Medical and Economics Benefits of Tele-expertise in Dermatology: Case study in eight Health Centers in Mali.

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Abstract

Background: Mali, like many Sub-Saharan African countries, is experiencing an acute crisis with respect to the shortage of qualified health professionals. This crisis is even more acute when it comes to specialized medical fields such as dermatology.

To address this shortage, a tele-dermatology project has been launched in Mali since 2015 in order to provide access to specialized care to the most remote populations.

Objective: The aim of our study is to assess the medico-economic benefits of the pilot phase of this project.

Methods: We conducted a retrospective cross-sectional study of all requests for expert advice sent to dermatology experts through the "Bogou" tele-expertise platform.

The sample consisted of 52 patients at eight remote sites and ten health professionals, including 4 specialists.

The economic study was done using a parameter of cost analysis and the professional evaluation of healthcare providers. It compared consultation and transportation fees (on-site and off-site), and used a questionnaire assessing items on a 5-level Likert scale and open-ended questions to evaluate the satisfaction of health professionals. Data analysis was performed by SPSS v25.

Results: During the period, 374 requests for tele-expertise were made for the benefit of 52 patients. 89.3% of requests were answered by specialists, with an average response time of 46 hours 59 minutes and extremes from 7 minutes to 415 hours 4 minutes. Eczema was the most common medical condition diagnosed. 98% of patients had never completed a dermatological consultation because of a lack of means to travel to the only specialized center in the country. Consequently, they were all very satisfied or satisfied with the tele-expertise service. The 52 participating patients in project have realized a great financial benefit. Together they saved an average of 5,824,500 XOF (9429 euros).

All the health professionals surveyed also expressed satisfaction with the application. They confirmed that the project has enabled them to strengthen their skills in the management of dermatological pathologies.

Conclusion: Based on the results of our study, we can say that tele-dermatology allows access to specialized care and a reduction in the costs of care for patients in remote areas.

Background

Mali, like many countries in sub-Saharan Africa, has been dealing with a serious and growing problem when it comes to access to qualified and specialized health professionals. That has created what we call "medical deserts" in the most remote areas in this vast country, where a large portion of the population is left without any type of access to medical care providers.

This crisis affects almost all medical specialties, particularly in the field of dermatology. For example, in Mali, there are only 38 dermatologists for a population of nearly 20 million and a single specialized center for the treatment and management of dermatological pathologies. While such pathologies account for 10 to 30% of the reasons for medical consultation, coupled with an extremely low per capita ratio of dermatologists (i.e. 2 dermatologists per 1,000,000 inhabitants) and a single treatment center located in the capital city, it is easy to conclude that many patients, particularly those from rural remote areas, will not have access to any type of quality and professional care.

In this context, e-health is becoming an interesting alternative to deal with this major challenge of eradicating medical deserts. It is such a pressing issue that the World Health Organization (WHO) has adopted several resolutions since 2005 to encourage its member states, particularly low-income nations, to use digital innovations in order to achieve the goals of universal health coverage [1, 2, 3]. Indeed, e-health can overcome certain barriers to access to cost effective and quality care, but also to the recruitment and retention of health professionals in remote areas [4, 5]. However, even if the potential of e-health is no longer in doubt, efforts are still needed to carry out sufficient quality studies to accurately evaluate the impact of the e-health tools used in the field [6].

Moreover, the regional committee of WHO in Africa has adopted a resolution known as "Solutions for E-Health in the African Region: Current State and Perspective" [7] in 2010 in order to strengthen its recommendation and demonstrate the urgent need of its application. The resolution put a particular emphasis on the need to evaluate e-health projects through the "Call to Action on Global e-Health Evaluation" initiative [8].

With the above mentioned guidelines in mind, we set the aim of our study to assess the medico-economic benefits of tele-dermatology. The project is known as "TELEDERMALI" and has been operating in Mali since 2015. Its pilot phase has recorded very encouraging results on the ground [9].

Methods

The study was carried out as part of the "TELEDERMALI" project, a tele-dermatology research launched by the Dermatology Hospital of Bamako (HDB) and the Faculty of Medicine, in collaboration with the Center for Expertise and Research in Telemedicine and E-Health (CERTES). It targeted the requests for tele-expertise made between November 2016 and August 2017. A total of six reference health centers known as "CSRef" (Koulíkoro, Banamba, Sikasso, Mopti, Bankass, Douentza), two community health centers called "CSCOM" (NGoloubougou and Sévaré) and the Dermatology Hospital of Bamako participated in the study. The latter served as the site for experts. « Bogou », a tele-expertise platform developed as part of the French Speaking Network in Africa for Telemedicine, was used for tele-expertise applications [10].
All requests along with skin images and clinical records posted on Bogou for dermatological advice during the study period were taken into consideration. Likewise, anyone seeking expert opinion on the study sites or who had logged a case on Bogou or had agreed to answer the questionnaires as well as the dermatologists who provided their expertise were included in the study. All other requests not in the field of dermatology, as well as those originating from sites different than the ones selected for this project were excluded. The medico-economic study involved a sample of 52 patients, 10 health professionals (i.e. one per site) and 4 dermatologists at the expert center.

Three questionnaires rated satisfaction on a Likert scale from 1 to 5 (from Not Satisfied to Very Satisfied), and open-ended questions were used to evaluate respectively the feedback of patients, healthcare professionals at remote medical centers and dermatology specialists in the city. The patient questionnaires were administered by our team on the ground. For the calculation of the waiting time, it was done on the basis of the data collected on “Bogou” from the time a request was sent for expert analysis to the time of reply by a specialist. Every day between them were counted, including weekends and holidays.

For the assessment of the economic benefits, a cost comparison analysis system was setup. We compared the costs associated with onsite consultation (i.e. remote areas without any dermatologist) with the availability of telehealth tools to the costs for patients who had to travel to the capital city, Bamako, in the absence of telemedicine. The latter category included costs related to transportation and other living expenses while staying in the city for treatment.

Data was collected and stored with SPSS version 25. The collected data was analyzed using both SPSS version 25 and Microsoft Excel 2016.

**Results**

A total of 374 requests for expert examination via tele-dermatology were posted during the study period from November 2016 to August 2017. Each request was related to a single identified patient. The requesting health professionals stated that of the 374 applications, 334 were handled within an appropriate and efficient time frame, while 40 were not. With a timely response rate of 89.3% of cases versus 10.7% of the delayed ones, a sound research assumption could be made that tele-dermatology helped to provide better patient care for the former group.

**Medical and Technical Findings**

Eczema was the most common diagnosis with 55 cases (15.24%), followed by dermatophytia with 22 cases and leprosy with 16 cases (Fig. 1). In terms of the number of cases, the Banamba site, located in the center of the country, had the highest demands for tele-expertise (i.e. 87 cases or 23% of the total posted), followed by Douentza and Bankass in northern Mali, with respectively 80 and 69 cases (Fig. 2).

Of the 52 patients who participated in the study, 98% had never received a specialized dermatological examination prior to the tele-dermatology project. 71% of patients said they visited the various centers because of the opportunity to be seen by a specialist via a remote platform, thus avoiding travelling and its associated cost. Every single surveyed patient participating in the project was generally satisfied with the telemedicine service. The average response time of the expert was 46 hours 59 minutes or 1.9 days, with extremes from 7 minutes to 415 hours 4 minutes (17.29 days).

**Impact on patient health expenditures**

A macro-economic analysis taking into account on-site and off-site consultation, transportation and other related costs associated with staying in the city to get treatment showed that all the patients included in the study were able to save between 6000 XOF and 23,000 XOF. The variation in that sum depended mainly on the distance between the research site and the only dermatological hospital located in Bamako. Therefore, with a total of 52 patients benefiting from the study, a margin of saving of 5,824,500 XOF was achieved during the study period.

| Variables related to health expenditure | Cost (XOF) Banamba | Cost (XOF) Kouloukoro | Cost (XOF) N’Golobougoou | Cost (XOF) Sikasso | Cost (XOF) Bankass | Cost (XOF) Douentza | Cost (XOF) Mopti |
|------------------------------------------|-------------------|----------------------|--------------------------|------------------|------------------|-------------------|----------------|
| On site | Bamako | On site | Bamako | On site | Bamako | On site | Bamako | On site | Bamako | On site | Bamako | On site | Bamako | On site | Bamako | On site | Bamako | On site | Bamako |
| Consultation | 1000 | 2000 | 1000 | 2000 | 500 | 2000 | 1000 | 2000 | 1000 | 2000 | 1000 | 2000 |
| Transportation | 0 | 5000 | 0 | 3000 | 0 | 6000 | 0 | 10000 | 0 | 20000 | 0 | 22000 | 0 | 20000 |
| Total | 1000 | 7000 | 1000 | 5000 | 500 | 8000 | 1000 | 12000 | 1000 | 22000 | 1000 | 24000 | 1000 | 22000 |
| Difference for project sites | 6000 | 4000 | 7500 | 11000 | 11000 | 23000 | 21000 |

Legend: This table shows the overall difference in expenditure per patient between the project sites and Bamako where the patient should go for specialist consultation without the telemedicine.

**Benefits for Health Professionals**

Overall, all health professionals thought that tele-expertise was a useful means for experts in the field of dermatology to provide better care for patients and manage dermatological pathologies within the whole country. Regarding the assumed benefits of the research activity, 6 of the 10 health professionals surveyed responded that tele-expertise through the “Bogou” platform was advantageous in two specific areas. It helped them:

- Improve their knowledge in the diagnosis and management of dermatological pathologies;
• Acquire more skills than their peers who have not used the tool, therefore gaining more recognition in the field.

For the 4 other 4 who took part in the study, their interest was focused on the ability of:

• Offering specialized consultations to patients;
• Providing specialized care for patients on site with the help of specialists remotely;
• Reducing referrals to specialists from other sites.

Discussion

The majority of tele-expertise requests (89.1%) received feedback from the experts. The remaining (10.9%) requests did not get any response mainly because they were submitted with poor quality images and/or insufficient clinical data. Such high rate of response recorded throughout the research proved the willingness of dermatologists to assist their peers in isolated and rural areas known as medical deserts. It also showed their confidence in the effectiveness of the application for tele-dermatology.

Eczema was the most common diagnosis with 55 cases representing 15.24% of the total number of conditions recorded during the study. It was followed by dermatophyte with 22 cases. These results are consistent with the findings of a study done in 2015 by Faye and collaborators at the Dermatology Reference Center (Dermatology Hospital of Bamako) [9]. These data confirm that there are as many patients with dermatologic diseases in the capital city where there is a specialized treatment facility as in remote areas with a scarce number of physicians lacking adequate support. Therefore, TELEDERMALI can be considered as an equalizer between patients living in the city and those in rural areas, as it allows equitable access to specialized care in the field of dermatology.

With respect to response time, the average response time of 1.9 day average found in our study seems acceptable compared to the one reported by a research by Colven et al in South Africa. The latter showed an average of 4.7 days [11].

We found out through our research survey that 98.1% of patients had never had a dermatological exam performed by a dermatologist. All their medical consultations were done by the same limited number of generalist healthcare providers regardless of the illnesses, which could only be due to the lack of specialists outside the capital city. Such finding supports and reinforces the concept of TELEDERMALI as an important mechanism to promote access to specialists by patients in remote areas. Such access, allowing them to get better care from dermatologists, is of paramount medical and financial benefit.

The majority of patient participants (71.2%) stated that they visited the participating centers solely because of the availability of tele-dermatology. They were mostly referred to the study centers by other healthcare providers. We were unable to process the exact ratio of increase in the number of patient visits because there was no previous recorded data we could use as a baseline measure. Despite the lack of data, we can say that medical centers participating in the TELEDERMALI project appealed to larger numbers of patients than those where the service was not available.

Patients treated at TELEDERMALI sites spent 500 XOF for a consultation in a CSCom and 1,000 XOF for a consultation at a CSRef. This represents the fixed fee for the ticket every patient needs for medical examination. The cost would be more expensive depending on where the patient lives if he or she had to travel to Bamako. For instance, it would be 6000 XOF for a patient from Koulikoro, while one from Douentza would pay up to 23,000 XOF. These numbers take into account only the cost of transportation. By adding other expenses such as those related to the transportation of a family member accompanying the patient, lodging and food, it is easy to conclude that the cost of getting care in the city could be really burdensome for patients already living in economic hardship. Therefore, with TELEDERMALI, patients can realize a significant financial saving comparable to the one reported in a medico-economic study of telehealth carried out by Bagayoko et al in 2014.

It is essential to point out that there is no additional fee associated with medical exams using tele-dermatology support. Its price structure is in line with that of the general regular doctor visit. In both cases, a patient pays a sum to acquire a ticket before seeing a healthcare provider no matter if the examination is done by a physician present onsite or remotely. That also validates that populations from rural locations who have access to TELEDERMALI enjoy tremendous economic benefit beside the medical advantages.

Patient satisfaction for the participants who received care through tele-dermatology management system was very high. Indeed, 85% of them declared being very satisfied and 15% satisfied. In the survey, patient satisfaction took into account the medical examination, images and the expected time frame of getting readout of the result by a specialist. This high satisfaction rate echoes what is reported in many other studies such as the one by Piette et al, which found an overall satisfaction level of 84.9% [12]. Patients especially appreciated the fact that tele-dermatology enabled them to avoid travelling to the capital to seek care, thus reducing drastically their expenses. This is why all the patients surveyed wished the initiative be extended to other sites.

Improved knowledge in the diagnosis and management of dermatological pathologies, new skills acquisition, access to experts’ and specialists’ opinion on site via remote information technology tools, ability of patients to get specialized medical exams without traveling and limited referrals to other sites are among the benefits mentioned by health professionals. These are the same assets revealed in many other studies like the one performed by Rog Kowska et al [13]. One of the health professionals, a nurse, told us “Thanks to my tele-dermatology skills, I am asked by my bosses (doctors) to perform more tasks”. A dermatologist stated “Thanks to Bogou, I can administer appropriate care and follow-up support to all the patients in my operation region regardless of the distance between us. I also continue to get timely adequate professional assistance from my managers when dealing with the most complicated cases.”

Healthcare providers who participated in the study showed a great deal of interest in the application deployed by TELEDERMALI. It helped them enhance their knowledge in dermatology to the point that one of them, a general practitioner, decided to specialize in the field.
Regarding the limits of our study, we were not able to appreciate an in-depth economic analysis taking into account, for example, the expenses related to accommodation for patients and their companions in the capital without tele-expertise.

The short time frame did not allow us to carry out a case-control study of the impact of tele-dermatology on the frequentation of the different centers.

Our future investigations will focus on responding to these limits.

**Conclusion**

Our findings indicate that tele-dermatology allows patients in remote areas to access cost effective specialized care. It is also an important medium in the ongoing medical training of health professionals in isolated zones.

Finally, it is a practice widely acclaimed, not only by the first beneficiaries who are the patients but also by health professionals. Both the applicants from isolated sites seeking for expert opinion and specialists bringing experienced proficiency in the administration of care find the tool to be very convenient.

Further investigation should go beyond the macro-economic benefits of tele-expertise in order to demonstrate its real impact on morbidity and mortality with further economic analysis.

**Abbreviations**

"Centre d'Expertise et de Recherche en Télémédecine et E-santé": CERTES

"Hôpital Dermatologique de Bamako": HDB

"Centre de Santé Communautaire": CSCom

"Centre de Santé de Référence": CSRéf

Mali's Teledermatology Project : TELERDERMALI

World Health Organization : WHO

**Declarations**

**Ethics approval and consent to participate**

To comply with the ethical and professional standards, the project was submitted to and approved by the Ethics Committee of the Faculty of Medicine and Odonto - Stomatology of Bamako.

We confirm that all methods were performed in accordance with the relevant guidelines and regulations.

All study participants signed an informed consent form.

**Consent for publication**

The publication of this work was authorized all the research staff.

**Availability of data and materials**

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

**Competing interests**

The authors declare that they have no competing interests.

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**Authors' contributions**
COB, MC, AJ and OF designed the study. COB and MC draft the first version. All authors revised the first draft of the manuscript. COB, MC and AJ carried out the second draft of the manuscript. MC, AA and MN did the statistical analysis. All the authors revised the manuscript. COB draft the final version of the manuscript. All authors checked and approved the submitted manuscript.

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