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# Smart phones make smart referrals

## The use of mobile phone technology in burn care – A retrospective case series

Daan den Hollander<sup>a,\*</sup>, Maurice Mars<sup>b</sup>

<sup>a</sup> Burns Unit, Inkosi Albert Luthuli Central Hospital, Department of Surgery, University of KwaZulu-Natal, South Africa

<sup>b</sup> Department of Telemedicine, Nelson R Mandela School of Medicine, University of KwaZulu-Natal, Durban, South Africa

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### ABSTRACT

Telemedicine using cellular phones allows for real-time consultation of burn patients seen at distant hospitals.

**Methods:** Telephonic consultations to our unit have required completion of a proforma, to ensure collection of the following information: demographics, mechanism of injury, vital signs, relevant laboratory data, management at the referring hospital and advice given by the burn team. Since December 2014 we have required referring doctors to send photographs of the burn wounds to the burns specialist before making a decision on acceptance of the referral or providing management advice. The photographs are taken and sent by smartphone using MMS or WhatsApp. The cases, with photographs, are entered into a database of telemedicine consultations which we have retrospectively reviewed.

**Results:** During the study period (December 2014–July 2015) we were consulted about 119 patients, in 100 of whom the telemedicine consultation was completed. Inappropriate transfer to the burns centre was avoided in 38% of cases, and in 28% a period of treatment in the referral hospital was advised before transfer. For a total of 66% of patients the telemedicine consultation changed, and either avoided an inappropriate admission, or delayed admission in late referrals until the patient was ready for definitive treatment.

**Conclusion:** We conclude that telemedicine consultations using a cellular phone significantly change referral pathways in burns.

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## 1. Introduction

Telemedicine, utilizing cell phone technology, plays an increasingly important role in the care of burns particularly in resource-limited settings. There have been a number of reports of the use of store and forward telemedicine, usually

email with attached images, and real-time videoconference based telemedicine for burn wound assessment and management [1]. More recently concordance studies have validated the use of cellular phones for clinical photography of burn wounds [1–3]. The potential of mobile phones to facilitate burn telemedicine has been identified [3–5] but recent reviews do not report cellular phone or smartphone use [1,4,6]. In 2012,

\* Corresponding author.

E-mail address: [daanhol@ialch.co.za](mailto:daanhol@ialch.co.za) (D. den Hollander).

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Wallace stated that 'We anticipate case reports and series of the use of mobile phones for interactive burn assessment' [1]. This has not occurred despite the ubiquity of cellular phones and ease and rapidity with which photographs can be taken and transmitted by email or instant messaging services like MMS (multimedia messaging service) or WhatsApp [3,5,7]. To date there have only been two cases reported of the assessment or management of burn wounds using mobile phones, one using the cell phone camera and email and the other, MMS [5,7]. In another service, information and images, are sent over a secure Internet connection to a hospital server and the encrypted photographs are then sent from the server to the burn surgeon's smart phone for viewing using a specific application Teleburn<sup>sm</sup> [3,8]. The use of phones to transmit images of burn wounds is not new with satellite phones used to do this in military settings in the 1990s [9,10].

The Burns Unit at Inkosi Albert Luthuli Central Hospital in Durban, South Africa, is the tertiary referral hospital for the province of KwaZulu Natal with a population of roughly 10 million people. The unit employs a tiered referral policy, as suggested in the WHO document *Guidelines for Essential Trauma Care* [11]. We have reported that more than a third of our patients have been inappropriately referred to the unit [12] and a recent audit of referrals to our clinic revealed that a third of patients had healed by the time they were seen at the clinic and that another third had small area burns that could have been dealt with in the unit that referred the patient (unpublished results). That this is not a problem only in resource-poor settings was illustrated by a recent study from Denmark, with similar findings to ours [13]. Although a significant portion of such inappropriate referrals represent overtriage, undertriage is an even greater problem when patients with major burns are deprived of the specialized care that is only available in a burn centre. An important cause of inappropriate referrals is the difficulty that many first-line practitioners experience in estimating the extent of the burn, particularly in children, with estimations sometimes varying by a factor of two between observers [14–17]. Telemedicine, including sending of images of the burn wounds to a burn specialist, has been suggested as a possible solution to this problem [13,18].

For a number of years we have been using Smartphone images taken by our registrars during dressing changes for in-house assessment of burns when the senior surgeons were occupied in theatre and we found these to be reliable for planning management. From there it was a small step to request similar pictures from peripheral medical officers consulting us about their patients with burns. Adding photographs to the telephonic consultation allowed us to make management decisions about the patient before transfer to the burn unit. The aim of this paper is to describe our initial experience of the addition of burn wound photographs sent by smartphone for the assessment and management of burn wounds.

## 2. Methods

A pro-forma pre-admission form is used for all patients that are discussed with the burn surgeon on call for referral. This includes both acute and later referrals. The following information is collected: the referring doctor's name; the

referral hospital; the patient's name, age and gender; the mechanism and circumstances of injury; vital signs and initial blood results; areas, percentage and depth of the burns; the presence of inhalation injury; initial management; the advice given to the referring doctor; and whether the patient was accepted for admission. The referring doctor is then asked to take photographs of the patient's burn wounds and send them to the burn surgeon's phone by either MMS or WhatsApp. Specific advice is given to exclude the patient's face, ask the patient's permission and document this in the notes. When burns are referred late (i.e. after more than a week) a wound culture is required to exclude multiresistant organisms, as the unit has limited ability to isolate patients. Advice is given regarding the treatment of such organisms by the burn unit. The burn surgeon feeds back to the referring doctor within an hour of receiving the images (usually sooner), either by MMS/WhatsApp or with a phone call. After the consultation data from the pro-forma are entered in a secure password protected database (Access 2007), to which the photographs received on the phone are also downloaded. The latter are then erased from the consultant's phone. The current study is a retrospective analysis of this database from inception in December 2014–July 2015.

Ethical approval for retrospective studies using the Trauma/Burns database was granted by the UKZN-BREC ethics committee (Class Approval BE 207/09).

## 3. Results

During the study period, 119 patients were referred, discussed, and entered into the database. There were 66 children aged 16 years or younger, and 49 adults, with the age of four patients unknown. The male: female ratio was 1.6: 1. There were 45 scalds, 51 flame injuries, fourteen electrical burns, four chemical burns and one contact burn. The mechanism of injury was unknown in four patients. Six burns were sustained during an epileptic fit. Mean percentage of the total body surface area burned, as assessed by a burn surgeon, was 21.4% with a median of 20% and an interquartile range of 10–35%. Seventy-five consultations (63.0% came from surgical units, and 41 (34.5%) from a general practitioner-run district general hospital or clinic. The referring hospital was not recorded for three patients. In nineteen cases referred from general surgical units (15.9%) the referring doctor did not send photographs and these patients were subsequently managed within the referring surgical unit. These patients were excluded from further analysis.

Thirty of the remaining 100 patients were acutely admitted to the burn unit, usually by the next morning. Eight patients had an indication for admission, but could not be admitted because no bed was available. Four of these patients were admitted at a later stage. Four were never discussed with us again and these have been excluded from further analysis. This brings the total of patients that qualified for direct admission to 34 (34%). One patient with extensive burns to the eye could not be adequately assessed on the basis of digital images, and was subsequently seen in our clinic.

In 38 patients (38%) inappropriate admission to the burns unit was averted. In 25 patients the burns were superficial

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