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## **Melanoma risk assessment and management: a qualitative study among Australian general practitioners**

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## **Abstract**

### **Background**

Preventive guidelines for melanoma recommend that patients at high risk of melanoma receive targeted screening; however, this requires careful selection of those at high risk. There has been no previous research into how physicians approach the selection and management of high-risk individuals. Melanoma risk prediction models are available to assist in the identification of high-risk patients but are not routinely used clinically.

### **Aim**

To examine how general practitioners (GPs) assessed and managed melanoma risk, and the opportunities for using melanoma risk prediction models in primary care.

### **Design and Setting**

Semi-structured telephone interviews were conducted with 20 Australian GPs.

### **Method**

We purposively sampled and recruited from GPs who had completed a cross-sectional online questionnaire study on melanoma risk. Semi-structured telephone interviews were conducted with Australian GPs between July 9 and September 10, 2019. Interviews were audio-recorded, professionally transcribed, and analysed using grounded theory.

### **Results**

We found that melanoma risk assessment and its management can be understood as a linear workflow consisting of five clinical process domains with patient selection as the entry point. There was variation between physicians on the identification of melanoma risk factors, melanoma risk estimation, management and patient education due to intuitive and analytical processes guiding risk assessment, and the influence of patient factors. GPs were largely receptive towards melanoma risk prediction models, sharing facilitators and barriers to their potential implementation.

## **Conclusions**

Further primary care interventions sensitive to existing workflow arrangements may be required to standardise melanoma risk assessment and management processes.

## **Keywords**

Melanoma

Risk assessment

General practitioners

## **How this fits in**

Preventive guidelines for melanoma recommend that patients at high risk of melanoma receive targeted screening; however, this requires careful selection of those at high-risk. Our study indicates there is variation in how GPs assess and manage melanoma risk across five clinical process domains, with greatest variation among GP participants on how they estimated overall melanoma risk. Further interventions may be required to standardise these processes. If melanoma risk prediction models are to be used within primary care, it will need to be sensitive to the host setting and the clinical workflow within it.

## Introduction

Melanoma is preventable. However, incidence rates continue to increase among fair-skinned populations despite long-standing public education programs.(1-3) Population-wide screening for melanoma is not supported by the current evidence.(4, 5) There is agreement across guidelines that patients who are at high risk of melanoma should be identified and receive targeted screening. Yet, there is poor agreement on what constitutes “high risk”.(6-8)

In Australia, where melanoma incidence is the highest in the world, general practitioners (GPs) play a critical role in reducing melanoma burden by identifying those patients at high risk, and in managing the majority of initial diagnoses.(9-12) Clinical guidelines recommend a risk stratified approach to melanoma prevention.(12) These guidelines stratify patients into risk levels based on the presence of individual melanoma risk factors. People at average risk receive primary preventive advice, those at increased risk receive primary preventive advice and opportunistic skin checks with a physician, and those at high risk (relative risk > 6) receive preventive advice, advice on self-skin-checks, and at least annual skin checks with a physician.(12)

Melanoma risk prediction models may assist in the accurate identification of high-risk patients by estimating an individual’s overall melanoma risk based on the combination of risk factors present,(13) with some models showing good discrimination on external validation.(14, 15) However, current guidelines do not recommend the routine use of melanoma risk prediction models due to a lack of validated models and prospective evaluation.(12, 16, 17)

Further research to support the identification and targeted screening of high-risk individuals in routine clinical practice is needed.(7, 8, 17, 18) There has been no previous research into how physicians approach melanoma risk assessment and its management. We aimed to examine how GPs assessed and managed melanoma risk, and the opportunities for using melanoma risk prediction models in primary care.

## **Methods**

### **Design, setting and participants**

This was a qualitative, descriptive-interpretive study following a grounded theory approach suggested by Corbin and Strauss to analyse data collected from semi-structured interviews. (19) This approach is useful for understanding the behaviours, thoughts, and emotions of people within their sociocultural context, in this case, GPs in their clinical practice. (19) Our analysis assumed the existence of an explanatory theory that was “grounded” in the data and could be co-constructed through the researcher’s interaction with the data. (20) We report in accordance with the consolidated criteria for reporting qualitative studies.(21)

This study was undertaken in 2019, in Australia. The lifetime risk of being diagnosed with melanoma in Australia is estimated to be 1 in 15 people, with a lifetime melanoma mortality risk of 1 in 140, making melanoma the third most diagnosed cancer (excluding keratinocyte cancers) and the eighth leading cause of cancer-related death.(22) Most residents (83%) consulted with a GP at least once during the 2019 Australian financial year.(23) GPs hold specialist registration in Australia and have important responsibilities in melanoma prevention, diagnosis, management and follow-up(24). Seven of the researchers (CT, KP, KMcL, MT, JH, AK, KV) are clinical academic GPs, KMcG is a biostatistician with research

experience in cancer prevention in primary care and BA is a medical student researcher. KV has research experience in cancer prevention and melanoma epidemiology.

We invited participants from the 136 Australian GPs who had completed a cross-sectional questionnaire-based study on the topic of melanoma risk assessment. The cross-sectional study participants were recruited between June-August 2019 from *GPs Down Under*, a Facebook group comprising over 6,000 authenticated Australian and New Zealand GPs.(25) In this cross-sectional study, the extent of agreement between unassisted clinician self-reported- and model-generated melanoma risk predictions were assessed. GPs who had previously received a diagnosis of melanoma were ineligible because they were at high risk of melanoma and were excluded from the cross-sectional study.

A total of 44 GPs expressed interest in participating in this qualitative study by providing their contact details. We purposively sampled for diversity in geographic location of practice, training pathways, registration type and clinical experience in melanoma from this pool of potential participants. We sent invitations by email in sequential recruitment rounds until theoretical saturation was achieved in analysis. Non-responders were sent a reminder email after two weeks. We did not seek reasons for non-participation. We obtained verbal consent from all participants prior to the interviews.

### **Data collection**

Semi-structured individual telephone interviews were conducted from July 9 to September 10, 2019. The semi-structured interviews collected open-ended data through dialogue guided by a flexible interview guide with follow-up questions, probes and comments.(26) Our

interview guide (see Supplementary Box 1) was developed through discussion and trial interviews with a convenience sample of four GPs.

The participants had no established relationship to the interviewer prior to study commencement. Interviews were conducted by one investigator (BA), a medical student researcher, trained and supervised by CT, a GP with qualitative research expertise. Interviews were digitally audio-recorded, transcribed verbatim by a professional service, checked for errors and de-identified before being uploaded into QSR NVivo 12 software for analyses. Participants were not invited to review their interview transcripts. Hand-written and typed field notes were taken during and immediately after each interview. Participant sociodemographic and professional details were obtained from the questionnaire items completed by the participants as part of the cross-sectional study.

We assessed for theoretical saturation at weekly team meetings by considering the fit of new data into the existing analyses.(27, 28) It was likely that the analysis was approaching saturation by the fifteenth interview; however, several further interviews were undertaken to increase participant variation and to specifically explore aspects of the developing model. It was agreed that theoretical saturation had occurred after the twentieth interview, and recruitment was halted.

### **Data analysis and interpretation**

BA and CT performed in-vivo open coding on the earlier interview transcripts to produce the verbatim codes. Four investigators (BA, CT, KV, and AK) assisted with the axial coding process whereby the verbatim codes were inductively abstracted and organised into concepts,

categories, and themes at weekly meetings. Emerging codes were tested using constant comparative analysis, further explored, and tested through the theoretical sampling of later interviewees, and selective coding of their interview transcripts. During team meetings, concept mapping and reflexivity through identifying, discussing, and challenging established assumptions was essential to developing the final theoretical model. QSR NVivo 12 software was used to facilitate the analysis.

## **Results**

Among the 29 GPs approached, 20 agreed to participate in telephone interviews. The age of participants ranged from 26 to 66 years, with an even split between men and women. Clinical experience as a GP ranged from 1 to 37 years. Participants were located across six (of a total of eight) states/territories within Australia, with all but two living in a major city. The interviews took on average 28 minutes to complete, ranging from 18 min to 34 min. Table 1 provides demographic and training characteristics of each participant in more detail.

The explanatory model that emerged demonstrated that GP assessment of melanoma risk and its management can be understood as a linear workflow consisting of five clinical process domains starting with patient selection as the entry point based on the clinical context (see Figure 1). The GPs largely welcomed the role of melanoma risk prediction models within clinical practice, sharing facilitators and barriers to them integrating into the existing clinical workflow and complementing risk-appropriate management and patient education.

### **Patient selection**

The participants framed melanoma risk assessment as initiated by two main clinical contexts. One involves the opportunistic assessment of melanoma risk as part of a general preventive health assessment.

“it's generally part of my whole preventative care screen ... highlighting that they need a skin check in other consults and then making them book appointments specifically to come back to me for the skin check” (Participant 20)

The other involves the assessment of melanoma risk following specific skin-cancer related prompts such as a skin check appointment, a suspicious skin lesion, or a discussion of skin cancer risk factors.

“I do a number of formal skin checks, people walk in to me specifically to have a skin check, so that's a formal part of that consult, but if somebody just comes in just concerned about one mole, then I will go through that list anyway, for that one mole.” (Participant 15)

“if somebody said to me "Oh, you know, I've got a lesion" but before I look at it I would be thinking, well, what factors would make me more suspicious or less suspicious before looking at the lesion” (Participant 8)

### **Identification of individual melanoma risk factors**

Most participants described verbally running through an informal checklist of risk factors and protective factors with each patient as part of their clinical assessment.

Risk factors and protective factors mentioned by the participant's on prompting included: patient age and sex; phenotypic features including eye and hair colour, naevi density and the presence of atypical naevi and actinic damage; past ultraviolet exposure including the country most lived in, actinic damage, occupational exposure and recreational exposure, and sunburn history; personal skin cancer history including of the number of skin excisions, the number of keratinocyte cancers and melanoma; and a family history of melanoma; immunosuppression as well as sun safe practices.

“it's Fitzpatrick skin types, personal and family history of skin cancers or other kinds of cancers. Whether they have had outdoor jobs or hobbies. If they got regular sunburns in childhood ... if they have used sun protection or sunscreen ...”

(Participant 20)

### **Overall melanoma risk estimation**

The participants considered the patient's set of risk factors and protective factors to stratify them to a risk level. This relied on both intuitive and analytical processes that were supported by participant's knowledge of clinical guidelines, skin cancer training and clinical experience. No participants reported using a melanoma risk prediction model in their routine clinical practice.

“The skin cancer college courses they've highlighted the risk factors that we need to highlight. So I've basically based my practice on that ... I don't actually follow a pathway as such. A lot of it is general judgment and assessments.” (Participant 16)

“I often turn to the Cancer Council's guide on melanoma and other skin cancer, that is probably my most useful resource in terms of making decisions and making assessments” (Participant 8)

On further probing, three analytical processes were used to varying degrees. Many participants described the importance of recognising the presence of major risk factors, such as family and sun exposure history, which immediately, qualifies the patient into a higher risk group.

“I guess it depends on which risk factor. If they've got a family history of melanoma then I would put them straight into the high [risk level]” (Participant 14)

Some participants described the use of the total the number of risk factors identified as a proportional measure of risk.

“I have a proforma history that I've been doing for so long. I just go through their history when they come in for their skin check ... with each one that they answer in the positive to, then my concern about their risk of melanoma goes up” (Participant 15)

A few participants described the moderation of the effect of certain risk factors in the setting of protective factors in the same patient.

“A Fitzpatrick 1 or 2 skin probably doesn't impress me ... if they've never developed a problem.” (Participant 4)

Participants then described allocating patients into a diverse number of risk levels. Some participants divided their patients into binary risk levels.

“The risks stratification's pretty crude. There's the basket called low risk and then there is everything else. Unless you are answering no to all those questions that I gave before, then you are not low risk” (Participant 18)

Other participants stratified the patients into three or four risk levels. The number of risk levels conceptualized by a participant seemed closely related to the number of conceptualized management pathways.

“I'm just trying to work out whether they're at low, medium, or high risk as a background thing, and that helps me also advise them on how often they should be having a skin check and how important it is for them to be taking outside sun precautions” (Participant 14)

### **Risk appropriate management**

The management options included sun safe education, skin surveillance, specialist referral and lesion excision. The chosen management was commensurate on the patient's overall melanoma risk level as estimated by the GP, patient factors, as well as physician factors such as confidence, expertise, and access to certain technologies and skin cancer services.

“If I think they’re at high risk, they may even need six monthly or yearly skin checks., otherwise, every one to two years I think is reasonable” (Participant 12)

“I think it just helps me because often you do see a lesion and you're thinking, "Oh, it looks benign but I'm not 100% sure," and I think having a background risk helps you in decision making as to whether you refer it, or whether you biopsy it yourself, or whether you're happy to observe it.” (Participant 14)

“I think it's probably the number of risk factors ... I guess it also depends on how likely they are [the patients] to be able to come in if there's something wrong.”  
(Participant 13)

### **Patient education**

The GP participants described communicating melanoma risk to patients in terms of the individual melanoma risk factors identified or the overall melanoma risk level estimated.

“I would probably say to them look, you've got this risk factor and that risk factor, and we should be checking you more frequently to make sure that we can pick early change and get things before they become major issues” (Participant 5)

“I’d say broadly like increased risk, and normally emphasis that it is preventable ... I don’t have patients asking for that type of specific information, wanting a percentage figure, most of them are fairly satisfied” (Participant 3)

The communication of risk was reported to be individualised based on the patient' identified risk factors, health literacy, and perceived concern. It was sometimes numerically supported with the relative risks conferred by individual risk factors or by comparing the absolute lifetime risk of developing melanoma in the general population to other events.

“I've got some stuff in my work space that talks about each of those things and how much additional risk they might confer ... I'll use that not just in words, but I'll actually go through those risks with them” (Participant 6)

“You can try compare it to other risks that they might be facing. You try to balance It; you don't want to have them in absolute fear, but you also want them to responsibly manage the risk.” (Participant 3)

### **Opportunities for using melanoma risk prediction models.**

Most participants were receptive towards potentially using melanoma risk prediction models in melanoma risk assessment and management. They felt it could (1) integrate into the clinical workflow, and (2) complement downstream clinical process themes including risk-appropriate management and patient education (Figure 1).

#### **Integration into existing clinical workflow**

Participants described the potential benefit of having a melanoma risk prediction model as part of the electronic health record for easy access.

“When I do find [risk prediction models] useful they are easily accessible for me, because I have things like the cardiovascular risk and the CHA2DS2-VASc score calculator on my computer anyway, so I've got those calculators at my fingertip”  
(Participant 19)

Intelligent data automation was suggested to bypass user interface inefficiencies.

“If it were to auto populate ... automatically calculate the score for you and maybe something about them then yes, absolutely we'll use it.” (Participant 16)

The participants also projected other settings in which a self-assessable melanoma risk prediction model could be used, such as in the waiting room (on a tablet computing device) or outside the practice, as potentially beneficial to both the patient and physician.

“it's beneficial for patients to have the opportunity to assess their own risk.”  
(Participant 3)

“If patients use it as a self-assessment tool, then it's not going to be a cognitive burden on the doctor” (Participant 18)

If a melanoma risk prediction model were to be used outside the practice, our participants considered it important for it complement and not replace medical advice as there is a risk that patients could misinterpret the results.

“you'd want to be making sure that it's in the context of them about to walk into the doctor's or there's an opportunity for them to discuss that risk afterwards. I guess it has the danger of falsely reassuring that'd be my potential worry” (Participant 6)

### **Complement downstream clinical process themes**

The participants shared opportunities for a melanoma risk prediction model to complement patient education, suggesting absolute risk levels to be delivered in easily understood formats, such as in colourised tables and graphs preferred. However, most participants preferred relative risk numbers when educating patients.

“I think absolute [risk] is more helpful for a clinician when they're thinking about risk, but I think relative risk is more useful when you're trying to influence behaviour change” (Participant 1)

Participants indicated that risk estimates should be paired with evidence-based management guidelines to support both risk appropriate-management, particularly for less experienced physicians, and patient education.

“As long as it went if you have this, this is the action you take, that could be helpful. I think that would be particularly helpful for GP registrars starting out” (Participant 13)

“I think having that really concrete information really helps patients be better with the preventative health. I think the vaguer we are, the less likely they are to adhere”

(Participant 7)

However, a few participants expressed that such models may not substantially change or improve current practices regarding management recommendations.

“I think the fact that there are relatively few courses of possible action when you identify someone at higher risk means that precisely estimating the risk probably doesn't feed into changes in clinical practice” (Participant 4)

Some participants expressed possible shortcomings of a melanoma risk prediction model in regard to its impact on patient-centred management, and its utility in motivating behavioural changes in patients.

“...at the end of the day you're treating a patient; you're not treating a risk assessment on the screen and the risk assessment's a good tool, it can tell you if it's low or high risk, but you shouldn't just go by that. It should also be guided by what you think the patient in front of you will actually do.” (Participant 20)

“If there's a modifiable risk factor [in the model], and they can see a comparison, sometimes that can be a motivating factor for them to change. But I only see the utility in it being a motivating factor for them to change” (Participant 13)

## **Discussion**

### **Summary**

This is the first in-depth study to examine how physicians assessed and managed overall melanoma risk. We identified five clinical process domains, with patient selection for melanoma risk assessment as the entry point. There was variation between physicians on the identification of melanoma risk factors, melanoma risk estimation, management and patient education due to intuitive and analytical processes guiding risk assessment, and the influence of patient factors. GPs were largely receptive towards the role of melanoma risk prediction models, sharing facilitators and barriers to them integrating into current clinical practice, specifically, in terms of them improving existing clinical workflow, and complementing risk-appropriate management and patient education.

### **Comparison with existing literature**

Reforms in primary care, in common with other health settings, have largely focused on disease management over prevention and there is a lack of consistency in risk assessment practices.(29) While Australian GPs manage melanoma frequently, there is no structured procedures to initiate patients for melanoma risk assessment. Our GP participants demonstrated high levels of melanoma risk factor knowledge identifying important melanoma risk factors to guide the identification of patients at high risk and used these factors to stratify management based on risk, which is congruent with preventive guidelines. (7, 12) Many participants also reported challenges in defining the threshold for high melanoma risk in both absolute and relative terms. This was like the phenomenon reported

among Canadian primary care physicians on definitions for high cardiovascular disease risk.(30)

There was greatest variation among GP participants on how they estimated overall melanoma risk. Some of our participants reported that they primarily used intuitive processes, while others used analytical processes to identify major melanoma risk factors or the total number of melanoma risk factors with moderation by protective factors.(31-33) This is not surprising as the preventive guidelines provide limited information on how to combine individual melanoma risk factors to estimate overall risk.(7) In 2015, a prospective Canadian study using real patients found that 29% of physicians used subjective clinical judgement to assess disease risk compared with 12% who counted the number of risk factors to assess disease risk.(34)

Our participants described risk stratification occurring into two, three or four melanoma risk levels compared with most international guidelines describing binary risk levels and the Australian preventive guidelines for GPs describing three risk levels.(7, 12)

Australian GPs are familiar with using risk assessment models in the clinical setting and delivering risk-based management.(35) Previously, we have shown real-time model-generated melanoma risk predictions and tailored prevention advice is associated with better sun protection behaviours in the intervention patients compared to usual care in Australian general practices.(36) In UK studies, model-generated melanoma risk predictions have been feasible and acceptable among general practice patients. (37, 38) However, there are no melanoma risk prediction models in routine clinical use in Australia or internationally.

Our GP participants, similar to physician participants in cardiovascular disease and other cancer studies, had preferences for a melanoma risk prediction model that can be integrated into electronic record systems,(39-42) is self-assessable,(43) presents risk estimates in both numerical and visual forms(39, 42, 44), pairs risk estimates with evidence-based management guidelines(39-41), and incorporates patient factors and motivates behavioural changes in patients(45, 46). Our GP participants also expressed potential barriers to the routine use of risk prediction models in primary care that is like previous findings regarding decision support aids for physicians. They expressed several possible shortcomings of risk prediction models on workflow including accessibility issues and documentation time (47-49), being less useful for more experienced doctors(50), and not significantly changing management recommendations (47).

### **Strengths and limitations**

The strengths of this study include the recruitment of volunteer GPs from across Australia from respondents to a questionnaire on melanoma risk, and therefore, it is likely they have a higher interest in assessing and managing melanoma risk in their patients, including the various melanoma risk assessment methods. We used a grounded theory approach which allowed for the robust development of a possible explanatory model. The study had sufficient data to reach theoretical saturation.

Our study findings should be interpreted in the context of several potential limitations.

Although we sampled for variation, GPs-in-training, GPs working in rural and remote areas, and overseas trained GPs were not well represented. Lastly, in some of the interviews the

participants were told that members of the research team had developed a melanoma risk prediction model. It is plausible that social desirability bias may have led to more favourable views to the role of a melanoma risk prediction model being shared than held by the participants; however, those participants who were not told also shared favourable views.

### **Implications for practice**

Our study indicates there is variation in how GPs assess and manage melanoma risk across five clinical process domains, with greatest variation among GP participants on how they estimated overall melanoma risk. Further interventions may be required to standardise these processes. If melanoma risk prediction models are to be successfully implemented within primary care, they will need to be sensitive to the host setting and the clinical workflow within it.

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## **Ethical approval**

The study was approved by the University of New South Wales Human Research Ethics Committee (HC190104)

## **Competing interests**

The authors declare no competing of interests.

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## **Contributor statement**

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## References

1. Whiteman DC, Green AC, Olsen CM. The Growing Burden of Invasive Melanoma: Projections of Incidence Rates and Numbers of New Cases in Six Susceptible Populations through 2031. *J Invest Dermatol*. 2016;136(6):1161-71.
2. Montague M, Borland R, Sinclair C. Slip! Slop! Slap! And SunSmart, 1980-2000: Skin Cancer Control and 20 years of population-based campaigning. *Health Educ Behav*. 2001(28):290-305.
3. Sinclair C, Foley P. Skin cancer prevention in Australia. *Br J Dermatol*. 2009(161):116-23.
4. Johansson M, Brodersen J, Gøtzsche PC, Jørgensen KJ. Screening for reducing morbidity and mortality in malignant melanoma. *Cochrane Database Syst Rev*. 2019(6).
5. Kaiser M, Schiller J, Schreckenberger C. The effectiveness of a population-based skin cancer screening program: evidence from Germany. *Eur J Health Econ*. 2018;19(3):355-67.
6. Whiteman D. Predicting melanoma risk: theory, practice and future challenges. *Melanoma Manag*. 2014;1(2):105-14.
7. Watts CG, Dieng M, Morton RL, et al. Clinical practice guidelines for identification, screening and follow-up of individuals at high risk of primary cutaneous melanoma: a systematic review. *Br J Dermatol*. 2015;172(1):33-47.
8. Wojcik KY, Escobedo LA, Miller KA, et al. Conflicts and contradictions in current skin cancer screening guidelines. *Curr Dermatol Rep*. 2017;6(4):316-24.
9. Watts CG, Madronio CM, Morton RL, et al. Diagnosis and clinical management of melanoma patients at higher risk of a new primary melanoma: A population-based study in New South Wales, Australia. *Australas J Dermatol*. 2017;58(4):278-85.
10. Weinstock MA. Early Detection of Melanoma. *JAMA*. 2000;284(7):886.
11. Bray F, Ferlay J, Soerjomataram I, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin*. 2018;68(6):394-424.
12. RACGP. Guidelines for preventive activities in general practice. East Melbourne, Victoria: The Royal Australian College of General Practitioners; 2016.
13. Usher-Smith JA, Emery J, Kassianos AP, Walter FM. Risk Prediction Models for Melanoma: A Systematic Review. *Cancer Epidemiol Biomarkers Prev*. 2014;23(8):1450.
14. Vuong K, McGeachan K, Armstrong BK, Cust AE. Risk prediction models for incident primary cutaneous melanoma: a systematic review. *JAMA Dermatol*. 2014;150(4):434-44.
15. Kaiser I, Pfahlberg AB, Uter W, et al. Risk Prediction Models for Melanoma: A Systematic Review on the Heterogeneity in Model Development and Validation. *Int J Environ Res Public Health*. 2020;17(21):7919.
16. Marsden JR, Newton-Bishop JA, Burrows L, et al. Revised UK guidelines for the management of cutaneous melanoma 2010. *J Plast Reconstr Aesthet Surg*. 2010;63(9):1401-19.
17. Johnson MM, Leachman SA, Aspinwall LG, et al. Skin cancer screening: recommendations for data-driven screening guidelines and a review of the US Preventive Services Task Force controversy. *Melanoma Manag*. 2017;4(1):13-37.
18. Gordon LG, Rowell D. Health system costs of skin cancer and cost-effectiveness of skin cancer prevention and screening: a systematic review. *Eur J Cancer Prev*. 2015;24(2):141-9.

19. Corbin J, Strauss A. Basics of Qualitative Research. 4th ed: SAGE Publications; 2015.
20. Mills J, Bonner A, Francis K. The Development of Constructivist Grounded Theory. *Int J Qual Methods*. 2006;5(1):25-35.
21. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *Int J Qual Health Care*. 2007;19(6):349-57.
22. Health Ato, Welfare. Cancer data in Australia. Canberra: AIHW; 2020.
23. Australian Bureau of Statistics. Patient Experiences in Australia: Summary of Findings, 2019-20. Australian Bureau of Statistics Canberra; 2020.
24. Medical Board of Australia. List of specialties, fields of specialty practice and related specialist titles 2018.
25. Price K. GPs Down Under: who are we and what do we do? *MJA InSight* [Internet]. 2018 [cited 2018 2018/2/16]; (2). Available from: <https://www.doctorportal.com.au/mjainsight/2018/2/gps-down-under-who-are-we-and-what-do-we-do/>.
26. DeJonckheere M, Vaughn LM. Semistructured interviewing in primary care research: a balance of relationship and rigour. *Fam Med Community Health*. 2019;7(2):e000057.
27. Research methods in health : foundations for evidence-based practice / edited by Pranee Liamputtong. Liamputtong P, editor. South Melbourne, Victoria: Oxford University Press; 2017.
28. Low J. A Pragmatic Definition of the Concept of Theoretical Saturation. *Sociol Focus*. 2019;52(2):131-9.
29. Javanparast S, Maddern J, Baum F, et al. Change management in an environment of ongoing primary health care system reform: A case study of Australian primary health care services. *Int J Health Plann Manage*. 2018;33(1):e76-e88.
30. Gupta M, Singh N, Tsigoulis M, et al. Perceptions of Canadian primary care physicians towards cardiovascular risk assessment and lipid management. *Can J Cardiol*. 2012;28(1):14-9.
31. Evans JSBT. Dual-process theories of reasoning: Contemporary issues and developmental applications. *Dev Rev*. 2011;31(2):86-102.
32. Kahneman D. Thinking, fast and slow. New York, NY, US: Farrar, Straus and Giroux; 2011. 499- p.
33. Cervellin G, Borghi L, Lippi G. Do clinicians decide relying primarily on Bayesian principles or on Gestalt perception? Some pearls and pitfalls of Gestalt perception in medicine. *Intern Emerg Med*. 2014;9(5):513-9.
34. Law TK, Yan AT, Gupta A, et al. Primary prevention of cardiovascular disease: global cardiovascular risk assessment and management in clinical practice. *Eur Heart J Qual Care Clin Outcomes*. 2015;1(1):31-6.
35. Heart Foundation. Heart Health Check. In: Heart Foundation, editor. [https://www.heartfoundationorgau/getmedia/12c3a44e-e304-4ebe-8796-1f8b1ce9d73d/200406\\_MBS-Factsheet-D2pdf](https://www.heartfoundationorgau/getmedia/12c3a44e-e304-4ebe-8796-1f8b1ce9d73d/200406_MBS-Factsheet-D2pdf). [https://www.heartfoundation.org.au/getmedia/12c3a44e-e304-4ebe-8796-1f8b1ce9d73d/200406\\_MBS-Factsheet-D2.pdf2019](https://www.heartfoundation.org.au/getmedia/12c3a44e-e304-4ebe-8796-1f8b1ce9d73d/200406_MBS-Factsheet-D2.pdf2019).
36. Vuong K, Armstrong BK, McGeechan K, Cust AE. Personalized melanoma risk assessments and tailored prevention advice: a pragmatic randomized controlled trial in Australian general practice. *Fam Pract*. 2018.

37. Jackson A, Wilkinson C, Ranger M, et al. Can primary prevention or selective screening for melanoma be more precisely targeted through general practice? A prospective study to validate a self administered risk score. *British Medical Journal*. 1998;316:34-9.
38. Usher-Smith JA, Kassianos AP, Emery JD, et al. Identifying people at higher risk of melanoma across the U.K.: a primary-care-based electronic survey. *Br J Dermatol*. 2017;176(4):939-48.
39. Schroy PC, 3rd, Caron SE, Sherman BJ, et al. Risk assessment and clinical decision making for colorectal cancer screening. *Health Expect*. 2015;18(5):1327-38.
40. Brown B, Cheraghi-Sohi S, Jaki T, et al. Understanding clinical prediction models as 'innovations': a mixed methods study in UK family practice. *BMC Med Inform Decis Mak*. 2016;16(1):106.
41. Plüddemann A, Wallace E, Bankhead C, et al. Clinical prediction rules in practice: review of clinical guidelines and survey of GPs. *Br J Gen Pract*. 2014;64(621):e233.
42. Muller-Riemenschneider F, Holmberg C, Rieckmann N, et al. Barriers to routine risk-score use for healthy primary care patients: survey and qualitative study. *Arch Intern Med*. 2010;170(8):719-24.
43. Wan Q, Harris MF, Zwar N, Vagholkar S. Sharing risk management: an implementation model for cardiovascular absolute risk assessment and management in Australian general practice. *Int J Clin Pract*. 2008;62(6):905-11.
44. Hill S, Spink J, Cadilhac D, et al. Absolute risk representation in cardiovascular disease prevention: comprehension and preferences of health care consumers and general practitioners involved in a focus group study. *BMC Public Health*. 2010;10:108.
45. Ju I, Banks E, Calabria B, et al. General practitioners' perspectives on the prevention of cardiovascular disease: systematic review and thematic synthesis of qualitative studies. *BMJ Open*. 2018;8(11):e021137.
46. Schroy PC, 3rd, Emmons KM, Peters E, et al. Aid-assisted decision making and colorectal cancer screening: a randomized controlled trial. *Am J Prev Med*. 2012;43(6):573-83.
47. Wu RR, Orlando LA, Himmel TL, et al. Patient and primary care provider experience using a family health history collection, risk stratification, and clinical decision support tool: a type 2 hybrid controlled implementation-effectiveness trial. *BMC Fam Pract*. 2013;14(1):111.
48. Tuzzio L, O'Meara ES, Holden E, et al. Barriers to Implementing Cardiovascular Risk Calculation in Primary Care: Alignment With the Consolidated Framework for Implementation Research. *Am J Prev Med*. 2021;60(2):250-7.
49. Harry ML, Truitt AR, Saman DM, et al. Barriers and facilitators to implementing cancer prevention clinical decision support in primary care: a qualitative study. *BMC Health Serv Res*. 2019;19(1):534.
50. Greaves K, Smith A, Agostino J, et al. Cross-sectional survey describing general practitioners' absolute cardiovascular disease risk assessment practices and their relationship to knowledge, attitudes and beliefs about cardiovascular disease risk in Queensland, Australia. *BMJ Open*. 2020;10(8):e033859.

**Table 1. Participant characteristics**

Table 1. Participant characteristics										
Participant number	Age	Sex	State*	Principal location of work	Registration status	Years worked in general practice	Number of half-day clinical work per week	Work in skin cancer clinic	Country where primary medical qualification was attained	Attainment of post-graduate skin qualification
1	32	M	VIC	Metropolitan	Specialist general practitioner	5	10	Yes	Australia	Yes, master's level
2	38	M	VIC	Metropolitan	Specialist general practitioner	3	6	No	Australia	None
3	57	M	QLD	Metropolitan	Specialist general practitioner	32	6	No	Australia	None
4	54	M	QLD	Regional town	Specialist general practitioner	25	9	No	Australia	None
5	57	F	NSW	Metropolitan	Specialist general practitioner	30	6	No	Australia	None
6	34	F	WA	Metropolitan	Specialist general practitioner	5	4	Yes	Australia	None
7	33	F	VIC	Metropolitan	Specialist general practitioner	5	8	No	Australia	None
8	33	M	WA	Metropolitan	Specialist general practitioner	5	2	No	Australia	None
9	61	F	VIC	Metropolitan	Specialist general practitioner	35	9	No	Australia	None
10	52	F	WA	Remote community	Specialist general practitioner	26	4	No	Australia	None
11	56	M	VIC	Metropolitan	Specialist general practitioner	29	10	No	Australia	None
12	41	M	NSW	Metropolitan	Specialist general practitioner	10	9	No	Australia	None
13	40	F	NSW	Metropolitan	Specialist general practitioner	14	5	No	Australia	None
14	30	F	NSW	Metropolitan	Specialist general practitioner	5	5	No	Australia	Yes, certificate level
15	51	F	VIC	Metropolitan	Specialist general practitioner	19	8	No	Australia	Yes, master's level
16	35	F	QLD	Metropolitan	Specialist general practitioner	2	7	No	New Zealand	Yes, certificate level
17	66	M	NSW	Metropolitan	Specialist general practitioner	37	8	No	Australia	Yes, certificate level
18	35	M	ACT	Metropolitan	Trainee	3	9	No	Australia	None
19	56	M	QLD	Metropolitan	Specialist general practitioner	25	8	No	United Kingdom	None
20	26	F	NSW	Metropolitan	Trainee	1	10	No	Australia	None

\* VIC = Victoria, QLD = Queensland, NSW = New South Wales, WA = Western Australia, ACT = Australian Capital Territory

Figure 1. Explanatory model of how GPs conceptualise melanoma risk assessment and management, and opportunities for using melanoma risk predictions models.

