Mobile Teledermatology in Sub-Saharan Africa: A Useful Tool in Supporting Health Workers in Low-resource Centres

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In developing countries, such as Uganda, skin problems are among the most common ailments seen in primary healthcare settings (1). Due to the dire lack of trained dermatologists, the vast majority of patients with skin diseases in these countries are treated by substitute auxiliary health workers with a limited education in skin disease management (1). To bridge this gap in access to dermatology services, we established a mobile teledermatology service and evaluated its applicability with regard to the impact of remote diagnoses on patient outcomes, as well as local health workers' perception concerning this mode of dermatology consultation.

MATERIALS AND METHODS

During an 8-month period, health workers located in 4 Ugandan health centres (Kampala, Masaka, Jinja, and Mbarara) submitted cases with uncertain diagnoses or treatment/management problems via smartphones (second and third generation iPhones; Apple Inc., Cupertino, California, USA, with a touch screen and a built-in 2-megapixel camera) to specialists in 3 dermatology departments in Europe, USA and Australia. Special phone software enabled the capture of patient's images (up to 3 images per case) and input of relevant clinical information. All requests were archived in an online database with a personal archive for each user (2). Remote African health workers could choose to send a case to a selected expert. In a few selected unclear cases, referring health workers were additionally required to send skin biopsies specimens of relevant lesions in order to confirm the final diagnosis.

Otherwise, for clear cases, skin biopsies were not required to be submitted. In those cases, the working diagnosis was considered to be the final expert diagnosis for further analysis based on which significant improvement or total remission was attained after a follow-up of at least 10 months.

For statistical analysis, skin diseases were grouped into several diagnostic categories including inflammatory, infectious, neoplastic, and autoimmune and "others". Diagnoses were further classified based on aetiology. Initial onsite and remote diagnoses were compared with a "final working diagnosis" derived from histopathological findings or clinical outcomes.

In addition, health workers' confidence in the teleconsultation service and their opinion about mobile teledermatology were assessed and recorded using a questionnaire.

RESULTS

A total of 216 images of 72 patients (48 females, 24 males; median age 29 years, range: 6 weeks–85 years) were received for teleconsultation. Suggested onsite diagnoses ranged from non-infectious, inflammatory skin diseases in 35 cases (48.6%) to infectious skin diseases in 19 (26.4%), neoplastic in 8 (11.1%), and autoimmune skin conditions in 3 cases (4.2%). Other skin conditions included ichthyosis vulgaris in 3 cases (4.2 %), vitiligo in 3 cases (4.2%) cases, and pellagra in 1 case (1.4%). Relevant pre-existing medical conditions included HIV infection in 14 patients (19%).

In 6 patients (8.3%), no remote diagnosis could be established due to poor photographs ($n=4$) or incomplete medical data ($n=2$). Of the remaining 66 cases, 50 (75.8%) could be managed satisfactorily via mobile teledermatology, leading to total remission ($n=21$) or improvement ($n=29$) of the skin conditions after a median duration of 3 months (range 1–10 months); in 10 (15.2%) cases skin status remained unchanged until the final follow-up visit; none of the patients experienced worsening of disease; 6 patients (9.1%) were lost to follow-up.

Excluding the cases without definite remote diagnoses, the cases lost to follow-up, as well as those with an unchanged skin status at the final follow-up visit, a "final working diagnosis" was attainable in 50/72 cases (69.4%) based on histopathology ($n=12$) or the clinical outcome ($n=38$). When compared with the final working diagnosis, onsite diagnostic decisions led to 37 (74%) concordances and 13 (26%) discordances. Mismatches were mainly observed for the categories "inflammatory" and "infectious skin disorders"; in particular, skin diseases such as eczema ($n=3$), seborrhoeic dermatitis ($n=1$), and intertrigo ($n=1$), were occasionally misdiagnosed as bacterial infections ($n=5$); lichen planus was occasionally misinterpreted as a photodermatosis ($n=1$) or a chronic actinic dermatitis ($n=1$) and vice versa ($n=2$). Among tumours, warts ($n=2$) and 1 haemangioma were misinterpreted as melanocytic lesions, and further, the 1 Bazex syndrome was misdiagnosed as a photodermatosis.

Local health workers reported high satisfaction with the technology (e.g. easy portability, shorter request time, ease of operability, and direct and instantaneous access to dermatology experts). Some concerns were expressed over the inability to access mobile 3G networks occasionally when urgent case submission was needed (6 occasions).

They felt confident in remote diagnostic/treatment instructions, which they considered helpful in 58/72

(81%) cases. In 14 cases, they expressed partial ($n=8$) or a total lack of satisfaction ($n=6$). Consistently, several patients ($n=10$) in the partly satisfied and unsatisfied groups were lost to follow-up or presented with unimproved skin conditions at the final follow-up visit.

DISCUSSION

The present investigation provides novel preliminary findings demonstrating the applicability of teledermatology using smartphones in supporting dermatology auxiliary health workers in low-resource sub-Saharan African countries. A recent study focusing on the value of mobile teledermatology consultation mainly involving well-trained dermatologists located in Egypt has revealed comparable findings (3). Overall, our experience is similar to that from a number of previous studies involving dermatologists in other settings using either mobile phones (4, 5) or standard teledermatology with personal computers (PCs) and digital cameras (6–11). The present project thus provides a further strategy to establish an evidence base, in order to determine whether the currently increasing unquestioning enthusiasm for the use of mobile teledermatology in low-resource settings of sub-Saharan Africa is justifiable.

There are a number of limitations to our study. A true gold standard based on histology was lacking in most cases. Difficulties of obtaining a true gold standard in the field of teledermatology are widely well known. A few authors have previously opted for using clinical follow-up as criteria comprehensively to address the impact of store-and-forward teledermatology on the clinical course of diseases (12, 13). In our circumstances, several pitfalls exist in the use of clinical follow-up as criteria to judge the impact of teledermatological diagnosis. Firstly, there are potential differences in interpretation regarding criteria for improvement of particular skin conditions. Moreover, many topical therapies may work well for several dermatological diagnoses, and some skin conditions are also self-healing or variable. Finally, the final diagnosis could be influenced by remote experts, as there are no independent onsite experts available to confirm the final working diagnosis.

In conclusion, a mobile teledermatology service appears to be valuable in improving the management of skin diseases in sub-Saharan Africa, especially through supporting a cadre of auxiliary health workers widely employed in treatment of skin diseases in these countries, although there are a number of inherent drawbacks.

Future, larger controlled trials are needed to evaluate whether the additional transmission of histopathological images on a mandatory basis may augment the applicability of the system.

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REFERENCES

1. Disease control priorities project: skin diseases. The World Bank Web Site. [cited 2011 Jun 30] Available from: http://www.dcp2.org/pubs/DCP/37/.
2. Kaddu S, Soyer HP, Gabler G, Kovarik C. The Africa Teledermatology Project: preliminary experience with a sub-Saharan teledermatology and e-learning program. J Am Acad Dermatol 2009; 61: 155–157.
3. Tran K, Ayad M, Weinberg J, Cherng A, Chowdhury M, Monir S, et al. Mobile teledermatology in the developing world: implications of a feasibility study on 30 Egyptian patients with common skin diseases. J Am Acad Dermatol 2011; 64: 302–309.
4. International Telecommunications Union (ITU) (2008a). Worldwide Mobile Cellular Subscribers To Reach 4 Billion Mark Late 2008. International Telecommunication Union, Geneva. [cited 2011 Jun 30]. Available from: http://www.itu.int/ITU-D/ict/statistics/.
5. International Telecommunications Union (ITU), (2008b). ICT Statistics Database, Geneva, 2008. [cited 2011 Jun 30]. Available from: http://www.itu.int/ITU-D/icteye/Indicators/Indicators.aspx.
6. Massone C, Lozzi GP, Wurm E, Hofmann-Wellenhof R, Schoellnast R, Zalaudek I, et al. Cellular phones in clinical teledermatology. Arch Dermatol 2005; 141: 1319–1320.
7. 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.
8. Chao LW, Cestari TF, Bakos L, Oliveira MR, Miot HA, Zampese M, et al. Evaluation of an Internet-based teledermatology system. J Telemed Telecare 2003; 9: 9–12.
9. High WA, Houston MS, Calobrisi SD, Drage LA, McEvoy, MT. Assessment of the accuracy of low-cost store-and-forward teledermatology consultation. J Am Acad Dermatol 2000; 42: 776–783.
10. Krupinski EA, LeSueur B, Ellsworth L, Levine N, Hansen R, Silvis N, et al. Diagnostic accuracy and image quality using a digital camera for teledermatology. Telemed J 1999; 5: 257–263.
11. Lim AC, Egerton IB, See A, Shumack SP. Accuracy and reliability of store-and-forward teledermatology: preliminary results from the St George teledermatology project. Australas J Dermatol 2001; 42: 247–225.
12. Pak HS, Harden D, Cruess D, Welch ML, Poropatich R. Teledermatology: an intraobserver diagnostic correlation study, Part I. Cutis 2003; 71: 399–403.
13. Pak HS, Harden D, Cruess D, Welch ML, Poropatich R. Teledermatology: an intraobserver diagnostic correlation study, Part II. Cutis 2003; 71: 476–480.