English

Teledermatology as a support tool for skin cancer diagnosis

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Abstract

Introduction: *The objective of the study is the evaluation of digital media and the diagnostic reproducibility of teledermatoscopy as a tool to support the diagnosis of skin cancer.* ***Method:*** *This is a cross-sectional study developed in three phases: In the first phase, pre-intervention, the evolution of the telehealth platform HealthNET was carried out. In the second phase, of the intervention itself, data were collected from patients in the dermatology service of HC.* ***Results:*** *Teledermatologists reported greater advantages for the practice of asynchronous over synchronous teledermatology were related to increased efficiency (59%), increased convenience of access (53%), increased patient satisfaction (53%), increased provider satisfaction reference (35%), timely service (35%) and economic care (18%). For this, standardized practices in teledermatology are consubstantially important for their implementation.* ***Conclusion:*** *Therefore, teledermatology must be developed in the light of a well-established work process as well as having technological tools and well-structured and recognized valid operating models.*

Keywords: *Teledermatology; Skin Cancer; Diagnosis; Telemedicine.*

Resumen

La teledermatología como herramienta de apoyo diagnóstico de cáncer de piel.

Introdución: *El objetivo del estudio es la evaluación de medios digitales y la reproducibilidad diagnóstica de la teledermatoscopia como herramienta de apoyo al diagnóstico del cáncer de piel.* ***Metodo:*** *Se trata de un estudio transversal desarrollado en tres fases: en la primera fase, preintervención, se llevó a cabo la evolución de la plataforma de telesalud HealthNET. En la segunda fase, de la propia intervención, se recogieron datos de los pacientes del servicio de dermatología de HC.* ***Resultados:*** *Los teledermatólogos informaron que las mayores ventajas para la práctica de la teledermatología asincrónica sobre la síncrona se relacionaron con mayor eficiencia (59%), mayor comodidad de acceso (53%), mayor satisfacción del paciente (53%), mayor referencia de satisfacción del proveedor (35%), servicio oportuno (35%) y asistencia económica (18%). Para ello, las prácticas estandarizadas en teledermatología son consustancialmente importantes para su implementación. Conclusión: Por tanto, la teledermatología debe desarrollarse a la luz de un proceso de trabajo bien establecido, además de contar con herramientas tecnológicas y modelos operativos válidos, bien estructurados y reconocidos.*

Palabras clave: *Teledermatología; Cáncer de Piel; Diagnóstico; Telemedicina.*

Resumo

A teledermatologia como ferramenta de apoio ao diagnóstico de câncer de pele.

Introdução: *o objetivo do estudo é a avaliação de meios digitais e da reprodutibilidade diagnóstica da teledermatoscopia como ferramenta de apoio ao diagnóstico do câncer de pele.* ***Método:*** *Trata-se de um estudo transversal desenvolvido em três fases: na primeira fase, pré-intervenção,foi realizada a evolução da plataforma de telessaúde HealthNET. Na segunda fase, da intervenção propriamente dita, foi realizada a coleta de dados de pacientes no serviço de dermatologia do Hospital das Clínicas.* ***Resultados:*** *Teledermatologistas relataram maiores vantagens para a prática da teledermatologia assíncrona sobre a síncrona foram relativas ao aumento da eficiência (59%), aumento da conveniência de acesso (53%), aumento da satisfação do paciente (53%), aumento da satisfação do provedor de referência (35%), atendimento oportuno (35%) e cuidados econômicos (18%). Para tanto, as práticas padronizadas em teledermatologia são consubstancialmente importantes para sua implementação.* ***Conclusão:*** *a teledermatologia deve ser desenvolvida a luz de um processo de trabalho bem estabelecido assim como deve contar com ferramentas tecnológicas e modelos operativos bem estruturados e reconhecidamente válidos.*

Palavras-chave: *Teledermatologia; Câncer de Pele; Diagnóstico; Telemedicina.*

INTRODUCTION

The incidence of cancer in the world and Brazil has been increasing in recent decades and tends to increase with the aging of the population[1]. According to the American Cancer Society, the number of new cases of skin cancer detected annually is greater than the incidence of breast, prostate, lung, and colon cancer together[2]. In Brazil, the National Cancer Institute (2017) points out that skin cancer is the most frequent, corresponding to 30% of all malignant tumors registered in the country.

There are three types of skin cancer evaluated according to their severity: Basal Cell Carcinoma (BCC), Squamous Cell Carcinoma (SCC) – both considered Non-Melanoma Skin Cancer (NMSC) – and Melanoma Skin Cancer. Melanoma is the most aggressive form of skin cancer. It has a low incidence (about 4% of all skin cancers) but a high degree of mortality of about 65% of all deaths from skin cancer due to a high probability of metastasis. [3,4]

In Brazil, the estimated occurrence, for each year of the 2020/2022 triennium, is 625,000 new cases (450,000, excluding cases of non-melanoma skin cancer). Non-melanoma skin cancer has a higher incidence, with 177,000 cases. The non-melanoma skin cancer rates will represent 27.1% of all cancer cases in men and 29.5% in women. Pernambuco, the place of this project, had an incidence rate of melanoma skin cancer of 1.13 (1.70 in the capital) new cases for every 100,000 men and 1.88 (2.11 in the capital) for every 100,000 women, in the period 2020[4].

The adjusted incidence rate, without considering non-melanoma skin cancer, was 15% higher in men (204.7 per 100,000) than in women (175.6 per 100,000), varying between different regions of the world.

Early diagnosis[5] and adequate intervention for skin cancers, especially melanoma, are essential factors for a favorable clinical outcome for patients, directly impacting survival and related costs for the Unified Health System (*Sistema Único de Saúde* – SUS) [6].

In this context, Telehealth is inserted, aimed to provide remote support by specialists, qualifying the diagnosis, reducing the need to move patients, and reducing costs in SUS. Also, this health action mediated by technologies facilitates the strengthening of comprehensive care[7], with a focus on achieving resolvability from the SUS gateways [8,9].

In Brazil, the National Program *Telesaúde Brasil Redes*, created by a Pilot Project in 2006 and supported by the Ministry of Health, implemented Technical-Scientific Telehealth Centers in all states, including the state of Pernambuco, at the Federal University of Pernambuco, which is responsible for offering tele-education, tele-consulting and tele-diagnosis in the state [3, 10].

Teledermatology has a fundamental role in supporting the diagnostic suspicion of cancer, especially in Brazil, a country with continental dimensions, predominantly tropical, with great exposure of the population to the sun, increasing risk factors for skin cancer and, scarcity and uneven distribution of experts [3,9]. Brazilian studies[10] in this approach report positive experiences with teledermatology in different states in the country.

Given the above, associated with new technologies and greater access to the Internet by different users, we need to evaluate digital media and the diagnostic reproducibility of teledermoscopy as a support tool for the diagnosis of skin cancer, which was the objective of this study.

METHOD

The study was developed by the team from the Telehealth Center at the Federal University of Pernambuco (NUTES/UFPE), from the National Program Telesaúde Brazil Redes with the support of the Dermatology Service of the Hospital das Clínicas (HC) of the Federal University of Pernambuco (UFPE), state reference for the specialty.

This is a cross-sectional study developed in three phases: In the first phase, pre-intervention, the evolution of the telehealth platform HealthNET of NUTES/UFPE was carried out so that it provides the teledermatology service and the development and validation of the Photo documentation protocol for teledermatology. In the second phase, the intervention itself, data were collected from patients in the HC dermatology service, through anamnesis, assessment of suspicious lesions, and photo documentation, and finally, after the intervention, we performed the teledermoscopy reproducibility analyses.

This study included patients assisted at the Dermatology Outpatient Clinic of Hospital das Clínicas da UFPE, who, at the first consultation, found the presence of pigmented lesions, from March to June 2018. We excluded from the study patients/requests for telediagnosis that did not agree to participate in the research, did not sign the Informed Consent Form, did not have images of the lesion with sufficient quality for evaluation. However, before the research was sent to the patients, the project was presented to the Research Ethics Committee of the HC, in compliance with the recommendations, resulted in its approval.

The calculation of the sample size necessary for the development of the project is 78 lesions, with a 95% confidence interval, based on estimated data for the 2016/2017 biennium, the occurrence of new cases of skin cancer in the state of Pernambuco.

From the telediagnosis module available in the HealthNET Platform and to implementing teledermatology, we needed to implement a specific environment for Teledermatology in the telediagnosis module of the HealthNET Telehealth Platform. Therefore, it became essential to develop methods, tools, and procedures that would provide the developer with a basis for building the environment.

After defining the scope of the project that resulted in the determination of a flowchart with the necessary characteristics for the teledermatology environment, we modeled these characteristics through the elaboration of archetypes, Action, Instruction, Observation, and Evaluation, and established the human resources, hardware/software consumption estimates and the environment construction schedule. The Photo Documentation Protocol proposes guidelines for the practice of Teledermatology as well as for photo documentation in Teledermatology to support the development of safe and effective teledermatology practices through the

construction of technical and scientific skills by health professionals to resolve failures and provide more accurate diagnoses.

The theoretical procedures for the construction of the Protocol began with a bibliographic survey about cancer, a photographic record in dermatology and cosmiatrics, and photo documentation. The validation of the Photo Documentation Protocol used the Content Validity Index (CVI), and the Protocol was validated by evaluators, specialists in dermatology and family and community medicine, who evaluated the protocol using a Validation Questionnaire prepared based on an adaptation of the instrument used by Souza Junior (2014). The instrument was also validated in appearance and content by two evaluators who offered suggestions that were after implemented.

The data collected were registered by the dermatologist responsible for the face-to-face care on the HealthNET Telehealth Platform and forwarded for remote evaluation by two specialist dermatologists (Teledermatologists), ensuring that they do not exchange information about the case. Teledermatologists added the main diagnosis and up to two secondary diagnoses for each telediagnosis request.

For the descriptive analysis of this work, the absolute and relative frequency of categorical variables was calculated, whether these are inherent or relative to the validation of the Photo Documentation Protocol for Teledermatology.

Table 1 – Kappa Agreement Scale

Kappa	Agreement
<0.20	Poor
0.21-0.40	Regular
0.41-0.60	Moderate
0.61-0.80	Good
0.81-1.00	Excellent

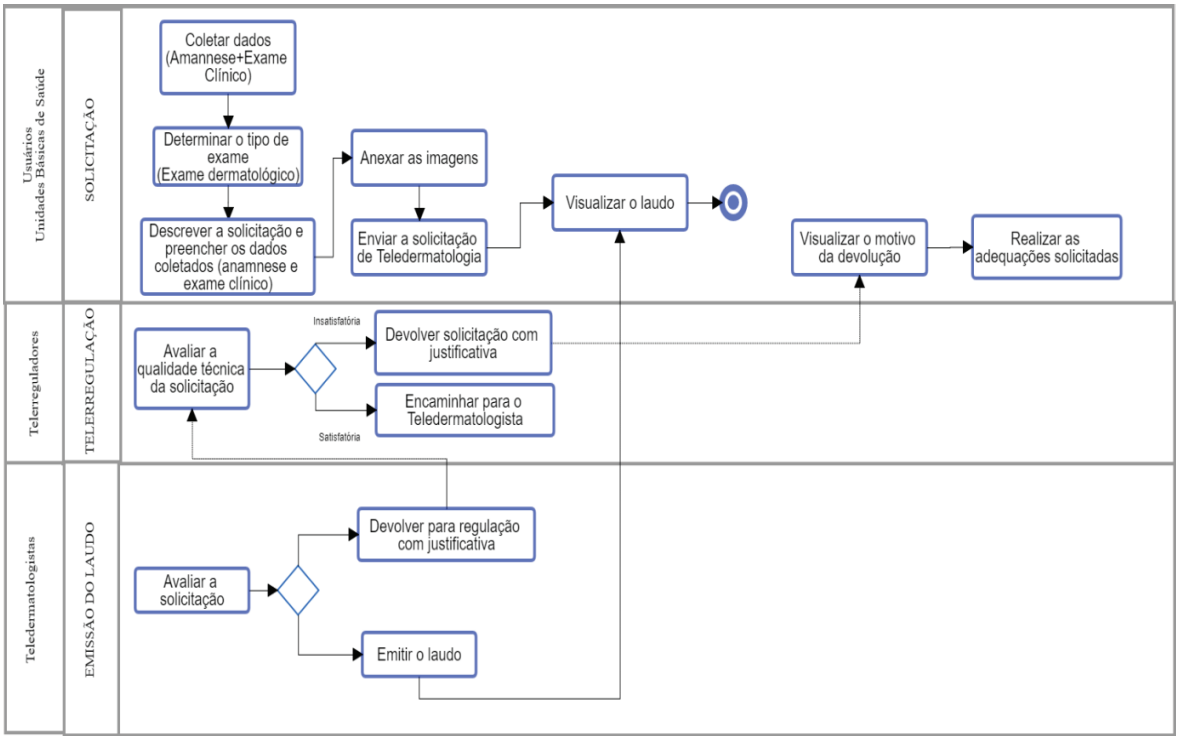
Source: ALTMAN,1991.

The analysis of the interfaces between the subjects involved, their action methods, and the way they intersect, allows us to understand how technology should behave to reach the intended objective and becomes a guiding axis for the work to be developed in the modeling of the technology.

Based on this analysis, we created a flowchart (see figure below) describing the features that the telediagnostic module of the HealthNET Telehealth Platform should have to develop teledermatology practices, specifically aimed at telediagnosis of dermatoscopic examination.

After the preparation, we submitted the Protocol for its validation by a group consisting of 07 evaluators, 05 dermatologists linked to two hospitals (one federal and the other philanthropic), and 02 doctors specializing in family and community medicine, linked to two Basic Health Units (UBS - Unidades Básicas de Saúde) in the city of Recife – PE, since the protocol was designed for primary care professionals.

Figure 5. Flowchart of functionalities for the HN Platform telediagnostic module.



dures and actions performed by healthcare professionals.

The evaluators were six (87.7%) women and one (14.3%) men, aged between 29 and 62 years old, mean of 41.4 years old, with the highest concentration between 34 and 39 years old in 5 evaluators.

The length of professional experience was between 4 and 39 years, with an average of 16.8 years. Regarding the area of professional practice, 05 (71.4%) evaluators are dermatologists with an average time of experience in the area of 21.2 years and 02 (28.5%) are specialists in family and community medicine with an average time of specific experience in the area of 6 years. Only one of the evaluators mentioned the time of experience in other areas (clinical medicine) with 09 years of experience.

As for academic degrees, two evaluators (28.6%) had a doctorate in their area of expertise, three (42.9%) had a master's degree and two (28.6%) had a specialization.

After the validation of the Photo Documentation Protocol in Teledermatology, we used the acquisition of dermatological images performed in the data collection stage as a method of standardizing, whose sample made up a total of 72 patients treated at the dermatology outpatient clinic of the Hospital das Clínicas da Federal University of Pernambuco.

The dermatological images collected were then submitted to reproducibility analyzes through the evaluation of inter-observer agreement by 04 (four) dermatologists, 02 (two) in person, and 02 (two) online. Each dermatologist assigned a main diagnostic hypothesis and a secondary diagnostic hypothesis for each case evaluated, to obtain the kappa index.

RESULTS AND DISCUSSION

Telemedicine has a set of tools that can help achieve better standards of access, quality, and resoluteness of care, and reduce costs for health systems. In this context, teledermatology, in addition to being an application of telemedicine, is a new look at health care [11].

To enable the practice of teledermatology in Pernambuco, the Teledermatology Module in the HN Telehealth Platform was developed and implemented as the scope of this work. It is a tool that brings together technological and methodological instruments capable of supporting the diagnosis of skin cancer through an easy-to-navigate and intuitive-to-use solution.

According to Arouck[12], important aspects to be considered for the construction of a telemedicine platform are considered to be the ability to gather information clearly and uniformly, securely transmit high-quality images, have readability, methodical data management, and possibility to explore the database, requirements architected and implemented in the HN telehealth platform.

Assim como os requisitos propostos por Arouck (2011), foram objetos de preocupação, durante a construção dos arquétipos do módulo de teledermatologia da Plataforma HN, a inserção de componentes que permitissem a melhor visualização dos dados clínicos inerentes ao caso em discussão através da condensação de um conjunto de informações de anamnese e exame clínico relativo a dermatologia, com campos de preenchimento obrigatório, para melhorar a completude dos dados, como também a representação em modelo gráfico da localização das lesões. Além disso, o banco de dados é acessível para os profissionais através de uma lista de casos enviados, de modo a permitir o telemonitoramento e a retomada da discussão clínica, quando necessário.

As well as the requirements proposed by Arouck (2011), during the construction of the archetypes of the teledermatology module of the HN Platform, the insertion of components that allowed better visualization of the clinical data inherent to the case under discussion through the condensation of a set of information on anamnesis and clinical examination related to dermatology were objects of concern, with mandatory fields to improve the completeness of the data, and the representation in a graphic model of the location of the lesions. Also, the database is accessible to professionals through a list of cases sent to allow telemonitoring and the resumption of clinical discussion, when necessary.

For Armstrong[13], the biggest technological challenge for the development of teledermatology is mainly the availability of inefficient and costly platforms that do not integrate with second medical opinion systems and poor image quality. He points out that the asynchronous nature of teledermatology has proved to be useful for the efficiency of the practice and reduction of overhead expenses.

According to Armstrong (2011), teledermatologists reported greater advantages for the practice of asynchronous over synchronous teledermatology. They were related to increased efficiency (59%), increased convenience of access (53%), increased patient satisfaction (53 %), increased satisfaction of the reference provider (35%), timely service (35%), and economical care (18%).

Corroborating this finding, David (2013) states that there is no other option to obtain access to a specialized consultant, given scenarios of scarce resources and difficulty in securing medical establishments in remote areas, such as those present in Pernambuco, except through this type of system, as it represents a pragmatic and efficient response to the chronic shortage of specialists.

In addition to a well-structured Teledermatology Platform, capable of bringing together clinical and imaging aspects completely, the practice of teledermatology also requires the standardization of the entire work process inherent to teledermatology to facilitate communication, resolve flaws and improve asynchronous diagnosis.

As an important point to be discussed regarding the standardization of teledermatology, it is important to focus on the need to ensure patient safety for the quality of care and minimize the risk of damage. Based on this, one way to improve patient care is the standardization of health proce-

In the health area, the standardization of procedures is extremely important to ensure the expected result of the action to be implemented, through the technical guidance of the procedure following scientific principles as a way to achieve the quality of health care provided (BARBOSA et al, 2010).

As we can see, the possibility of evaluating a skin lesion is as valuable to dermatologists as reading about it. Given this fact, we observe the importance of photography for this specialty and the need for its registration [14].

Photo documentation in dermatology is present in the evaluation and follow-up of skin lesions, helping to choose the best treatment, in medical education, in clinical research, as a form of legal documentation and for use in teledermatology [14,15], as well as being useful for the telemonitoring of chronic conditions such as skin cancer, psoriasis, and cutaneous T-cell lymphoma. However, due to the diversity of work scenarios, the range of dermatological pathologies, and the difficulty of documentation, it is essential to create specific protocols aimed at standardizing the collection and recording of images to enable remote diagnosis according to Von Wangenheim.

Without standardized and consistent approaches to photo documentation, teledermatologists have the risk of limiting the usefulness of a large data source of great value for research and clinical practice [16].

There are norms for clinical photo documentation aimed at specific regions of the body, particularly in the area of cosmiatrics and aesthetic medicine. Also, the American Telemedicine Association (ATA) has recently updated the guidelines for the practice of teledermatology that provides, as well as the elaborated protocol, guidelines for clinical practice, recommended technical requirements, and administrative aspects, applicable to US healthcare professionals (ATA, 2016).

The standardization of images gives greater credibility to the diagnosis. When it comes to standardization, having images comparable to each other, the only variable in the photos must be the patient [15], so it is important to establish a routine for photo documentation.

However, the standardization instrument must go through a content validation process to obtain these values. The group of evaluators who validated the Photo Documentation Protocol included dermatologists and family and community physicians from different institutions, which contributes to a greater diversity of their professional experiences.

Regarding the item “objectives” that corresponds to the purposes, goals, or objectives to achieve with the protocol, the evaluators’ responses had a CVI equal to 1.0. Therefore, there was no response “disagree”, “strongly disagree”, and “I do not know”.

CONCLUSION

As ICTs continue to contribute to medical practice, the continued adoption of teledermatology makes it imperative to build collaborative, accessible, and versatile tools that add efficiency and resolvability to healthcare practices. In this sense, this work proposed the development of a web environment for teledermatology to provide health professionals with a specialized support tool for the diagnosis of skin cancer.

Therefore, standardized practices in teledermatology are consubstantially important for its implementation. Therefore, teledermatology must be developed in the light of a well-established work process and having well-structured and admittedly valid technological tools and operating models.

Once the reproducibility analysis of teledermatology against the presented method has achieved a value of excellence, teledermatology will become part of the NUTES-UFPE service portfolio.

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