Dermatology Practical & Conceptual

Training Primary Care Practitioners In Dermoscopy Diagnostic Algorithms Enhances Diagnostic Accuracy and Triage of Suspected Skin Cancer: Scoping Review Evidence

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ABSTRACT

Introduction: In many Western countries, access to a dermatologist can be difficult, while the incidence of skin cancer has risen steadily over the past 50 years.

Objective: We reviewed the published literature to determine whether training primary care practitioners (PCPs) in dermoscopy through brief interventions based on diagnostic algorithms could improve patient care by improving their diagnostic accuracy of suspect lesions.

Methods: A scoping review of the literature was conducted, focusing on studies published in the period 2003–2023 that assessed the ability of low-experienced PCPs to triage suspicious dermatological lesions using dermoscopic diagnostic algorithms. Regarding outcomes, we focused on quantitative variables relevant to screening practice in general practice, including sensitivity, specificity, referrals to specialists, and unnecessary lesion excisions.

Results: Of the 926 studies initially identified, 13 were eventually selected: 10 cross-sectional observational studies and three randomized controlled trials. The studies were carried out in North America (N=6), Western Europe (N=4), and Australia (N=3). There was heterogeneity in the training interventions and the criteria used to assess diagnostic accuracy of PCPs after training; however, all studies showed an improvement in this parameter. The preferred algorithms for training PCPs were the 3-point checklist, the 7-point checklist, and the Triage Amalgamated Dermoscopy Algorithm.

Conclusion: This review demonstrates the value of training PCPs in dermoscopic diagnostic algorithms through short courses to improve triage of suspicious lesions. However, it is still necessary to define a territorial organization, a precise working framework and limits for PCPs who take on this role.

Introduction

Many Western countries are facing a shortage of healthcare professionals, including in the field of dermatology. In Europe, the ageing physician population and lack of replacements is straining healthcare systems [1]. North America has not been spared either, with a predicted shortage of primary and secondary care physicians by 2033 in the USA [2] and a chronic shortage of physicians in rural areas in Canada [3]. In many Western countries with publicly-funded healthcare systems, the waiting time to see a dermatologist is long, increasing pressure on PCPs to acquire new skills to fill the gap [4–7]. Furthermore, skin cancer incidence is increasing, particularly in developed countries with ageing populations. The prognosis for melanoma, which is the most serious of these cancers, depends on the Breslow thickness and can therefore be improved by early detection and appropriate management [8, 9].

Dermoscopy has become an established tool in dermatology that facilitates diagnosis, particularly of pigmented skin lesions. It is widely used in practice throughout the world. In Europe, the most recent observational studies show a usage rate among dermatologists of between 94.6% and 99% [10-12]. A very recent questionnaire-based study conducted in Greece showed that dermoscopy is used in more than 80% of clinical situations [13]. Dermoscopy could also be useful in primary care for identifying suspicious lesions and prioritizing their management while reducing unnecessary excisions and referrals. Teledermoscopy could further improve triage accuracy. However, dermoscopy is only beneficial when performed by trained operators [14-16]. Algorithms can be used to train non-experts in dermoscopic screening, providing acceptable diagnostic sensitivity and specificity [17]. Various algorithms, such as the ABCD rule, Menzies method, 3-point and 7-point checklists, CASH algorithm, BLINCK, and TADA (Table 1) have, to varying degrees, been validated for use by dermoscopy operators [18-24]. Strengthening training of PCPs in dermatology and promoting dermoscopy practice could help address the skin cancer burden; however, it is important to assess whether training PCPs in dermoscopic algorithms improves their diagnostic accuracy. Additionally, identifying scientifically robust and suitable dermoscopic algorithms for PCP training is necessary.

Method

A scoping review was conducted following the PRISMA extension reference checklist focusing on the analysis of dermatological lesions suspicious for cancer using dermoscopy algorithms [25]. The selected algorithms were the 3-point and 7-point checklists, Menzies method, ABCD rule, CASH, BLINCK, and TADA [18-24] (Table 1). The review specifically looked at primary care settings and practitioners with little dermoscopy experience. Studies involving specialists, hospitals, other algorithms, or benign lesions were excluded.

Searches were conducted in the following databases: MEDLINE, EMBASE, PASCAL, Cochrane Library, National Institute for Health Research Dissemination Centre, Campbell Library of Systematic Reviews, and the HealthSTAR database for grey literature.

The use of the PICO method, categorizing subjects into Population, Intervention, Control, and Outcome, was employed in the research strategy. The selection of keywords considered synonyms, alternative formulations, acronyms, and spelling variations [26].

The search was limited to the period 2003–2023, and only articles in English, French, Italian, Spanish, or German were reviewed. Most studies available were observational and of low evidence. Therefore, we included all studies up to level 3b of the Oxford Centre for Evidence-Based Medicine classification [27].

Regarding outcomes, we focused on quantitative variables relevant to screening practice in general practice, including sensitivity, specificity, referrals to specialists, and unnecessary excisions. To assess strengths and weaknesses, we used a generic method for evaluating articles, which included eight evaluation criteria, using critical appraisal tools proposed by the Oxford Centre for Evidence-Based Medicine [28]. Finally, we used an interpretative method to analyze and summarize the results obtained. The lack of consistent data in publications made it challenging to use quantitative methods for analysis.

Results

Selection of Studies and Data Collected

The seven selected databases were searched between March and July 2023, identifying 926 studies potentially relevant to the research topic. The selection process was carried out in successive stages, reducing the working sample to 39 studies, of which 12 fully meeting the pre-defined criteria were retained. One additional study emerged after repeating the same selection process on the 912 references cited in the last 39 studies assessed. In the end, 13 studies were selected (Figure 1); of these, 10 were observational studies and three were controlled trials (Table 2). The studies were conducted between 2005 and 2021 in North America (N=6), Western Europe (N=4), and Australia (N=3) [23, 29-40]. Of the sample of studies collected by our method, only the 13 selected fully met our inclusion and exclusion criteria. We only selected studies that aimed to evaluate the diagnostic accuracy of lesions suspected of being cancerous by inexperienced PCPs who had received a short training course and used dermoscopy by means of algorithms.

Table 1. Overview of Algorithms Utilized in the Included Studies.

Full name	Abbreviation	Description
3-point checklist	None	Using this algorithm, the operator looks for 7 signs of malignancy in the pigmented lesion. Two points are given for each of the three major criteria: atypical pigment network, blue-white veil and atypical vascular pattern and one point for each of the four minor criteria: irregular streaks, blotches or globules and regression structures. A score of 3 or more identifies a melanoma with a sensitivity of 95% and a specificity of 75%..
7-point checklist	None	Using this algorithm, the operator looks for 7 signs of malignancy in the pigmented lesion: atypical pigment network, blue-white veil, atypical vascular pattern, streaks, blotches, globules, all irregularly distributed and regression structures. It is a weighted scoring system. The signs are divided into 2 categories: major signs and minor signs, which are assigned a score of 2 or 1 respectively. A score of 3 or more identifies a melanoma with a sensitivity of 95% and a specificity of 75%.
Menzies method	None	The principle of this algorithm is that to be suspicious for melanoma, the lesion must not have a symmetrical pattern or a single colour, and it must have at least one feature that is considered a warning sign: blue-white veil, pseudopods, scar-like depigmentation, multiple brown dots, radial streaming, peripheral black globules, peppering and multiple colours. The colours considered by this algorithm are black, light and dark brown, red, blue and grey.
ABCD rule	None	A scoring tool with parameters such as asymmetry in 2 axes (0-2 points), border in 8 sectors (0-8 points), number of colours (1-6 points) and number of dermoscopic structures (1-5 points). The score for each parameter is then weighted by a coefficient and the values are added together to give the final score. Scores below 4.75 indicate a benign lesion, scores above 5.45 indicate a melanoma and intermediate scores indicate at least the need for lesion monitoring.
Colour, Architecture, Symmetry, and Homogeneity	CASH	This algorithm is similar to the ABCD rule but also considers architecture. It evaluates colour (blue, red, black, dark brown, tan or white), architecture, symmetry and homogeneity. The architecture is assessed by the operator's overall impression of whether it is ordered or not. Each criterion is scored on a scale from 2 to 17. A score of 8 or more indicates melanoma with a sensitivity of 98% and a specificity of 68%.
Benign, Lonely, Irregular, Nervous, Change and Known	BLINCK	The BLINCK algorithm is a simplified method designed for PCPs. The checklist mixes macroscopic clinical and dermoscopic items. The first clinical step is to determine whether the lesion is benign in which case the process is stopped. The other steps are used to produce a score. A score of 2 or more indicates the need for referral or biopsy.
Triage Amalgamated Dermoscopy Algorithm	TADA	The TADA is designed for PCPs with little experience of dermoscopy. Its aim is not to make a diagnosis, but simply to triage between lesions for which the patient should be reassured and those for which they should be referred to a specialist or biopsied. It dispenses with the first stage of differentiation between melanocytic and non-melanocytic lesions using the 2-step algorithm. In this sense, it makes it possible to include NMSCs in the lesions to be referred or biopsied. It consists of 3 steps. The first aims to eliminate 3 types of commonly encountered benign lesions. The second looks for disorganised patterns and the third looks for clues associated with malignant lesions. The sensitivity of this algorithm for all types of cancer is 94.6% and the specificity is 72.5%.

The population of PCPs in the studies was heterogeneous: 11 studies observed a population that was 100% primary care, while two observed a mixed population. Three studies included nurses, and one included students. Seven studies observed practitioners with little experience of dermatology and dermoscopy, while the other six studies observed populations with varying levels of experience. The number of participants in the individual studies varied (range 4–293; mean 76, median 61). Three studies that observed performance in real clinical situations included only practitioners with a sufficient volume of skin cancer screening activity.

The number of studies utilizing the various dermoscopy algorithms were as follows: TADA – five; 3-point checklist – three; 7-point checklist – three; Menzies method – three; ABCD rule – two; BLINCK – one. Of these studies, one compared BLINCK, the 3-point checklist, and the Menzies method, while another compared the 7-point checklist, the ABCD rule, pattern analysis, and the Menzies method.

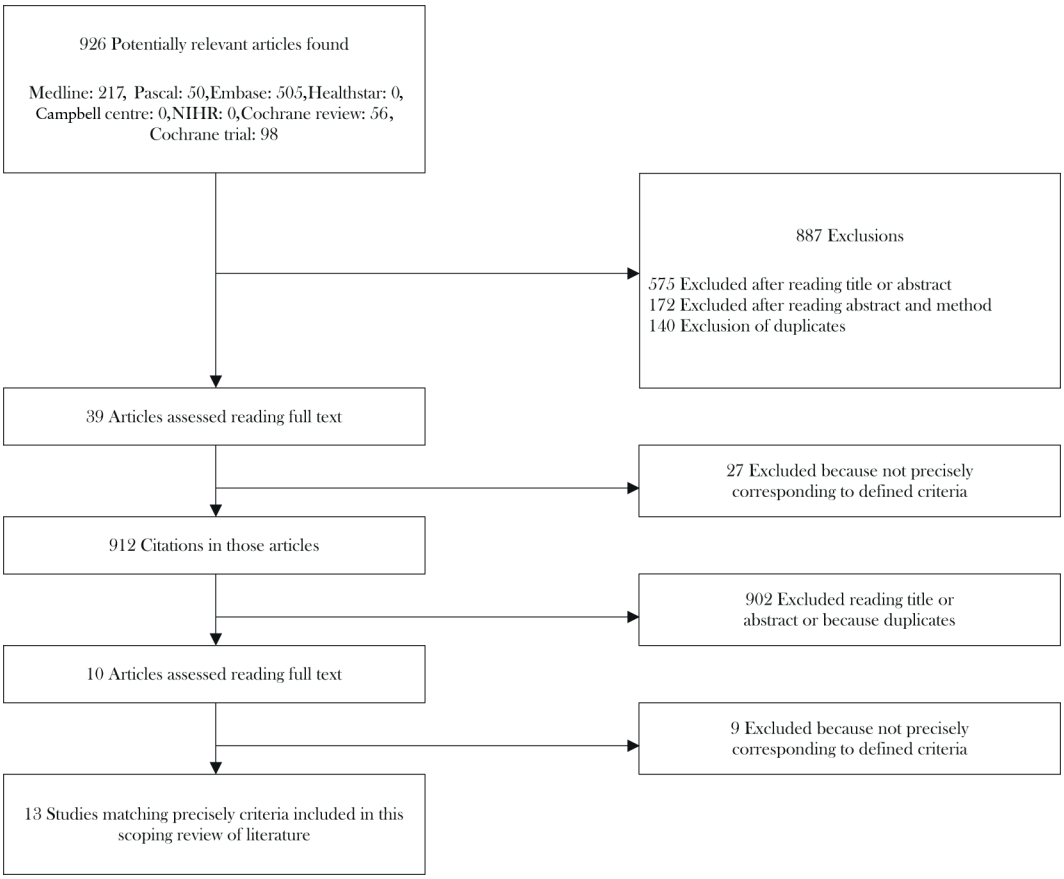

Figure 1. Flowchart of study selection.

The learning interventions varied. In nine studies, participants received face-to-face training, and in three studies they received training using various computer media, CD-ROM, web or smartphone, or books; one study did not clearly indicate the teaching method. Three studies utilized mixed types of training. The duration of face-to-face training ranged from one to 10 hours (mean three hours 40 minutes, median two hours 40 minutes). All included an introduction to dermatological oncology and dermoscopy before focusing on the chosen algorithm.

Only five studies assessed lesions in clinical practice by PCPs. Four of them assessed lesions in real-life conditions by the practitioner. A minimum of 235 and a maximum of 2,548 lesions were assessed (mean 899, median 406). The reference comparators varied, including pathology, expert opinion, teledermoscopy, or absence of evolution over time. The last study evaluated the impact of a dermoscopy diagnostic algorithm training on referral numbers. The study durations ranged from six to 17 months (mean 10.5 months, median eight months). In the other eight studies, the clinician assessed the lesions using high-resolution photographs, with clinical information in four of them. The photographs provided covered all types of skin cancer, except one study, which included only pigmented lesions, and the malignant lesions were only early-stage melanomas. The number of images analyzed ranged from 30 to 200, (mean 74, median 55).

Outcomes

Four cross-sectional studies found that PCPs without experience in dermatological oncology or dermoscopy showed significantly improved diagnostic accuracy (range 18–54%) for skin cancer screening from dermoscopic images after receiving training in skin cancer basics and TADA. The PCPs had increased sensitivity and stable or increased specificity in their diagnoses. One comparable study which, however, used the 7-point checklist, found the same outcome apart from a significant decrease in performance for benign lesions. Another similar study compared the performance of different practitioner subpopulations and showed no difference except that dermatologists had better specificity. The sensitivity and specificity values for PCPs (93.7% and 72.1%, respectively) were consistent with those reported in previous studies.

Two studies compared the effect of teaching different algorithms on diagnostic accuracy. In both studies, assessment was based on high-resolution photographs selected by experts. One study evaluated the difference between the BLINCK, 3-point checklist and Menzies method, and the purely clinical method. The use of BLINCK showed a

Table 2. Profile of Selected Studies.

Article	Type	Population	Algorithm	Intervention	Lesions	Comparison	Outcome
Seiverling et al. 2021 USA	Observation study, Cross-sectional	• 100% PCP • Low experience • 96 participants	TADA	• 120 min In-Person Generalities • 60 min Web Algorithm	• Images • No clinical information • All types of tumours • 30 images	Before vs after	• Significant increase of accuracy for benign and malignant lesions
Cyr et al. 2021 USA	Observation study, Cross-sectional	• 100% PCP • Very low experience • 32% Students • 12% Nurses • 31 participants	TADA	• 90 min in-person workshop	• Images • No clinical information • All types of tumours • 60 images	Before vs after	• Significant improvement in test results regardless of subpopulation
Sawyers et al. 2020 Canada	Observation study, Cross-sectional	• 100% PCP • 31 participants • Special interest in screening diabetes, BP, osteoporosis • No experience in dermatology	TADA	• In-Person slides short presentation	• Images • Clinical information • All types of tumours • 100 images	• Before vs after • TADA 1st step only is assessed	• Significant improvement in test results • Women did better than men • Significant increase in specificity (-33% of unnecessary excision or referrals) • Significant increase in sensibility for all malignancies
Seiverling et al. 2019 USA	Observation study, Cross-sectional	• 100% PCP • 59 participants • 8 Nurses • Special interest in dermatology • Low experience in dermoscopy	TADA	• 1h about TADA + aspect of benign lesions	• Images • No clinical information • All types of tumours • 60 images	Before vs after	• Significant improvement in test results regardless of sub-population • Significant increase in sensibility • Stability of specificity for all lesions but significant increase of specificity for 3 types of benign lesions (dermatofibroma, seborrheic keratosis, angioma)
Robinson et al. 2018 USA	RCT	• 100% PCP • Sufficient volume of patients • 89 participants	3-point checklist	• 3 sessions: 20 min, 1h, 1h • Smartphone • Nothing about NMSC	• Observed in clinical practice • Referrals assessment • 6 months	Referrals assessment 3 months before vs 3 months after	• Significant reduction of number of referrals for benign lesions for trained participants • Significant increase of number of melanoma referrals for trained participants • No effect on NMSC referrals
Secker et al. 2017 Netherlands	Observation study, Cross-sectional	• 100% PCP • Low experience • 293 participants	7-point checklist	• 1 day In-Person workshop • Book provided	• Images • Clinical information • All types of tumours • 40 images	Before vs after	• Significant increase of accuracy for all lesions except naevi after training • Significant improve of therapeutic strategy for all lesions including all malignant lesions after training except for naevi
Rogers et al. 2016 USA	Observation study, Cross-sectional	• Mixed • 34.2% PCP • 42.3% No training • 23.3% No experience • 120 participants	TADA	• 1 day in-person workshop	• Images • Clinical information • All types of tumours • 50 images	• Dermatologists vs PCP • Experienced vs non experienced	• Sensitivity 94.8% • Specificity 72.3% • No significant differences between sub-populations excepting specificity of dermatologists

Table 2 continues

Table 2. Profile of Selected Studies. *(continued)*

Article	Type	Population	Algorithm	Intervention	Lesions	Comparison	Outcome
Koelink et al. 2014 Netherlands	RCT	• 100% PCP • 53 participants	7-point checklist	• 4h general training for all • 6h extra course about dermoscopy for one arm	• Observed in clinical practice • Secondary assessment by 2 experts via teledermatology • Tertiary assessment if excision or face-to-face consultation with dermatologist needed • 400 patients 437 lesions • 17 months	Naked eye vs dermoscopy	• OR of correct diagnosis with dermoscopy compared with naked eye: 151 • Same OR for melanomas only: 552 • RR: 125 (probability of correct diagnosis is 25% higher with dermoscopy)
Bourne et al. 2012 Australia	Observation study, Cross-sectional	• 100% PCP • 4 participants only including 1 nurse • Variable experience	• BLINCK • 3-point checklist • Menzies method	• Only BLINCK is taught • Method of teaching is not known	• Images • Clinical information provided only after assessment using 3pCheck then Menzies • All types of tumours but selection of lesions • 50 images	Method vs method including naked-eye assessment	• No differences between clinicians • BLINCK showed a significant higher sensibility than other method • Menzies method and clinical assessment showed a significant higher specificity
Menzies et al. 2009 Australia	Observation study, Cross-sectional	• 100% PCP • Low experience • Sufficient volume of patients • 63 participants	Menzies method	• Textbook and CD-Rom provided • 2h in-person workshop	• Observed in clinical practice • Secondary assessment by pathology or expert or no change for benign lesions • Suspicious pigmented lesions only • 374 lesions • 8 months	• Naked eye vs dermoscopy • Naked eye vs Dermoscopy + SDDI	• Benign pigmented lesion/melanoma ratio significant decrease from 95/1 to 37/1 with dermoscopy alone and to 33/1 with dermoscopy + SDDI • Non significant improvement of sensitivity and specificity for melanoma diagnosis between naked-eye examination and dermoscopy alone • Significant improvement in confidence of diagnosis (naked eye vs dermoscopy) • Significant improvement of sensitivity with dermoscopy + SDDI Specificity unchanged • Melanoma's mean thickness is not significantly different after waiting 3 months for SDDI second picture

Grimaldi et al. 2009 Italy	Observation study, Cross-sectional	• 100% PCP • 13 participants	ABCD rule	• Web-training	• Observed in clinical practice • Secondary assessment by experts using teledermoscopy • 197 patients 235 lesions • 5 months	• Naked-eye vs dermoscopy • Naked-eye + dermoscopy vs teledermoscopy	• Significant change in OR • Clinical vs Dermoscopy 035 • Clinical vs Teledermoscopy 018 • Dermoscopy vs Teledermoscopy 052
Argenziano et al. 2006 Italy and Spain	RCT	• 100% PCP • Sufficient volume of patients • 73 participants	3-point checklist	• In-Person • 2h, clinical ABCD rule • 2h, algorithm	• Observed in clinical practice • Secondary assessment by 2 experts then excision if needed • 2522 patients 2548 lesions • 16 months	• Naked eye vs dermoscopy • PCP vs expert	• Improvement of PPV, NPV and sensitivity • Stability of specificity • Good accuracy for NMSC even if the algorithm is not designed for
Dolianitis et al. 2005 Australia	Observation study, Cross-sectional	• Mixed • 57.4% PCP • Mainly with experience • 61 participants	• 7-point checklist • ABCD Rule • Pattern Analysis • Menzies method	• CD-Rom provided	• Images • No clinical information • Pigmented lesions only • Early stage melanoma only • 200 images	Algorithm vs algorithm	• Best sensitivity and accuracy for Menzies method • Best specificity for clinical examination • Heterogeneous results depending on lesion

significant improvement in sensitivity, while the Menzies method or the pure clinical method retained the best specificity. The methodology of the intervention was poorly described. The population was small (four participants), and the photographs showed all types of lesions. The other study compared the diagnostic accuracy of the 7-point checklist, ABCD rule, pattern analysis, and Menzies method. Only 57.4% of the study population were PCPs, with varying levels of experience. Only pigmented lesions were evaluated. The cancers were all early-stage melanomas. The results were very heterogeneous, depending on the type of lesion. The Menzies method showed the best sensitivity and diagnostic accuracy. The best specificity was obtained by examining macroscopic images only.

Five studies assessed the diagnostic accuracy of PCPs in a real-life situation; two were cross-sectional studies, which evaluated dermoscopy versus naked eye examination using the Menzies method or the ABCD rule algorithms. The former study focused on suspicious pigmented lesions, showing a significant reduction in referrals for these lesions by using dermoscopy, further improved by the combined use of Sequential Digital Dermoscopic Imaging (SDDI). However, sensitivity and specificity for melanoma diagnosis were not improved. The combination with SDDI only significantly improved sensitivity for melanoma detection. The use of dermoscopy in this study also improved clinicians' diagnostic confidence. The latter study looked more broadly at diagnosis of all lesion types and showed a significant improvement in the odds ratio in favor of dermoscopy, further improved by the use of teledermoscopy. The other three studies were RCTs investigating the diagnostic skills of PCPs trained in the 3-point checklist or 7-point checklist algorithms for any type of lesion. The first one showed a significant improvement in the odds ratio in favor of a correct diagnosis with dermoscopy. This increase is particularly relevant for diagnosing melanoma. The second showed a significant improvement in sensitivity, negative predictive value, and positive predictive value, while specificity remained stable. Diagnostic accuracy for non-melanoma skin cancers (NMSCs) increased, although the 3-point checklist algorithm was not designed for this purpose. The third study focused on the number of referrals three months before and three months after training, showing a significant reduction in benign lesion referral and a significant increase in melanoma referrals for trained participants, with no effect on NMSC referrals.

Discussion

Introducing Dermoscopy in Primary Practice

There are currently too few trials of melanoma screening to be able to say with certainty that implementing a large-scale screening program in the general population would be effective [41]. However, there is a strong presumption in favor of involving health professionals in melanoma screening to promote early diagnosis and thus reduce associated mortality [42]. A study in France found that training a portion of PCPs in melanoma management significantly reduced the proportion of late diagnoses (Breslow thickness >3 mm) in their practice [43].

From our review it is clear that short training courses for PCPs on skin tumors and diagnostic dermoscopy can lead to improved diagnostic performance, earlier detection of skin cancer, and reduction in unnecessary excisions and referrals. It is therefore reasonable to recommend implementing educational measures and encourage the use of dermoscopy in primary care, especially given the ageing population, increasing skin cancer incidence, and strained healthcare systems.

Teaching Format

By studying published findings concerning the training of PCPs in dermatology, we consider that the positive results in our review are linked to the common characteristics of the teaching utilized. Indeed, it appears that short, interactive, practical dermoscopy training courses utilizing algorithms are effective in increasing awareness of dermatological oncology among PCPs. Furthermore, the available evidence suggests that the best format is interactive teaching, available online, designed by expert dermatologists in close collaboration with PCPs, and covering the practical management of the lesions observed. Other types of teaching have had more mixed results [17, 44-49].

Durability of Training Interventions

This question remains, as few studies have been conducted for longer than six months. One study suggested that refresher courses are necessary to maintain the benefits of training. However, one Dutch study showed that the effects of dermato-oncology training did not fade over nine months without any refresher training [38, 50, 51]. Nevertheless, we know that humans' ability to perform complex tasks deteriorates over time and that refresher training is one way to counteract this phenomenon [52, 53]. In the more specific field of dermoscopy in PCPs, a recent study confirms this deterioration after a short period (one year) [54]. We therefore suggest that a continuing education program, preferably in a short online format, is a reasonable option for maintaining the benefits of training, particularly for PCPs who perform dermoscopy on a regular basis.

Reproducibility in Real Life of Studies Using Images Only

It is reasonable to ask whether assessing diagnostic accuracy on photographs is a coherent approach. The recent development of teledermoscopy, although requiring further

validation, appears promising [15,55]. The good results of clinical practice studies after similar interventions also support the results of studies that have evaluated PCPs using images alone. It is known that dermoscopy supports clinical examination but does not replace it and that clinical examination has better specificity than dermoscopy [17]. All proposed interventions included a teaching component on dermatological oncology in general, with workshops including a simulation component. This mixed teaching format thus seems to be the one to replicate to maximize the chances of adapting the training to future practice.

Best Algorithm

Three algorithms, namely, the 3-point checklist, 7-point checklist, and TADA, were highlighted for teaching purposes in the 13 selected studies. These algorithms were frequently used and consistently showed positive results in improving diagnostic accuracy. The 3-point and 7-point checklists were used in trials with robust designs, while TADA was evaluated in observational studies. All three algorithms demonstrated diagnostic performance, even when used by relatively inexperienced practitioners. TADA was specifically designed for PCPs and seems well-suited for triaging suspicious skin lesions [34]. However, large-scale studies under real conditions are still needed. Our review accepted all algorithms in its inclusion criteria. We chose to highlight the 3-point checklist because in this review it was associated with studies with the highest level of evidence. In addition, we find it easy to use and teach, which is important to encourage PCPs to use dermoscopy. Furthermore, we believe that TADA occupies a special place because it is specifically designed for use by PCPs by avoiding the preliminary phase of detection of melanocytic lesions by the 2-step algorithm. Its purpose is not so much to make an accurate diagnosis but rather to triage lesions and is relevant to all types of skin cancer.

Future Role for PCPs

The adoption of dermoscopy by PCPs and their role in managing skin cancer is still limited. As most of the studies in this review focused on physicians with an interest in dermatology, the results may not be fully representative of the wider community. In Australia, where skin cancer is a major public health concern [56], dermatology has a special GPwSI (General Practitioner with a Special Interest) status, with PCPs who have an interest in skin cancer taking the lead in skin cancer screening locally and acting as a link between primary and secondary care [57].

This status also exists in the UK with the GPwER (General Practitioner with an Extended Role) [58]. However, even among such motivated practitioners, there may be barriers to accessing training [51]. Surveys show that dermoscopy use among PCPs without a specific interest in dermatology varies worldwide but is generally limited [59-60]. It therefore seems that, although the assessment of suspicious lesions by PCPs using clinical and dermoscopic tools has proved its worth, there is still a long way to go before this practice becomes widespread. Factors influencing dermoscopy use by PCPs were identified in a recent qualitative study conducted in the UK, which showed that easy access to training and support in teaching dermoscopy build confidence in PCPs and may be the main game changer [61]. However, the cost of purchasing a dermoscope can be a barrier [38]. This suggests that a small group of motivated PCPs should be trained and provided with the necessary tools, while maintaining a link with continuing education and expert support. On the other hand, despite its clear potential, the role of PCPs in diagnosing cutaneous tumors has limitations compared to experts [34-36], and it is important to define the boundaries and framework for their practice. Furthermore, it would appear logical that PCPs involved in skin cancer screening should be able to communicate directly with experts for advice when necessary.

Scope for Future Research

Research on the triage of skin lesions by PCPs to address the skin cancer burden is incomplete. Future research required includes evaluating the TADA algorithm under real clinical conditions, exploring the role of nurses and other non-physician healthcare professionals in triage, assessing the cost-effectiveness of SDDI devices, investigating alternative training methods for PCPs, and considering the organization of PCPs with extended roles. Qualitative studies on the impact of these changes on workload and patient care are also needed. Furthermore, the role of teledermoscopy, which has recently developed with the advance of computer systems, can be considered. The benefits of this practice on the diagnostic accuracy of online consultations have been demonstrated, although standardization efforts will be needed in the future to limit the heterogeneity of practice. When used by a trained PCP, teledermoscopy can introduce a second level of triage to minimize unnecessary face-to-face consultations [15,55,62]. Finally, the use of artificial intelligence algorithms to triage suspicious lesions is even more recent and has shown promising results in the diagnosis of skin cancer. AI can assist in tasks that involve comparing patterns over time. However, at its current stage of development, AI cannot completely replace the clinician's diagnostic approach [63-66].

Strengths and Limitations

This study was based on a well-designed methodology to minimize bias. The principal investigator's perspective as a PCP adds relevance to the qualitative analysis. The study includes a sufficient amount of diverse material to meet the objectives and provide recommendations for professional

practice. However, we acknowledge several limitations, including the inability to use cross-methods due to a single investigator. Furthermore, the choice of search algorithm and language limitations could have introduced selection bias. The decision to focus on the last 20 years, made to highlight recent teaching techniques and modern technology, led to the exclusion of one study even if this did not contradict the review's conclusions. Furthermore, the relative heterogeneity of the populations of PCPs in our review may suggest an additional weakness; however, as dermoscopy is rarely taught to PCPs and primary care trainees, it is reasonable to assume that all participants in fact started from the same low level of dermoscopy expertise prior to training [67-70].

Conclusions

The increasing incidence of skin cancer and the shortage of doctors have led to a need for PCPs to participate in skin cancer screening using dermoscopy. However, there are barriers to doing so, including limited access to training and equipment. One proposed solution is a coordinated practice model where PCPs with an interest in dermatology take the lead at a practice and/or territory level. Additionally, nurses and other non-physician healthcare professionals could also be involved in carrying out screening. Teledermoscopy and AI lesion analysis techniques could be further options. Research is needed to establish coherent models with clearly defined roles and effective communication between different levels of care providers.

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