

Skin checks for potential skin cancers in general practice in Victoria, Australia: the upfront and downstream patterns and costs

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Key points

- Skin cancer is the most commonly diagnosed cancer in Australia, with annual treatment costs of around A\$1.9 billion, but there is little published information about the skin checks leading to diagnosis and treatment
- Skin checks occurred at around 1% of general practice encounters, almost all billed as standard or long GP consultations, and 20% of these had subsequent skin-related healthcare in general practice

Abstract

Objectives: To describe patterns of skin checks for potential skin cancers in general practice and subsequent skin-related healthcare, and the associated costs.

Study type: Retrospective longitudinal health record linkage.

Methods: Patient encounters between 2010 and 2017 were extracted from clinical information systems at 73 general practice sites in Victoria, Australia, including Medicare billing information, from the MedicinesInsight primary care dataset. The main outcomes were skin checks, skin-related healthcare up to 3 months after the skin check, and health system costs.

Results: There were 59 046 skin check encounters (0.7% of all general practice encounters) identified for 40 014 people with a median age of 52 years (interquartile range 36–67). Of these people, 26% had multiple skin checks. Of the subsequent skin checks, 28% were within 3 months of the initial skin check and 15% were after > 2 years. There was subsequent skin-related healthcare ≤ 3 months after 20% of all skin checks: 8% had a skin biopsy, 11% had a skin excision (of which 2% indicated a melanoma diagnosis, 29% keratinocyte carcinoma and 68% benign or other skin lesion), 2% had skin-related medicine prescribed and 5% had other skin-related treatment such as cryotherapy (not mutually exclusive). Ninety per cent of skin checks were billed as general practitioner (GP) consultations, including 65% as GP consultations of < 20 minutes although the proportion of longer consultations increased over time. The mean 3-month skin-related general practice health system costs for people without and with subsequent skin-

Key points (continued)

- Mean health system costs ranged from A\$58 for skin checks without subsequent healthcare to A\$595 for melanoma excisions

related healthcare were A\$58 and A\$240, respectively, and up to a mean of A\$595 for those having a melanoma excised.

Conclusions: Skin checks for potential skin cancers occur frequently in Australian general practice and accumulate substantial health system costs, with one in five skin checks resulting in subsequent treatment. This study adds to scarce real-world skin check and cost data in Australia.

Introduction

Skin cancer is the most common cancer in Australia.¹ With no organised screening program, most skin cancers in Australia are identified by general practitioners (GPs) in primary care, when patients present with specific skin lesions or through a clinical skin examination (“skin check”).² Most skin cancers are classified as either melanomas or keratinocyte carcinomas (non-melanoma skin cancers).³ Detection of skin cancers in primary care can involve visual skin examination, dermoscopy and biopsy. Treatments used in primary care include surgical excision, curettage, cauterisation, cryotherapy, photodynamic therapy and topical therapy.^{4,5}

The health system cost for the care of keratinocyte carcinomas in Australia was estimated at A\$1.52 billion in 2020–21, with another A\$408 million for melanomas.⁶ This government-subsidised care includes approved procedures and services listed in the Medicare Benefits Schedule (MBS)⁷ and prescription medicines subsidised under the Pharmaceutical Benefits Scheme (PBS)⁸, including an estimated A\$149 million for GP treatments for these skin cancers.⁶ However, there is little reported information about the frequency and costs of people having skin checks in primary care in Australia, nor of the subsequent healthcare, as there is no specific MBS item for skin checks and they are not routinely recorded in administrative data. Understanding existing opportunistic skin screening practices and the outcomes and costs has been identified as a key gap in knowledge and a research priority in Australia, and these data are essential to inform decisions about a potential risk-stratified national melanoma screening program.⁹

MedicineInsight is a primary care quality improvement program run by NPS MedicineWise (transferred to become the responsibility of the Australian Commission on Safety and Quality in Health Care in 2023) and funded by the Australian Government Department of Health and Aged Care.^{10,11} MedicineInsight includes a longitudinal general practice database that records the reasons for encounters, allowing identification of skin checks and subsequent care such as skin biopsies, cryotherapy, excisions and prescription medicines. It is one of the few available sources of data on skin checks and management in primary care in Australia.

We aimed to determine the frequency and health system costs of skin checks for potential skin cancers in general practice, and the subsequent skin-related healthcare. These findings provide information

addressing key gaps in knowledge for stakeholders including consumers, clinicians and policymakers seeking to optimise the early detection and management of skin cancer in Australia.

Methods

Source data

This is a retrospective cohort study using the subcomponent of the MedicineInsight longitudinal general practice database covering the state of Victoria.¹⁰ The database contains de-identified records for each patient consultation/encounter (“encounters”) from the clinical information systems at participating practices (“sites”), including patient demographics, encounter details, and clinical/management data entered by practice staff. Each record can include multiple encounter reasons, entered via a drop-down menu and/or free-text field. The study cohort comprised people in Victoria with a record indicating a skin check as an encounter reason (Supplementary Table 1, available from: figshare.com/articles/journal_contribution/_/25727706).

For completeness of cost information, analyses were restricted to practices with integrated billing data, including MBS claims – this accounted for > 70% of all patients. Multiple records for an individual at the same practice could be identified in the MedicineInsight dataset using a unique patient number, and prescribed medications were linked using a unique patient encounter number. BioGrid Australia, a connectivity platform for medical data¹², probabilistically linked records across sites when sufficient identifiers (for example, name, address, date of birth) were present. The proportion of encounters that had an encounter reason recorded varied by site (5–95%), and we excluded five sites that had < 30% of encounters with an encounter reason recorded (See Supplementary figure 1, available from: figshare.com/articles/journal_contribution/_/25727706).

Healthcare

We analysed skin check encounters and related healthcare that occurred in the 3 months after the encounter, as many treatments would be scheduled for another day. The study period was from January 2010 to December 2017. To allow 3 months of follow-up, we considered skin checks up to September 2017. Demographic information included age, gender,

socioeconomic status (using the Index of Relative Socio-economic Advantage and Disadvantage¹³) and remoteness of place of residence.¹⁴

We identified skin cancer-related care using MBS item numbers specific to melanoma, keratinocyte carcinomas and benign or other skin lesions (Supplementary Table 1, available from: figshare.com/articles/journal_contribution/_/25727706). The MBS items for skin cancer treatment required histological confirmation of malignancy, by type, to qualify for reimbursement. Other treatments were identified using MBS items and/or encounter reasons. Skin-related medicines were identified from medicine-specific tables in MedicineInsight by searching the medicine name or active ingredient (Supplementary Table 1, available from: figshare.com/articles/journal_contribution/_/25727706). Our focus was on skin checks related to potential skin cancer and subsequent skin-related healthcare, so any records missing the encounter reason and not identified in the skin cancer-related care items were not included in the final analysis.

Costs in general practice

Health system costs (government-as-payer perspective) were assigned to each MedicineInsight encounter according to the rebate payable for the MBS items listed on that date. Only GP consultation and skin-related MBS items were included in costing. The costs of skin-related medicine prescriptions were assigned using subsidies listed in the PBS. All costs were converted to 2020 Australian dollars using the Australian health index from the Australian Consumer Price Index.¹⁵

Statistical analysis

Each skin check encounter was categorised by consultation length (from the corresponding MBS item) and demographic information. We analysed the proportion of patients who had another skin check or other related healthcare up to 3 months after the initial skin check, and the associated costs. We investigated the medicines prescribed, MBS-indicated diagnoses from skin excisions (keratinocyte carcinoma, melanoma, benign/other), and frequency of skin checks. We presented time and cost results as a mean, median, standard deviation (SD) and interquartile range (IQR), and used a sensitivity analysis to analyse treatment records up to 1 month and 6 months after the initial skin check.

Ethics and data storage

Ethical approval was granted by Melbourne Health Human Research Ethics Committee (202002/1) and MedicineInsight Governance Committee (2020-020). Study data were stored within a secure research environment at the University of Melbourne, with access restricted to authorised users. Analyses were carried out using Stata v16.

Results

Skin checks

For the period between January 2010 and September 2017, we identified 59 046 skin check encounters for 40 014 patients across 73 general practice sites. Skin checks represented 0.7% of all encounters with a “reason for encounter” recorded. Of the 73 sites identified, 51 (70%) were in major cities and 18 (25%) were in the highest socioeconomic quintile areas. The mean skin checks per practice was 809 (median 352, IQR 141–774), with 16 skin checks per practice per month (median 7, IQR 3–19). The median age at a skin check was 52 years (IQR 36–67). Most people (65%) were from major cities and 29% were from the highest socioeconomic quintile areas (Table 1). There was an increasing number of skin checks each year due to the increasing coverage of the MedicineInsight dataset during the study period, with additional practices being included in the dataset each year (See Supplementary Table 2, available from: figshare.com/articles/journal_contribution/_/25727706).

Among the people having a skin check, there was a mean of 1.5 skin checks per person (SD 1.1, IQR 1–2) and 26% had multiple skin checks within the study period. The mean follow-up per person was 4.1 years (SD 2.4, median 4.3, IQR 2.1–6.2) between the first and last recorded encounters of any kind. Among the people having multiple skin checks, 28% of subsequent skin checks were within 3 months of the original skin check, 32% were after > 3–12 months, 25% were after > 1–2 years and 15% were after > 2 years. Among the subset of 10 875 patients with a BioGrid (cross-site) identifier, 0.6% had a skin check at multiple sites.

Grouping the skin checks by their encounter reason, 38% were recorded as being for a skin lesion or damage, 36% were recorded as a skin check or exam, 18% were recorded as being for a mole or naevus and 8% were recorded as skin cancer screening. Ninety per cent of skin check encounters were billed as GP consultations in the MBS: 65% were standard GP consultations of < 20 minutes (decreasing from 71% in 2010 to 55% in 2017), 23% were long GP consultations of 20–40 minutes (increasing from 18% in 2010 to 32% in 2017) and 2% had time groupings from other MBS GP consultation items. Seven per cent of skin check encounters had no MBS claim entered on the same date, and the remaining 3% had a non-consultation item (for example, management planning) or an invalid MBS item number.

Downstream management

A skin biopsy and/or skin excision was recorded ≤ 3 months after 18% of skin checks (Table 2), with 17% of excisions and 21% of biopsies performed on the same day as the skin check. There was a record of a skin-

Table 1. Number of skin check encounters ($N = 59\,046$) and people having skin check encounters ($N = 40\,014$), January 2010–September 2017

Category	Number of skin checks	Percentage of skin checks	Number of people ^a	Percentage of people
Gender				
Female	33 009	55.9	22 409	56.0
Male	26 001	44.0	17 574	43.9
Other/not stated	36	0.1	31	0.1
Age (years)				
<30	7 804	13.2	6 248	15.6
30–39	10 079	17.1	7 403	18.5
40–49	9 625	16.3	6 886	17.2
50–59	9 631	16.3	6 616	16.5
60–69	10 232	17.3	6 344	15.9
70–79	7 343	12.4	4 116	10.3
80+	4 332	7.3	2 401	6.0
Remoteness of residence				
Major cities	38 436	65.1	25 859	64.6
Inner regional	17 228	29.2	11 573	28.9
Outer regional	3 061	5.2	2 339	5.9
Remote/very remote	28	0.1	26	0.1
Not reported/unknown	293	0.5	217	0.5
Socioeconomic quintile of residence				
Most disadvantaged quintile	8 146	13.8	5 673	14.6
Quintile 2	5 717	9.7	4 026	10.0
Quintile 3	13 858	23.5	9 813	24.0
Quintile 4	13 389	22.7	8 739	21.8
Least disadvantaged quintile	17 596	29.8	11 514	29.0
Unknown	340	0.6	249	0.6

^a Categorisation is based on the person's characteristics at their first skin check encounter.

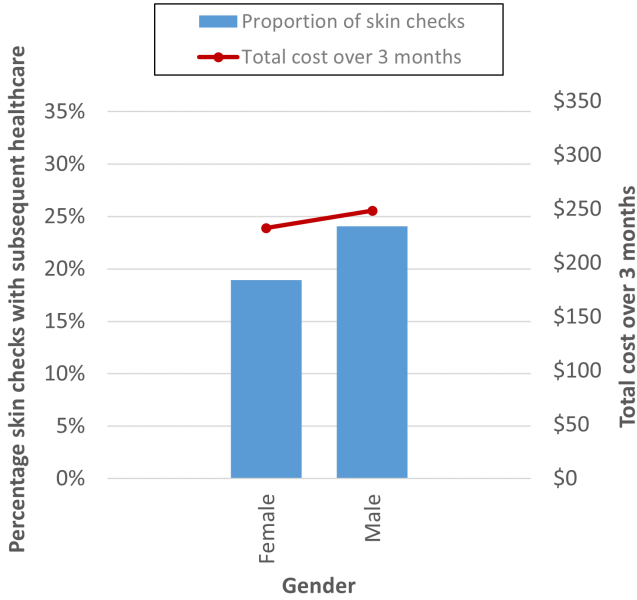
Table 2. Skin-related healthcare records up to 3 months after a skin check encounter ($N = 59\,046$), January 2010–September 2017

Subsequent healthcare after ≤ 3 months	Number	Percentage of skin checks
Skin biopsy or skin excision	10 377	17.6
Skin biopsy	4 887	8.3
Skin excision, total	6 576	11.1
Skin excision, melanoma	149	0.3
Skin excision, keratinocyte carcinoma	2 014	3.4
Skin excision, benign or other skin lesion	4 699	8.0
Both skin biopsy and skin excision	1 086	1.8
Skin-related topical medicine	1 023	1.7
Other skin-related healthcare (e.g. cryotherapy)	2 867	4.9
Any of the above skin-related healthcare	11 861	20.1

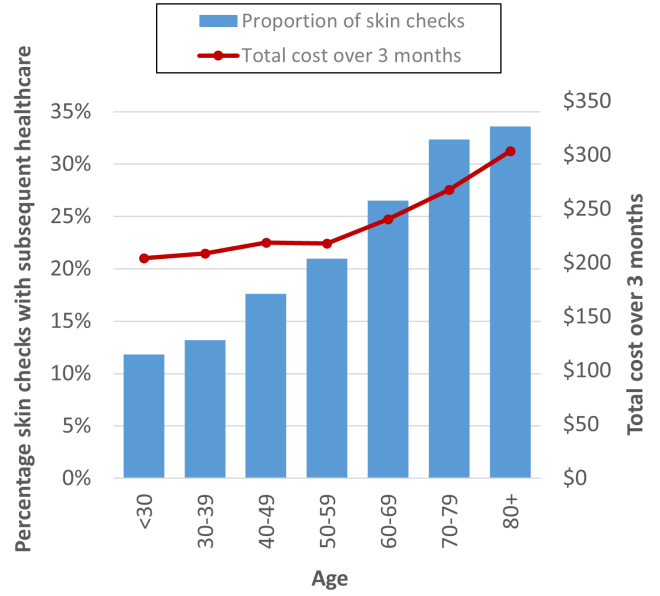
Note: Categories are not mutually exclusive.

Figure 1. Proportion of skin checks with subsequent skin-related healthcare within 3 months and mean general practice-related health system costs over that time for those having subsequent care

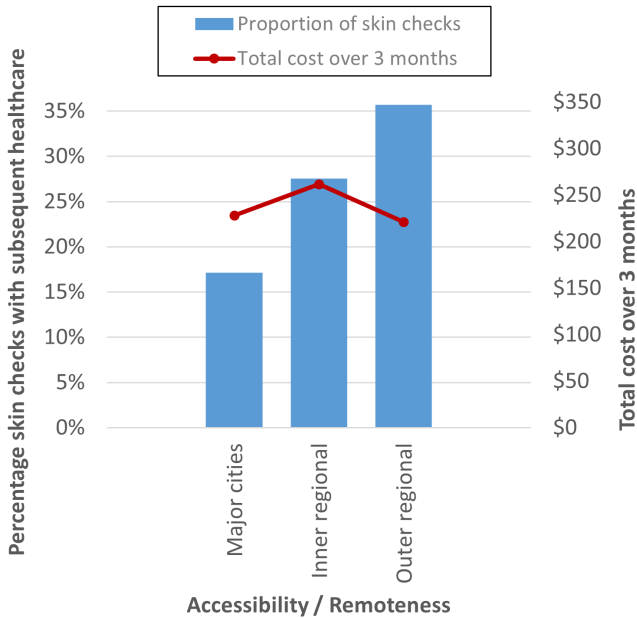
1a) Proportion and mean costs by gender



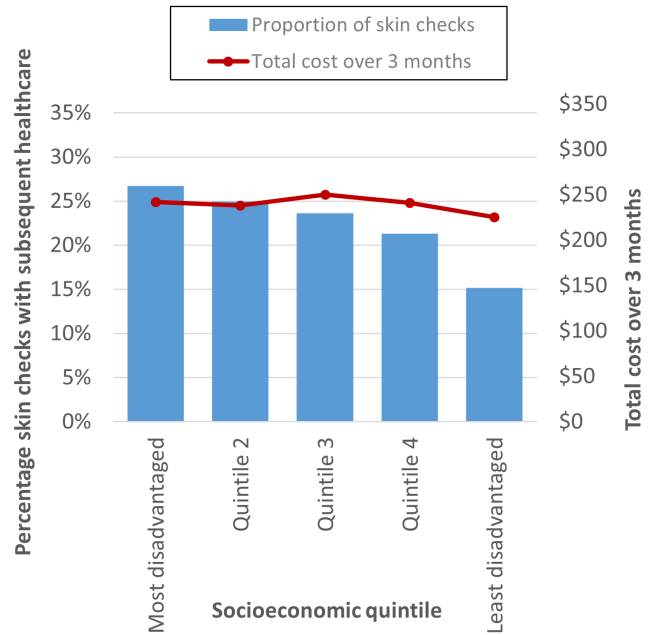
1b) Proportion and mean costs by age



1c) Proportion and mean costs by accessibility/remoteness



1d) Proportion and mean costs by socioeconomic status



related topical medicine after 2% of skin checks, and 5% had other skin-related treatment (90% cryotherapy). Overall, at least one of these treatment items was recorded in the 3 months after 20% of skin checks; it was within 1 month for 18% of skin checks and within 6 months for 21% of skin checks, the sensitivity analysis found. The proportion of skin checks with subsequent care appeared to be higher with older age and for people from outer regional and more disadvantaged areas (Figure 1). For 9% of skin checks, the patient had another skin check within 3 months and for 4% of checks, patients had another skin check after 3–6 months, suggesting that lesions were being monitored for change over this period. Of the people who had another skin check within 3 months, 37% had a biopsy and/or excision in the subsequent 3 months.

MBS items indicating the histopathological diagnosis of an excised or biopsied lesion were claimed (within 3 months) after 11% of skin checks – 2% of these indicated melanomas, 29% were keratinocyte carcinomas and 68% were benign or other skin lesions. The proportion of skin checks with a subsequent excision ranged from 8% for people aged < 30 years to 17% for people aged ≥ 80 – the main age-based difference was for keratinocyte carcinomas (< 1% and 11%, respectively). The proportion of skin checks that had a subsequent biopsy was 4% for people aged < 30 years, 13% for people aged ≥ 80 years and 19% for people from outer regional areas (Supplementary

Table 3, available from: figshare.com/articles/journal_contribution/_/25727706).

Costs of skin checks and downstream management

Of the 54 875 skin checks with valid MBS billing data on the date of the encounter, 94% were billed as a GP consultation only, 5% had MBS billing codes for a GP consultation and other skin-related healthcare, and 0.5% only had an MBS billing code for skin-related healthcare (for example, skin biopsy). The mean cost of a skin check encounter was A\$64 (SD 38, median 50, IQR 44–80). For skin checks without subsequent skin-related healthcare, the mean cost was A\$58 (SD 24, median 49, IQR 43–77), with little cost variation across patient characteristics (Supplementary Table 4, available from: figshare.com/articles/journal_contribution/_/25727706).

For skin checks with subsequent skin-related healthcare (including biopsy or excision on the same day), the mean total costs (including skin-related healthcare) in the subsequent 3 months was A\$240 (Table 3). Costs varied based on the type of healthcare, ranging from A\$162 for people who had a biopsy without a separate excision to A\$595 for those having surgical excision of a melanoma (Table 3). Costs increased with increasing age. While the proportion of people with subsequent skin-related healthcare varied markedly according to other characteristics (gender, remoteness and socioeconomic status), there was less

Table 3. Summary of total skin-related primary care health system costs in the 3 months after an initial skin check encounter for people with subsequent skin-related healthcare

Subsequent healthcare after ≤ 3 months	Number of skin checks	Mean total costs over 3 months (SD), \$	Median total costs over 3 months (Q1–Q3), \$
Had subsequent skin healthcare record	11 634	240 (153)	199 (147–282)
Had additional skin check	2 098	284 (187)	229 (168–335)
Had skin excision and/or skin biopsy	10 177	254 (158)	213 (157–298)
Had skin biopsy ^a	4 816	227 (172)	170 (129–253)
Had skin excision ^b	6 432	307 (171)	258 (203–351)
Had skin excision, benign	4 592	264 (140)	228 (183–286)
Had skin excision, keratinocyte carcinoma	1 981	433 (209)	364 (303–493)
Had skin excision, melanoma	141	595 (216)	539 (458–678)
Had skin biopsy but no skin excision	3 745	162 (63)	149 (119–188)
Had skin excision but no skin biopsy	5 361	278 (139)	242 (191–315)
Had both skin excision and skin biopsy	1 071	454 (230)	386 (310–515)
Had other form of treatment	2 315	219 (164)	163 (120–251)

^a Regardless of whether had skin excision

^b Regardless of whether had skin biopsy

SD = standard deviation.

Notes: All cost figures are in Australian dollars.

Costs include the cost of the initial skin check encounter.

variation in costs across these characteristics. (Figure 1; Supplementary Table 5, available from: figshare.com/articles/journal_contribution/_/25727706).

Discussion

In this study of approximately 40 000 people who underwent 60 000 skin checks for potential skin cancers in general practice, 20% of skin checks led to subsequent skin-related health system costs in general practice within 3 months, most commonly for biopsies and benign skin lesion excisions. We found that two in three skin checks in general practice were billed as part of a standard GP consultation of < 20 minutes, with the proportion of longer consultations increasing over time, and 5% were billed with some other skin-related healthcare. The mean general practice health system costs from the skin checks were A\$240 for those with subsequent skin-related healthcare and A\$58 for those without, up to a mean of A\$595 for those with a melanoma excision – this does not include the additional out-of-pocket costs patients may encounter when healthcare providers charge above government subsidy levels. These results add to the scarce real-world skin check and cost data in Australia, and can be used in future evaluations of population-wide skin cancer screening.

Previous studies have estimated the overall Australian health system costs for skin cancers.^{6,16} A recent study reported a mean 12-month cost of A\$525 per keratinocyte carcinoma and A\$11 787 per melanoma, with detailed treatment pathways indicating the sensitivity of costs to emerging high-cost targeted therapies for more advanced melanoma cases.¹⁶ Our findings reflect general practice-related health system costs, and show the range of costs for skin checks and the likelihood and costs of subsequent treatment. We did not have data on hospitalisations, where around 10% of excisions occur¹⁷, nor data on referrals to specialists or treatment with more expensive systemic therapies for later-stage lesions.

However, previous studies have had to estimate costs for skin checks. Approximately 120 million GP consultation claims in general practice were recorded in the MBS each year between 2015 and 2017¹⁸, but the reason for the consultation was not recorded. We found skin check encounters that did not include treatment of a skin cancer were generally billed as a GP consultation of either < 20 minutes or 20–40 minutes, reflecting the absence of a specific MBS item for a skin check and highlighting the difficulty in assessing skin check numbers and costs in Australia. In our sample, 0.7% of GP encounters included a skin check, matching the Bettering the Evaluation and Care of Health (BEACH) study “skin checkup” rate of a large sample of Australian GP practices between 2012 and 2016.¹⁹ Assuming that 0.7% of 120 million annual GP encounters include a skin check, this gives approximately 840 000 skin check encounters in general practice each year.

Applying a mean cost of A\$64 per encounter equates to an estimated A\$53 million in general practice-related health system costs for skin checks each year. This is likely an underestimate of primary care-related costs for skin checks, as many skin cancers are detected and managed in primary care skin cancer clinics rather than in general practice² and we did not have skin cancer clinic data. Underestimation of costs may also occur from using Victorian data because, compared to national data, Victoria has slightly lower rates of skin checks (in the previous 12 months: Victoria 30%, Australia 36%)²⁰ and melanoma incidence (age-standardised rate per 100 000 people: Victoria 47, Australia 65).²¹ It is also possible that some of the skin checks identified using the encounter reason could have been for non-cancerous conditions, although the similar rate of skin checks in the BEACH study suggests this is minimal. The skin check was coded as the primary reason for the encounter, and although the encounter may have addressed other health issues, other non-skin-related items were not included in the frequency or cost calculations.

Limitations

This study has several limitations. The reason for each encounter in the MedicineInsight dataset is recorded in a free-text field, so we may not have identified all skin check encounters if they were not clearly recorded. We were also unable to determine whether the encounter was a routine skin check, a patient-presented lesion or mole of concern, or an incidental finding during a general consultation. In Australia, approximately one-third of people report some type of skin check in the past 12 months, with 22% reporting a whole-body check (37% for people aged 45–69 years).²⁰ Moreover, MedicineInsight is primarily a quality improvement program, so it is possible that the included GP practices are not representative of all GP practices. However, the sample is considered to be broadly representative of people who visit GPs, and the relevant data are generally well recorded.^{22,23}

In addition, we could not determine if the included sample had additional skin checks in other practices that were not part of this study, potentially underestimating their healthcare use and costs. However, we checked a subset of our sample who could be linked across multiple practices and found there was limited use of multiple practices. Also, we relied on MBS item numbers to indicate skin cancer diagnoses, rather than “gold standard” cancer registry data.

Further research could address patient out-of-pocket costs associated with these encounters and downstream care, especially with falling rates of general practice encounters in which patients are not charged additional out-of-pocket fees above the Medicare rebate (i.e. bulk-billing).²⁴ The variation in frequency of subsequent healthcare after a skin check, especially for people from outer regional and more disadvantaged areas,

suggests that access to skin checks may not necessarily reflect need. However, additional patient information is needed to make stronger inferences about whether this represents the inverse care law – that people most in need of healthcare are least likely to receive it.

Conclusion

This study provides sought-after information about the frequency and costs of skin checks relating to potential skin cancers in general practice in Australia, and the downstream related healthcare. This is one of few studies to report on the real-world experience of people having skin checks and the associated costs, and shows that one in five skin checks results in subsequent treatment. The findings can be used by stakeholders and researchers in an ongoing assessment of the benefits, harms, cost-effectiveness and resource implications of establishing a potential risk-stratified melanoma screening program in Australia.

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Peer review and provenance

Externally peer reviewed, not commissioned.

Competing interests

None declared.

Author contributions

Authors DG and DM contributed equally to the manuscript as first authors, as did JE and AC as senior authors.

DG was responsible for drafting the manuscript and providing analytical advice. DM and OW were responsible

for formal data analysis and data curation. AC and JE were responsible for conceptualising the study and project administration. CK was responsible for project administration. AC, JE and CW were responsible for study funding acquisition. AC, JE, GRM, KM, CS and CW guided the analysis and interpretation. All authors were responsible for reviewing and editing the manuscript.

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