

Community Dermatology

From teledermatology, Apps and Web forums: modern communication tools for dermatology in areas with limited resources

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Introduction

The *World Health Report 2006 - Working together for health* reveals an estimated shortage of more than 4 million doctors, midwives, nurses and support workers worldwide, the deficiency being most severe in the poorest countries, especially in sub-Saharan Africa (<http://www.who.int/whr/2006/en/index.html>). Patients living in such areas suffer from a large number of skin diseases, a problem compounded by limited public health resources, long distances and very limited access to dermatological expertise. The same World Health Organization's report suggested that skin diseases were associated with mortality of 20,000 in Sub-Saharan Africa in the year 2001 (1).

Digitally based communication tools have been increasingly common in the recent decades – ranging from e-mail, internet use to the new social networks (such as Facebook, Twitter etc). Also new tools have been developed, allowing easier internet access, such as the many mobile phones with many additional features called smart phones, light weight and low cost portable computers tailored mostly for Web access- netbooks - and most recently tablet PC's with touch screens allowing the use of internet and having a reasonable image size (such as iPad or the numerous, mostly Android based, alternatives). In this article the use and potential of such technologies for dermatology in a tropical setting in areas with limited resources will be discussed. Besides consulting services, web and mobile phone based tools for patient monitoring, education and teaching of involved health personnel will be included.

Teleconsulting – a useful tool in areas with limited access to dermatological expertise

Teledermatology has become a useful tool in the exchange of dermatological knowledge between experts and advice-seeking colleagues, institutions or patients worldwide. Classical

teledermatology is based on store-and-forward based exchange of digital images by E-mail or Web using desktop PC or portable notebooks. In several studies a high level of agreement for diagnostic accuracy between clinical dermatology and teledermatology was demonstrated, e.g. for various inflammatory skin conditions, geriatric skin and also pigmented lesions and most recently geriatric skin problems and considering also cost-effectiveness (2-8).

In a very recent systematic review of teledermatology analysing 78 studies (9) it was concluded that diagnostic accuracy of clinic dermatology is better than teledermatology, but diagnostic concordance of teledermatology with clinic dermatology is acceptable. Management concordance was fair to excellent. Also patient satisfaction and preferences were comparable. Teledermatology reduced time to treatment and clinic visits and was cost-effective if certain assumptions were met.

Teledermatology is perhaps more beneficial when different levels of dermatological expertise are linked. Tertiary teledermatology – where a general practitioner seeks advice from a dermatologist by digital image discussion has proved to be efficient, reliable and cost-saving . (10, 11). Also quaternary teledermatology with picture transfer direct from the patient to a dermatologist has been investigated (12). Making a specific diagnosis was feasible in 67% of cases of 46 patients and the dermatologist was able to narrow down the differential diagnosis in an additional 17%. Also recommending therapeutic interventions was possible for the skin problems of 70% of patients, as most of the patient-supplied skin images sent by the patients were of sufficient quality.

In brief, the advantage of having any access to dermatological advice by telemedicine overcomes possible limitations compared to clinical dermatology. Limited accuracy compared to a clinical examination is overcome by additional expertise if different levels of dermatological expertise exchange. If there is no dermatologist available within reasonable distance, teledermatology can bring specialist knowledge, to a certain degree, to a much remoter place with sufficient accuracy and cost-effectiveness.

Teledermatology activities in areas with limited resources

In tropical areas often there is not only such a limited access to knowledgeable medical experts, but long distances often restrict mobility due to lack of good connections; distance and economic limitations will, in addition, reduce access to medical expertise. Thus, teledermatology can be used to overcome these hurdles and substantially increase access to dermatological expertise in these regions. There are already a substantial number of projects using teledermatology in such areas, originating from areas in sub-Saharan Africa (13-19), but also in Latin America (20), Asia (21, 22) and rural Australia (23).

Possibly due to the striking lack of dermatologists in sub-Saharan Africa, teledermatology has been established in this continent to a considerable extent, with reports from at least 14 countries.

In a very first report in 1998 we established a preliminary project of store and forward exchange of dermatological images between the Regional Dermatology Training Centre, RDTC, in Moshi, Tanzania and Switzerland (14). Since then various much larger projects have been initiated, including partial in-depth analyses of the transmitted cases and also skin problems in travellers in this area (16-19). The largest project in regard to the number of patients so far is the Africa Teledermatology Project. In this store-and-forward based and still ongoing project 345 consultations were analysed between February 2007 and February 2009, from sites in thirteen

Sub-Saharan African nations. These were received and processed via a project website (19). The most frequent diagnoses, where educational material was also prepared, included adverse drug reactions, atopic dermatitis and eczema, cutaneous infections, psoriasis and HIV/AIDS-related cutaneous diseases.

A simple but instructive example how teledermatology can improve knowledge of Primary Care providers, such as GP's, was reported from South Africa (14), where digital images were sent to an experienced dermatologist. He was able to make a diagnosis in 105 out of 110 consultations and in 57 cases. At least as important, the teledermatology consultation leads to an improvement in the treatment and an increased knowledge about management of skin diseases for the GP. In conclusion, teledermatological consultation may help to maximise the potential for patient care in these underserved areas where there is a severe lack of medical and specialist dermatological expertise. It is even more beneficial if additional educative aims and tools are linked to the service.

Teleconsulting and discussion fora for dermatology in underserved areas

A next step from simple exchange of dermatological images for consultations between two direct partners of whatever discipline and qualification is the establishment of platforms, where the input of various participants can be integrated for submitting and discussing cases. Also such platforms have also been created in recent years for dermatological cases with a special focus on tropical and underserved areas.

The afore-mentioned Africa Teledermatology Project platform offers an online archive of tropical skin conditions and a monthly case presentation (<http://africa.telederm.org/>). It serves also as a most valuable internet source of educational material for training and updating of medical specialists and health personnel with a special focus for the needs in underserved African areas. Another aim of the project is to establish and secure an active channel and platform for dermatological research collaboration – something very much needed as structured dermatological health systems research projects in sub-Saharan Africa are scarce. The platform is actively served and updated by Steven Kaddu and Carrie Kovarik and offers not only online access by Internet, but also by mobile access via Podcast in the form of an application, briefly called “App” used on Smartphone based on Apple devices, such as the iPhone.

Another tool offering teleconsulting exchange for tropical dermatology covering worldwide aspects is available in the iPath telemedicine platform (www.ipath.ch). This platform has been founded by pathologists and contains a large variety of discussion and consultation forums mainly for pathology and radiology but also dermatology. The primary aims of the iPath association are to operate an open telemedicine platform, to develop an open source iPath telemedicine software and to support simple and sustainable telemedicine projects in developing countries. Cases of global origins, with special emphasis on Cambodia, Mongolia and African areas are among other items regularly discussed. As a special module it contains the Tropical Dermatology and Venereology Forum. Regularly challenging or interesting dermatological cases are discussed. Experts subscribing to the forum get an e-mail alert to give their comments to cases presented with clinical history and images.

Medical personal of “Medecins sans frontieres MSF” – Medical doctors without borders are often working in areas with very limited or, even worse, destroyed access to medical infrastructure. Being trained in general medicine, dermatological conditions often are a real challenge. Thus the IFD has started a digitally based consultation service given by a panel of 7 experts providing a geographic spread of opinion. On the basis of a brief clinical story and digital pictures expert

advice can be given to colleagues who are often working under very difficult conditions. Until now some 50 cases have been processed and the service is rated by the MSF colleagues as being useful and highly appreciated.

Discussion fora related to medicine, in areas with limited resources among others, are also offered by the Global Health Information Network (<http://www.ghi-net.org/default.asp>), where the HIF-net (Health Information Forum) provides an email discussion group which aims to increase access to information for health researchers and health professionals in developing countries; currently over 1800 health professionals participate. In this forum, coordinated by Neil Pakenham-Walsh the site has a different focus: usually no single cases are discussed, also no images are exchanged, but there is a dynamic exchange of opinions, expertise and own experience using IT in areas with limited resource. There are plenty of other platforms such as med@Tel, an international e-health, telemedicine and health ICT for education, networking and business (<http://www.medetel.lu/index.php>) and these offer access to plenty of exchanges related to “eHealth”.

The combination of teledermatology and dermatopathology – a powerful tool to improve dermatological care in areas with limited resources

Besides access to dermatology also dermatopathology services are extremely scarce in many areas such as in sub-Saharan Africa, remote Asian areas or isolated islands. There are two ways in which telemedicine can serve in this field to improve access to pathological findings: either by correlating teledermatological images taken on site with biopsies analysed elsewhere (24) or where there are the technical tools to ensure that histological specimens can be prepared on site they can be digitally transmitted to an expert situated elsewhere in the world, a technique also named telepathology (25, 26).

Both variants help to improve clinical diagnosis and to validate findings, especially when dealing with malignant diseases. While the first variant has already been described with a special focus on dermatology in underserved areas (24), such reports are found for the 2nd variant with on site specimen preparation and digital transmission for teledermatology only in industrialised nations (25). However telepathology based on distant reading but locally digitised slides is already performed in remote areas for other disciplines with great benefit but as yet there is no special focus on dermatopathology (26).

Both approaches have their advantages and limitations and should be used in the way most adapted to the local needs and facilities. The availability of technical equipment, possible collaboration with other services using telemedicine (e.g. radiology, pathology) and reliability and speed of Internet but also surface mail or other means of transport of specimens have to be considered. Linking dermatology with other visual disciplines using similar imaging tools such as radiology or pathology is of utmost importance in areas with limited resources to get the most benefit with least cost. Especially when it comes to malignant but curable lesions a clear histopathological finding may justify demanding travel and long transfers as reported e.g., from the Solomon islands (27).

Teledermatology based on mobile phones

Mobile phone technology has advanced also in many areas with limited resources in the last decade. Besides providing an important impact on the communication possibilities in general and social interaction, these also offer a huge potential for increased communication in these areas for medical use. Mobile telephone technology advances also provide rapid improvements

in photographic quality and speed of data transfer - new generations of cellular phones or personal digital assistants offer excellent image quality compared with older devices. With the implementation of modern wireless telecommunication, wireless local area network and satellite communication is now surprisingly widely available, including many, if not most, areas of the globe, even those with very limited resources. Communication has really been revolutionised by the use of cellular phones in many of these areas. Thus the use of mobile phones and their digital imaging capacities is a very attractive option in these areas.

The feasibility of using mobile telephones and other handheld devices to collect and transmit diagnostically reliable dermatological information has already been successfully demonstrated in various studies (28-33). Cellular phones as image sources can be useful tools to project various skin conditions such as psoriasis (29), wounds (30) or pigmented lesions - for the latter there is the possibility of integrating with the so called mobile teledermatology (31-32). Mobile teledermatology may also provide a triage service to manage patients with new skin disease or for follow-up of patients requiring systemic treatment. (33).

As mobile teledermatology does not require computers with internet connectivity it offers a great potential for use in areas with limited resources. A recent study performed by Carrie Kovarik – again one of the pioneers and leading promoter in the area of teledermatology in African settings - and co-workers has demonstrated the feasibility of mobile dermatology in an Egyptian setting (34) using newer-generation mobile telephones with specialized software and wireless connectivity. Diagnostic agreement between face-to-face consultation and senior dermatologists performing independent evaluation by teleconsultation was achieved in a mean of 75% cases –comparable to conventional teledermatology with classical PCs or notebooks in industrialized nations. Dermatological medical information was obtained and transmitted by way of a tailor-made multiple-choice questionnaire designed by the authors of this study. Responses to the questionnaire, which allowed insights into the patient history, were keyed numerically into the telephone keypad. Although still a small study involving only 30 patients, these results are very encouraging to further promote mobile teledermatology in such settings and getting increasing independence of fixed computers and Internet availability.

Teledermatology by use of specialized mobile telephones to perform store-and-forward technology may quickly become very useful and the standard technology is expanding the role of teledermatology in remote and underserved areas.

Improving compliance and follow up by the use of mobile phones and short message service SMS

Adherence to treatment, long term follow-up and treatment monitoring and advice-giving are very often limiting factors in the management of many chronic diseases. In recent years some studies have demonstrated that reminding patients of drug intake can substantially increase not only the compliance but also the long term success of a medication. Also treatment advice by E-mail and Short Messaging Service (SMS) has been shown in the management of asthma, for example in the case of an automatically determined patient alert (35-37). Patients could obtain customized instructions depending on their daily personal symptoms, peak expiratory flow (PEF), medications and restriction of activity. (35). Also other medical conditions such as hyperkalemia or Diabetes have been monitored by SMS alert services (36).

In a recent review (35) of the scientific literature 25 controlled studies evaluating cell phone voice and text message interventions to provide care and disease management support were analysed. Frequency of message delivery ranged from 5 times per day for diabetes and smoking

cessation support to once a week for advice on how to maintain regular physical activity. Significant improvements were noted in compliance with e.g. medicine taking, asthma symptoms, HbA1C, stress levels, cessation of smoking rates, and self-efficacy. The authors concluded that disease monitoring and management, and education through cell phone voice and short message service can improve health outcomes and care processes and have implications for both patients and providers.

Recently a mobile phone-based telemonitoring system for long-term psoriasis therapy was described (38), where patients themselves can log health parameters, take photos of their psoriasis lesions and report side effects. The data are automatically sent to a monitoring centre, where they are provided to the patient's physician via the use of a web-browser. If necessary, the physician can send feedback messages to the patient, e.g. for recommending the patient to see the doctor for further examinations.

Looking at the rapidly increasing use of mobile phones such compliance and monitoring programmes could be useful for improving compliance in areas with limited resources. For instance patients with diseases requiring long-term action such as in leprosy or with difficult to handle skin diseases where sometimes rapid action is required could benefit from such distance follow ups, thereby overcoming long distances and lack of local experts. Automated questionnaires as reported by Kovarik et al (34) might enable such tools to be used in populations with limited experience in the use of modern IT technologies.

The use of Web-based online programmes for dermatologic education

The use of teledermatology including image-taking by mobile phones is already widely established. Also, several digitally-based learning programmes are available; many of them are summarized in the Med-ealth platform, another initiative of the WHO (www.medehealth.org). Besides numerous digitally available text books a number of interactive learning programmes are available. A good example for dermatology is the award winning interactive learning programme “Doit” (www.swisdom.org). This software allows interactive learning on the full dermatological range at medical student level and is currently being upgraded to cover the specialist level. Besides structured learning modules on all major dermatological diseases, games and examination tools are available for testing, e.g., clinico-pathological correlation or treatment modules. “Doit” is already available in 8 major languages: besides English, Chinese, French, German (all modules), Italian, Japanese, Portuguese and Spanish, others are in preparation. Modules focused on tropical and travel dermatology are currently under construction. The WHO offers some excellent useful digital tools such as those available under www.healthinonet.com where some dermatological areas are covered. These programmes are accessible via Internet and can therefore be used wherever the Web is accessible – whether from a computer or increasingly commonly from mobile phones such as smart phones.

Educational tools based on mobile phones: the world of Apps moving into dermatology

There is a increasing amount of so called “Apps” that have been created - lightweight, web-based applications tailored to mobile device's such as a mobile phone or tablet PC . Such software can usually be acquired via an online shop and downloaded to the smart phone, the largest and most popular shop being App Store for Apple devices, other such as Android Market. Windows Phone Marketplace and others are also rapidly growing and enlarging their numbers of offers. Two systems - Dynamed and Skyscape, among many others, will be

mentioned here, being of major use in acquiring medical information by mobile phones and might therefore be of special use in medically underprivileged areas.

DynaMed is a clinical reference tool created by physicians for physicians and other healthcare professionals for use primarily at the 'point-of-care' with clinically-organized summaries for more than 3,200 topics. As an evidence-based resource updated daily, *DynaMed* offers quality, well-organized information and an intuitive means for accessing this material. *DynaMed* is available on an unlimited basis via the Web and also mobile devices for easy access at the point-of-care. For practicing physicians and health care professionals not affiliated with a larger group, *DynaMed* offers for unlimited access to this valuable resource. *DynaMed* is priced differently for health care groups and individual users.

Another very useful tool is Skyscape that offers a list of several hundred of apps for clinical medicine. Many major textbooks are accessible by such apps, including some basic textbooks in Dermatology as for example Fitzpatrick's Colour Atlas and Synopsis of Clinical Dermatology (US\$63.95). EBM Guidelines: Dermatology, STI and Allergology (US\$ 42.95), or Paediatric Dermatology: A quick reference guide (US\$ 139.95). The easy access to an actual textbook is a real advantage, although the prices of such sources are still quite high for many potential users in areas with limited resources. Also there is still very little information and resources found with a special focus on tropical dermatology and its related fields, for both *DynaMed* and Skyscape. Some topics are however covered under infectious diseases.

Limitations are furthermore access to Internet that is not always possible especially not outside medical centres. Also the download of large amounts of data up to several Megabytes or even Gigabytes can be restricted by time or data space limitations or the related costs.

Carrie Kovarik and colleagues have started a program for mobile learning in Botswana, in which smart phones are provided to the residents of the University of Botswana, loaded with locally available content, including the use of *DynaMed* and Skyscape. (For more details please contact carrie.kovarik@uphs.upenn.edu). The many references and books seem to be used not only at work but also for reading and learning at home. As these residents often complete rotations in underserved areas with few medical resources (no internet, few accessible books, but with functioning mobile phone network), this technology is a way to provide medical information at the point of care.

Conclusions

Teledermatology as telemedicine may serve only individual patients in a first instance, while in underserved areas public health aspects mainly prevention are crucial. However by adding educational tools, promoting dermatological knowledge to other health personnel and allowing through this earlier diagnosis and better management quality of skin care can be substantially improved. The use of mobile phones for mobile telemedicine offers a further option to spread access to dermatological consultation to care levels of small health posts or even the patient himself. Integrating and combining dermatopathology with telemedicine further enhances the accuracy and impact of dermatological information, especially for remote areas where otherwise there is no access to dermatopathology. Also integrating modern platforms for interactive discussion, education and extensive medical resources based on the Internet and increasingly based on cellular phones using so-called Apps promotes dermatological knowledge and expertise substantially. Finally disease management and follow up might benefit by Internet/ SMS reminders and consultation systems in areas with limited expertise and resources.

There also some drawbacks that have to be considered – there is still a lack of reliable electricity and Internet in many areas, partly due to technical or infrastructural reasons, partly due to the related costs. In the medium term increased generation of waste will have to be considered, as many modern IT tools are currently produced for an increasingly short half life of one to few years. Also for apps not only Apple based products should be developed but other software programmes including the Android system should be considered in order to enlarge the number of possible users and avoid dependence on a single hardware provider for smart phones or tablet PCs`which might be even more problematic in areas with limited resources. On the other hand it would be worth seeking to persuade important players in the mobile phone market such as Apple, Blackberry, Nokia, Motorola, Samsung or Sony to provide low-cost or even free Apps, databases and mobile phones for improving medical skin care in these underserved areas.

In summary the advantages of greater accessibility to dermatological expertise for many underprivileged areas of our world are obvious. The platforms and tools exist and are even rapidly improving, including new tools such as tablet computers that are easy to handle, lightweight and highly suitable for Internet and app access and with excellent image viewing possibilities. Still there is a lack of content with a special focus on dermatology in tropical areas and those with limited resources. The structures are excellent and for those active in the field of tropical dermatology it is up to the dermatological experts to fill this gap. By linking with other specialities and tools already available will speed up this process that finally may help to promote better skin care globally.

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Table 1

Pro/cons of digital communication for dermatology in areas with limited resources

Advantages of digital dermatology

- Rapid access to specialist's opinion for both, health care worker and patient, where otherwise only very limited/not possible
- Reduction of travel saving time and costs
- Improved professional exchange
- Improved structure for epidemiologic data and possible research
- Improved patient management e.g. via SMS alert system
- Access to continuously updated Web based resources and educational material
- Software update mostly online possible

Drawbacks

- Increased usage / dependence on electricity (although lower for mobile communication than from fixed PC/notebook)
- Risk of dependence on one single system requiring according hardware (smartphone, tablet PC)
- Increased technical waste due to relative short half-life of hardware

Table 2

Future strategies to be addressed

- 1) Promotion of mobile teledermatology by adapted software and mobile phones
- 2) Preparation of educational material adapted to usage as Apps/Mobile communication
- 3) Exchange/facilitated links between various platforms related to tropical dermatology and allied fields
- 4) Exchange with other related disciplines
- 5) Implementation of technologies already available in/outside medicine
- 6) Acquiring grants/donations to enable usage with minimal costs/free of charge