

Measuring current and future cost of skin cancer in England

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ABSTRACT

Background Increasing incidence of and mortality from skin cancer are posing a large financial burden on the NHS in England. Information provided by cost-of-illness (CoI) studies are used in policy making and are particularly useful for measuring the potential savings from averting a case of disease.

Methods We estimate the cost of skin cancer in England, and model future costs up to 2020. We compare two costing approaches (top-down and bottom-up).

Results We estimate that costs due to skin cancer were in the range of £106–£112 million in 2008. These figures are very closely related to those provided by the Department of Health (estimated to be £104.0 million in 2007–8 and £105.2 million 2008–9). The expected cost per case of malignant melanoma was estimated to be £2607 and £2560, using the bottom-up and top-down approaches, respectively. The mean cost per case of non-melanoma skin cancer was £889 and £1226, respectively. We estimate that the cost to the NHS due to skin cancer will amount to over £180 million in 2020.

Conclusion Effective prevention of skin cancer might not only reduce a significant burden of disease but it could also save considerable resources to the NHS.

Keywords burden of disease, cost, cost of illness, skin cancer

Introduction

Skin cancer is one of the most rapidly increasing cancers among fair-skinned populations worldwide. In England, the incidence of and mortality from skin cancer are increasing each year, with current estimates suggesting in excess of 9000 new cases of malignant melanoma per annum,¹ and around 1800 deaths from malignant melanoma per annum.² Rates of malignant melanoma have risen faster than any of the other top 10 cancers in recent years.³ Non-melanoma skin cancer (NMSC) is much more common than melanoma, with over 80 000 new cases reported in 2008 in England.¹ This is probably an underestimate as not all NMSC cases are recorded.⁴

Given the sizable number of cases of skin cancer, the increased number of cases in recent times, and that the majority are thought to be preventable, there is a growing

interest in skin cancer prevention in the UK. Raising awareness about the health impacts of skin cancer and, given the scale of the financial challenge facing the NHS, its financial cost, is therefore important.

Cost-of-illness (CoI) studies are conducted to measure the economic burden of a disease. This type of study highlights the magnitude of the financial impact of an illness on a society. CoI studies do not provide information on the cost-effectiveness of interventions and thus are of limited

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use to inform policy makers about which interventions should be provided. However, estimating the cost of skin cancer is particularly useful for measuring the potential cost savings from averting a case, thereby emphasizing the importance of skin cancer prevention. In addition, in some cases these estimates can aid in cost-effectiveness analyses by providing a framework for estimating costs, especially when CoI are based on incidence data. For these reasons, the publication of cost data for the management of cancer has been highlighted as an important priority for the future.⁵

The aims of this study are 2-fold; first to provide a detailed estimate of the current cost of skin cancer management in England, and second, to estimate the cost of skin cancer in the future up to 2020.

Analyses estimating the economic burden of a disease in the literature have employed varying methods, which can limit the comparability of findings. The approaches generally used to estimate costs can be broadly categorized into two categories: top-down and bottom-up.⁶ The top-down approach to costing skin cancer involves assigning a proportion of national all-cause expenditure data from administrative sources to skin cancer treatment. An alternative method is the bottom-up approach based on the costs of care incurred by individual patients receiving skin cancer treatment, which are then aggregated up to the national level based on the numbers of patients receiving each type of treatment.

While both approaches might provide valid estimates, the choice normally depends on the availability of data. The bottom-up approach has the advantage of providing more disaggregated information of the contribution of each element of health care provision to the total individual cost, and if good data are available, the estimates are expected to be more reliable, accurate and flexible. However, because it can involve constructing and modelling disease care pathways it is more demanding in terms of data and can be costly and time consuming to undertake.

In this paper, we undertake a detailed analysis of the cost of skin cancer in England using both approaches. We focus on measuring direct NHS costs due to skin cancer. We begin by replicating the top-down analysis previously undertaken by Morris *et al.*⁷ using more up-to-date figures. We compare the results using this approach with the estimated cost of skin cancer using a bottom-up approach. These estimates are also compared with figures provided by the National Programme Budgeting Data (PBD) project.

As previously noted, incidence rates of malignant melanoma in Britain have increased faster than any of the top 10 cancers. If this trend increases, the financial burden of skin cancer will continue to increase in the future. The second

aim of this study is to model the expected costs of skin cancer in England up to 2020. To do so, we project our current estimates out to 2020 based on the published estimates of the future incidence of skin cancer.

Methods

This paper describes the methodology and results from a project which was commissioned by the South West Public Health Observatory.⁸ All costs were reported in 2008 UK pounds sterling (UK£). Where 2008 was not the cost base year of the unit costs obtained, inflation indices (NHS Pay and Prices Indices, taken from Curtis, 2008)⁹ were applied.

Costs are estimated separately for two classifications of skin cancer defined using the ninth and tenth revisions of the International Classification of Diseases (ICD-9 and ICD-10, respectively): malignant melanoma (ICD-9 code 172, ICD-10 code C43); and non-melanoma skin cancer (173 and C44). In the bottom-up approach, we also identify separately the cost of benign cases.

Top-down approach

NHS costs using a top-down approach are calculated by combining data on health service use by patients with skin cancer with data on the unit cost of services. We require data on the number of general practitioner (GP) consultations, inpatient stays, day cases, and outpatient visits due to skin cancer, as well as the unit costs for each of these services.

Table 1 describes the data we use and the assumptions that are applied in the analysis. Number of inpatient stays, day cases and outpatient visits due to skin cancer were taken from the *Hospital Episode Statistics*,¹⁰ while GP consultations for skin cancer were estimated using information on GP consultation rates for skin cancer from the *Morbidity Statistics from General Practice*.¹¹ Similar to the approach taken in Morris *et al.*⁷ information on current skin cancer incidence are used to update number of GP consultations (see Table 1). Policies and resource availabilities for the recording of non-melanoma vary among cancer registries and over time, and therefore available figures are known to be underestimates.⁴ We use inflation estimates computed by South West Public Health Observatory (SWPHO) to model the incidence of non-melanoma skin cancer based on the cases of melanoma. These are based on the ratio of non-melanoma skin cancer to malignant melanoma found in two Government Office Regions—South West and the West Midlands—which both contain Cancer Intelligence Units that are recognized as having good quality data collection of

Table 1 Top-down costing of skin cancer—number of contacts and unit cost data

Cost component	Data	Source(s)	Notes
<i>Contacts</i>			
Number of GP consultations	153 091	OPCS ¹¹ ONS ¹ SWPHO inflation adjustment for non-melanoma	GP consultations per new case of melanoma were computed using the ratio of GP consultation by age and gender from <i>Morbidity statistics from general practice: fourth national study 1991–1992, series MB5 no. 3</i> , and applying these rates to 2006 data on the incidence of melanoma from <i>Cancer statistics: registrations, series MB1 no. 32</i> . In the case of non-melanoma skin cancer, we use inflation estimates computed by SWPHO to model the incidence of non-melanoma skin cancer based on cases of melanoma.
Number of elective inpatient admissions	10 906	Department of Health ¹⁰	Hospital episodes statistics, England: financial year 2007–08.
Number of non-elective inpatient admissions	1391		
Number of day cases	77 332		
Number of outpatient visits (first appointment)	135 643	Department of Health ¹⁰	Hospital episodes statistics, Outpatient Statistics, England: financial year 2007–08.
Number of outpatient visits (follow-up appointment)	498 192		Since primary diagnosis is not a mandated field in the HES outpatient dataset, recording of ICD-10 code in these data is poor. We calculated the proportion of all attendances where an ICD-10 code was recorded which were attributable to skin cancer. We then multiplied the total number of outpatient attendances by this proportion to estimate the total number of outpatient attendances that were attributable to skin cancer.
<i>Unit costs</i>			
Cost per GP visit	£36	Curtis ⁹	Including direct care staff costs with qualification costs.
Cost per elective inpatient admission	£2650	Department of Health ¹²	NHS reference costs 2005–06.
Cost per non-elective inpatient admission	£2473		Inflated to 2008 prices using inflation indices reported by Curtis
Cost per day case	£327		
Cost per outpatient visits (first appointment)	£112	Curtis ⁹	
Cost per outpatient visits (follow-up appointment)	£68		

first cases of non-melanoma skin cancer. In these areas, the ratios of non-melanoma skin cancer to malignant melanoma were between 7:1 and 10:1. Taking the mid-point of this range, estimates of the incidence of non-melanoma skin cancer were calculated by SWPHO based on 8.5 times the incidence of malignant melanoma. Unit cost of inpatient stays, day cases and outpatient visits are taken from NHS reference cost data¹², while GP visit costs are provided by Curtis.⁹

Bottom-up approach

We constructed a simplified model of skin cancer care in the NHS using: (i) guidelines produced by the British Association of Dermatologists for the management of

melanoma,¹³ basal cell carcinoma¹⁴ and squamous cell carcinoma,¹⁵ and (ii) health guides from the Map of Medicine website (<http://mapofmedicine.com/>) for melanoma and for basal cell carcinoma. Input from expert clinicians was also sought. We aimed to produce a simplified care pathway that reflected current management patterns, but which is simple enough to be able to populate with available data.

We required data on the probabilities of patients following different elements of the pathway, and the unit costs associated with each element. We systematically searched three databases for these data: Published reports from the NIHR Health Technology Assessment Programme (<http://www.hta.ac.uk/project/htapubs.asp>), The NHS Economic Evaluation Database at the Centre for Reviews and

Dissemination at the University of York (<http://www.york.ac.uk/inst/crd/crddbatabases.htm>) and PubMed (<http://www.ncbi.nlm.nih.gov/sites/entrez?db=pubmed>).

From this search, the probabilities of patients receiving different elements of the care pathway were obtained from a series of published journal papers,^{16–23} plus data from *Cancer Statistics: Registrations*.¹ Unit costs were obtained from published national averages for England, taken from published journal papers,^{24,25} published reports,^{9,26} administrative data^{10,12,27} and relevant websites (British National Formulary, <http://www.bnf.org>; CancerHelp UK, <http://www.cancerhelp.org.uk>). In a number of cases directly relevant unit costs were not available and assumptions were required to be able to populate the care pathway; we state clearly the assumptions used in Table 2.

We calculated the total costs to the NHS in England by multiplying the expected costs per case by the total number of cases (cases are defined as individuals with a diagnosis based on Cancer Statistics Registration data). We used the estimates computed by SWPHO to model the incidence of non-melanoma skin cancer based on cases of melanoma as explained above. The total cost of benign cases was computed assuming 12 benign cases for every new case of melanoma.^{16,17}

Programme Budgeting Data

The National Programme Budgeting project provides retrospective data on NHS spending broken down into 23 programmes of care. The project was developed to provide a source of information to better understand where money is spent in the NHS. The 2008–09 Cancer Network Workbook allows analysis of total national expenditure on specific cancers, including skin cancer. These data enable us to investigate the robustness of our estimates of the financial cost of skin cancer.

Skin cancer expenditure data were obtained from the 2008–09 Cancer Network Workbook version 1.0 from the National Programme Budget project.²⁸ The data cover expenditure on each Primary Care Trust (PCT)'s own population which is the net expenditure, adjusted to add back expenditure funded from sources outside of the NHS and to deduct expenditure on other PCTs populations through lead commissioning arrangements.

Projections to 2020

We project our 2008 cost estimates out to 2020 based on the published estimates of the future incidence of melanoma.²⁹ Using an age cohort model Diffey, 2004, estimates the future incidence of melanoma in the UK up to 2070.

He uses incidence data for the period 1975–2000 in 5-year age bands to extrapolate future incidence out to 2070 based on three scenarios describing how future lifetime risk of melanoma might change. Scenario A assumes increasing lifetime risk of melanoma, in which the increasing risk over time observed over 1975–2000 continues into the future. Scenario B assumes stabilization in lifetime risk with a flattening of the incidence over time. Scenario C assumes a falling lifetime risk, on the basis of intervention strategies to reduce sun exposure with a resulting fall in the incidence of melanoma.

We use these data to compute the ratio of the total incidence in each year to the incidence in 2008. We then multiply our cost estimates for 2008 by the ratio of the incidences each year to project future costs for every year up to 2020. We base our projections on the future incidence of melanoma only given uncertainties surrounding the true incidence of non-melanoma skin cancer, and that our estimates of the incidence of non-melanoma skin cancer are assumed to be proportional to the cases of melanoma.

Results

Incidence

According to cancer registry data, there were 8658 new registrations of malignant melanoma and 69 840 new registrations of NMSC in England in 2006. Using SWPHO estimates, we were able to get a better estimate of the incidence of non-melanoma skin cancer. Taking the mid-point of the range estimated by the SWPHO (i.e. 8.5 times the incidence of malignant melanoma), there were 73 593 cases in 2006.

Top-down approach

Table 1 describes the data on the number of GP consultations, inpatient admissions, day cases and outpatient visits due to skin cancer and their corresponding unit costs.

The resulting costs of skin cancer borne by the NHS were estimated to be £112.4 million. The cost of each component and the proportion of total NHS costs attributable to each component are shown in Table 3. Twenty per cent of the total cost to the NHS is due to melanoma, and outpatient attendances account for the largest share of NHS costs (44%).

Bottom-up approach

A simplified care pathway was developed and is presented in Fig. 1. In brief, following an initial examination, patients are either treated initially in primary care or referred directly to a specialist. Among those who are treated in primary care,

Table 2 Bottom-up costing of skin cancer—probabilities and unit cost data

<i>Probability of event</i>	<i>Data</i>	<i>Source(s)</i>	<i>Notes</i>
Treat in primary care	0.215	Murchie <i>et al.</i> ²² Malhomme de la Roche <i>et al.</i> ¹⁹	Weighted mean probability of being treated in primary care from two studies, with weights given by the sample size of each study.
Benign case after treatment in primary care	0.310	Jackson <i>et al.</i> ¹⁷	
Referral after treatment in primary care	0.160	Hussain <i>et al.</i> ¹⁸	
Diagnostic biopsy in secondary care	0.236	Gudi <i>et al.</i> ²¹ Orr <i>et al.</i> ²³	Weighted mean probability of performing diagnostic biopsy from two studies, with weights given by the sample size of each study.
Benign case after diagnostic biopsy	0.553	Jackson <i>et al.</i> ¹⁷ Goulding <i>et al.</i> ¹⁶	Weighted mean probability of case being benign from two studies, with weights given by sample size of each study.
Non-melanoma case after diagnostic biopsy	0.400	ONS ¹	Based on the inflation estimates computed by SWPHO to model the incidence of non-melanoma skin cancer
Melanoma case after diagnostic biopsy	0.047	SWPHO inflation adjustment for non-melanoma	
Treating non-melanoma with surgical excision	0.860	Bachelor <i>et al.</i> ²⁰ ; Gudi <i>et al.</i> ²¹ ; Goulding <i>et al.</i> ¹⁶	Weighted mean probabilities based on treatment probabilities for SSC and BCC, with weights given by SSC and BCC prevalence
Treating non-melanoma with curettage and cautery	0.075		
Treating non-melanoma with cryotherapy	0.031		
Treating non-melanoma with radiotherapy	0.017		
Treating non-melanoma with phototherapy	0.008		
Treating non-melanoma with topical drug treatment	0.005		
Treating non-melanoma with Mohs surgery	0.004		
Treating melanoma with surgical excision	0.879	Orr <i>et al.</i> ²³	
Treating melanoma with radical lymph node dissection	0.088		
Treating melanoma with excision + radiotherapy	0.022		
Treating melanoma with radiotherapy	0.011		
<i>Unit costs</i>	<i>Data</i>	<i>Source(s)</i>	<i>Notes</i>
GP visit	£36	Curtis ⁹	Including direct care staff costs with qualification costs.
Treatment in primary care	£85	NICE ²⁶	Estimated excision costs for BCCs in primary care.
Specialist visit	£112	Department of Health ¹²	Outpatient Adult First Attendance Face to Face: Dermatology 330F.
Diagnostic biopsy	£112		Assume same as cost of specialist visit.
Topical treatment	£200	British National Formulary (www.bnf.org); Curtis	Assume treatment with Imiquimod; application for 5 days each week for 6 weeks, assessing response 12 weeks after completing treatment. Drug cost is £51.32 for a 12 sachet pack, or £4.28 per pack. Require 30 packs at a cost of £128.30. Assume two GP visits; one at the start of treatment and one 12 weeks after completing treatment.

Continued

Table 2 Continued

Unit costs	Data	Source(s)	Notes
Phototherapy	£3910	CancerHelp UK website (www.cancerhelp.org.uk); Department of Health ²⁷	Assume three sessions a week for 8 weeks, then one session every 2 weeks up to one year = $3 \times 8 + 0.5 \times 44 = 46$ sessions in total, costed per session on the basis of Outpatient procedure cost: Phototherapy HRG JC29Z.
Mohs surgery	£114	Department of Health ¹²	Outpatient procedure cost: Microscopically Controlled Excision of Lesion of Skin HRG J02op
Curettage and cautery	£137	Department of Health ¹²	Outpatient procedure cost: Other Excision / Biopsy of Skin HRG J04op
Surgical excision	£885	Department of Health ²⁷	Weighted average of inpatient procedure and day case procedure cost: Minor Skin Procedures category 1HRG JC07Z; weights given by proportion of inpatient and day cases episodes for Minor Skin Procedures category 1 in Hospital Episode Statistics
Radiotherapy	£2260	Department of Health ¹⁰	Teletherapy with technical support >12, <24 fractions HRG w22
Cryotherapy	£204	Department of Health ¹² Keogh-Brown <i>et al.</i> ²⁴	Based on the cost of GP-administered cryotherapy from cost-effectiveness analysis of wart treatment, in which cryotherapy involved three GP visits. Assume in a hospital setting this requires three specialist visits, costed on the basis of three outpatient attendances (Outpatient Adult Follow Up Attendance Face to Face: Dermatology 330F).
Radical lymph node dissection	£16 808	Thomas <i>et al.</i> ²⁵	
Surgical excision + radiotherapy	£3145		Sum of surgical excision and radiotherapy costs
Follow-up in primary care	£36	Curtis ⁹	Assume one GP surgery consultation
Follow-up in secondary care	£68	Department of Health ¹²	Assume one Outpatient Adult Follow-up Attendance Face to Face: Dermatology 330F

Table 3 Cost of skin cancer in England in 2008

	<i>Malignant melanoma of skin</i>		<i>Non-melanoma skin cancer</i>		<i>Benign cases</i>		<i>All skin cancers</i>	
	£000's	%	£000	%	£000's	%	£000's	%
Top-down costing								
GP consultation	1077	0.96	4435	3.95	N/A		5511	4.90
Inpatient stays	9098	8.09	23 273	20.70			32 372	28.80
Day cases	2465	2.19	22 849	20.33			25 314	22.52
Outpatient attendances	9522	8.47	39 684	35.31			49 206	43.78
<i>Total costs</i>	22 162	19.72	90 241	80.28			112 403	100.00
Bottom-up costing								
Total costs	22 570	21.21	65 401	61.46	18 448	17.34%	106 418	100.00

some will be found to have benign tumours, some will be found to have malignant tumours and will be treated successfully, and some will require subsequent referral to a specialist. Among those referred to a specialist (either directly

or following a course of treatment in primary care), a proportion of patients will undergo a diagnostic biopsy. Patients in specialist care will have either a benign tumour or a malignant melanoma or non-melanoma skin cancer. A range of

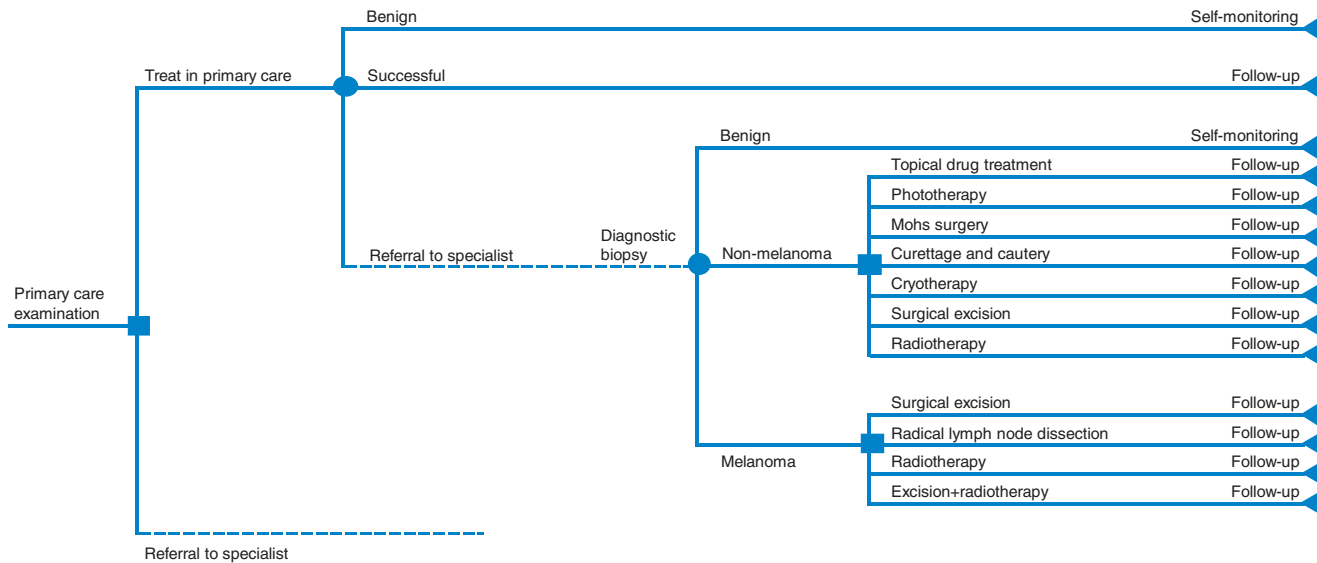


Fig. 1 Simplified care pathway.

management options are then used to treat the patients depending on the condition of the patient. As noted above, the patient pathways were simplified to allow populating the model with current available estimates. As a result, some possible treatment options or combination of treatments might not be reflected in our analysis.

The probabilities and unit costs used to populate the care pathway, along with the sources of data used, are described in Table 2. Combining these data, the expected cost per case for malignant melanoma and non-melanoma skin cancer was calculated to be £2607 and £889, respectively. The expected cost per case for benign cases was £181. Based on a total of 8658 cases of malignant melanoma, 73 593 cases of non-melanoma skin cancer and 101 720 benign cases, the total financial cost to the NHS was calculated to be £106.4 million (Table 3).

Programme Budgeting data

According to programme budgeting data, total NHS spending on skin cancer in England in 2007–8 and 2008–9 was £104.0 million and £105.2 million respectively.

Projections to 2020

Under each of the three scenarios, the incidence of melanoma is projected to increase each year up to 2020, though at a slower rate for scenario B compared with scenario A and for scenario C compared with scenario B.

NHS costs for skin cancer are projected to be £190.5 million, £185.5 million and £180.1 million in 2020 under scenarios A, B and C, respectively, using the top-down approach (Fig. 2). Based on the estimates derived from the

bottom-up approach, NHS costs are projected to be £181.6 million, £176.2 million and £170.9 million, respectively.

Discussion

Main findings of this study

NHS costs due to skin cancer were estimated to be £112.4 million per annum using a top-down approach and £106.4 million using the bottom-up approach. These figures are very similar to each other, and also to the estimates produced by the Department of Health as part of the National Programme Budgeting project.

What is already known in this topic

A previous top-down estimate of the NHS cost of skin cancer in England in 2002 was £101.6 million.⁷ The health care costs due to skin cancer have been estimated in a number of countries with a varying number of cases. Direct health care costs due to skin cancer in Sweden were €79.8 million in 2005 (£78.8 million in 2008 prices).³⁰ In New Zealand, these costs were NZ\$57 million in 2006 (£34 million in 2008 prices).³¹ In Australia, skin cancer costs were AU\$300 million in 2000–01,³² and more recently the total cost of non-melanoma skin cancers alone was AU\$512.3 million in 2010 (£346 million).³³ Information from the PBD programme allows us to compare NHS costs of skin cancer with those of other diseases in England. NHS spending on head and neck cancers and gynaecological cancers are similar to those for skin cancer (£139 and £156 million, respectively, in 2008–09). Mental health problems and cardiovascular diseases were highest spending

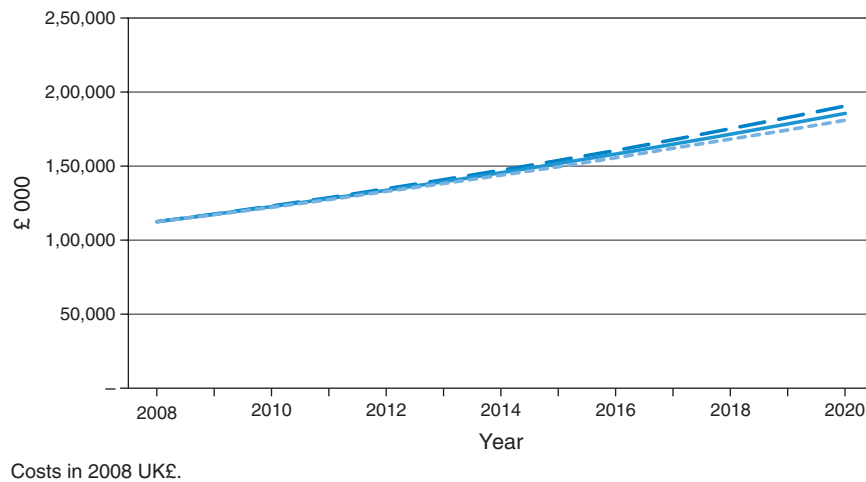


Fig. 2 Projected future cost of skin cancer in England up to 2020. Costs in 2008 UK£. The dashed line assumes increasing lifetime risk of melanoma (scenario A), the solid line assumes stabilization in lifetime risk of melanoma (scenario B) and the dotted line assumes falling lifetime risk of melanoma (scenario C).

categories in England in 2008–09 accounting for £9.7 and £6.6 billion, respectively.

What this study adds

We provide up-to-date estimates of the cost of skin cancer in England and projections to 2020. Our estimates are slightly larger than the PBD estimates, probably due to differences in the cost components used. PBD figures do not include expenditure by the Department of Health, Strategic Health Authorities and Special Health Authorities, and do not include expenditure on prevention or GP expenditure. Unlike PBD analyses, our analysis can be disaggregated into different components of care: into broad types of care categories in the top-down approach; and into components of the care pathway in the bottom-up approach. This permits more in-depth investigation of the specific areas where cost containment strategies are likely to play a major role.

Estimating the cost per case also provides useful information about the potential savings of averting a case, especially in the context of skin cancer where prevention is recommended. The expected NHS costs per case of malignant melanoma were £2607 and £2560, using the bottom-up and top-down approaches, respectively. The expected costs of non-melanoma skin cancer were £889 and £1226, respectively.

Limitations

There is some uncertainty surrounding some of these estimates. Based on the previous estimates of the projected future incidence of melanoma, we estimate by 2020 that the NHS cost of skin cancer will lie in the range £170–190 million. Even the most optimistic assumptions suggest that the costs

of skin cancer are likely to rise considerably over the next few years. Also note that our estimated future costs are based on the published estimates of the future incidence of skin cancer, and assume that management and costs of skin cancer cases would remain broadly unchanged, which might not necessarily be the case. If more expensive technologies are used in the future, our projections will provide a conservative estimate. For instance, new chemotherapy treatments for late-stage malignant melanoma are currently becoming available.

Finally it is worth noting that we have focused in this study on the direct NHS costs due to skin cancer; other costs such as patient costs incurred in the receipt of treatment, productivity losses and premature mortality impose a large additional burden to these estimated costs³⁴ which are not included in this study.

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