

## Research Article

# Teleconsultation on Skin Diseases: The Challenge of Providing Health Care to Isolated Populations in the Amazon Rainforest

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## ABSTRACT

This observational study was carried out in the state of Amazonas (Brazil), a huge and remote Rainforest area with only 2.2 inhabitants per square kilometer. This isolation is due to both geographical setting and ethnic-cultural barriers, with the indigenous population representing around 4% (20% of the entire indigenous population of Brazil, 60 ethnic groups and more than 40 languages).

The lack of dermatology specialists encourages the few Primary Health Care Doctors (PCD) to apply for asynchronous support on skin disease occurrences through the portal of the Manaus-based Telemedicine and Telehealth Centre (TTC). Subsequently, the TTC counsels the PCD at a distance through his dermatologist-consultants (DC). The performance of such a teleconsultation system was audited by a TTC independent board of experts. They reviewed a 24 months continuous case series by focusing on the quality of PCD applications and DC counseling. The quality of anamnesis, description of physical signs and attached clinical documentation by the PCD was

satisfactory in only 56/100, 44/100 and 53/100, respectively. A significantly negative trend ( $p < 0.05$ ) from the first to the second year was also observed. However, the PCD prompted presumptive diagnosis in 87/100, with a 72% of agreement with the DC's final diagnosis. Indicators of good DC performance were: a) the response to the application within 72 h time occurring in 51/100, with a significantly improving trend ( $P < 0.05$ ); and b) the referrals to the health facilities of the capital of the state being recommended in only 13/100. Teleconsultation represents an opportunity for providing access to isolated populations and minorities. Although DC performance is improving, the high turnover of PCDs and the lack of training in e-health at the undergraduate level result in the poor quality of PCD applications. Thus, instruction in e-health tools should be added to the curriculum of the undergraduate program in medicine.

**Keywords:** Teleconsultation; Primary health care; Performance; Skin diseases; Minorities

### Key points about what is known

- 1) In the Amazon Rainforest, health care providing is a hard challenge because of geographical and cultural barriers.
- 2) Public primary health care centers and municipal hospitals challenge low-complexity and some intensive care clinical cases of medium complexity.
- 3) The rainforest context is not attractive for specialists of any discipline, including a distinct lack of dermatologists.
- 4) Skin diseases occur in a high prevalence, in part due to the strong ultraviolet ray irradiation.

### Key points about adds-on

- 1) The medical teleconsultation system is a feasible tool to challenge the lack of expertise and inequality due to isolation and cultural diversities.
- 2) Doctor performance in posting skin disease cases into the teleconsultation system continues to demonstrate poor quality.
- 3) The quality of the counseling of the dermatology teleconsultants had been improving over 24 months.
- 4) Skin diseases should not be managed through store and forward proceedings, but as complete peer-to-peer internal medicine case files.
- 5) Training in e-health should be added to the curriculum of the undergraduate program in medicine to prepare the new generation of doctors for handling medical teleconsultation and other e-health tools.

## Introduction

The state of Amazonas covers 1,559,149 km<sup>2</sup> of the Northern Region of Brazil. The total population of the state is estimated at 3,938,336 inhabitants. Around 2 million people live in the municipal area of the capital, Manaus. The remaining 1.8 million inhabitants are spread over the other 61 municipalities lying within the Amazon Rainforest. Thus, the density of the population is as low as 2.2/km<sup>2</sup>, while the mean surface of the municipalities is very wide (25,373 km<sup>2</sup>) [1]. About 168,680 inhabitants are self-declared as indigenous, representing the greatest concentration (20%) of the entire indigenous population in Brazil [2]. They reportedly represent 62 ethnic groups speaking 45 languages [3]. The transport of people and goods usually takes place by boat and only along the navigable portions of the Amazon River Basin. Nevertheless, the low density of the population results in many communities remaining isolated. With regards to telecommunications, of the mobile telephone companies operating in the state of Amazonas, only one has a satisfactory coverage of repeaters, with the wireless repeater cell phone signals limited to the main settlements and internet data transmission often not supported. During thunderstorms the signal is always lost. Actually, transferring data is almost restricted to the use of satellite antenna.

Thus, the geographic context, as well as the ethnic and cultural mosaic, of the state of Amazonas is an extreme challenge for any of social services to work and often demands personalized solutions.

The Unified and Universal Brazilian National Health System (Sistema Único de Saúde-SUS) provides primary health care (PHC) in health post out-stations through family health care teams, led by a Primary Health Care Doctor (PCD). Most of the main towns within the municipalities maintain their own district hospital (secondary health care), to which medium-complexity and life-threatening cases are referred. Urgent cases or elective surgery of the highest complexity of care are evacuated to the capital Manaus, via expensive air transport [4]. Since 2013, the Telemedicine and Telehealth Center (TTC) has been providing synchronous (teleconferencing) and asynchronous (e-mail based) satellite teleconsultation services through its portal, in order to cope with isolation and lack of health expertise in the field [5]. PCDs registered through the portal, practicing in the health post out-stations, can request teleconsultation regarding their occurring cases by logging into the portal and posting the case asynchronously. Thereafter, TTC relays the cases to the relevant consultants and provides the consultants' counseling feedback to the applicants.

Since in the Amazon Rainforest a) the prevalence of skin diseases is high, due to the intense radiation of the ultraviolet rays, b) the municipal hospitals have no dermatologists available and c) skin diseases do not usually amount to life-threatening conditions, the PCD often requests TTC for solving dermatological cases. To ensure a competent counseling service, the TTC established a partnership with the Alfredo Da Matta Foundation (FUAM), which is a highly specialized center based in Manaus for skin disease care. By retrospectively going through the continuous series of 100 applications of dermatological cases in the TTC

portal from PCDs, the objectives of this observational study are: a) to evaluate the quality of the applications through quality indicators and its trend; and b) to evaluate the promptness and quality of the consultation service by the TTC and their trends.

## Materials and Methods

The continuous series of 100 skin disease case applications was reviewed by an auditing board, made up of three specialists, who were external and independent from both TTC and FUAM, namely: one internal medicine specialist, being skilled in medical clinics and clinical methodology, one dermatologist and one public health system manager. The series covers specifically the 24 months period from September 2013 to August 2015. Data were studied globally over the 24 months and divided into two periods of one year each (the first year from September 2013 to August 2014 and the second year from September 2014 to August 2015) in order to investigate the trends. The turnover in the TTC and FUAM teams was very poor throughout the entirety of the 24 months period. The teams implemented the same methodology and ensured homogeneous standards of conduct. Conversely, as a common and hard-to-manage problem in the countryside of the state of Amazonas, the PCDs demonstrated very high turnover, making it difficult to maintain improved standards of application.

Whenever the PCD in the health post comes across a dermatological case he cannot solve, he can log in the portal, post the essential data and get the case through to the dermatologist (DC) asynchronously via the TTC. The layout of the portal drives the applying PCD to provide the following information in text format: anamnesis, physical examination, patient declared allergies, on-going drug treatment, presumptive diagnosis, and proposed therapy. The PCD can attach images of the skin lesions as well.

The guidelines for the DC to reply are the following: a) Prompting a diagnosis, whenever possible, as well as the level of certainty; b) commenting on the etiopathogenesis of the case; c) drawing-up of a differential diagnosis diagram, even for training purposes and PCD capacity building; d) counseling with regards to the best medical conduct, including additional laboratory or clinical tests, prevention measures, therapies; e) listing and attaching references and manuals for the PCD's improved understanding and informed follow-up; f) recommending a teleconference or other follow-up measures, while realizing that the asynchronous teleconsultation is not enough to ensure safe patient management at the PHC level; and g) recommending referral to FUAM, whenever the case cannot be solved or managed at the PHC level (in practice that happens in four conditions: 1) neoplasms suspected, 2) surgical treatment recommended, 3) pending life-threatening conditions and 4) no diagnostic frame drawn-up).

In order to evaluate the quality of the applications and the conduct of the PCD, in accordance with good semiotic practices and previously disseminated TTC guidelines, the following on/off binomial indicators (satisfactory or unsatisfactory) were studied by the auditing board: 1) the accuracy of the anamnesis; 2) the accuracy of the description of the physical examination of

the dermatological lesions; 3) the quality of the pictures and any other documentation attached; 4) the prompting of a presumptive diagnosis; 5) the consistency of the presumptive diagnosis with the DC's diagnosis in the reply; and 6) the asynchronous or synchronous feedback given to the DC regarding the follow-up of the patient.

The auditing board also checked whether the patient had a further face-to-face consultation against the DC's recommendations. Although the PCD might not have been responsible for that and the patient elected to do so through his own initiative, such behavior by the patient hints at poor trust in the PHC system.

With the purpose of assessing the quality of the DC's counseling performance, the following indicators (on/off binomial choice), were estimated: 1) The time taken for replying (within the Ministry of Health recommended 72 h for delay), 2) the certainty of diagnosis prompted upon the first response, 3) the recommendation for patient referral (in first response or during the follow-up whenever the results of the treatment were unsatisfactory), 4) the recommendation for the performing of a biopsy, 5) the recommendation of scheduling a teleconference with the PCD to analyze the case more thoroughly, and 6) the recommendations for non-pharmacological remedies and/or preventive measures and/or extension of epidemiological investigations of patient contacts.

Based on the board members' skills and experience as well as on the TTC-issued good practice guidelines, the auditing board checked and made their decision one indicator at a time. While shifting the indicator, the sequence of cases was re-arranged randomly and blindly. The auditing board remained consistently unaware of the patient's identity and municipality. The whole auditing process was repeated at one-month intervals, with arising mismatches discussed and a final decision made.

Whenever applicable, the data of the first year were compared to the data from the second year through the *chi-square* test.

Furthermore, while referring to the nosological pattern of skin disease occurrences in FUAM, the DC-ascertained diagnoses were classified into the following main groups: a) leprosy, b) communicable diseases other than leprosy, c) sexually transmitted diseases, d) neoplastic diseases, e) allergic-hypersensitivity skin diseases, including eczema, and f) skin diseases of unknown origin [6].

## Results

The profile of the series of cases, the nosological categories of definitive diagnoses, the indicators of quality of the applications by PCDs, and the indicators of quality of DC counseling (Table 1).

Over the first year, there were only 26 applications, increasing to 74 over the second year. The mean age  $\pm$  standard deviation of the series of cases was  $32 \pm 23$  globally,  $33 \pm 25$  in the first year,  $32 \pm 23$  in the second year. In the first year the male-female ratio of patients was 1.17, shifting to 0.68 in the second year.

Only 12 municipalities logged into the platform over 24

months, notwithstanding the availability of satellite antenna in about 20 municipalities.

Focusing on the nosological pattern of the skin diseases, PCDs requested no consultations for sexually transmitted diseases. Leprosy occurred in 5/100, fungal and other infectious diseases occurred in 19/100, non-communicable diseases of presumed allergic/atopic origin (including eczema) in 21/100. No modification of the nosological pattern was observed between the first and the second year.

Regarding the quality of the applications, the accurate anamnesis collection and accurate physical examination were 56/100 and 46/100 globally. Both had a significantly negative trend ( $P < 0.001$ ).

Despite the recommendations issued, good quality pictures were attached only in 53/100 and no improvement was observed from the first year to the second year.

Over 24 months, PCDs prompted a presumptive diagnosis in 87/100 with no significant difference between the first and the second year (24/26 and 63/74). Over 24 months, the agreement of the presumptive diagnosis with the DC's definitive diagnosis was 63/87 (72%). Again, no difference was observed between the first and the second year (17/24 and 46/63).

The applying PCDs provided subsequent feedback to the DC in 15/100, considered poor against the expectations. The very low feedback ratio of the first year (1/26) demonstrated a not significant increase to 14/74 in the second year.

Only 3 patients were referred (or perhaps referred themselves by their own initiatives) to a face-to-face consultation against the DC's recommendations. In two of these cases, the diagnosis had already been settled by the teleconsultation and was confirmed by a different dermatologist in the face-to-face consultation. In the remaining case, the face-to-face consultation helped merely to perform a sensibility test which ought to have been carried out at the PHC level, as was recommended.

With regards to DC conduct, counseling was carried out within 72 h from the application in 51/100. In the first year it occurred in only 8/26, increasing to 43/74 in the second year, with the difference being statistically significant ( $P < 0.05$ ). One can observe also a decrease in the mean delay (from 10 to 8 days), although this was not statistically significant.

In 70/100 applications, the DC managed to settle on a definitive diagnosis upon his first reply. Moreover, the certainty of diagnosis increased from 15/26 in the first year to 55/74 in the second year, but not significantly. Of the remaining 30 cases, in 28 the DC managed to draw-up a differential diagnosis diagram for the PCD to help him in solving the case.

The recommendation for referral was 10/100 in the first reply and 3 in the follow-up, making a total of 13/100. A significant decrease was observed in such recommendations, as the second year demonstrated 6/74 against 7/26 in the first year ( $P < 0.05$ ).

Over 24 months, the 13 causes of referrals were: n. 6 suspected malignancies, n. 4 systemic diseases needing multidisciplinary approach, 2 lepromatous leprosy cases in

**Table 1:** Medical teleconsultation on skin diseases - September 2013-August 2015.

<b>Medical teleconsultation on skin diseases - September 2013-August 2015</b>				
	<b>Over 24 months</b>	<b>First year (September 13-August 14)</b>	<b>Second year (September 14- August 15)</b>	<b>First vs. second year p (chi-square test)</b>
<b>Series of cases</b>				
Mean age of cases	32 +/- 23	33 +/- 25	32 +/- 23	
Male/female	0,79	1,17	0,68	
Applying municipalities	12	5	9	
Male	44/100	14/26	30/74	
<b>Ascertained skin diseases</b>				
Leprosy	5/100	1/26	4/74	
Sexually transmitted diseases	0/100	0/100	0/100	
Neoplasms	3/100	1/26	2/74	
Mycosis and other infectious diseases	19/100	4/26	15/74	
Vitiligo and other non-leprosy related dischromias	5/100	2/26	3/74	
Non-communicable diseases of suspected allergic/atopic origin (including eczema)	21/100	4/26	17/74	
Skin diseases of unknown origin	8/100	2/26	6/74	
Life-threatening skin diseases	4/100	1/26	3/74	
<b>Primary health care doctor's performance</b>				
Anamnesis of good quality	56/100	23/26	33/74	P<0,001
Physical examination of good quality	46/100	20/26	26/74	p<0,001
Pictures of good quality	53/100	16/26	37/74	ns
Presumptive diagnosis prompted	87/100	24/26	63/74	ns
Presumptive diagnosis matching final diagnosis	63/87	17/24	46/63	ns
Follow-up feed-back given (synchronously or asynchronously)	15/100	1/26	14/74	ns
Not recommended referral	3/100	0/26	3/74	ns
<b>Dermatologist consultant's performance</b>				
Counseling within 72 h	51/100	8/26	43/74	P<0,05
Definitive diagnosis prompted	70/100	15/26	55/74	ns
Differential diagnosis diagram suggested in not-definitive diagnosis cases	28/30	10/11	18/19	ns
Referral recommended upon first counseling	10/100	5/26	5/74	ns
Referral recommended upon follow-up	3/100	2/26	1/74	na
Total referrals	13/100	7/26	6/74	p<0,05
Biopsy recommended at first counseling	26/100	10/26	16/74	ns
Preventive measures or extra-drug prescription suggested (surgery ruled out)	49/100	7/26	42/74	p<0,001
Teleconferencing recommended	4/100	1/26	3/74	ns
Teleconferencing given out of the recommended ones	0/4	0/1	0/3	na

need of intensive treatment and 1 post-surgery keloid needing multidisciplinary treatment.

The biopsy recommendation ratio was 26/100 with no significant difference between the two years.

Beyond drug prescription, the DC gave additional therapeutic recommendations and suggestions in 49/100 with a significantly increasing trend (P<0.001).

Globally the DC reckoned the asynchronous teleconsultation unsatisfactory for case solving and requested synchronous teleconferencing in 4/100; however, this teleconferencing never took place.

## Discussion

The effectiveness of teledermatology versus conventional consultation is proven [7]. Skin disease cases are easily reported and submitted on line through simple text files for anamnesis and physical examination description and still images for showing the lesions. They are rarely urgent or life threatening; therefore, some delay in replying has a poor impact on the outcome [8,9].

Teledermatology is a mature subject in the literature and a priority subject for developing within some framework of national telemedicine [10,11].

Recently, studies of real-time synchronous teledermatology

were published [12]. Most likely, these are based on interactive teaching experiences rather than on health care activities. In our study, asynchronous teleconsultation is effective for problem solving and real-time synchronous teleconferencing was requested by the DC as rarely as 4/100 and this was merely to discuss the differential diagnosis diagram and not to get a better live view of the dermatological lesions. Definitely, teleconferencing in dermatology seems to have a poor added value.

The *store and forward techniques - SFT* (the mere sending of pictures of skin lesions to get a report from the DC, as it happens for whatever imaging test reporting) should not be confused with the PCD-DC virtual debate of skin disease cases, which is the more structured procedure we present in this study [13-15]. Although SFT may be an option for skin neoplasm triage and other screening purposes in the majority of skin diseases, a peer-to-peer complete case file has to be built and submitted.

Conversely, the direct dermatologist-patient teleconsultation both asynchronously and synchronously, was proved to be rather unsatisfactory, due to the poor accuracy in information exchanging and the bad quality of the patient-self captured snapshots of his own skin lesions [16]. Thus, it is confirmed that the best quality of outcome can be achieved only through the support of one doctor to another doctor [17-19].

However, if one focuses on other SFT services of whatever discipline, the importance of the human factor is expected to decrease. Actually, as computing technology develops, the task of image interpreting and reporting will be increasingly automated [20]. Although automation does not necessarily mean more effectiveness, the time-saving can compensate the 28% increase of time spent by the doctor for applying [21].

Papers addressing the performance of health professionals working in teleconsultation services in Amazon Rainforest are very rare.

In our study, although the number of posted cases increased three-fold over the second year, the number of municipalities making use of the platform is still below the expectations and no significant breakthrough occurred.

The mismatch of the nosological pattern of our series of cases with the one of the face-to-face consultations in FUAM was up only on sexually transmitted diseases for which PCDs do not usually apply. Actually, sexually transmitted diseases often require a systemic and multidisciplinary approach, rather than dermatology alone.

The poor quality of anamnesis, physical examination, and pictures attached makes the PCDs' performance unsatisfactory. The negative trend of the first two indicators makes this challenge even more alarming and demands a strategy of permanent refresher training of the PCD about good practices in the application process. Although this could also partly address the problem of high turnover in PCDs, permanent refresher training for PCD's improved performance would be a very heavy and poorly sustainable task for the TTC and health system's formation facilities. The increasing use of medical

teleconsultation suggests that the new generation of medical doctors ought to be prepared on e-health tools at an early age, ever since the graduation course of studies. Therefore, such training on e-health tools should be permanently added to the curriculum of the graduation in medicine and perhaps courses of studies of other health professions, included in primary health care teams.

PCDs appear to be inclined to prompt a presumptive diagnosis and such presumptive diagnosis is in agreement with the DC's definitive diagnosis in 72%, which is a higher percentage than the 56% reported by Patro [22]. However, one should not view this overenthusiastically, because it may hint at the over-applying of cases.

Whenever the case is not recommendable for referral and the DC does not manage to make a definitive diagnosis upon his first reply, the DC is likewise supportive by proposing a differential diagnostic diagram and advising a treatment the effectiveness of which has to be followed-up to confirm back the diagnosis. By summing the number of definitive diagnoses (70/100) and the 28/30 proposed differential diagnosis diagrams, one realizes that the DC is supportive to the PCDs in 98/100. Unfortunately, very rarely do PCDs return such support by providing feedback to the DC with follow-up data. Lack of feedback is not only an indicator of PCD's poor performance, but also badly affects the outcome of the entire teleconsultation-supported patient management and enhances the medical error vulnerability of the patient [23].

The importance of case solving within the municipality is apparently well perceived by the DC. Only 13/100 patients were recommended for referral and the trend is even decreasing significantly. Moreover, the low ratio of referrals not recommended confirms that teleconsultation has an important exclusive role in the state of Amazonas.

The steady ratio of biopsies recommended, most of which can be smoothly performed in the municipality hospital, highlights the DC's enduring feeling of keeping the health care decentralized. By comparing teledermatology approach versus conventional face-to-face consultation, skin biopsy is more recommended by 10%, because the former makes the consultant more uncertain, but the mean time for performing the biopsy decreases by 4 days [24,25].

Important telemedicine experiences from other countries of the world are inapplicable in the context of the state of Amazonas.

Firstly, in the Netherlands, dermatologists of the second level of care did not prefer teledermatology to "common work processes" for getting tertiary level consultations [26]. In the state of Amazonas, there are no alternative "common work processes" available. Our data on the very low ratio of referrals not recommended confirms how uneasy the seeking of the face-to-face consultation is. Actually, the cutoff point of convenience between teleconsultation and face-to-face consultation is derived from the quotient of the time spent for the one-way travel to access the consultant by the time spent by the patient in waiting and being attended. Is the quotient over 6, teleconsultation is

convenient [27]. In the state of Amazonas, the time-consuming displacements by boat make the cutoff point to be easily reached as it happens in many other remote areas, but not in densely populated and developed countries [28,29].

As a second example, in the United States, companies launch a high quantity of mobile applications for teleconsultation, including teledermatology [30]. In the state of Amazonas mobile repeater network coverage is so weak as to not be conducive for teleconsultation purposes.

## Conclusion

In geographical settings with poor transport infrastructures and cultural barriers, such as the Amazon Rainforest, the medical teleconsultation and other e-health disciplines can be of some support in coping with diversity and bring equal opportunities of access to the health services. However, medical doctors are still unprepared for handling e-health tools productively and do not keep up with information and communication technologies introduced. Thus, it is necessary to prepare the new generations of medical doctors as of the undergraduate level by adding e-health tools in the curriculum of studies.

## Ethical Approval

This study was carried out conforming the Declaration of Helsinki. Moreover, as it is also informed in the paper, the involved investigators could not have access to the identity and race of the patients throughout the revision of the case series. The methodology of the research preserved anonymity and privacy of the patients at full extent.

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## Conflict of Interest

The authors declare that none of them have any conflict of interest in this research.

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