Development of the SkinScan App: An Application to Help Primary Care Physicians Identify Skin Lesions Suspected of Malignancy

Desenvolvimento do aplicativo SkinScan: Um aplicativo para auxiliar médicos da atenção primária a identificar lesões de pele com suspeita de malignidade

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Abstract

Introduction The evaluation of skin lesions by plastic surgeons or dermatologists is not feasible due to their high prevalence. The present study describes the development of SkinScan, a web-based application to help primary care physicians identify skin lesions suspicious of malignancy. This app may enable more effective screening of lesions requiring specialist evaluation, allowing for early diagnosis and treatment.

Materials and Methods We performed a literature review on skin cancer screening to support the creation of an algorithm. We refined the algorithm content through a round of Delphi consensus-building with 20 experts, including plastic surgeons and dermatologists. They used a 5-point Likert scale to assess the appropriateness of the language, sequence of information, ease of understanding, and relevance of the content. In addition, they made suggestions for adjustments. We calculated Cronbach's alpha coefficient to verify the internal consistency.

Results Of the 20 experts, 13 (65%) consented to participate, including 8 plastic surgeons and 5 dermatologists. Their average time of certification and practice in the medical specialty was 13 years (ranging from 5–29 years). The calculated Cronbach's alpha coefficient was 0.8, indicating the algorithm was reliable. The algorithm supported the development of a free web-based application for physicians (http://skinscan.progm.net.br/). We registered the SkinScan at the Brazilian National Institute of Industrial Property (Instituto Nacional de Propriedade Industrial – INPI, in Portuguese [BR512020001285–0]).

Keywords
- algorithms
- diagnosis
- primary health care
- referral and consultation
- skin neoplasms

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Conclusion The SkinScan has been successfully developed and is available free of charge for medical use.

Resumo

Introdução A alta prevalência de lesões cutâneas torna inviável que todas sejam avaliadas por cirurgiões plásticos ou dermatologistas. Este estudo descreve o desenvolvimento do SkinScan, um aplicativo para auxiliar médicos que atuam na atenção primária a identificar lesões suspeitas de malignidade, com potencial de possibilitar uma triagem mais eficaz das lesões que devem ser avaliadas por especialistas, permitindo diagnóstico e tratamento precoce.

Materiais e Métodos Realizou-se uma revisão de literatura sobre rastreamento de câncer de pele, para dar suporte à criação de um algoritmo. O conteúdo do algoritmo foi refinado por meio de uma rodada de construção de consenso (técnica Delphi) com 20 especialistas, incluindo cirurgiões plásticos e dermatologistas. Eles usaram uma escala Likert de 5 pontos para avaliar a adequação da linguagem, sequência de informações, facilidade de compreensão e relevância do conteúdo, e fizeram sugestões de ajustes. Calculou-se o coeficiente alfa de Cronbach para verificar a consistência interna.

Resultados Dos 20 especialistas, 13 (65%) consentiram em participar, incluindo 8 cirurgiões plásticos e 5 dermatologistas, com tempo médio de certificação e prática na especialidade de 13 anos (variando de 5–29 anos). O alfa de Cronbach calculado foi de 0,8, indicando que o algoritmo era confiável. Um aplicativo foi então criado a partir do algoritmo, de uso gratuito para médicos (http://skinscan.progm.net.br/). O SkinScan foi registrado no Instituto Nacional de Propriedade Industrial – INPI (BR512020001285–0).

Conclusão O SkinScan foi desenvolvido com sucesso e está disponível para uso gratuito dos médicos.

Palavras-chave
- algoritmos
- atenção primária à saúde
- diagnóstico
- encaminhamento e consulta
- neoplasias cutâneas

Introduction

Cancer represents a significant healthcare problem worldwide. Malignant neoplasms are among the major death causes. Furthermore, the disease and its treatment have different degrees of morbidity.[1]

Skin cancer is the most common type of cancer in Brazil and worldwide.[1–3] The term "skin cancer" encompasses a range of cutaneous neoplasms, often divided into two groups. Non-melanoma tumors include basal cell carcinomas (BCC), the most frequent (70% of cases), and squamous cell carcinomas (SCC), accounting for 25% of cases.[4] These two tumors originate from epidermal keratinocytes.

The other group of skin tumors consists of melanomas arising from the uncontrolled proliferation of melanocytes. These neoplasms can occur in any organ containing melanocytes, including mucous membranes, retina, and meninges, although they are more frequent in the skin.[5] Although non-melanoma tumors represent 97% of skin cancers, melanomas stand out due to their high lethality rates,[5] accounting for up to 75% of deaths from skin cancer.[6] For Brazil, 220,490 new cases of non-melanoma skin tumors were estimated for each year from 2023 to 2025, with an estimated risk of 101.95 cases per 100,000 inhabitants and 8,980 new cases of melanoma, corresponding to a risk of 4.13 cases per 100,000 inhabitants.[1]

Skin tumors, with their high prevalence, constitute a public healthcare issue, generating costs overwhelming to healthcare systems,[2,3] and negatively impacting the quality of life of the patients.[7,8] Therefore, early detection is relevant since it allows for less aggressive and mutilating treatments.

Physicians working in primary healthcare, including family doctors, regularly see patients with skin lesions who are not under follow-up or do not have access to specialists (dermatologists or plastic surgeons). Each encounter with patients, regardless of their main purpose, is an opportunity for skin cancer detection.[9]

Applications revolutionized access to information, and those for clinical evaluation help reduce the time for a therapeutic approach, enabling more effective screening and early skin cancer detection.[10,11] The present study describes the development of SkinScan, an application to help primary care physicians identify lesions suspicious of malignancy. The app may enable more effective screening of lesions requiring specialized evaluation, allowing for early diagnosis and treatment.

Materials and Methods

This is a descriptive study of a technological development occurred at a university service. The institutional Ethics Committee approved the project (CAAE: 04751118.2.0000.5102, opinion number 3.661.228).

Initially, to support the creation of an algorithm, we performed a literature review in the main databases of Health Sciences, including Scientific Electronic Library Online (SCIELO), Latin American and Caribbean Literature in Health Sciences (LILACS), and Medical Literature Analysis and Retrieval System Online (MEDLINE). The descriptors included *mobile device applications*, *skin cancer*, *prevention*, *clinical diagnosis*, *professional practice*, and their combinations. We selected the relevant articles published in Portuguese or English in the last 10 years. We also consulted other references of interest, such as websites, books, theses, dissertations, and technical reports.

Based on this survey of the literature, an algorithm was created for the identification and referral of skin lesions suspected of being malignant. We used images from the archives of the Plastic Surgery Service of the university hospital to illustrate the different lesion types taking care to avoid identifying any patient.

The algorithm validation used the Delphi technique, a systematic method for obtaining a consensus from a group of specialists on a given topic by applying structured questionnaires.[12] We invited 20 physicians to join the expert panel according to eligibility criteria. The inclusion criteria were physicians with a specialist degree in plastic surgery or dermatology, duly registered with the Regional Medical Council (CRM) of the Brazilian state they work, and with at least 5 years of experience in their field. We excluded those who did not respond within the deadline or the extension limits of this deadline. The sampling was by convenience.

We contacted the selected specialists by email. Those who agreed to participate by electronically signing the informed consent form received the file with the algorithm and a structured questionnaire to evaluate it regarding the adequacy of the language, sequence of information, ease of understanding, and relevance of the content. We graded the response options on a five-point Likert scale, according to the level of agreement involving the question, and provided spaces for adjustment suggestions.

After 15 days, we sent a new email reminding those who had not answered. After another 15 days, we excluded those who did not respond. Thirty days after sending the algorithm, we analyzed the responses, made adjustments, and, if necessary, held new rounds with the experts. After reaching a consensus and making the required changes, an information technology professional transformed the algorithm into an application.

A statistical analysis was conducted using Minitab, version 18.1, and IBM SPSS Statistics for Windows, version 22.0. The calculation of the Cronbach's alpha (α) coefficient assessed the internal consistency of the assessment instrument, estimating its reliability.

Table 1 Items evaluated by the 13 panelists and calculation of the Cronbach's alpha coefficient

Item evaluated	Cronbach's alpha coefficient
Sequence of information	0.9
Ease of understanding	0.8
Language	0.7
Content relevance	0.7
Global coefficient	**0.8**

Results

Of the 20 specialists invited to participate in the study, 13 (65%) agreed to participate, including 8 plastic surgeons and 5 dermatologists. The time since certification and practice in the specialty ranged from 5 to 29 years, with an average of 13 years. Regarding qualifications, five were specialists, three had Master's degrees, and five were Doctors of Philosophy.

►**Table 1** shows the Cronbach's alpha coefficient for the items evaluated by the 13 panelists.

An Information Technology professional developed the SkinScan app. We registered it with the National Institute of Industrial Property (Instituto Nacional de Propriedade Industrial – INPI, in Portuguese) [BR512020001285–0]). The web version of the application is available at the following link: http://skinscan.progm.net.br/

Discussion

Skin cancer is the most common neoplasm in humans, particularly in the white population.[13] The main risk factor for skin cancer development (melanoma and non-melanoma) is ultraviolet radiation, which induces cumulative DNA damage. Specifically for melanomas, unnatural ultraviolet radiation, such as lamps, also stands out.[13]

Brazil is a tropical country with one of the highest levels of ultraviolet radiation on Earth and culturally values tanned skin.[14] In Australia and New Zealand, countries with the highest rate of skin cancer worldwide, studies have highlighted the importance of primary care physicians in providing information about skin cancer, encouraging patients to practice sun safety, and using educational apps indicating ultraviolet radiation levels.[15,16]

Early diagnosis and primary prevention are the best options for reducing morbidity and mortality from skin tumors.[17,18] Squamous cell carcinomas are biologically more aggressive, and neglected lesions can be fatal due to local extension or metastasis. In contrast, BCC is rarely life-threatening. Although both are locally invasive, outcomes are better if treated early.[19]

Melanoma, which originates from the malignant transformation of melanocytes, is the most aggressive skin tumor, notorious for its high resistance to multiple drugs, high recurrence rates, and low survival rates, accounting for most skin cancer-related deaths.[6]

Early detection is essential to reduce morbidity and mortality in patients with melanoma. Given the increasing incidence of this aggressive type of cancer, primary care physicians play a key role in early melanoma diagnosis since these professionals represent the first point of contact for any patient with a health problem in most countries.[20]

Several diagnostic technologies can help general practitioners and specialists identify skin cancers (melanomas and non-melanomas), minimizing diagnostic delays.[19] Smartphone health applications are widely used in clinical practice, as they are easily accessible and help identify suspicious lesions, facilitating patient triage for specialist evaluation.[6] Screening applications for lesions suspicious of malignancy play a significant role in addressing gaps in underserved regions. In addition, they contribute to increasing accessibility to medical services and reducing disparities in healthcare.[21]

The number of plastic surgeons and dermatologists working in the Brazilian Unified Health System (Sistema Único de Saúde – SUS, in Portuguese) and corporate and private health networks is insufficient to serve all patients with some skin lesions. Furthermore, the number of unnecessary referrals to these specialists is noticeable due to the lack of information and training of primary care physicians, which overloads the system. The SkinScan app, aimed at professionals working on the front lines of care, has the potential to facilitate more efficient screening, allowing for earlier diagnosis and treatment.

Conclusion

SkinScan app has been successfully developed and is available free of charge for medical use.

Authors' Contributions

JWMF: data analysis and/or interpretation, statistical analysis, final manuscript approval, data collection, study conception and design, investigation, and methodology; MPC: data analysis and/or interpretation, final manuscript approval, study conception and design, and methodology; CAMG and DVSS: data analysis and/or interpretation final manuscript approval, and writing – original draft; JVF: data analysis and/or interpretation final manuscript approval, and methodology, and DFV: data analysis and/or interpretation, final manuscript approval, conceptualization, study conception and design, project management, methodology, writing – original draft, and supervision.

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Clinical Trial

None.

Conflict of Interests

The authors have no conflict of interests to declare.

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