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# Training general practitioners in melanoma diagnosis: a scoping review of the literature

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## Abstract

*Background*: General practitioners (GPs) are recognized to play a key role in early melanoma detection. In order to help GPs deal with suspicious skin lesions, melanoma diagnostic training programs were developed. However, it is unclear whether these programs guarantee the acquisition of skills that will be applied by the GPs in their daily clinical practice and maintained over time.

*Objectives:* This scoping review aimed to examine and compare educational programs training GPs in melanoma diagnosis using clinical (naked eye) examination alone, dermoscopy alone or clinical diagnosis followed by dermoscopy and sought to inform on the long-term sustainability of the GPs' acquired skills.

*Eligibility criteria:* Studies eligible for inclusion evaluated educational programs teaching diagnosis of melanoma to GPs. MEDLINE, EMBASE, and Cochrane databases were searched for relevant articles between February and May 2020.

*Results*: Forty-five relevant articles were found assessing 31 educational programs. Most programs that improved the diagnostic accuracy and long-term performances of the GPs, i.e. increase in confidence, decrease in dermatologist referral of benign skin lesions, and improvement of the benign/malignant ratio of excised skin lesions, trained the GPs in clinical diagnosis followed by dermoscopy. To maintain the GPs' acquired performances in the long term, they provided refresher training material.

*Conclusion:* This review shows that studies generally report positive outcomes from the training of GPs in melanoma diagnosis. However, refresher training material seemed necessary to maintain the GPs' acquired skills. The optimal form and ideal frequency for these updates have yet to be defined.

## Strengths and limitations of the review

- Systematic review conducted following the guidelines of the PRISMA-Scr (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) checklist
- It evaluates all educational programs in melanoma diagnosis for general practitioners
- Specifically, the review examines the long-term effect of the educational programs and the value providing regular refresher training sessions after the training
- This review led inevitably to some publication bias as only English language peer-reviewed articles were included.

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## Contributorship statement

E. Harkemanne developed the research protocol, completed the literature search and screened the articles for inclusion, extracted the data, synthesised the findings, interpreted the results and drafted the manuscript. M. Baeck screened the articles for inclusion, extracted data and critically revised the manuscript. I. Tromme developed the protocol, independently reviewed the articles for inclusion, extracted data, interpreted the results and critically revised the manuscript. All authors approved the final version.

## Data availability statement

All data relevant to the study are included in the article.

## Introduction

Early melanoma detection is essential to reduce morbidity and mortality of melanoma patients.[1] Given the increased incidence of this aggressive skin cancer, primary care physicians (PCPs) are recognized to play a key role in early melanoma diagnosis.[2–4] PCPs are health care professionals providing first and continuing medical care to a patient. They include general practitioners (GPs), internists, physician assistants, and registered nurses, among others. In this review, we decided to focus on GPs who take care of patients in community settings and are, in most countries, the first point of contact for any patient with a health issue.

To improve the GPs' diagnostic accuracy, educational training programs in melanoma diagnosis have been developed. At first, training courses in melanoma diagnosis were proposed using clinical (naked eye) examination alone. A systematic review[5] published in 2011 reported on 20 studies evaluating 13 educational interventions in clinical melanoma diagnosis for PCPs. All these evaluated interventions demonstrated to improve the diagnostic accuracy and melanoma management.

Later on, educational programs including dermoscopy training were created and evaluated for primary care. So far, dermoscopy has been the most widely non-invasive *in vivo* technique used in clinical practice to assess skin tumors.[6] It uses a handheld device, which allows observation of skin structures invisible to the naked eye. However, its sensitivity and specificity are operator-dependent (trained *vs.* untrained physicians).[7] To note that 92% sensitivity and 95% specificity can be achieved for melanoma by a trained dermatologist using visual inspection plus *in vivo* dermoscopy.[8] In primary care, dermoscopy has also been shown to be an effective tool for the triage of suspicious pigmented skin lesions when performed by properly trained PCPs.[9,10] Yet, the minimum in training to reach competence is still unknown.[11]

The previously published reviews[5,11–14] on training programs in melanoma diagnosis for GPs focused on the content, teaching method, outcome measures and study-by-study efficacy of the evaluated educational interventions. However, they did not assess whether the GPs' acquired skills were measured in the short or long term. Yet, given the increasing burden of melanoma on general practice, it is crucial to know whether these programs are capable of teaching GPs easily applicable and sustainable skills in melanoma diagnosis and management.

This scoping review aimed to examine educational programs training GPs in melanoma diagnosis using clinical (naked eye) examination alone, dermoscopy alone or clinical diagnosis followed by dermoscopy. It also sought to inform on the long-term sustainability of the GPs' acquired skills.

## Material and methods

To carry out this literature review, a scoping review seemed the most appropriate. Indeed, the results from studies on educational programs on melanoma diagnosis for GPs presented with a wide range of study designs and heterogeneous outcome measures, which made it impossible to formally assess the quality of these studies and to conduct a meta-analysis. To conduct this scoping review, the guidelines of the PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) checklist were followed.[15]

### Eligibility criteria

Studies eligible for inclusion in this review (Table 1) evaluated educational programs teaching either clinical diagnosis of melanoma and/or diagnosis using dermoscopy, both designed primarily for PCPs including GPs. Indeed, the population of interest were qualified GPs and GP trainees. Studies that trained PCPs not including GPs were not eligible. Specialists and GPs working in hospital settings and/or specialized clinics were excluded. Studies where no participant training in melanoma diagnosis was proposed and studies evaluating exclusively nonmelanoma skin cancer detection were excluded. Studies using teledermoscopy and computer-aided diagnosis of melanoma were not assessed as they do not require specific education in melanoma recognition by the participants. Outcomes of interest were the type of educational program and the short and/or long-term evaluation of its efficacy on the GPs' skills. Finally, articles not subject to peer review and written in languages other than English were not taken into account.

### Data sources and study selection

Literature searches were undertaken between February and May 2020. MEDLINE, EMBASE, and Cochrane databases were searched for relevant articles published between 1995 and End of May 2020. Studies were selected for inclusion by three authors (EH, MB, and IT), with IT providing the final decision in the event of disagreement.

To cover all the literature on the subject, 4 categories of terms were identified: (1) general practitioners, family doctor, general medicine, family practice, primary care physicians; (2) education, continuing medical education (3) melanoma, malignant melanoma, cutaneous melanoma, skin neoplasms; (4) diagnosis, cancer early detection. In MEDLINE, the following Medical Subject Headings (MeSH) were used: *general practitioners* OR *family practice* OR *primary care physicians* OR *general medicine* AND *melanoma* AND *diagnosis*. No limits were defined. In EMBASE, Emtree terms were exploded: *general practitioner, family doctor, primary care, family physician, primary care physician, melanoma, diagnosis,* and *education*. In the Cochrane database, the following terms were searched: *melanoma* AND *diagnosis* AND *general practitioners* OR *family medicine* AND *dermoscopy*. In addition, the reference lists of included studies were screened as a source of further relevant articles.

**Data extraction**

Two authors (EH and MB) reviewed all included articles and independently collected data. Extracted data included authors, year of publication, origin of the article, study design, number of participating GPs, type of educational program, type of outcome measures and short- and/or long-term evaluation of these outcomes. The type of educational program included training content, teaching method, training duration and refresher training material (if provided). To facilitate comparison with data found in previous reviews, all these data were reported into categories adapted from those presented by Fee *et al.*[14]

Table 2 gives the definition of the different categories. The training content was subdivided into 6 components: epidemiology, clinical diagnosis, clinical algorithm, dermoscopic diagnosis, dermoscopic algorithm and management. The teaching method was considered either as live, in the form of scientific literature, e-learning, or self-assessment and the refresher training material specified the material available for participants to refresh their skills after the training. The outcome measures were expressed either in terms of competence or in terms of performance, according to the assessment approach of continuing medical education programs proposed by Moore.[16] Finally, since the limits between short-term and long-term evaluation of a medical educational program are not standardized, arbitrary limits have been chosen based on the observations made during this literature review.

**Patient and Public Involvement**

No patient and public involvement was required for this review.

## Results

In total, 325 articles were identified from the electronic database searches, as shown in the PRISMA flowchart (Figure 1).[17] At the end of the study selection process, 45 relevant articles were included in the review analysis. These articles reported on five reviews and 37 studies, which assessed 31 educational interventions.

### Study designs

Thirty-seven interventional studies with a range of study designs were found: 11 randomized controlled trials (RCTs)[9,10,26,27,18–25], 19 diagnostic accuracy studies[28,29,38–46,30–37], three cohort studies[47–49] and three case-control study.[50–52] To note that five of the 31 trainings were assessed twice.[22,25,27,30,47]

Four systematic reviews were identified: one on training PCPs in clinical melanoma diagnosis,[5] two on training PCPs in dermoscopy for melanoma diagnosis,[12,13] and one on the use of dermoscopy in primary care.[11] A scoping review on training PCPs in dermoscopy[14] was also included. The final three articles were descriptive articles of the educational programs and study protocols.[53–55]

### Educational programs

The educational programs in melanoma diagnosis for GPs varied in terms of content, teaching method and outcome measures. The characteristics of these training programs are summarized in Table 3.

*Training content*

Of the 31 educational programs, 15 involved training GPs in clinical diagnosis, five in dermoscopic diagnosis alone, and 11 trained GPs in both melanoma diagnostic methods. Twelve (80%) of the clinical diagnostic training programs involved also learning of epidemiology and 11 (73%) learning of management guidelines for suspicious lesions. Only 7 (47%) programs teaching clinical diagnosis used an algorithm to teach melanoma recognition, with the ABCD(E) rule[56] (Asymmetry, uneven Borders, uneven Colors, Diameter > 6mm, and Evolution) being most commonly taught. Of the dermoscopic training programs, 12 (80%) included learning of at least one dermoscopic algorithm (Menzies' method,[20,33,35,38] Three-point checklist,[9,38,39] the 7-point checklist,[10,33] TADA,[42,45] the ABCD rule,[33,36] BLINCK,[38] and

pattern analysis[33,52]). In addition, two educational programs included training on other diagnostic tools, such as sequential digital dermoscopy imaging[35] and polaroid instant camera photography.[22]

*Teaching method, training duration and refresher training material*

Live training courses and the use of educational books, posters or videos (literature) were the two preferred teaching methods of clinical diagnostic training programs. Five trainings used also an e-learning approach.[25,27,29,49,51] The most common teaching method used in dermoscopic training programs was live training. This approach was combined to literature and/or e-learning in six programs. Three programs also used self-assessment. Overall, the teaching method did not appear to have influenced the program outcomes. Duration of training varied from 75 minutes to 1 day. It was not specified in two studies[28,38] and was participant dependent in six studies using self-assessment methods. Six dermoscopic diagnostic training programs[26,35,36,39,47,52] and three programs in clinical diagnosis[23,34,48] provided regular refresher training material such as unlimited e-learning access or self-assessment training sessions.

*Training outcomes*

Table 4 summarizes the outcome measures of the studies. In the selected studies, the GPs' competences were generally measured in the short term while the performances of the GPs were measured in the long term after the training.

Eight clinical diagnostic training programs and seven dermoscopic training programs were assessed only in the short term (Table 4A). For these studies, the most evaluated competences were the diagnostic accuracy and the appropriate management of the GPs measured in a training setting. The most evaluated performance in the short-term, measured in a clinical setting, was the GPs' confidence in diagnosing melanoma. Except for two, all showed a positive impact of their intervention.[18,24] Four clinical diagnostic training programs and three dermoscopic training programs were only assessed in the long term (Table 4B). The most evaluated performances, measured in daily clinical practice, were the GPs' diagnostic accuracy and the benign/malignant ratio of excised lesions. Three studies[9,34,47] reported improvement of the GPs' performances on melanoma diagnosis. The other studies reported none. Finally, three clinical diagnostic and seven dermoscopic training programs were evaluated in the short and long term (Table 4C). All training programs demonstrated to improve the GPs' competences measured in a training setting in the short term, except one.[24] In the long term, eight

trainings[10,35,36,39,47,48,51,52] reported significant improvement of the GPs' performances for the diagnosis of melanoma and benign skin lesions. This led to either a decrease in the referral rates to dermatologists[35,39,51] and/or a decrease in the ratio of benign/malignant excised skin lesions.[35,47] Among the major studies, Koelink *at al.*[10] found that their dermoscopic training program improved the GPs' performances up to 1.25 times greater diagnostic accuracy for skin lesions including melanomas in the long term. In a French department, Grange *et al.*[48] observed an impressive reduction of the incidence of advanced melanomas (Breslow thickness ≥ 3 mm) during the 3-year period after their GP training campaign in clinical melanoma diagnosis. A very recent study conducted by Marra *et al.*[51] found that of a total of 1662 referrals, GPs trained in melanoma diagnosis had a better quality of referrals than untrained GPs, leading to less potentially unnecessary referrals. However, two educational programs[25,26] were unable to maintain the GPs' acquired performances in the long term.

## Discussion

This scoping review aimed to examine educational programs training GPs in melanoma diagnosis using clinical (naked eye) examination alone, dermoscopy alone or clinical diagnosis followed by dermoscopy and sought to inform on the long-term sustainability of the GPs' acquired skills.

In total, 31 educational programs were found. Fifteen programs trained GPs in clinical diagnosis alone and 16 trained GPs in dermoscopy (Table 3). Duration of training varied from 75 minutes to 1 day and various teaching methods were used among live training courses, educational books and e-learning. After the course, nine programs provided their participants with regular refresher training material such as unlimited e-learning access or self-assessment training sessions.

### Types of educational programs with positive long-term outcomes

Two main diagnostic training methods, clinical examination and diagnosis using dermoscopy, were identified. Most reported educational programs that improved the long-term diagnostic accuracy and changed the GPs' melanoma practice patterns, such as reducing the referral rates to dermatologists and the benign/malignant ratio of excised skin lesions, trained their participating GPs in both methods.

Educational programs in clinical examination alone might have been less likely to convince positive long-term outcomes than programs teaching both methods because they used less powerful measures of performance. They compared, for instance, the GPs' confidence and the number of total-body skin examinations performed before and after training, whereas programs teaching both methods measured the GPs' diagnostic accuracy and decrease of referral rates to dermatologists. Nevertheless, a very recent study conducted in the Netherlands compared the quality of referral and diagnostic accuracy of GPs mostly trained in clinical melanoma diagnosis alone to that of untrained GPs and demonstrated a significant better outcome by the trained GPs.[51]

To note that only one training in dermoscopy alone was found to be assessed in the long term.[52] Indeed, it is more and more common and pertinent to teach GPs in clinical examination followed by dermoscopy. This teaching method is furthermore supported by a recent Cochrane review,[8] which found that dermoscopy alone was less accurate than clinical examination followed by dermoscopy, for the diagnosis of melanoma.

Moreover, the same Cochrane review[8] suggested that dermoscopic algorithms were most useful to train non-experts in dermoscopy. In the present review, we found that five of the programs with long-term positive impact used dermoscopic algorithms to teach melanoma diagnosis.[10,35,36,39,52] These algorithms, Menzies' method,[57] the ABCD rule,[58] pattern analysis and the 7-point checklist,[59] were designed at first for trained physicians and afterwards tested as effective when used by nonexperts.[60] Other algorithms, such as the Three-point checklist[61] were created directly for use by PCPs. In 2005, Dolianitis *et al.*[33] compared the performance of four of these algorithms (Menzies' method, the 7-point checklist, the ABCD rule, and pattern analysis) for teaching dermoscopy to untrained GPs and found similar performances for all algorithms. In this review, similar observation was made among the trainings that improved the GPs' performances, each using a different algorithm. Recently, a new promising 3-step dermoscopic algorithm, The Triage Amalgamated Dermoscopic Algorithm (TADA), has been proposed especially for GPs.[62] Three studies already confirmed the short-term efficacy of TADA in improving the GPs' melanoma diagnostic accuracy.[42,45,63] A recent study demonstrated that teaching only the first step of the TADA was already enough to improve the diagnostic accuracy of untrained GPs from 76.9% to 95% for melanoma.[46] However, the long-term performance of these trainings using the TADA-algorithm has not been tested yet.

In the literature, the main limitation to the use of dermoscopy in general practice was reported to be the large number of training hours in order to become competent.[64,65] At this time, there is no evidence on the optimal length of training, even though it has been demonstrated that diagnostic accuracy of dermoscopy depends on the degree of training of the practitioner.[66] A study suggested that 1 day of live training in dermoscopy was sufficient to build the confidence of GPs with special interest in melanoma diagnosis.[67] Actually, we found two RCTs showing sustained improvement of the diagnostic accuracy of GPs proposing a live training in dermoscopy with a duration of 1 day to 10 hours, respectively.[9,10] The long duration of training in dermoscopy being a limiting factor for most GPs, it is important to keep in mind that training in clinical melanoma diagnosis also showed to improve the GPs' performances while requiring less training time (+- 2.5h).[34,48]

**Long-term improvement of the GPs' performances in clinical settings**

The GPs' performances measured in clinical settings were assessed over the long term for 15 educational programs: six in clinical diagnosis and nine in dermoscopic diagnosis. Ten showed a positive impact on the GPs' performances measured over periods ranging from 6 to 19 months. Seven of these 10 trainings demonstrated sustainability of the GPs' acquired diagnostic skills measured in a training setting leading to changes in real-life practice. The studies mostly stated a decrease of referral rates to a dermatologist for benign skin lesions and an improvement of the benign/malignant ratio of excised skin lesions. Furthermore, a decrease of the incidence of advanced melanomas was shown in a French department over a 3-year period after their training program in clinical melanoma diagnosis.[48] The INFORMED group[39] also reported an increase in melanoma diagnosis during a screening program by GPs trained with their program in 2016.[68] Unfortunately, two educational programs[25,26] failed to maintain the GPs' acquired performances at 1 year after the end of the training. In contrast to other dermoscopy training programs, Badertscher *et al.*[26] used Lumio®, a polarized magnifying glass with 2x magnification (10x for standard dermoscopy device) to teach dermoscopy and teledermatology feedback as refresher training material. Concerning Markova *et al.,*[25] they chose to assess by interviews of patients the number of total-body skin examinations performed but did not evaluate the GPs' diagnostic accuracy.

To retain acquired diagnostic skills over the long term, a recent RCT, which failed to maintain the performances of trained internists at 12 months, suggested a need for "refresher sessions at regular intervals".[69,70] In this review, nine (60%) educational programs, which were evaluated

in the long-term, provided refresher training material for their participating GPs. Seven of these programs were successful. In 2014, Grange *et al.*[48] furnished a CD-ROM containing the teaching material and sent regular information about melanoma to the GPs. The INFORMED group[39] provided GPs with a free unlimited access to their web-based course. Menzies *et al.*[35] gave the GPs an educational textbook and an unlimited e-learning access. Grimaldi *et al.*[36] and Youl *et al.*[47] also ensured self-assessment refresher training sessions. Marra *et al.*[51] found a 10-month sustainability of the diagnostic accuracy of their trained GPs and assumed that daily use of the obtained knowledge during the study period achieved this effect. Only Koelink et al.,[10] who evaluated the longest post-training period (19 months) demonstrating sustainability of diagnostic skills, did not specify whether update training modalities were provided.

However, the ideal frequency and form of these updates have never been studied. A RCT, taking place in the English National Defibrillator Programme, determined that update session intervals after a medical education session should not exceed 7 months to limit the loss of acquired skills and maintain the participants confidence.[71] In the UK, a survey among GPs with special interest in dermatology stated that self-assessment learning was the most popular for refresher sessions.[67] Nevertheless, they also showed that 36% of GPs using dermoscopy in their clinical practice reported to never have updated their training skills. We found that the most appreciated form of self-assessment updates was unlimited access to an e-learning course. In the future, this craze for online training could lead to the development of smartphone applications to train GPs in melanoma diagnosis. Some newly developed applications have currently been evaluated among medical students[72] and dermatology residents.[73] Initial results already looked very promising.

## Limitations

This scoping review has some limitations and led inevitably to certain publication bias. We used keywords for the selection of articles and only peer-reviewed articles were included. By limiting our research to English language articles, some studies may also have been missed. It is also very likely that melanoma diagnostic training programs exist in unpublished forms, for example in university continuing medical education programs. Moreover, we focused only on studies assessing melanoma diagnostic training methods among GPs. This way, some educational programs for primary care may not be mentioned in this review. Furthermore, educational programs, which were not evaluated in studies, were overlooked. Finally, this review covers educational programs over a 25-year period. As technology has evolved

considerably since then, some teaching methods and refresher training materials have for the most been overshadowed by interactive online tutorials (e-learning). This is all the truer since the health crisis caused by COVID-19 has allowed this distance learning method to develop very rapidly.

## Conclusion

In conclusion, educational programs trained GPs in melanoma diagnosis using clinical examination alone, dermoscopy alone or clinical diagnosis followed by dermoscopy. Most reported programs that improved the long-term diagnostic accuracy and changed the daily-life performances of the GPs, i.e. decrease in dermatologist referral of benign skin lesions, and improvement of the benign/malignant ratio of excised skin lesions, trained their participating GPs in both methods. The preferred teaching method was live and e-learning but the teaching method did not seem to influence the GPs' acquired performances. It is important to note that the educational programs that achieved to maintain long term performances of the GPs in daily clinical practice included refresher training material. However, the optimal form and ideal frequency of these updates have yet to be defined.

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**Table 1. Inclusion and exclusion criteria for article selection**

| **Inclusion criteria:** |
|---|
| **Articles**<br>• Articles written in English<br>• Study articles and descriptive articles of educational programs<br>**Population**<br>• Qualified GPs and GP trainees working in community settings<br>**Intervention**<br>• Studies evaluating educational programs in clinical (naked eye) diagnosis and/or diagnosis of melanoma using dermoscopy<br>**Outcome(s)**<br>• Studies assessing the type of educational program and its short and/or the long-term efficacy on the skills acquired by the GPs |
| **Exclusion criteria:** |
| **Articles**<br>• Articles not subject to peer review and written in languages other than English<br>**Population**<br>• Studies involving specialists, medical students, non-GPs, GPs working in hospital settings and/or specialized skin cancer clinics<br>**Intervention**<br>• Studies evaluating exclusively nonmelanoma skin cancer<br>• Teledermoscopy studies<br>• Studies on computer-aided diagnosis of melanoma<br>**Outcome(s)**<br>• No method of measuring outcomes was ruled out |

*Key: GPs= general practitioners*

**Table 2. Definition of study categories**

| Criteria | Categories | Definition |
|---|---|---|
| **Training content** | Epidemiology | Background information on rates of melanoma cancer, risk factors, localization and evolution of melanomas |
| | Clinical diagnosis | Naked eye melanoma recognition |
| | Clinical algorithm | Use of a pre-existing algorithm as a learning tool to aid for clinical diagnosis |
| | Dermoscopic diagnosis | Recognition of melanoma using dermoscopy |
| | Dermoscopic algorithm | Use of an algorithm as a learning tool to aid for dermoscopic diagnosis |
| | Management | Determination of a plan of action for a skin lesion i.e. reassurance, follow-up, or lesion excision |
| **Teaching method** | Live | Presentation by a speaker to a group of participants |
| | Scientific literature | Use of educational books, posters, letters, CD-ROMs or videos |
| | E-learning | Interactive online tutorials including audio and visual information |
| | Self-assessment | Learning by the participant himself using educational material |
| **Refresher training material** | Teledermatology feedback | Feedback from a dermatologist on the image and clinical history of a suspicious lesion at a distance, using remote internet-based technologies |
| **Outcome measures** | Competences | Acquired skills, which are evaluated in a training setting on clinical and/or dermoscopic photographs of skin lesions |
| | Diagnostic accuracy | Ability of the participants to discriminate between melanoma and benign lesions |
| | Knowledge | Report of conceptual understanding |
| | Appropriate management | Determination of the right plan of action for a skin lesion |
| | Performances | Changes in real-life practice measured in a clinical setting, i.e. changes in the benign/malignant ratio of excised lesions, the number of total-body skin examinations performed, confidence of the GPs, changes in referral rates to a dermatologist, and decrease in the incidence of advanced melanomas |
| **Evaluation** | Short-term | Measurement of outcomes immediately or up to 3 months after the training |
| | Long-term | Measurement of outcomes at $\geq$ 6 months after the training |

**Table 3. Characteristics of educational programs in melanoma diagnosis for general practitioners**

| Article | Study design | Study participants | Training content | | | | | | Teaching method | Training duration | Refresher training material |
|---|---|---|---|---|---|---|---|---|---|---|---|
| author, year, location[ref] | | | Epidemiology | Clinical diagnosis | Clinical algorithm | Dermoscopic diagnosis | Dermoscopic algorithm | Management | | | |
| Marra, 2020, The Netherlands[51] | Case-control study | 185 (83; 102)* | | X | | X (optional) | | X | e-learning | 2h | |
| Sawyers, 2020, Canada[46] | DA study | 33 GPs | | | | X | TADA step-I | | Live | 3.5h | |
| Augustsson, 2019, Sweden[52] | Case-control study | 43 GPs (27;16)* | | | | X | Pattern analysis | | Live | 1-day | PDF-files of the course |
| Seiverling,2019, USA[45] | DA study | 59 GPs | | X | | X | TADA | | Live | 75min | |
| Beecher, 2018, Ireland[44] | DA study | 23 GP trainees | X | X | | | | X | Live, Literature | 1h | |
| Secker, 2017, The Netherlands[43] | DA study | 293 PCPs including ? GPs | | X | | X | | X | Live, Literature and E-learning | 1-day | |
| Rogers, 2016, USA[42] | DA study | 16 GPs | | | | X | TADA | | Live | 1-day | |
| Badertscher, 2011 and 2015, Switzerland[54,26] | RCT | 78 GPs (39;39)* | | X | | Lumio® | | | Live | 1-day | Teledermatology feedback |
| Gulati, 2015, UK[49] | Cohort study | 967 GPs | X | X | | | | X | E-learning | PD | |
| Koelink, 2014, The Netherlands[10] | RCT | 53 GPs | X | X | | X | 7-point checklist | | Live | 4h clinical diagnosis; 6h dermoscopy | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Grange, 2013, France[48] | Cohort study | 398 GPs | X | X | | | | | Live, Literature | 2.5h | CD-ROM+ regular information sheets |
| Markova, 2013, USA[25]<br>Mikkilineni, 2001 and 2002, USA[40,41] (Weinstock 1996)[55] | RCT<br><br>DA study | 46 GPs (20;26)*<br><br>7 GPs | <br><br>X | <br><br>X | ABCD(E) | | | <br><br>X | E-learning<br><br>Live Literature | <br><br>2h | |
| Eide, 2013,[39] (Shaikh, 2012)[53] INFORMED | DA study | 54 PCPs including 9 GPs (20%) | X | X | ABCD(E) + Ugly duckling sign | X | Three-point checklist | X | E-learning, Self-assessment | 2h web-based learning | Unlimited e-learning access |
| Bourne, 2012, Australia[38] | DA study | 3 GPs | | X | | X | BLINCK Three-point checklist Menzies method | | Live, Literature | UD | |
| Shariff, 2010, UK[37] | DA study | 94 GPs | | X | | | | | Literature | PD | |
| Grimaldi, 2009, Italy[36] | DA study | 13 GPs | | X | | X | ABCD rule | | Live, E-learning, Self-assessment | PD | Self-assessment e-learning training sessions |
| Menzies, 2009, Australia[35] | DA study | 63 GPs | | X | | Yes + Sequential digital dermoscopy | Menzies method | | Live, Literature, E-learning | 2h-workshop | Unlimited e-learning access |
| Peuvrel, 2009, France[34] | DA study | 210 GPs | X | X | ABCD(E) | | | X | Live, Literature (CD-ROM) | 2h | CD-ROM |
| Youl, 2007, Australia[47] | Cohort study | 16 GPs | <br><br>X | <br><br>X | <br><br>ABCD(E) | <br><br>X | | X | <br><br>Literature | <br><br>PD | Self-assessment paper-based training sessions |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Raasch, 2000, Australia[24] | RCT | 46 GPs (23;23)* | | | | | | | | | |
| Argenziano, 2006, Italy and Spain[9] | RCT | 73 GPs (36;37)* | | X | ABCD | X | Three-point checklist | | Live | 1-day | |
| Dolianitis, 2005, Australia[33] | DA study | 35 GPs | | | | X | Menzies method 7-point checklist ABCD rule Pattern analysis | | Literature, E-learning, Self-assessment | PD | |
| Carli, 2005, Italy[32] | DA study | 41 GPs | X | X | ABCD(E) | | | X | Live | 4h | |
| De Gannes, 2004, Canada[23] | RCT | 27 GPs (10;17)* | X | X | | | | | Literature (Video-format) | 12min | Unlimited access to the 12-minute Video |
| English, 2003, Australia[22]<br><br>Del Mar,1995, Australia[21] | RCT<br><br>RCT | 468 GPs (245;228)*<br><br>93 GPs (48;45)* | | X + Polaroid instant camera | | | | X | Literature | >6h<br><br>1h | |
| Brochez, 2001, Belgium[31] | DA study | 146 GPs | X | X | | | | X | Live, Literature | 2h | |
| Harris, 1999 and 2001, USA[29,30] | DA study | 232 GPs<br><br>17 GPs | X | X | ABCD 7-point Glasgow checklist | | | X | Literature, E-learning | 1h | |
| Westerhoff, Australia 2000 [20] | RCT | 74 GPs | | | | X | Menzies method | | Live, Literature | 1h live | |
| Bedlow, 2000, UK[28] | DA study | 17 GPs | | X | | | | | Live, Literature | UD | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gerbert, 1998 and 2002, USA[19,27] | RCT | 52 GPs (26;26)* | X | X | | | | X | Live, Literature, E-learning | >3h | |
| Dolan, 1997, USA[18] | RCT | 82 PCPs including 16 GPs (46;36)* | X | X | | | | | Live | 2h | |
| Girgis, 1995, Australia[50] | Case-control study | 41 GPs (24;17)* | X | X | | | | X | Live, literature | >6h | |

*Key: GPs=general practitioners; PCPs= primary care physicians; RCT= randomized controlled trial; DA= diagnostic accuracy; INFORMED= Internet curriculum for melanoma early detection; PD= participant dependent; UD=undisclosed; TADA=triage amalgamated dermoscopic algorithm*
**number of participants in the intervention group and control group*

## Table 4. Outcome measures of the melanoma diagnostic educational programs for general practitioners.

| A. Studies with short-term outcomes | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Studies** | **Measured competence in training setting** | | | **Measured performance in clinical setting** | | | | | | **Timing after the training** | | |
| (1st author and year of publication) | **DA** | **Knowledge** | **AM** | **B/M lesion ratio** | **TBSE** | **DA** | **confidence** | **Decrease of VTM incidence** | **RR** | **immediately** | **at 1 month** | **at 3 months** |
| **Dermoscopic diagnostic training programs** | | | | | | | | | | | | |
| Sawyers 2020 [46] | + | | | | | | | | | X | | |
| Seiverling 2019 [45] | + | | | | | | | | | X | | |
| Secker 2017 [43] | + | | + | | | | | | | | | X |
| Rogers 2016 [42] | + | | | | | | | | | X | | |
| Bourne 2012 [38] | + | | | | | | | | | X | | |
| Dolianitis 2005 [33] | + | | | | | | | | | X | | |
| Westerhoff 2000 [20] | + | + | | | | | | | | X | | |
| **Clinical diagnostic training programs** | | | | | | | | | | | | |
| Beecher, 2018 [44] | + | + | + | | | | | | | X | | X |
| Carli 2005 [32] | + | | + | | | | | | | X | | |
| Mikkilineni 2001;2002 [32,33] | | + | + | | + | | + | | | X | | |
| Brochez 2001 [31] | + | | | | | | | | | X | | |
| Harris 2001 [30] | + | + | + | | | | + | | | X | | |
| Harris 1999 [29] | + | - | + | | | | + | | | X | | |
| Raasch 2000 [26] | - | | | | | | + | | | 3-month period | | |
| Bedlow 2000 [28] | + | + | | | | | | | | X | | |
| Gerbert 1998;2002 [19,27] | + | + | + | | | | + | | | X | | |
| Dolan 1997 [18] | - | + | - | | | | | | | X | X | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Girgis 1995 [50] | - | + | | | | | + | | | X | | X |

**B. Studies with long-term outcomes**

| Studies | Measured competence in training setting | | | Measured performance in clinical setting | | | | | | Timing after the training |
|---|---|---|---|---|---|---|---|---|---|---|
| | DA | Knowledge | AM | M/B lesion ratio | TBSE | DA | Confidence | Decrease of VTM incidence | RR | |
| **Dermoscopic diagnostic training programs** | | | | | | | | | | |
| Shariff 2010 [37] | | | | | | - | | | | at 11 months |
| Youl 2007 [47] | | | | + | | + | | | | 6-month period |
| Argenziano 2006 [9] | | | | | | + | | | + | 16-month period |
| **Clinical diagnostic training programs** | | | | | | | | | | |
| Gulati 2015 [49] | | | | | | - | + | | | 8-month period |
| Peuvrel 2009 [34] | | + | | | | | + | | | 15-month period |
| De Gannes 2004 [23] | - | - | - | | | | | | | at 6 months |
| English 2003 [22] | | | | - | | | | | | 21-month period |
| Del Mar 1995 [21] | | | | + | | | | | | 24-month period |

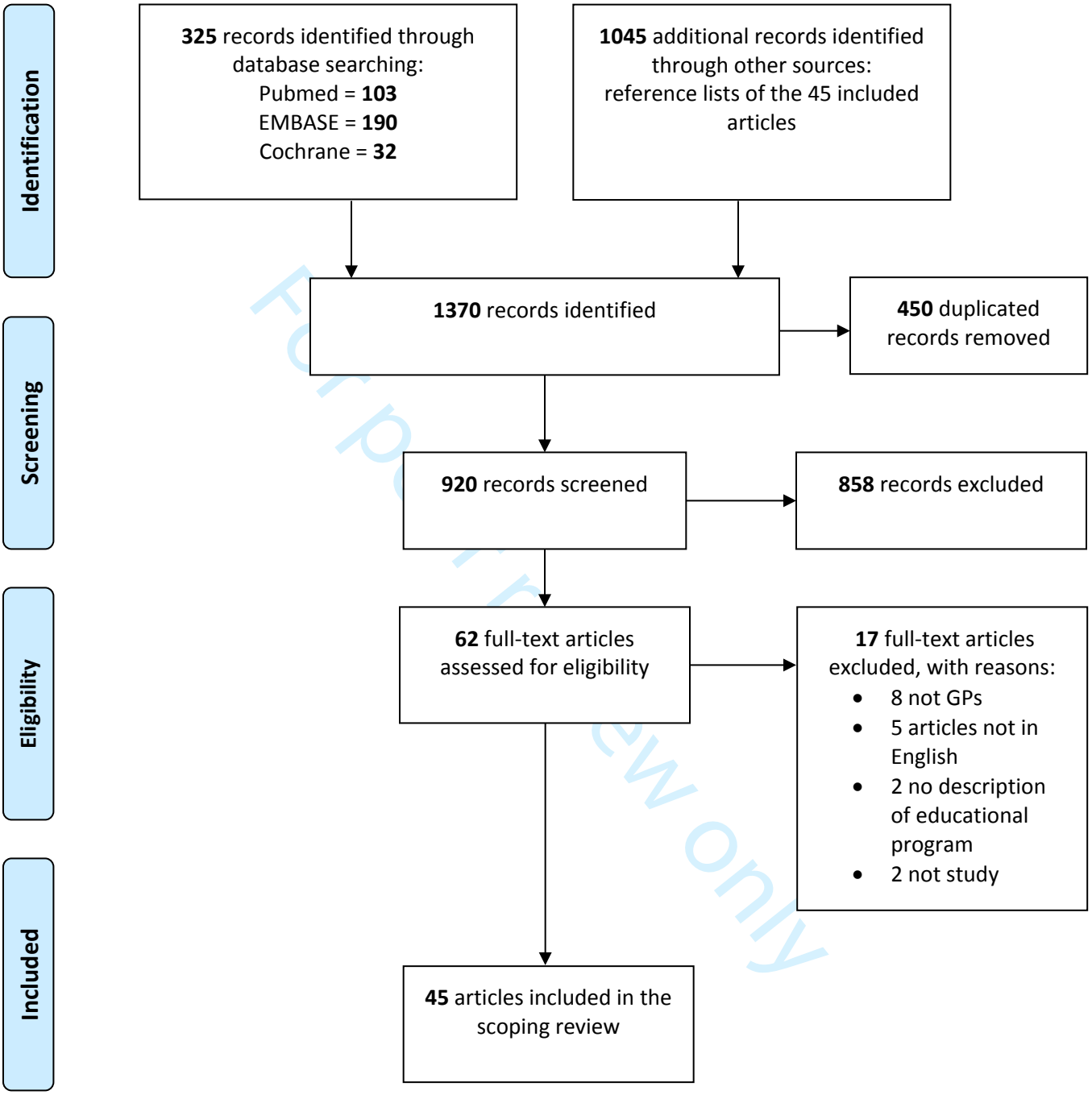
**C. Studies with short and long-term outcomes**

| Studies | Measured competence in training setting | | | Timing after the training | | Measured performance in clinical setting | | | | | | Timing after the training | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DA | Knowledge | AM | Immediately after | at 1-3 months | B/M lesion ratio | TBSE | DA | Confidence | Decrease of VTM incidence | RR | | | |
| **Dermoscopic diagnostic training programs** | | | | | | | | | | | | | | |
| Augustsson 2019 [52] | + | | | X | | | | | | | | at 6 months (here competence measure) | | |
| Badertscher2015 [26] | + | | | X | | | | - | + | | | at 12 months | | |
| Koelink 2014 [10] | + | | + | X | | | | + | + | | | at 8 months | at 12 months | at 19 months |
| Eide 2013 [39] | + | + | + | X | | | | + | + | | + | at 6 months | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Youl 2007 [46]<br>Raasch 2000 [24] | - | | | 3-month period | | + | | + | | | | 6-month period |
| Grimaldi 2009 [36] | + | | | X | X | | | + | | | | 6-month period |
| Menzies 2009 [35] | + | | + | X | | + | | | | | + | 6-month period |
| **Clinical diagnostic training programs** | | | | | | | | | | | | |
| Marra, 2020 [51] | + | | | | X | | | + | + | | + | at 10 months |
| Grange 2013 [48] | + | + | | X | | | | | | + | | 3-year period |
| Markova 2013 [25]<br>Mikkilineni 2001; 2002 [40,41] | | + | + | X | | | - | | | | | at 12 months |

*Key: DA= diagnostic accuracy; AM=appropriate management; TBSE= total body skin examination; B/M=benign/malignant; VTM= very thick melanomas; RR= decrease in dermatologist referral rates for benign lesions and increase in referral rates for malignant lesions*
*'+'= statistically significant improvement; '-' = no statistically significant improvement*

**Figure 1.** PRISMA flowchart of study selection process[17]



**Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist**

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a scoping review. | **1** |
| **ABSTRACT** | | | |
| Structured summary | 2 | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | **2** |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | **4** |
| Objectives | 4 | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | **4** |
| **METHODS** | | | |
| Protocol and registration | 5 | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | **N.A.** |
| Eligibility criteria | 6 | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | **5** |
| Information sources* | 7 | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | **5-6** |
| Search | 8 | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | **6** |
| Selection of sources of evidence† | 9 | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. | **6** |
| Data charting process‡ | 10 | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | **6** |
| Data items | 11 | List and define all variables for which data were sought and any assumptions and simplifications made. | **Table 2** |
| Critical appraisal of individual sources of evidence§ | 12 | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | **5** |

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| Synthesis of results | 13 | Describe the methods of handling and summarizing the data that were charted. | 6 |
| **RESULTS** | | | |
| Selection of sources of evidence | 14 | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | **Figure 1** |
| Characteristics of sources of evidence | 15 | For each source of evidence, present characteristics for which data were charted and provide the citations. | **Table 3** |
| Critical appraisal within sources of evidence | 16 | If done, present data on critical appraisal of included sources of evidence (see item 12). | **N.A.** |
| Results of individual sources of evidence | 17 | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | **Table 3** |
| Synthesis of results | 18 | Summarize and/or present the charting results as they relate to the review questions and objectives. | **7-8** |
| **DISCUSSION** | | | |
| Summary of evidence | 19 | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | **9-10-11** |
| Limitations | 20 | Discuss the limitations of the scoping review process. | **12** |
| Conclusions | 21 | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | **13** |
| **FUNDING** | | | |
| Funding | 22 | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | **1** |

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.
* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).
‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

*From:* Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.

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# Training general practitioners in melanoma diagnosis: a scoping review of the literature.



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# Training general practitioners in melanoma diagnosis: a scoping review of the literature

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## Abstract

*Background*: General practitioners (GPs) play a key role in early melanoma detection. In order to help GPs deal with suspicious skin lesions, melanoma diagnostic training programs have been developed. However, it is unclear whether these programs guarantee the acquisition of skills that will be applied by the GPs in their daily clinical practice and maintained over time.

*Objectives:* This scoping review aimed to examine and compare educational programs designed to train GPs in melanoma diagnosis using clinical (naked eye) examination alone or dermoscopy +/- clinical examination, and sought to inform on the long-term sustainability of the GPs' acquired skills.

*Eligibility criteria:* Studies eligible for inclusion evaluated educational programs for teaching diagnosis of melanoma to GPs. MEDLINE, EMBASE, and Cochrane databases were searched for relevant articles from 1995 to May 2020.

*Results*: Forty-five relevant articles were found assessing 31 educational programs. Most programs that improved the diagnostic accuracy and long-term performances of the GPs i.e., increase in confidence, decrease in dermatologist referral of benign skin lesions, and improvement of the benign/malignant ratio of excised skin lesions, trained the GPs in clinical diagnosis followed by dermoscopy. To maintain long-term performances, these programs provided refresher training material.

*Conclusion:* This review shows that studies generally report positive outcomes from the training of GPs in melanoma diagnosis. However, refresher training material seemed necessary to maintain the acquired skills. The optimal form and ideal frequency for these updates have yet to be defined.

## Strengths and limitations of the review

- Systematic review conducted following the guidelines of the PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) checklist.
- It thoroughly evaluates educational programs on melanoma diagnosis for general practitioners.
- Specifically, the review examines the long-term effect of the educational programs and the value of providing regular refresher training sessions after the training.
- This review led inevitably to some publication bias as only English language peer-reviewed articles were included.

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## Contributorship statement

E. Harkemanne developed the research protocol, completed the literature search and screened the articles for inclusion, extracted the data, synthesised the findings, interpreted the results and drafted the manuscript. M. Baeck screened the articles for inclusion, extracted data and critically revised the manuscript. I. Tromme developed the protocol, independently reviewed the articles for inclusion, extracted data, interpreted the results and critically revised the manuscript. All authors approved the final version.

## Data availability statement

All data relevant to the study are included in the article.

## Introduction

Early melanoma detection is essential to reduce morbidity and mortality of melanoma patients.[1] Given the increased incidence of this aggressive skin cancer, primary care physicians (PCPs) play a key role in early melanoma diagnosis.[2–4] PCPs include a number of health care professionals who provide first and continuing medical care to a patient. In this review, we focus on GPs who take care of patients in community settings and are, in most countries, the first point of contact for any patient with a health issue.

To improve the diagnostic accuracy of melanoma by GPs, specific educational training programs have been developed. At first, training courses focused on melanoma diagnosis by clinical (naked eye) examination alone. A systematic review[5], published in 2011, reported on 20 studies that evaluated 13 educational interventions in clinical melanoma diagnosis for PCPs. All the evaluated interventions improved diagnostic accuracy and melanoma management. Later, educational programs that included dermoscopy training were created and were then evaluated for primary care. To date, dermoscopy has been the most widely non-invasive *in vivo* technique used in clinical practice to assess skin tumors.[6] It involves the use of a handheld device which allows the observation of skin structures invisible to the naked eye. However, the sensitivity and specificity of the technique are operator-dependent (trained *vs.* untrained physicians).[7] Ninety-two percent sensitivity and 95% specificity can be achieved for melanoma diagnosis by a trained dermatologist combining visual inspection and *in vivo* dermoscopy.[8] In primary care, dermoscopy has also been shown to be an effective tool for the triage of suspicious pigmented skin lesions when performed by properly trained PCPs.[9,10] Yet, the minimum training required to reach competence is still unknown.[11]

Previously published reviews[5,11–14] on training programs in melanoma diagnosis for GPs focused on the content, teaching method, outcome measures and study-by-study efficacy of the evaluated educational interventions. However, they did not assess whether the GPs' acquired skills were measured in the short or long term. Yet, given the increasing burden of melanoma on general practice, it is crucial to know whether these programs are capable of teaching GPs easily applicable and sustainable skills in melanoma diagnosis and management. This scoping review aimed to explore educational programs training GPs in melanoma diagnosis using clinical (naked eye) examination alone and diagnosis using dermoscopy +/- clinical examination. Educational programs were examined with regard to training content, teaching

method, training duration, availability of refresher training material, and outcome measures. This review also specifically sought to inform on the long-term sustainability of the skills acquired during these training programs.

## Material and methods

To carry out this literature review, a scoping review seemed the most appropriate. Indeed, the results from studies on educational programs on melanoma diagnosis for GPs presented with a wide range of study designs and heterogeneous outcome measures, which made it impossible to formally assess the quality of these studies and to perform a meta-analysis. To conduct this scoping review, the framework developed by Arksey and O'Malley,[15] subsequently refined by Levac,[16] and the guidelines of the PRISMA-ScR[17] (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) checklist were followed.

### Eligibility criteria

Studies eligible for inclusion in this review (Table 1) evaluated educational programs teaching either clinical diagnosis of melanoma and/or diagnosis using dermoscopy +/- clinical examination and designed primarily for PCPs including GPs. The population of interest included qualified GPs and GP trainees. Specialists and GPs working in hospital settings and/or specialized clinics were excluded. Studies that included training programs for PCPs other than GPs were not eligible. Studies where no participant training in melanoma diagnosis was proposed and studies evaluating exclusively non-melanoma skin cancer detection were also excluded. Studies evaluating teledermoscopy and computer-aided diagnosis of melanoma were not assessed as they do not require specific education in melanoma recognition by the participants. Only studies assessing the type of educational program and its short and/or the long-term efficacy on the skills acquired by the GPs were included. Finally, only peer-reviewed and English language articles were included.

### Data sources and study selection

MEDLINE, EMBASE, and Cochrane databases were searched for relevant articles published from 1995 to May 2020. Studies were selected for inclusion by three authors (EH, MB, and IT), with IT providing the final decision in the event of disagreement. The studies were not assessed for bias, as the risk of bias assessment was reported as not applicable to scoping reviews in the 2018 PRISMA-ScR guidelines.[17]

To extensively cover the literature on the subject, four categories of terms were identified: (1) general practitioners, family doctor, general medicine, family practice, primary care physicians; (2) education, continuing medical education; (3) melanoma, malignant melanoma, cutaneous melanoma, skin neoplasms; (4) diagnosis, and cancer early detection. In MEDLINE, the following Medical Subject Headings (MeSH) were used: *general practitioners* OR *family practice* OR *primary care physicians* OR *general practice* AND *melanoma* AND *diagnosis.* No limits were defined. In EMBASE, Emtree terms were exploded: *general practitioner, family doctor, primary care, family physician, primary care physician, melanoma, diagnosis,* and *education*. In the Cochrane database, the following terms were searched: *melanoma* AND *diagnosis* AND *general practitioners* OR *family medicine* AND *dermoscopy* (see Supplementary Table 1 for search strategies). In addition, the reference lists of included studies were screened as a source of further relevant articles.

**Data extraction**

Two authors (EH and MB) reviewed all included articles and independently collected data. Extracted data included authors, year of publication, origin of the article, study design, number of participating GPs, type of educational program, type of outcome measures and short- and/or long-term evaluation of these outcomes. The type of educational program included training content, teaching method, training duration and refresher training material (if provided). To facilitate comparison with data found in previous reviews, all these data were reported into categories adapted from those presented by Fee *et al.*[14]

Table 2 gives the definition of the different categories. The training content was subdivided into six components: epidemiology, clinical diagnosis, clinical algorithm, dermoscopic diagnosis, dermoscopic algorithm and management. The teaching method was considered either as live, in the form of scientific literature, e-learning, or self-assessment. The refresher training material specified the material available for participants to refresh their skills after the training. The outcome measures were expressed either in terms of competence or in terms of performance, according to the assessment approach of continuing medical education programs proposed by Moore.[18] Finally, since the limits between short-term and long-term evaluation of a medical educational program are not standardized, arbitrary limits have been chosen based on the observations made during this literature review.

### Patient and Public Involvement

No patient and public involvement was required for this review.

## Results

In total, 325 articles were identified from the electronic database searches, as shown in the PRISMA flowchart[19] (Figure 1). At the end of the study selection process, 45 relevant articles, which assessed 31 educational interventions, were included in the review analysis.

### Study designs

Thirty-six interventional studies with a range of study designs were found: 11 randomized controlled trials (RCTs)[9,10,20–29], 19 diagnostic accuracy studies[30–39,40–48], three cohort studies[49–51] and three case-control studies.[52–54] Five of the 31 training programs were assessed twice.[22,23,26,30,42]

Four systematic reviews were identified: one on the training of PCPs in clinical melanoma diagnosis,[5] two on the training of PCPs in dermoscopy for melanoma diagnosis,[12,13] and one on the use of dermoscopy in primary care.[11] A scoping review on the training of PCPs in dermoscopy[14] was also included. The final three articles were descriptive articles of the educational programs and study protocols.[55–57]

### Educational programs

The educational programs in melanoma diagnosis for GPs varied in terms of content, teaching method and outcome measures. The characteristics of these training programs are summarized in Table 3.

*Training content*

Of the 31 educational programs, 15 involved the training of GPs in clinical diagnosis, five involved dermoscopic diagnosis alone, and 11 involved the training of GPs in both of these melanoma diagnostic methods. Twelve (80%) of the clinical diagnostic training programs also involved learning of epidemiology and 11 (73%) learning of management guidelines for suspicious lesions. Only seven (47%) programs teaching clinical diagnosis used an algorithm to teach melanoma recognition, with the ABCD(E) rule[58] (Asymmetry, uneven Borders, uneven Colors, Diameter > 6mm, and Evolution) being most commonly taught. Of the dermoscopic

training programs, 12 (80%) included learning of at least one dermoscopic algorithm (Menzies' method,[24,35,37,40] Three-point checklist,[9,40,41] the 7-point checklist,[10,35] TADA,[44,47] the ABCD rule,[35,38] BLINCK,[40] and pattern analysis[35,53]). The Menzies' method,[59] the ABCD rule,[60] pattern analysis and the 7-point checklist[61] were designed originally for trained physicians, and were later tested as effective when used by non-experts.[62] Other algorithms, such as the Three-point checklist[63] and the Triage Amalgamated Dermoscopic Algorithm (TADA)[44] were initially created for use by PCPs. In addition, two educational programs included training on other diagnostic tools, such as sequential digital dermoscopy imaging[37] and polaroid instant camera photography.[26]

*Teaching method, training duration and refresher training material*

Live training courses and the use of educational books, posters or videos (literature) were the two preferred teaching methods of clinical diagnostic training programs. Five training programs also used an e-learning approach.[25,28,30,51,54] The most common teaching method used in dermoscopic training programs was live training. This approach was combined with literature and/or e-learning in six programs. Three programs also used self-assessment. Overall, the teaching method did not appear to have influenced the program outcomes. Duration of training varied from 75 minutes to 1 day, was not specified in two studies[31,40], and was participant dependent in six studies using self-assessment methods. Six dermoscopic diagnostic training programs[29,37,38,41,49,53] and three programs in clinical diagnosis[27,36,50] provided regular refresher training material such as unlimited e-learning access or self-assessment training sessions.

*Training outcomes*

Table 4 summarizes the outcome measures of the studies. In the selected studies, the GPs' competences were generally measured in the short term and their performances measured in the long term after the training.

Eight clinical diagnostic training programs and seven dermoscopic training programs only assessed the short-term efficacy of their program (Table 4A). For these studies, the competences most often evaluated were diagnostic accuracy and appropriate management measured in a training setting. The most evaluated short-term performance, measured in a clinical setting, was the GPs' confidence in diagnosing melanoma. With the exception of two studies, all showed a positive impact of their intervention.[21,23] Four clinical diagnostic training programs and three dermoscopic training programs (one teaching dermoscopy alone[53]) only assessed long-term

performances (Table 4B). The most evaluated long-term performances, measured in daily clinical practice, were the GPs' diagnostic accuracy and the benign/malignant ratio of excised lesions. Three studies[9,36,49] reported improvement of the GPs' performances in melanoma diagnosis. The other studies reported no improvement.

Finally, three clinical diagnostic and seven dermoscopic training programs assessed the short- and long-term outcome of their training (Table 4C). Except for one,[23] all these training programs demonstrated improvement of the GPs' competences, measured in a training setting in the short term. In the long term, eight training programs[10,37,38,41,49,50,53,54] reported significant improvement of the GPs' performances for the diagnosis of melanoma and benign skin lesions. This led to either a decrease in the referral rates to dermatologists[37,41,54] and/or a decrease in the ratio of benign/malignant excised skin lesions.[37,49] Among the major studies, Koelink *at al.*[10] found that their dermoscopic training program improved the GPs' long-term performances with up to 1.25 times greater diagnostic accuracy for skin lesions including melanomas. In a French department, Grange *et al.*[50] observed an impressive reduction of the incidence of advanced melanomas (Breslow thickness ≥ 3 mm) during the 3-year period after their GP training campaign in clinical melanoma diagnosis. A very recent study by Marra *et al.,*[54] assessing 1662 referrals, reported better quality of referrals by GPs trained in melanoma diagnosis than by untrained GPs, potentially leading to less unnecessary referrals. However, two educational programs[28,29] were unable to maintain the GPs' acquired performances in the long term.

## Discussion

This scoping review aimed to explore educational programs training GPs in melanoma diagnosis using clinical (naked eye) examination alone and diagnosis using dermoscopy +/- clinical examination. Educational programs were examined with regard to training content, teaching method, training duration, availability of refresher training material, and outcome measures. This review also specifically sought to inform on the long-term sustainability of the skills acquired during these training programs.

### Types of educational programs with positive long-term outcomes

Most reported educational programs that improved long-term diagnostic accuracy and changed GPs' melanoma practice patterns trained their participating GPs in dermoscopy combined with clinical diagnosis. This teaching method is supported by a recent Cochrane review[8] in which dermoscopy alone was found to be less accurate than clinical examination followed by

dermoscopy for the diagnosis of melanoma. The Cochrane review results also suggested that dermoscopic algorithms were the most useful method to train non-experts in dermoscopy. In our review, we found that five of the programs with long-term positive impact used dermoscopic algorithms to teach melanoma diagnosis.[10,37,38,41,53]

Unfortunately, the substantial number of training hours necessary to become competent in dermoscopy is the main reported factor limiting its use in general practice.[64,65] At this time, there is no evidence on the optimal length of training, even though it has been demonstrated that diagnostic accuracy of dermoscopy depends on the degree of training of the practitioner.[66] One study suggested that 1 day of live training in dermoscopy was sufficient to build the confidence of GPs with special interest in melanoma diagnosis.[67] We found two RCTs that demonstrated sustained improvement of GPs' diagnostic accuracy, both of which proposed live training in dermoscopy over 1 day or 10 hours.[9,10] Because the duration of training in dermoscopy is a limiting factor for most GPs, it is important to keep in mind that training in clinical melanoma diagnosis has also been shown to improve the GPs' performances while requiring less training time (in this review, a mean duration of 2.5 hours was observed for clinical diagnostic training programs).[36,50]

However, we found that educational programs teaching dermoscopy have been more likely to assure positive long-term outcomes than programs teaching clinical examination alone. One of the reasons could be that the latter used measures of performance such as GPs' confidence level and number of total-body skin examinations performed before and after training, which did not reflect GPs' diagnostic ability in clinical practice. One the one hand, measuring the confidence of GPs is more useful in assessing the quality of a training program than in assessing skills acquired by participants. From a pedagogical point of view, participants feel more confident when they know how to use the teaching content in daily practice.[18] On the other hand, the number of total-body skin examinations performed may be useful in measuring GPs' awareness of skin tumours, but not for evaluation of GPs' diagnostic skills.

**Long-term improvement of the GPs' performances in clinical settings**

The GPs' long-term performances measured in clinical settings were assessed for 15 educational programs: six in clinical diagnosis and nine in dermoscopic diagnosis. Ten showed a positive impact on the GPs' performances measured over periods ranging from 6 to 19 months. The most frequent observations were a decrease of referral rates to dermatologists for

benign skin lesions and an improvement of the benign/malignant ratio of excised skin lesions. The INFORMED group[41] reported an increase in melanoma diagnosis during a screening campaign by GPs trained with their program in 2016.[68] Furthermore, a decrease of the incidence of advanced melanomas was shown in a French department over a 3-year period after their training program in clinical melanoma diagnosis.[50] Unfortunately, two educational programs[28,29] failed to maintain the GPs' acquired performances at 1 year after the end of the training. The reasons might be that Markova *et al.*[28] chose to assess the number of total-body skin examinations performed but did not evaluate the GPs' diagnostic accuracy and that Badertscher *et al.*[29] trained their GPs to use Lumio®, a polarized magnifying glass with 2x magnification instead of a standard dermoscopy device (10x magnification).

To retain acquired diagnostic skills over the long term, results of a recent RCT suggested the need for "refresher sessions at regular intervals".[69,70] In our review, nine (60%) educational programs evaluated in the long-term provided refresher training material. Seven of these programs were successful. In 2014, Grange *et al.*[50] produced a CD-ROM containing their teaching material and sent regular information about melanoma to the GPs. The INFORMED group[41] provided GPs with a free unlimited access to their web-based course. Menzies *et al.*[37] gave participating GPs an educational textbook and an unlimited e-learning access. Grimaldi *et al.*[38] and Youl *et al.*[49] also ensured self-assessment refresher training sessions. Marra *et al.*[54] found a 10-month sustainability of the diagnostic accuracy of their trained GPs and assumed that daily use of the obtained knowledge during the study period achieved this effect. Only Koelink et al.,[10] who evaluated the longest post-training period (19 months) and who demonstrated sustainability of diagnostic skills, did not specify whether update training modalities were provided.

However, the ideal frequency and form of updates have never been studied. An RCT, taking place in the English National Defibrillator Programme, determined that update session intervals after a medical education session should not exceed 7 months to limit the loss of acquired skills and maintain the participants confidence.[71] In the UK, a survey among GPs with special interest in dermatology stated that self-assessment learning was the most popular for refresher sessions.[67] Nevertheless, they also showed that 36% of GPs that use dermoscopy in their clinical practice reported to have never updated their training skills. We found that the most appreciated form of self-assessment updates was the unlimited access to an e-learning course. In the future, this enthusiasm for online training could lead to the development of smartphone applications to

train GPs in melanoma diagnosis. Some newly developed applications have currently been evaluated among medical students[72] and dermatology residents.[73] Initial results already looked very promising.

## Limitations

This scoping review has some limitations and led inevitably to certain publication biases. We used keywords for the selection of articles and only peer-reviewed articles were included. By limiting our research to English language articles, some studies may also have been missed. It is also very likely that melanoma diagnostic training programs exist in unpublished forms, for example in university continuing medical education programs. Moreover, we focused only on studies assessing melanoma diagnostic training methods among GPs. Therefore, we may have failed to mention some educational programs for primary care in this review. Furthermore, educational programs which were not evaluated in studies were overlooked. Finally, this review covers educational programs over a 25-year period. As technology has evolved considerably over this time, some teaching methods and refresher training materials have been overshadowed by interactive online tutorials (e-learning) - all the more so with the health crisis caused by COVID-19 during which distance learning methods have developed very rapidly.

## Conclusion

In conclusion, educational programs trained GPs in melanoma diagnosis using clinical examination alone or dermoscopy +/- clinical diagnosis. Most reported programs that improved the long-term diagnostic accuracy and changed routine performances of the GPs (i.e., decrease in dermatologist referral of benign skin lesions, and improvement of the benign/malignant ratio of excised skin lesions), trained their participating GPs in both diagnostic methods. The preferred teaching methods were live and e-learning but the teaching method did not seem to influence the GPs' acquired performances. It is important to note that the educational programs that achieved long term sustainability of GPs' performances in daily clinical practice provided refresher training material. However, the optimal form and ideal frequency of these updates have yet to be defined.

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**Table 1. Inclusion and exclusion criteria for article selection**

| **Inclusion criteria:** |
|---|
| **Articles**<br>• Articles written in English<br>• Study articles and descriptive articles of educational programs<br>**Population**<br>• Qualified GPs and GP trainees working in community settings<br>**Intervention**<br>• Studies evaluating educational programs in clinical (naked eye) diagnosis and/or diagnosis of melanoma using dermoscopy<br>**Outcome(s)**<br>• Studies assessing the type of educational program and its short and/or the long-term efficacy on the skills acquired by the GPs |
| **Exclusion criteria:** |
| **Articles**<br>• Articles not subject to peer review and written in languages other than English<br>**Population**<br>• Studies involving specialists, medical students, non-GPs, GPs working in hospital settings and/or specialized skin cancer clinics<br>**Intervention**<br>• Studies evaluating exclusively nonmelanoma skin cancer<br>• Teledermoscopy studies<br>• Studies on computer-aided diagnosis of melanoma<br>**Outcome(s)**<br>• No method of measuring outcomes was ruled out |

*Key: GPs= general practitioners*

**Table 2. Definition of study categories**

| Criteria | Categories | Definition |
|---|---|---|
| **Training content** | Epidemiology | Background information on rates of melanoma cancer, risk factors, localization and evolution of melanomas |
| | Clinical diagnosis | Naked eye melanoma recognition |
| | Clinical algorithm | Use of a pre-existing algorithm as a learning tool to aid for clinical diagnosis |
| | Dermoscopic diagnosis | Recognition of melanoma using dermoscopy |
| | Dermoscopic algorithm | Use of an algorithm as a learning tool to aid for dermoscopic diagnosis |
| | Management | Determination of a plan of action for a skin lesion i.e. reassurance, follow-up, or lesion excision |
| **Teaching method** | Live | Presentation by a speaker to a group of participants |
| | Scientific literature | Use of educational books, posters, letters, CD-ROMs or videos |
| | E-learning | Interactive online tutorials including audio and visual information |
| | Self-assessment | Learning by the participant himself using educational material |
| **Refresher training material** | Teledermatology feedback | Feedback from a dermatologist on the image and clinical history of a suspicious lesion at a distance, using remote internet-based technologies |
| **Outcome measures** | Competences | Acquired skills, which are evaluated in a training setting on clinical and/or dermoscopic photographs of skin lesions |
| | Diagnostic accuracy | Ability of the participants to discriminate between melanoma and benign lesions |
| | Knowledge | Report of conceptual understanding |
| | Appropriate management | Determination of the right plan of action for a skin lesion |
| | Performances | Changes in real-life practice measured in a clinical setting, i.e. changes in the benign/malignant ratio of excised lesions, the number of total-body skin examinations performed, confidence of the GPs, changes in referral rates to a dermatologist, and decrease in the incidence of advanced melanomas |
| **Evaluation** | Short-term | Measurement of outcomes immediately or up to 3 months after the training |
| | Long-term | Measurement of outcomes at $\geq$ 6 months after the training |

**Table 3. Characteristics of educational programs in melanoma diagnosis for general practitioners**

| Article | Study design | Study participants | Training content | | | | | | Teaching method | Training duration | Refresher training material |
|---|---|---|---|---|---|---|---|---|---|---|---|
| author, year, location[ref] | | | Epidemiology | Clinical diagnosis | Clinical algorithm | Dermoscopic diagnosis | Dermoscopic algorithm | Management | | | |
| Marra, 2020, The Netherlands[54] | Case-control study | 185 (83; 102)* | | X | | X (optional) | | X | e-learning | 2h | |
| Sawyers, 2020, Canada[48] | DA study | 33 GPs | | | | X | TADA step-I | | Live | 3.5h | |
| Augustsson, 2019, Sweden[53] | Case-control study | 43 GPs (27;16)* | | | | X | Pattern analysis | | Live | 1-day | PDF-files of the course |
| Seiverling,2019, USA[47] | DA study | 59 GPs | | X | | X | TADA | | Live | 75min | |
| Beecher, 2018, Ireland[46] | DA study | 23 GP trainees | X | X | | | | X | Live, Literature | 1h | |
| Secker, 2017, The Netherlands[45] | DA study | 293 PCPs including ? GPs | | X | | X | | X | Live, Literature and E-learning | 1-day | |
| Rogers, 2016, USA[44] | DA study | 16 GPs | | | | X | TADA | | Live | 1-day | |
| Badertscher, 2011 and 2015, Switzerland[56,29] | RCT | 78 GPs (39;39)* | | X | | Lumio® | | | Live | 1-day | Teledermatology feedback |
| Gulati, 2015, UK[51] | Cohort study | 967 GPs | X | X | | | | X | E-learning | PD | |
| Koelink, 2014, The Netherlands[10] | RCT | 53 GPs | X | X | | X | 7-point checklist | | Live | 4h clinical diagnosis; 6h dermoscopy | |
| Grange, 2013, France[50] | Cohort study | 398 GPs | X | X | | | | | Live, Literature | 2.5h | CD-ROM+ regular |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | information sheets |
| Markova, 2013, USA[28]<br>Mikkilineni, 2001 and 2002, USA[42,43] (Weinstock 1996)[57] | RCT<br><br>DA study | 46 GPs (20;26)*<br><br>7 GPs | X | X | ABCD(E) | | | X | E-learning<br><br>Live Literature | 2h | |
| Eide, 2013,[41] (Shaikh, 2012)[55] INFORMED | DA study | 54 PCPs including 9 GPs (20%) | X | X | ABCD(E) + Ugly duckling sign | X | Three-point checklist | X | E-learning, Self-assessment | 2h web-based learning | Unlimited e-learning access |
| Bourne, 2012, Australia[40] | DA study | 3 GPs | | X | | X | BLINCK Three-point checklist Menzies method | | Live, Literature | UD | |
| Shariff, 2010, UK[39] | DA study | 94 GPs | | X | | | | | Literature | PD | |
| Grimaldi, 2009, Italy[38] | DA study | 13 GPs | | X | | X | ABCD rule | | Live, E-learning, Self-assessment | PD | Self-assessment e-learning training sessions |
| Menzies, 2009, Australia[37] | DA study | 63 GPs | | X | | Yes + Sequential digital dermoscopy | Menzies method | | Live, Literature, E-learning | 2h-workshop | Unlimited e-learning access |
| Peuvrel, 2009, France[36] | DA study | 210 GPs | X | X | ABCD(E) | | | X | Live, Literature (CD-ROM) | 2h | CD-ROM |
| Youl, 2007, Australia[49]<br>Raasch, 2000, Australia[23] | Cohort study<br><br>RCT | 16 GPs<br><br>46 GPs | X | X | ABCD(E) | X | | X | Literature | PD | Self-assessment paper-based training sessions |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (23;23)* | | | | | | | | | |
| Argenziano, 2006, Italy and Spain[9] | RCT | 73 GPs (36;37)* | | X | ABCD | X | Three-point checklist | | Live | 1-day | |
| Dolianitis, 2005, Australia[35] | DA study | 35 GPs | | | | X | Menzies method 7-point checklist ABCD rule Pattern analysis | | Literature, E-learning, Self-assessment | PD | |
| Carli, 2005, Italy[34] | DA study | 41 GPs | X | X | ABCD(E) | | | X | Live | 4h | |
| De Gannes, 2004, Canada[27] | RCT | 27 GPs (10;17)* | X | X | | | | | Literature (Video-format) | 12min | Unlimited access to the 12-minute Video |
| English, 2003, Australia[26]<br><br>Del Mar,1995, Australia[20] | RCT<br><br>RCT | 468 GPs (245;228)*<br><br>93 GPs (48;45)* | | X + Polaroid instant camera | | | | X | Literature | >6h<br><br>1h | |
| Brochez, 2001, Belgium[33] | DA study | 146 GPs | X | X | | | | X | Live, Literature | 2h | |
| Harris, 1999 and 2001, USA[30,32] | DA study | 232 GPs<br><br>17 GPs | X | X | ABCD 7-point Glasgow checklist | | | X | Literature, E-learning | 1h | |
| Westerhoff, Australia 2000 [24] | RCT | 74 GPs | | | | X | Menzies method | | Live, Literature | 1h live | |
| Bedlow, 2000, UK[31] | DA study | 17 GPs | | X | | | | | Live, Literature | UD | |
| Gerbert, 1998 and 2002, USA[22,25] | RCT | 52 GPs (26;26)* | X | X | | | | X | Live, Literature, E-learning | >3h | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Dolan, 1997, USA[21] | RCT | 82 PCPs including 16 GPs (46;36)* | X | X | | | | | Live | 2h | |
| Girgis, 1995, Australia[52] | Case-control study | 41 GPs (24;17)* | X | X | | | | X | Live, literature | >6h | |

*Key: GPs=general practitioners; PCPs= primary care physicians; RCT= randomized controlled trial; DA= diagnostic accuracy; INFORMED= Internet curriculum for melanoma early detection; PD= participant dependent; UD=undisclosed; TADA=triage amalgamated dermoscopic algorithm*

**number of participants in the intervention group and control group*

**Table 4. Outcome measures of the melanoma diagnostic educational programs for general practitioners.**

| A. Studies with short-term outcomes | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Studies** | **Measured competence in training setting** | | | **Measured performance in clinical setting** | | | | | | **Timing after the training** | | |
| (1st author and year of publication) | **DA** | **Knowledge** | **AM** | **B/M lesion ratio** | **TBSE** | **DA** | **confidence** | **Decrease of VTM incidence** | **RR** | **immediately** | **at 1 month** | **at 3 months** |
| **Dermoscopic diagnostic training programs** | | | | | | | | | | | | |
| Sawyers 2020 [48] | + | | | | | | | | | X | | |
| Seiverling 2019 [47] | + | | | | | | | | | X | | |
| Secker 2017 [45] | + | | + | | | | | | | | | X |
| Rogers 2016 [44] | + | | | | | | | | | X | | |
| Bourne 2012 [40] | + | | | | | | | | | X | | |
| Dolianitis 2005 [35] | + | | | | | | | | | X | | |
| Westerhoff 2000 [24] | + | + | | | | | | | | X | | |
| **Clinical diagnostic training programs** | | | | | | | | | | | | |
| Beecher, 2018 [46] | + | + | + | | | | | | | X | | X |
| Carli 2005 [34] | + | | + | | | | | | | X | | |
| Mikkilineni 2001;2002 [42,43] | | + | + | | + | | + | | | X | | |
| Brochez 2001 [33] | + | | | | | | | | | X | | |
| Harris 2001 [32] | + | + | + | | | | + | | | X | | |
| Harris 1999 [30] | + | - | + | | | | + | | | X | | |
| Raasch 2000 [23] | - | | | | | | + | | | 3-month period | | |
| Bedlow 2000 [31] | + | + | | | | | | | | X | | |
| Gerbert 1998;2002 [22,25] | + | + | + | | | | + | | | X | | |
| Dolan 1997 [21] | - | + | - | | | | | | | X | X | |
| Girgis 1995 [52] | - | + | | | | | + | | | X | | X |

## B. Studies with long-term outcomes

| Studies | Measured competence in training setting | | | Measured performance in clinical setting | | | | | | Timing after the training |
|---|---|---|---|---|---|---|---|---|---|---|
| | DA | Knowledge | AM | M/B lesion ratio | TBSE | DA | Confidence | Decrease of VTM incidence | RR | |
| **Dermoscopic diagnostic training programs** | | | | | | | | | | |
| Shariff 2010 [39] | | | | | | - | | | | at 11 months |
| Youl 2007 [49] | | | | + | | + | | | | 6-month period |
| Argenziano 2006 [9] | | | | | | + | | | + | 16-month period |
| **Clinical diagnostic training programs** | | | | | | | | | | |
| Gulati 2015 [51] | | | | | | - | + | | | 8-month period |
| Peuvrel 2009 [36] | | + | | | | | + | | | 15-month period |
| De Gannes 2004 [27] | - | - | - | | | | | | | at 6 months |
| English 2003 [26] | | | | - | | | | | | 21-month period |
| Del Mar 1995 [20] | | | | + | | | | | | 24-month period |

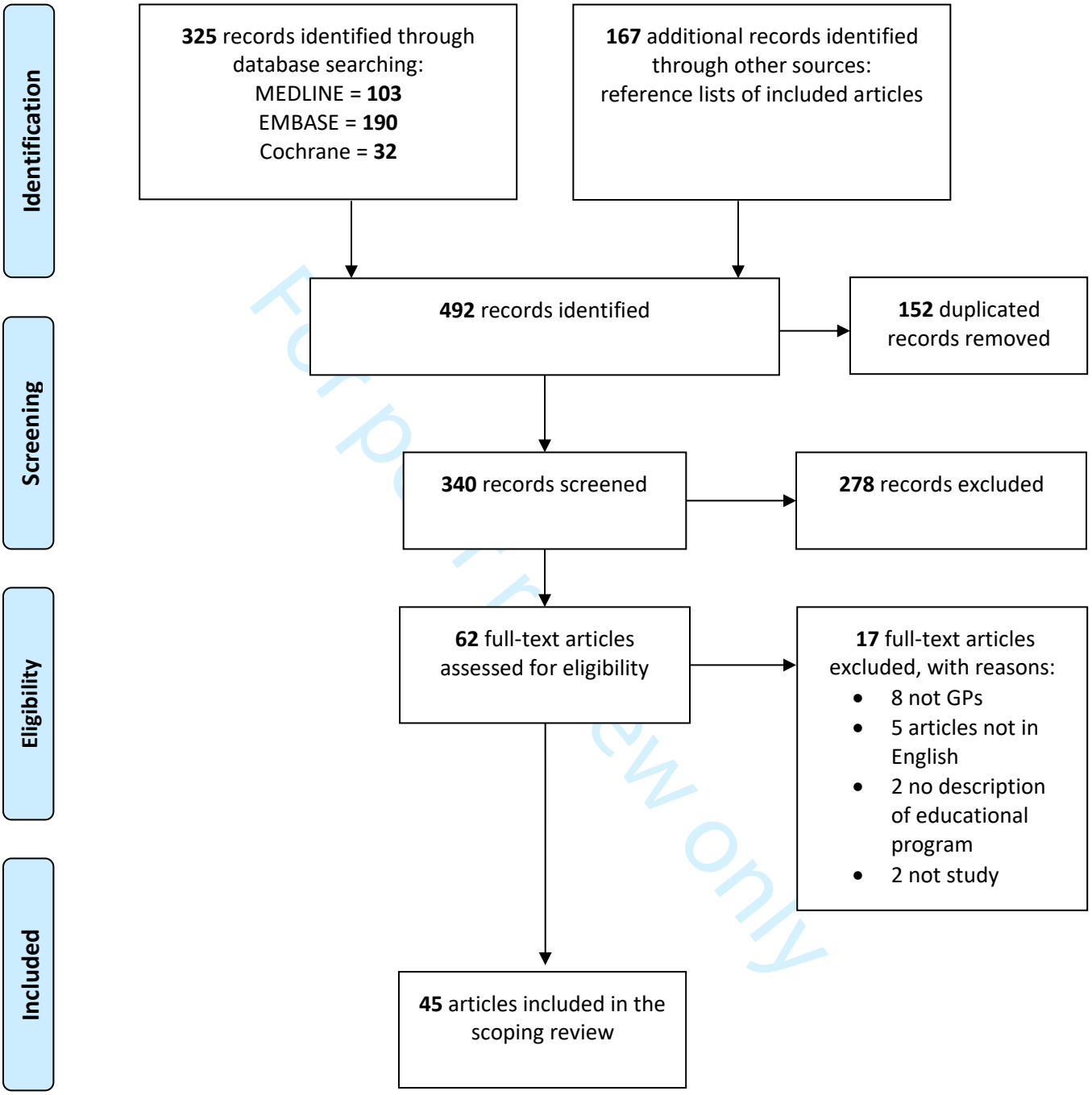
## C. Studies with short and long-term outcomes

| Studies | Measured competence in training setting | | | Timing after the training | | Measured performance in clinical setting | | | | | | Timing after the training | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | DA | Knowledge | AM | Immediately after | at 1-3 months | B/M lesion ratio | TBSE | DA | Confidence | Decrease of VTM incidence | RR | | | |
| **Dermoscopic diagnostic training programs** | | | | | | | | | | | | | | |
| Augustsson 2019 [53] | + | | | X | | | | | | | | at 6 months (here competence measure) | | |
| Badertscher 2015 [29] | + | | | X | | | | - | + | | | at 12 months | | |
| Koelink 2014 [10] | + | | + | X | | | | + | + | | | at 8 months | at 12 months | at 19 months |
| Eide 2013 [41] | + | + | + | X | | | | + | + | | + | at 6 months | | |
| Youl 2007 [49] | - | | | 3-month period | | + | | + | | | | 6-month period | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Raasch 2000 [23] | | | | | | | | | | | | |
| Grimaldi 2009 [38] | + | | | X | X | | | + | | | | 6-month period |
| Menzies 2009 [37] | + | | + | X | | + | | | | | + | 6-month period |
| **Clinical diagnostic training programs** | | | | | | | | | | | | |
| Marra, 2020 [54] | + | | | | X | | | + | + | | + | at 10 months |
| Grange 2013 [50] | + | + | | X | | | | | | + | | 3-year period |
| Markova 2013 [28] | | | | | | | - | | | | | at 12 months |
| Mikkilineni 2001; 2002 [42,43] | | + | + | X | | | | | | | | |

*Key: DA= diagnostic accuracy; AM=appropriate management; TBSE= total body skin examination; B/M=benign/malignant; VTM= very thick melanomas; RR= decrease in dermatologist referral rates for benign lesions and increase in referral rates for malignant lesions*
*+ = significant improvement; - = no significant improvement*
*To note that Shariff et al.[37] and Peuvrel et al.[34] provided only descriptive statistics of their study results. For the other studies, a P-value < 0.05 was considered significant, except for Grimaldi et al.[36] (P-value < 0.001).*

**Figure 1.** PRISMA flowchart of study selection process[17]



**Supplementary Table 1: Search strategies**

| Database | Search query | Limits | Filters | Results | Date |
|---|---|---|---|---|---|
| EMBASE | ('general practitioner'/exp OR 'gp (general practitioner)' OR 'family doctor' OR 'family physician' OR 'general practitioner' OR 'general practitioners' OR 'physicians, family' OR 'physicians, primary care' OR 'practitioner, general' OR 'primary care doctor' OR 'primary care physician' OR 'primary care physicians') AND ('education'/exp OR 'education' OR 'self-evaluation programmes' OR 'self-evaluation programs' OR 'training support') AND ('melanoma'/exp OR 'malignant melanoma' OR 'melanoma' OR 'nevi and melanomas' OR 'naevi and melanomas') AND ('diagnosis'/exp OR 'diagnosis' OR 'diagnostic tool') | none | none | 190 | 4 May 2020 |
| MEDLINE | "(""General Practitioners""[MeSH Terms] OR ""General Practice""[MeSH Terms] OR ""Family Practice""[MeSH Terms] OR ""physicians, primary care""[MeSH Terms]) AND ""Melanoma""[MeSH Terms] AND ""Diagnosis""[MeSH Terms])" | none | none | 103 | 27 April 2020 |
| Cochrane Library | melanoma in Title Abstract Keyword AND diagnosis in Title Abstract Keyword AND general practitioner in Title Abstract Keyword OR family medicine in Title Abstract Keyword AND dermoscopy in Title Abstract Keyword (Word variations have been searched) | none | none | 32 | 28 April 2020 |

## Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a scoping review. | **1** |
| **ABSTRACT** | | | |
| Structured summary | 2 | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | **2** |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | **4** |
| Objectives | 4 | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | **4** |
| **METHODS** | | | |
| Protocol and registration | 5 | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | **N.A.** |
| Eligibility criteria | 6 | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | **5** |
| Information sources* | 7 | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | **5-6** |
| Search | 8 | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | **6** |
| Selection of sources of evidence† | 9 | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. | **6** |
| Data charting process‡ | 10 | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | **6** |
| Data items | 11 | List and define all variables for which data were sought and any assumptions and simplifications made. | **Table 2** |
| Critical appraisal of individual sources of evidence§ | 12 | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | **5** |

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| Synthesis of results | 13 | Describe the methods of handling and summarizing the data that were charted. | 6 |
| **RESULTS** | | | |
| Selection of sources of evidence | 14 | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | **Figure 1** |
| Characteristics of sources of evidence | 15 | For each source of evidence, present characteristics for which data were charted and provide the citations. | **Table 3** |
| Critical appraisal within sources of evidence | 16 | If done, present data on critical appraisal of included sources of evidence (see item 12). | **N.A.** |
| Results of individual sources of evidence | 17 | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | **Table 3** |
| Synthesis of results | 18 | Summarize and/or present the charting results as they relate to the review questions and objectives. | **7-8** |
| **DISCUSSION** | | | |
| Summary of evidence | 19 | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | **9-10-11** |
| Limitations | 20 | Discuss the limitations of the scoping review process. | **12** |
| Conclusions | 21 | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | **13** |
| **FUNDING** | | | |
| Funding | 22 | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | **1** |

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.
* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).
‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

*From:* Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.

BMJ Open

# Training general practitioners in melanoma diagnosis: a scoping review of the literature.



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# Training general practitioners in melanoma diagnosis: a scoping review of the literature

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## Abstract

*Background*: General practitioners (GPs) play a key role in early melanoma detection. In order to help GPs deal with suspicious skin lesions, melanoma diagnostic training programs have been developed. However, it is unclear whether these programs guarantee the acquisition of skills that will be applied by GPs in their daily clinical practice and maintained over time.

*Objectives:* This scoping review aimed to examine and compare educational programs designed to train GPs in melanoma diagnosis using clinical (naked eye) examination alone or dermoscopy +/- clinical examination, and sought to inform on the long-term sustainability of the GPs' acquired skills.

*Eligibility criteria:* Studies eligible for inclusion evaluated educational programs for teaching diagnosis of melanoma to GPs. MEDLINE, EMBASE, and Cochrane databases were searched for relevant articles from 1995 to May 2020.

*Results*: Forty-five relevant articles were found assessing 31 educational programs. Most programs that improved the diagnostic accuracy and long-term performances of the GPs i.e., increase in confidence, decrease in dermatologist referral of benign skin lesions, and improvement of the benign/malignant ratio of excised skin lesions, trained the GPs in clinical diagnosis followed by dermoscopy. To maintain long-term performances, these programs provided refresher training material.

*Conclusion:* This review shows that studies generally report positive outcomes from the training of GPs in melanoma diagnosis. However, refresher training material seemed necessary to maintain the acquired skills. The optimal form and ideal frequency for these updates have yet to be defined.

## Strengths and limitations of the review

- Systematic review conducted following the guidelines of the PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) checklist.
- It thoroughly evaluates educational programs on melanoma diagnosis for general practitioners.
- Specifically, the review examines the long-term effect of the educational programs and the value of providing regular refresher training sessions after the training.
- This review led inevitably to some publication bias as only English language peer-reviewed articles were included.

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## Contributorship statement

E. Harkemanne developed the research protocol, completed the literature search and screened the articles for inclusion, extracted the data, synthesised the findings, interpreted the results and drafted the manuscript. M. Baeck screened the articles for inclusion, extracted data and critically revised the manuscript. I. Tromme developed the protocol, independently reviewed the articles for inclusion, extracted data, interpreted the results and critically revised the manuscript. All authors approved the final version.

## Data availability statement

All data relevant to the study are included in the article.

## Introduction

Early melanoma detection is essential to reduce morbidity and mortality of melanoma patients.[1] Given the increased incidence of this aggressive skin cancer, primary care physicians (PCPs) play a key role in early melanoma diagnosis.[2–4] PCPs include a number of health care professionals who provide first and continuing medical care to a patient. In this review, we focus on GPs who take care of patients in community settings and are, in most countries, the first point of contact for any patient with a health issue.

To improve the diagnostic accuracy of melanoma by GPs, specific educational training programs have been developed. At first, training courses focused on melanoma diagnosis by clinical (naked eye) examination alone. A systematic review[5], published in 2011, reported on 20 studies that evaluated 13 educational interventions in clinical melanoma diagnosis for PCPs. All the evaluated interventions improved diagnostic accuracy and melanoma management. Later, educational programs that included dermoscopy training were created and were then evaluated for primary care. To date, dermoscopy has been the most widely non-invasive *in vivo* technique used in clinical practice to assess skin tumors.[6] It involves the use of a handheld device which allows the observation of skin structures invisible to the naked eye. However, the sensitivity and specificity of the technique are operator-dependent (trained *vs.* untrained physicians).[7] Ninety-two percent sensitivity and 95% specificity can be achieved for melanoma diagnosis by a trained dermatologist combining visual inspection and *in vivo* dermoscopy.[8] In primary care, dermoscopy has also been shown to be an effective tool for the triage of suspicious pigmented skin lesions when performed by properly trained PCPs.[9,10] Yet, the minimum training required to reach competence is still unknown.[11]

Previously published reviews[5,11–14] on training programs in melanoma diagnosis for GPs focused on the content, teaching method, outcome measures and study-by-study efficacy of the evaluated educational interventions. However, they did not assess whether the GPs' acquired skills were measured in the short or long term. Yet, given the increasing burden of melanoma on general practice, it is crucial to know whether these programs are capable of teaching GPs easily applicable and sustainable skills in melanoma diagnosis and management. This scoping review aimed to explore educational programs training GPs in melanoma diagnosis using clinical (naked eye) examination alone and diagnosis using dermoscopy +/- clinical examination. Educational programs were examined with regard to training content, teaching

method, training duration, availability of refresher training material, and outcome measures. This review also specifically sought to inform on the long-term sustainability of the skills acquired during these training programs.

## Material and methods

To carry out this literature review, a scoping review seemed the most appropriate research method. Indeed, the studies we identified, which provided evidence on the efficacy of educational programs in melanoma diagnosis for GPs, showed a wide range of study designs and heterogeneous outcome measures. This observation made it impossible to formally assess the quality of these studies and to perform a meta-analysis leading to a narrative synthesis of our research results. To conduct this scoping review, the framework developed by Arksey and O'Malley,[15] subsequently refined by Levac,[16] and the guidelines of the PRISMA-ScR[17] (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) checklist were followed.

### Eligibility criteria

Studies eligible for inclusion in this review (Table 1) evaluated educational programs teaching either clinical diagnosis of melanoma and/or diagnosis using dermoscopy +/- clinical examination and designed primarily for PCPs including GPs. The population of interest included qualified GPs and GP trainees. Specialists and GPs working in hospital settings and/or specialized clinics were excluded. Studies that included training programs for PCPs other than GPs were not eligible. Studies where no participant training in melanoma diagnosis was proposed and studies evaluating exclusively non-melanoma skin cancer detection were also excluded. Studies evaluating teledermoscopy and computer-aided diagnosis of melanoma were not assessed as they do not require specific education in melanoma recognition by the participants. Only studies assessing the type of educational program and its short and/or the long-term efficacy on the skills acquired by the GPs were included. Finally, only peer-reviewed and English language articles were included.

### Data sources and study selection

MEDLINE, EMBASE, and Cochrane databases were searched for relevant articles published from 1995 to May 2020. Studies were selected for inclusion independently by three authors (EH, MB, and IT), with IT providing the final decision in the event of disagreement. The studies

were not assessed for bias, as the risk of bias assessment was reported as not applicable to scoping reviews in the 2018 PRISMA-ScR guidelines.[17]

To extensively cover the literature on the subject, four categories of terms were identified: (1) general practitioners, family doctor, general medicine, family practice, primary care physicians; (2) education, continuing medical education; (3) melanoma, malignant melanoma, cutaneous melanoma, skin neoplasms; (4) diagnosis, and cancer early detection. In MEDLINE, the following Medical Subject Headings (MeSH) were used: *general practitioners* OR *family practice* OR *primary care physicians* OR *general practice* AND *melanoma* AND *diagnosis.* No limits were defined. In EMBASE, Emtree terms were exploded: *general practitioner, family doctor, primary care, family physician, primary care physician, melanoma, diagnosis,* and *education*. In the Cochrane database, the following terms were searched: *melanoma* AND *diagnosis* AND *general practitioners* OR *family medicine* AND *dermoscopy* (see Supplementary Table 1 for search strategies). In addition, the reference lists of included studies were screened as a source of further relevant articles.

**Data extraction**

Two authors (EH and MB) reviewed all included articles and independently collected data. Extracted data included authors, year of publication, origin of the article, study design, number of participating GPs, type of educational program, type of outcome measures and short- and/or long-term evaluation of these outcomes. The type of educational program included training content, teaching method, training duration and refresher training material (if provided). To facilitate comparison with data found in previous reviews, all these data were reported into categories adapted from those presented by Fee *et al.*[14]

Table 2 gives the definition of the different categories. The training content was subdivided into six components: epidemiology, clinical diagnosis, clinical algorithm, dermoscopic diagnosis, dermoscopic algorithm and management. The teaching method was considered either as live, in the form of scientific literature, e-learning, or self-assessment. The refresher training material specified the material available for participants to refresh their skills after the training. The outcome measures were expressed either in terms of competence or in terms of performance, according to the assessment approach of continuing medical education programs proposed by Moore.[18] Finally, since the limits between short-term and long-term evaluation of a medical

educational program are not standardized, arbitrary limits have been chosen based on the observations made during this literature review.

### Patient and Public Involvement

No patient and public involvement was required for this review.

## Results

In total, 325 articles were identified from the electronic database searches, as shown in the PRISMA flowchart (Figure 1).[19] At the end of the study selection process, 45 relevant articles, which assessed 31 educational interventions, were included in the review analysis.

### Study designs

Thirty-six interventional studies with a range of study designs were found: 11 randomized controlled trials (RCTs)[9,10,20–25,26–29], 19 diagnostic accuracy studies[30–35,36–40,41–48], three cohort studies[49–51] and three case-control studies.[52–54] Five of the 31 training programs were assessed twice.[25,26,28,32,49]

Four systematic reviews were identified: one on the training of PCPs in clinical melanoma diagnosis,[5] two on the training of PCPs in dermoscopy for melanoma diagnosis,[12,13] and one on the use of dermoscopy in primary care.[11] A scoping review on the training of PCPs in dermoscopy[14] was also included. The final three articles were descriptive articles of the educational programs and study protocols.[55–57]

### Educational programs

The educational programs in melanoma diagnosis for GPs varied in terms of content, teaching method and outcome measures. The characteristics of these training programs are summarized in Table 3.

*Training content*

Of the 31 educational programs, 15 involved the training of GPs in clinical diagnosis, five involved dermoscopic diagnosis alone, and 11 involved the training of GPs in both of these melanoma diagnostic methods. Twelve (80%) of the clinical diagnostic training programs also involved learning of epidemiology and 11 (73%) learning of management guidelines for

suspicious lesions. Only seven (47%) programs teaching clinical diagnosis used an algorithm to teach melanoma recognition, with the ABCD(E) rule[58] (Asymmetry, uneven Borders, uneven Colors, Diameter > 6mm, and Evolution) being most commonly taught. Of the dermoscopic training programs, 12 (80%) included learning of at least one dermoscopic algorithm (Menzies' method,[24,35,37,40] Three-point checklist,[9,40,41] the 7-point checklist,[10,35] TADA,[44,47] the ABCD rule,[35,38] BLINCK,[40] and pattern analysis[35,54]). The Menzies' method,[59] the ABCD rule,[60] pattern analysis and the 7-point checklist[61] were designed originally for trained physicians, and were later tested as effective when used by non-experts.[62] Other algorithms, such as the Three-point checklist[63] and the Triage Amalgamated Dermoscopic Algorithm (TADA)[44] were initially created for use by PCPs. In addition, two educational programs included training on other diagnostic tools, such as sequential digital dermoscopy imaging[37] and polaroid instant camera photography.[26]

*Teaching method, training duration and refresher training material*

Live training courses and the use of educational books, posters or videos (literature) were the two preferred teaching methods of clinical diagnostic training programs. Five training programs also used an e-learning approach.[25,28,30,51,53] The most common teaching method used in dermoscopic training programs was live training. This approach was combined with literature and/or e-learning in six programs. Three programs also used self-assessment. Overall, the teaching method did not appear to have influenced the program outcomes. Duration of training varied from 75 minutes to 1 day, was not specified in two studies[31,40], and was participant dependent in six studies using self-assessment methods. Six dermoscopic diagnostic training programs[29,37,38,41,49,54] and three programs in clinical diagnosis[27,36,50] provided regular refresher training material such as unlimited e-learning access or self-assessment training sessions.

*Training outcomes*

Table 4 summarizes the outcome measures of the studies. In the selected studies, the GPs' competences were generally measured in the short term and their performances measured in the long term after the training.

Eight clinical diagnostic training programs and seven dermoscopic training programs only assessed the short-term efficacy of their program (Table 4A). For these studies, the competences most often evaluated were diagnostic accuracy and appropriate management measured in a training setting. The most evaluated short-term performance, measured in a clinical setting, was

the GPs' confidence in diagnosing melanoma. With the exception of two studies, all showed a positive impact of their intervention.[21,23] Four clinical diagnostic training programs and three dermoscopic training programs (one teaching dermoscopy alone[54]) only assessed long-term performances (Table 4B). The most evaluated long-term performances, measured in daily clinical practice, were the GPs' diagnostic accuracy and the benign/malignant ratio of excised lesions. Three studies[9,36,49] reported improvement of the GPs' performances in melanoma diagnosis. The other studies reported no improvement.

Finally, three clinical diagnostic and seven dermoscopic training programs assessed the short- and long-term outcome of their training (Table 4C). Except for one,[23] all these training programs demonstrated improvement of the GPs' competences, measured in a training setting in the short term. In the long term, eight training programs[10,37,38,41,49,50,53,54] reported significant improvement of the GPs' performances for the diagnosis of melanoma and benign skin lesions. This led to either a decrease in the referral rates to dermatologists[37,41,53] and/or a decrease in the ratio of benign/malignant excised skin lesions.[37,49] Among the major studies, Koelink *at al.*[10] found that their dermoscopic training program improved the GPs' long-term performances with up to 1.25 times greater diagnostic accuracy for skin lesions including melanomas. In a French department, Grange *et al.*[50] observed an impressive reduction of the incidence of advanced melanomas (Breslow thickness ≥ 3 mm) during the 3-year period after their GP training campaign in clinical melanoma diagnosis. A very recent study by Marra *et al.,*[53] assessing 1662 referrals, reported better quality of referrals by GPs trained in melanoma diagnosis than by untrained GPs, potentially leading to less unnecessary referrals. However, two educational programs[28,29] were unable to maintain the GPs' acquired performances in the long term.

## Discussion

This scoping review aimed to explore educational programs training GPs in melanoma diagnosis using clinical (naked eye) examination alone and diagnosis using dermoscopy +/- clinical examination. Educational programs were examined with regard to training content, teaching method, training duration, availability of refresher training material, and outcome measures. This review also specifically sought to inform on the long-term sustainability of the skills acquired during these training programs.

**Types of educational programs with positive long-term outcomes**

Most reported educational programs that improved long-term diagnostic accuracy and changed GPs' melanoma practice patterns trained their participating GPs in dermoscopy combined with clinical diagnosis. This teaching method is supported by a recent Cochrane review[8] in which dermoscopy alone was found to be less accurate than clinical examination followed by dermoscopy for the diagnosis of melanoma. The Cochrane review results also suggested that dermoscopic algorithms were the most useful method to train non-experts in dermoscopy. In our review, we found that five of the programs with long-term positive impact used dermoscopic algorithms to teach melanoma diagnosis.[10,37,38,41,54]

Unfortunately, the substantial number of training hours necessary to become competent in dermoscopy is the main reported factor limiting its use in general practice.[64,65] At this time, there is no evidence on the optimal length of training, even though it has been demonstrated that diagnostic accuracy of dermoscopy depends on the degree of training of the practitioner.[66] One study suggested that 1 day of live training in dermoscopy was sufficient to build the confidence of GPs with special interest in melanoma diagnosis.[67] We found two RCTs that demonstrated sustained improvement of GPs' diagnostic accuracy, both of which proposed live training in dermoscopy over 1 day or 10 hours.[9,10] Because the duration of training in dermoscopy is a limiting factor for most GPs, it is important to keep in mind that training in clinical melanoma diagnosis has also been shown to improve the GPs' performances while requiring less training time (in this review, a mean duration of 2.5 hours was observed for clinical diagnostic training programs).[36,50]

However, we found that educational programs teaching dermoscopy have been more likely to assure positive long-term outcomes than programs teaching clinical examination alone. One of the reasons could be that the latter used measures of performance such as GPs' confidence level and number of total-body skin examinations performed before and after training, which did not reflect GPs' diagnostic ability in clinical practice. On the one hand, measuring the confidence of GPs in their own ability to diagnose melanoma is more useful in assessing the quality of a training program than evaluating skills acquired by participants. From a pedagogical point of view, participants feel more confident when they know how to use the teaching content in daily practice but this does not define their true diagnostic competence.[18] On the other hand, the number of total-body skin examinations performed may be useful in measuring GPs' awareness of skin tumours, but not for evaluation of GPs' diagnostic skills.

**Long-term improvement of the GPs' performances in clinical settings**

The GPs' long-term performances measured in clinical settings were assessed for 15 educational programs: six in clinical diagnosis and nine in dermoscopic diagnosis. Ten showed a positive impact on the GPs' performances measured over periods ranging from 6 to 19 months. The most frequent observations were a decrease of referral rates to dermatologists for benign skin lesions and an improvement of the benign/malignant ratio of excised skin lesions. The INFORMED group[41] reported an increase in melanoma diagnosis during a screening campaign by GPs trained with their program in 2016.[68] Furthermore, a decrease of the incidence of advanced melanomas was shown in a French department over a 3-year period after their training program in clinical melanoma diagnosis.[50] Unfortunately, two educational programs[28,29] failed to maintain the GPs' acquired performances at 1 year after the end of the training. The reasons might be that Markova *et al.*[28] chose to assess the number of total-body skin examinations performed but did not evaluate the GPs' diagnostic accuracy and that Badertscher *et al.*[29] trained their GPs to use Lumio®, a polarized magnifying glass with 2x magnification instead of a standard dermoscopy device (10x magnification).

To retain acquired diagnostic skills over the long term, results of a recent RCT suggested the need for "refresher sessions at regular intervals".[69,70] In our review, nine (60%) educational programs evaluated in the long-term provided refresher training material. Seven of these programs were successful. In 2014, Grange *et al.*[50] produced a CD-ROM containing their teaching material and sent regular information about melanoma to the GPs. The INFORMED group[41] provided GPs with a free unlimited access to their web-based course. Menzies *et al.*[37] gave participating GPs an educational textbook and an unlimited e-learning access. Grimaldi *et al.*[38] and Youl *et al.*[49] also ensured self-assessment refresher training sessions. Marra *et al.*[53] found a 10-month sustainability of the diagnostic accuracy of their trained GPs and assumed that daily use of the obtained knowledge during the study period achieved this effect. Only Koelink et al.,[10] who evaluated the longest post-training period (19 months) and who demonstrated sustainability of diagnostic skills, did not specify whether update training modalities were provided.

However, the ideal frequency and form of updates have never been studied. An RCT, taking place in the English National Defibrillator Programme, determined that update session intervals after a medical education session should not exceed 7 months to limit the loss of acquired skills and maintain the participants confidence.[71] In the UK, a survey among GPs with special interest

in dermatology stated that self-assessment learning was the most popular for refresher sessions.[67] Nevertheless, they also showed that 36% of GPs that use dermoscopy in their clinical practice reported to have never updated their training skills. We found that the most appreciated form of self-assessment updates was the unlimited access to an e-learning course. In the future, this enthusiasm for online training could lead to the development of smartphone applications to train GPs in melanoma diagnosis. Some newly developed applications have currently been evaluated among medical students[72] and dermatology residents.[73] Initial results already looked very promising.

Finally, the variability of refresher training material provided in the educational programs and the heterogeneity of outcome measures did not allow more robust conclusions to be drawn on the most beneficial training modality for sustainable improvements in GPs' diagnostic skills.

## Limitations

This scoping review has some limitations and led inevitably to certain publication biases. We used keywords for the selection of articles and only peer-reviewed articles were included. By limiting our research to English language articles, some studies may also have been missed. It is also very likely that melanoma diagnostic training programs exist in unpublished forms, for example in university continuing medical education programs. Moreover, we focused only on studies assessing melanoma diagnostic training methods among GPs. Therefore, we may have failed to mention some educational programs for primary care in this review. Furthermore, educational programs which were not evaluated in studies were overlooked. Finally, this review covers educational programs over a 25-year period. As technology has evolved considerably over this time, some teaching methods and refresher training materials have been overshadowed by interactive online tutorials (e-learning) - all the more so with the health crisis caused by COVID-19 during which distance learning methods have developed very rapidly.

## Conclusion

In conclusion, educational programs trained GPs in melanoma diagnosis using clinical examination alone or dermoscopy +/- clinical diagnosis. Most reported programs that improved the long-term diagnostic accuracy and changed routine performances of the GPs (i.e., decrease in dermatologist referral of benign skin lesions, and improvement of the benign/malignant ratio of excised skin lesions), trained their participating GPs in both diagnostic methods. The

preferred teaching methods were live and e-learning but the teaching method did not seem to influence the GPs' acquired performances. It is important to note that the educational programs that achieved long term sustainability of GPs' performances in daily clinical practice provided refresher training material. However, no conclusions on the most beneficial training modality to sustainably improve GPs' diagnostic skills could be drawn given the heterogeneity of outcome measures and study designs. Therefore, the optimal form and ideal frequency of these updates have yet to be defined.

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**Table 1. Inclusion and exclusion criteria for article selection**

| **Inclusion criteria:** |
|---|
| **Articles**<br>• Articles written in English<br>• Study articles and descriptive articles of educational programs<br>**Population**<br>• Qualified GPs and GP trainees working in community settings<br>**Intervention**<br>• Studies evaluating educational programs in clinical (naked eye) diagnosis and/or diagnosis of melanoma using dermoscopy<br>**Outcome(s)**<br>• Studies assessing the type of educational program and its short and/or the long-term efficacy on the skills acquired by the GPs |
| **Exclusion criteria:** |
| **Articles**<br>• Articles not subject to peer review and written in languages other than English<br>**Population**<br>• Studies involving specialists, medical students, non-GPs, GPs working in hospital settings and/or specialized skin cancer clinics<br>**Intervention**<br>• Studies evaluating exclusively nonmelanoma skin cancer<br>• Teledermoscopy studies<br>• Studies on computer-aided diagnosis of melanoma<br>**Outcome(s)**<br>• No method of measuring outcomes was ruled out |

*Key: GPs= general practitioners*

**Table 2. Definition of study categories**

| Criteria | Categories | Definition |
|---|---|---|
| **Training content** | Epidemiology | Background information on rates of melanoma cancer, risk factors, localization and evolution of melanomas |
| | Clinical diagnosis | Naked eye melanoma recognition |
| | Clinical algorithm | Use of a pre-existing algorithm as a learning tool to aid for clinical diagnosis |
| | Dermoscopic diagnosis | Recognition of melanoma using dermoscopy |
| | Dermoscopic algorithm | Use of an algorithm as a learning tool to aid for dermoscopic diagnosis |
| | Management | Determination of a plan of action for a skin lesion i.e. reassurance, follow-up, or lesion excision |
| **Teaching method** | Live | Presentation by a speaker to a group of participants |
| | Scientific literature | Use of educational books, posters, letters, CD-ROMs or videos |
| | E-learning | Interactive online tutorials including audio and visual information |
| | Self-assessment | Learning by the participant himself using educational material |
| **Refresher training material** | Teledermatology feedback | Feedback from a dermatologist on the image and clinical history of a suspicious lesion at a distance, using remote internet-based technologies |
| **Outcome measures** | Competences | Acquired skills, which are evaluated in a training setting on clinical and/or dermoscopic photographs of skin lesions |
| | Diagnostic accuracy | Ability of the participants to discriminate between melanoma and benign lesions |
| | Knowledge | Report of conceptual understanding |
| | Appropriate management | Determination of the right plan of action for a skin lesion |
| | Performances | Changes in real-life practice measured in a clinical setting, i.e. changes in the benign/malignant ratio of excised lesions, the number of total-body skin examinations performed, confidence of the GPs, changes in referral rates to a dermatologist, and decrease in the incidence of advanced melanomas |
| **Evaluation** | Short-term | Measurement of outcomes immediately or up to 3 months after the training |
| | Long-term | Measurement of outcomes at $\geq$ 6 months after the training |

**Table 3. Characteristics of educational programs in melanoma diagnosis for general practitioners**

| Article | Study design | Study participants | Training content | | | | | | Teaching method | Training duration | Refresher training material |
|---|---|---|---|---|---|---|---|---|---|---|---|
| author, year, location[ref] | | | Epidemiology | Clinical diagnosis | Clinical algorithm | Dermoscopic diagnosis | Dermoscopic algorithm | Management | | | |
| Marra, 2020, The Netherlands[53] | Case-control study | 185 (83; 102)* | | X | | X (optional) | | X | e-learning | 2h | |
| Sawyers, 2020, Canada[48] | DA study | 33 GPs | | | | X | TADA step-I | | Live | 3.5h | |
| Augustsson, 2019, Sweden[54] | Case-control study | 43 GPs (27;16)* | | | | X | Pattern analysis | | Live | 1-day | PDF-files of the course |
| Seiverling,2019, USA[47] | DA study | 59 GPs | | X | | X | TADA | | Live | 75min | |
| Beecher, 2018, Ireland[46] | DA study | 23 GP trainees | X | X | | | | X | Live, Literature | 1h | |
| Secker, 2017, The Netherlands[45] | DA study | 293 PCPs including ? GPs | | X | | X | | X | Live, Literature and E-learning | 1-day | |
| Rogers, 2016, USA[44] | DA study | 16 GPs | | | | X | TADA | | Live | 1-day | |
| Badertscher, 2011 and 2015, Switzerland[56,29] | RCT | 78 GPs (39;39)* | | X | | Lumio® | | | Live | 1-day | Teledermatology feedback |
| Gulati, 2015, UK[51] | Cohort study | 967 GPs | X | X | | | | X | E-learning | PD | |
| Koelink, 2014, The Netherlands[10] | RCT | 53 GPs | X | X | | X | 7-point checklist | | Live | 4h clinical diagnosis; 6h dermoscopy | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Grange, 2013, France[50] | Cohort study | 398 GPs | X | X | | | | | Live, Literature | 2.5h | CD-ROM+ regular information sheets |
| Markova, 2013, USA[28]<br>Mikkilineni, 2001 and 2002, USA[42,43] (Weinstock 1996)[57] | RCT<br><br>DA study | 46 GPs (20;26)*<br><br>7 GPs | <br><br>X | <br><br>X | ABCD(E) | | | X | E-learning<br><br>Live Literature | <br><br>2h | |
| Eide, 2013,[41] (Shaikh, 2012)[55] INFORMED | DA study | 54 PCPs including 9 GPs (20%) | X | X | ABCD(E) + Ugly duckling sign | X | Three-point checklist | X | E-learning, Self-assessment | 2h web-based learning | Unlimited e-learning access |
| Bourne, 2012, Australia[40] | DA study | 3 GPs | | X | | X | BLINCK Three-point checklist Menzies method | | Live, Literature | UD | |
| Shariff, 2010, UK[39] | DA study | 94 GPs | | X | | | | | Literature | PD | |
| Grimaldi, 2009, Italy[38] | DA study | 13 GPs | | X | | X | ABCD rule | | Live, E-learning, Self-assessment | PD | Self-assessment e-learning training sessions |
| Menzies, 2009, Australia[37] | DA study | 63 GPs | | X | | Yes + Sequential digital dermoscopy | Menzies method | | Live, Literature, E-learning | 2h-workshop | Unlimited e-learning access |
| Peuvrel, 2009, France[36] | DA study | 210 GPs | X | X | ABCD(E) | | | X | Live, Literature (CD-ROM) | 2h | CD-ROM |
| Youl, 2007, Australia[49] | Cohort study | 16 GPs | <br><br>X | <br><br>X | <br><br>ABCD(E) | <br><br>X | | X | <br><br>Literature | <br><br>PD | Self-assessment paper-based training sessions |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Raasch, 2000, Australia[23] | RCT | 46 GPs (23;23)* | | | | | | | | | |
| Argenziano, 2006, Italy and Spain[9] | RCT | 73 GPs (36;37)* | | X | ABCD | X | Three-point checklist | | Live | 1-day | |
| Dolianitis, 2005, Australia[35] | DA study | 35 GPs | | | | X | Menzies method 7-point checklist ABCD rule Pattern analysis | | Literature, E-learning, Self-assessment | PD | |
| Carli, 2005, Italy[34] | DA study | 41 GPs | X | X | ABCD(E) | | | X | Live | 4h | |
| De Gannes, 2004, Canada[27] | RCT | 27 GPs (10;17)* | X | X | | | | | Literature (Video-format) | 12min | Unlimited access to the 12-minute Video |
| English, 2003, Australia[26]<br><br>Del Mar,1995, Australia[20] | RCT<br><br>RCT | 468 GPs (245;228)*<br><br>93 GPs (48;45)* | | X + Polaroid instant camera | | | | X | Literature | >6h<br><br>1h | |
| Brochez, 2001, Belgium[33] | DA study | 146 GPs | X | X | | | | X | Live, Literature | 2h | |
| Harris, 1999 and 2001, USA[30,32] | DA study | 232 GPs<br><br>17 GPs | X | X | ABCD 7-point Glasgow checklist | | | X | Literature, E-learning | 1h | |
| Westerhoff, Australia 2000[24] | RCT | 74 GPs | | | | X | Menzies method | | Live, Literature | 1h live | |
| Bedlow, 2000, UK[31] | DA study | 17 GPs | | X | | | | | Live, Literature | UD | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Gerbert, 1998 and 2002, USA[22,25] | RCT | 52 GPs (26;26)* | X | X | | | | X | Live, Literature, E-learning | >3h | |
| Dolan, 1997, USA[21] | RCT | 82 PCPs including 16 GPs (46;36)* | X | X | | | | | Live | 2h | |
| Girgis, 1995, Australia[52] | Case-control study | 41 GPs (24;17)* | X | X | | | | X | Live, literature | >6h | |

*Key: GPs=general practitioners; PCPs= primary care physicians; RCT= randomized controlled trial; DA= diagnostic accuracy; INFORMED= Internet curriculum for melanoma early detection; PD= participant dependent; UD=undisclosed; TADA=triage amalgamated dermoscopic algorithm*
**number of participants in the intervention group and control group*

**Table 4. Outcome measures of the melanoma diagnostic educational programs for general practitioners.**

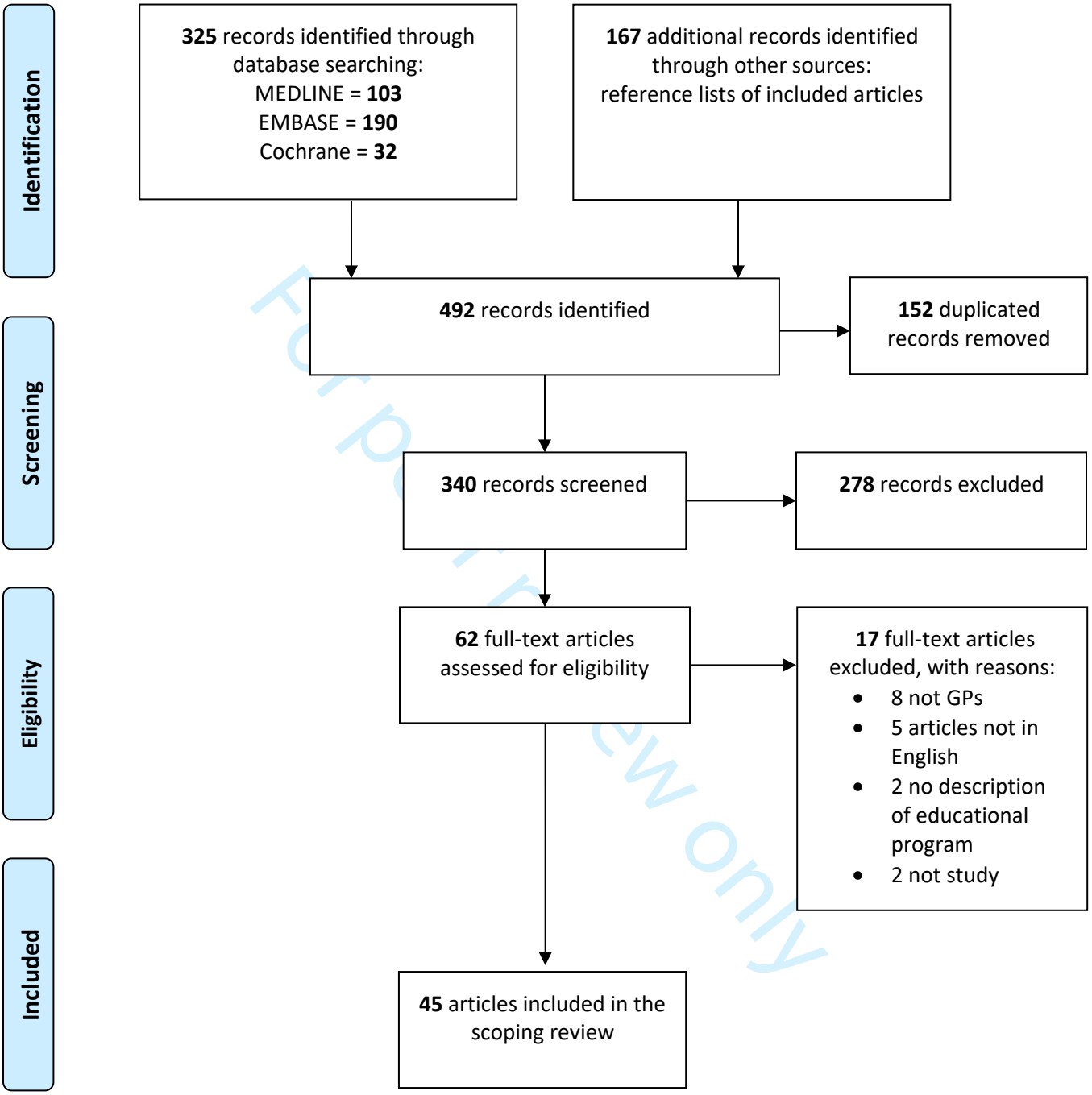
| **A. Studies with short-term outcomes** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Studies** | **Measured competence in training setting** | | | **Measured performance in clinical setting** | | | | | | **Timing after the training** | | |
| (1st author and year of publication) | **DA** | **Knowledge** | **AM** | **B/M ratio** | **TBSE** | **DA** | **confidence** | **Decrease of VTM incidence** | **RR** | **immediately** | **at 1 month** | **at 3 months** |
| **Dermoscopic diagnostic training programs** | | | | | | | | | | | | |
| Sawyers 2020 [48] | + | | | | | | | | | X | | |
| Seiverling 2019 [47] | + | | | | | | | | | X | | |
| Secker 2017 [45] | + | | + | | | | | | | | | X |
| Rogers 2016 [44] | + | | | | | | | | | X | | |
| Bourne 2012 [40] | + | | | | | | | | | X | | |
| Dolianitis 2005 [35] | + | | | | | | | | | X | | |
| Westerhoff 2000 [24] | + | + | | | | | | | | X | | |
| **Clinical diagnostic training programs** | | | | | | | | | | | | |
| Beecher, 2018 [46] | + | + | + | | | | | | | X | | X |
| Carli 2005 [34] | + | | + | | | | | | | X | | |
| Mikkilineni 2001;2002 [42,43] | | + | + | | + | | + | | | X | | |
| Brochez 2001 [33] | + | | | | | | | | | X | | |
| Harris 2001 [32]<br><br>Harris 1999 [30] | +<br><br>+ | +<br><br>- | +<br><br>+ | | | | +<br><br>+ | | | X<br><br>X | | |
| Raasch 2000 [23] | - | | | | | | + | | | 3-month period | | |
| Bedlow 2000 [31] | + | + | | | | | | | | X | | |
| Gerbert 1998;2002 [22,25] | + | + | + | | | | + | | | X | | |
| Dolan 1997 [21] | - | + | - | | | | | | | X | X | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Girgis 1995 [52] | - | + | | | | | + | | | X | | X |
| **B. Studies with long-term outcomes** | | | | | | | | | | | | |
| **Studies** | **Measured competence in training setting** | | | **Measured performance in clinical setting** | | | | | | **Timing after the training** | | |
| | **DA** | **Knowledge** | **AM** | **B/M ratio** | **TBSE** | **DA** | **Confidence** | **Decrease of VTM incidence** | **RR** | | | |
| **Dermoscopic diagnostic training programs** | | | | | | | | | | | | |
| Shariff 2010 [39] | | | | | | - | | | | at 11 months | | |
| Youl 2007 [49] | | | | + | | + | | | | 6-month period | | |
| Argenziano 2006 [9] | | | | | | + | | | + | 16-month period | | |
| **Clinical diagnostic training programs** | | | | | | | | | | | | |
| Gulati 2015 [51] | | | | | | - | + | | | 8-month period | | |
| Peuvrel 2009 [36] | | + | | | | | + | | | 15-month period | | |
| De Gannes 2004 [27] | - | - | - | | | | | | | at 6 months | | |
| English 2003 [26] | | | | - | | | | | | 21-month period | | |
| Del Mar 1995 [20] | | | | + | | | | | | 24-month period | | |
| **C. Studies with short and long-term outcomes** | | | | | | | | | | | | |
| **Studies** | **Measured competence in training setting** | | | **Timing after the training** | | **Measured performance in clinical setting** | | | | | **Timing after the training** | |
| | **DA** | **Knowledge** | **AM** | **Immediately after** | **at 1-3 months** | **B/M ratio** | **TBSE** | **DA** | **Confidence** | **Decrease of VTM incidence** | **RR** | |
| **Dermoscopic diagnostic training programs** | | | | | | | | | | | | |
| Augustsson 2019 [54] | + | | | X | | | | | | | | at 6 months (here competence measure) |
| Badertscher 2015 [29] | + | | | X | | | | - | + | | | at 12 months |
| Koelink 2014 [10] | + | | + | X | | | | + | + | | | at 8 months / at 12 months / at 19 months |
| Eide 2013 [41] | + | + | + | X | | | | + | + | | + | at 6 months |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Youl 2007 [49]<br>Raasch 2000 [23] | - | | | 3-month period | | + | | + | | | | 6-month period |
| Grimaldi 2009 [38] | + | | | X | X | | | + | | | | 6-month period |
| Menzies 2009 [37] | + | | + | X | | + | | | | | + | 6-month period |
| **Clinical diagnostic training programs** | | | | | | | | | | | | |
| Marra, 2020 [53] | + | | | | X | | | + | + | | + | at 10 months |
| Grange 2013 [50] | + | + | | X | | | | | | + | | 3-year period |
| Markova 2013 [28]<br>Mikkilineni 2001; 2002 [42,43] | | + | + | X | | | - | | | | | at 12 months |

*Key: DA= diagnostic accuracy; AM=appropriate management; TBSE= total body skin examination; B/M=benign/malignant; VTM= very thick melanomas; RR= decrease in dermatologist referral rates for benign lesions and increase in referral rates for malignant lesions*
*+ = significant improvement; - = no significant improvement*
*To note that Shariff et al.[37] and Peuvrel et al.[34] provided only descriptive statistics of their study results. For the other studies, a P-value < 0.05 was considered significant, except for Grimaldi et al.[36] (P-value < 0.001).*

**Figure 1.** PRISMA flowchart of study selection process[17]



**Supplementary Table 1: Search strategies**

| Database | Search query | Limits | Filters | Results | Date |
|---|---|---|---|---|---|
| EMBASE | ('general practitioner'/exp OR 'gp (general practitioner)' OR 'family doctor' OR 'family physician' OR 'general practitioner' OR 'general practitioners' OR 'physicians, family' OR 'physicians, primary care' OR 'practitioner, general' OR 'primary care doctor' OR 'primary care physician' OR 'primary care physicians') AND ('education'/exp OR 'education' OR 'self-evaluation programmes' OR 'self-evaluation programs' OR 'training support') AND ('melanoma'/exp OR 'malignant melanoma' OR 'melanoma' OR 'nevi and melanomas' OR 'naevi and melanomas') AND ('diagnosis'/exp OR 'diagnosis' OR 'diagnostic tool') | none | none | 190 | 4 May 2020 |
| MEDLINE | "(""General Practitioners""[MeSH Terms] OR ""General Practice""[MeSH Terms] OR ""Family Practice""[MeSH Terms] OR ""physicians, primary care""[MeSH Terms]) AND ""Melanoma""[MeSH Terms] AND ""Diagnosis""[MeSH Terms])" | none | none | 103 | 27 April 2020 |
| Cochrane Library | melanoma in Title Abstract Keyword AND diagnosis in Title Abstract Keyword AND general practitioner in Title Abstract Keyword OR family medicine in Title Abstract Keyword AND dermoscopy in Title Abstract Keyword (Word variations have been searched) | none | none | 32 | 28 April 2020 |

**Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist**

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a scoping review. | **1** |
| **ABSTRACT** | | | |
| Structured summary | 2 | Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives. | **2** |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach. | **4** |
| Objectives | 4 | Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives. | **4** |
| **METHODS** | | | |
| Protocol and registration | 5 | Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number. | **N.A.** |
| Eligibility criteria | 6 | Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale. | **5** |
| Information sources* | 7 | Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed. | **5-6** |
| Search | 8 | Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated. | **6** |
| Selection of sources of evidence† | 9 | State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review. | **6** |
| Data charting process‡ | 10 | Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators. | **6** |
| Data items | 11 | List and define all variables for which data were sought and any assumptions and simplifications made. | **Table 2** |
| Critical appraisal of individual sources of evidence§ | 12 | If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate). | **5** |

| SECTION | ITEM | PRISMA-ScR CHECKLIST ITEM | REPORTED ON PAGE # |
|---|---|---|---|
| Synthesis of results | 13 | Describe the methods of handling and summarizing the data that were charted. | 6 |
| **RESULTS** | | | |
| Selection of sources of evidence | 14 | Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram. | **Figure 1** |
| Characteristics of sources of evidence | 15 | For each source of evidence, present characteristics for which data were charted and provide the citations. | **Table 3** |
| Critical appraisal within sources of evidence | 16 | If done, present data on critical appraisal of included sources of evidence (see item 12). | **N.A.** |
| Results of individual sources of evidence | 17 | For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives. | **Table 3** |
| Synthesis of results | 18 | Summarize and/or present the charting results as they relate to the review questions and objectives. | **7-8** |
| **DISCUSSION** | | | |
| Summary of evidence | 19 | Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups. | **9-10-11** |
| Limitations | 20 | Discuss the limitations of the scoping review process. | **12** |
| Conclusions | 21 | Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps. | **13** |
| **FUNDING** | | | |
| Funding | 22 | Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review. | **1** |

JBI = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.
* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.
† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).
‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.
§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

*From:* Tricco AC, Lillie E, Zarin W, O'Brien KK, Colquhoun H, Levac D, et al. PRISMA Extension for Scoping Reviews (PRISMAScR): Checklist and Explanation. Ann Intern Med. 2018;169:467–473. doi: 10.7326/M18-0850.