for trauma, emergencies, and disaster management. ARTECH HOUSE; USA; 2010.

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