

Improving estimates of specialist-diagnosed, work-related respiratory and skin disease

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Background	Work-related skin and respiratory disease still constitute an important part of the work-related ill-health (WRIH) burden of Great Britain (GB). It is therefore important to be able to accurately quantify the true incidence of these two groups of disease.
Aims	To improve the accuracy of the methodology to estimate clinical specialist incidence rates, with a focus on skin and respiratory disease. Specifically, we sought to estimate the number of additional cases not captured by voluntary surveillance through The Health and Occupation Reporting (THOR) network and provide a better estimation of the true incidence of work-related skin and respiratory disease in GB.
Methods	Cases not captured by THOR in 2005–2007 due to non-participation of eligible clinical specialists and due to <100% response rates by THOR participants were estimated, and the numerator adjusted accordingly. Adjusted incidence rates were calculated using Labour Force Survey data as the denominator.
Results	During 2005–2007, 62% of skin cases and 60% of GB respiratory cases were likely to have been captured by THOR. After adjustment, dermatologist-derived incidence rates for skin disease were raised from 9 to 14 per 100 000 employed, while those for respiratory disease were raised from 10 to 17 per 100 000 employed.
Conclusions	We have provided a significant improvement in the surveillance-based methodology used to estimate the number of cases of WRIH captured by THOR and hence enabled more accurate estimations of GB incidence rates for clinical specialist-reported WRIH.
Key words	Incidence; respiratory disease; skin disease; surveillance.

Introduction

Respiratory and skin diseases constitute a substantial proportion of the overall work-related ill-health (WRIH) burden in Great Britain (GB) [1,2]. It is therefore important to accurately quantify the true incidence of these two groups. To achieve this, accurate numerator and denominator data are required. Sources of data on work-related respiratory and skin disease include the Self-reported Work-related Illness (SWI) surveys, which are conducted annually within the Labour Force Survey (LFS), and enable the general public to report cases of WRIH [3]. The LFS uses a stratified random sampling design; thus, data should be fairly representative of the GB population. The main disadvantage of the SWI is that the diagnosis, and judgement as to whether the case is work-related, is not made by a medical practitioner.

Incidence data on WRIH are also collected by The Health and Occupation Reporting (THOR) network that performs an observatory function through voluntary medical reporting. Within THOR, chest physicians and dermatologists report to Surveillance of Work-Related and Occupational Respiratory Disease (SWORD) and Occupational Skin Surveillance (EPIDERM), respectively [4–6]. These data are restricted to the top end of the disease ‘severity pyramid’ as they only include cases referred to clinical specialists. Occupational physicians (OPs) can report skin and respiratory cases to the Occupational Physicians Reporting Activity (OPRA) [7]. However, OPRA data are limited in coverage and by the very uneven access [8] of the GB workforce to trained OPs. Finally, THOR-general practitioners (GP) enables GPs with some training in occupational medicine

to report cases of WRIH as seen in a general practice setting [9].

For OPRA and THOR-GP, there are ongoing studies to determine the size of the populations covered by reporters and hence to estimate incidence rates [10]. To date, to estimate incidence rates from THOR's clinical specialist schemes, it has been assumed that all cases of interest in GB have been captured and the relevant GB workforce (from the LFS) has been used as the denominator. However, the assumption that all cases are captured is questionable since this assumes that all eligible reporters actually report to THOR.

The aim of the present study was to improve the accuracy of clinical specialist rates for GB, focussing on work-related skin and respiratory disease. In particular, we sought to estimate the number of additional cases not captured by THOR in 2005–07 and to enable the provision of a better estimation of the true incidence of these disease categories in GB.

Methods

The methodology behind EPIDERM and SWORD has been summarized previously [5,6]. Briefly, physicians report as 'core' reporters (reporting every month) or 'sample' reporters (who report for one randomly allocated month each year). To determine the estimated number of incident cases in a year, cases reported by sample reporters are multiplied by 12 and added to cases reported by core reporters. Physicians are asked to report only new cases seen within a reporting month, and the decision as to whether the case is work-related is left to the physician, although guidance for reporting is given [4].

Recruitment to EPIDERM and SWORD is based on approaching all known GB dermatologists and chest physicians. However, it is possible that not all eligible physicians have been approached. Moreover, among those participating, response rates have been <100%. These factors would tend to result in underestimation of the true rates but if their extent could be estimated, the bias could potentially be corrected. The methodology used to estimate the true clinical specialist-reported incidence rates is outlined in Figure 1. To estimate the number of GB dermatologists and chest physicians eligible to report to THOR (i.e. currently practising in GB and seeing patients of working age), the National Health Service (NHS) Clinical Excellence Awards (CEA) registers of eligibility for GB were obtained [11]. Those eligible for a CEA are NHS (substantive or honorary) consultants with at least 1 year's experience at consultant level, who are currently practicing in GB.

THOR's specialist databases contain information relating to every physician approached to report and the outcome of the approach. If a physician withdrew, the details remain in the database including the reason for

withdrawal (if given). The number of physicians never approached to report to THOR was determined by cross-checking physicians' details contained on the 2005 NHS CEA with physicians' details on THOR's specialist databases (as of December 2005).

Physicians who were approached by THOR were classified as shown in Figure 2. Not every consultant is eligible to report: for example a consultant may sub-specialize by age (and only see children) or by disease (and only see patients with diseases not considered occupational). For physicians who had reported to THOR but have since withdrawn, eligibility was based on the reason they gave for withdrawing; those who gave no reason were assumed eligible. For physicians whose eligibility was unknown (either because they had been approached to report but had never replied or had never been approached to report), the method used involved assigning all those with medical registration dates on or before 1969 (assuming general medical qualification aged 24 years and retirement at age 60 years) to the 'ineligible' category. The proportion eligible from the remainder was then estimated, based on information from physicians whose eligibility was known. In this way, the overall participation rate by eligible reporters was estimated.

The simplest way of correcting the number of estimated cases in EPIDERM and SWORD for non-participation would be to multiply estimated cases by the inverse of the corresponding participation rate. However, it was apparent that certain reporters (or centres/groups of reporters) return far greater numbers of cases per month than others. If there are centres/groups within GB where the majority of relevant cases are seen, it is important that THOR has coverage of these 'super centres' in order to give accurate estimates of disease incidence. After consultation with dermatologists and chest physicians, super centres were defined (for the purpose of this study) as follows:

- Dermatologists: a centre with more than five members of the British Association of Dermatologists among its consultant staff.
- Chest physicians: a centre with the facilities to carry out specific bronchial provocation challenge tests.

Subsequently, EPIDERM and SWORD case capture rates were estimated separately for 'ordinary' and super centres.

The EPIDERM and SWORD databases revealed a small decrease (~1%) in the number of physicians participating in EPIDERM in 2006 and 2007 compared to 2005, while participants in SWORD had increased (by ~5%). In view of these relatively small changes in participant numbers, coupled with substantial difficulties in obtaining year-specific numbers of eligible physicians in GB for 2006–2007 (from the NHS CEA lists), it was decided to estimate case capture in 2006–2007 based on information for 2005.

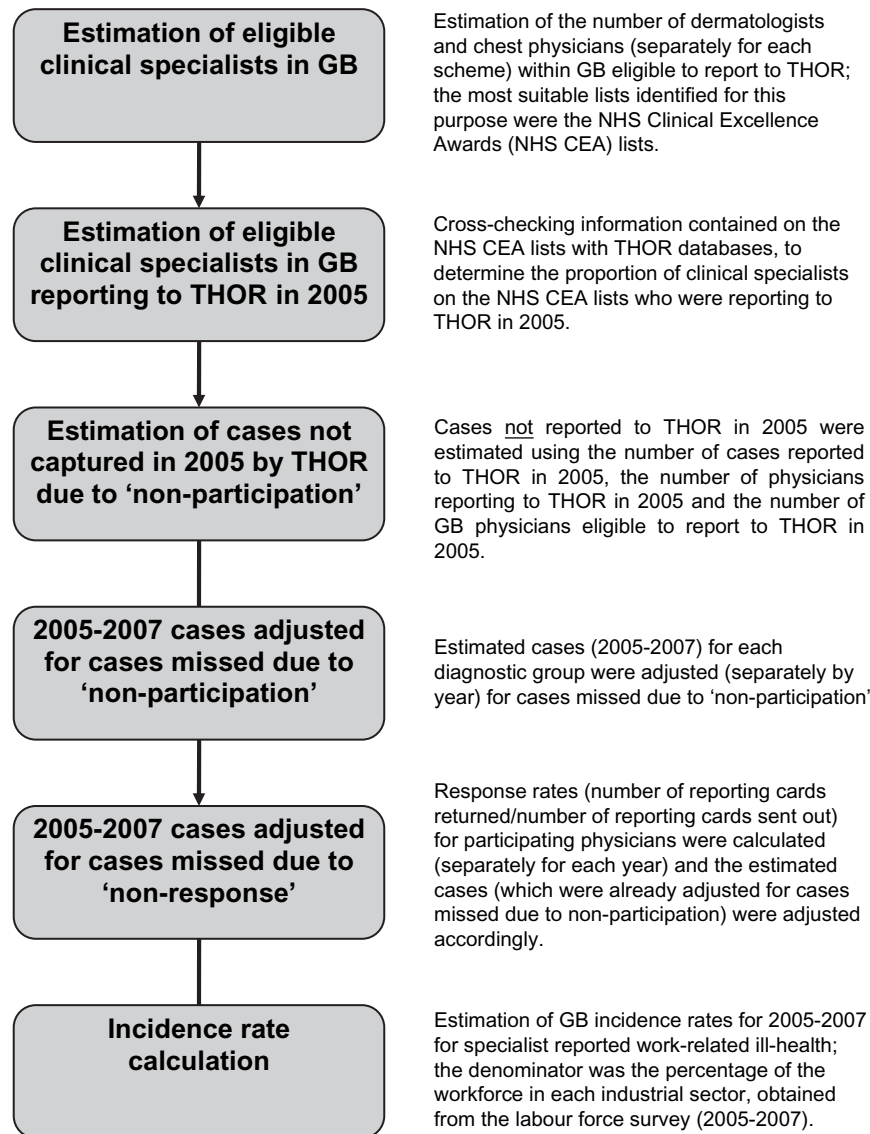


Figure 1. Methodology used to determine clinical specialist-reported incidence rates.

A physician may also see relevant cases during a reporting month but not return a report (i.e. non-response); reporter response rates (for each year) were available for EPIDERM and SWORD. To adjust for non-response, estimated case numbers were multiplied by the reciprocal of the response rate (factored up) for each scheme.

Unadjusted and adjusted incidence rates were calculated separately by year for total skin and respiratory disease and also for diagnoses with an annual average of ≥ 50 estimated cases. The unadjusted rate provides no adjustment for missing cases, while the adjusted rate uses number of case reports after factoring up for non-participation and non-response. The GB workforce numbers for each year, obtained from the LFS (but excluding the LFS data for Northern Ireland), were used as the denominator [12].

Incidence rates in EPIDERM and SWORD were compared with SWI incidence rates for total skin and respiratory disease, obtained from the Health and Safety

Executive's website [13], and OP incidence rates as reported to OPRA. To estimate OP incidence rates, the denominator used was obtained from a survey in which each OPRA reporter was asked about the workforce they covered [10]. The total GB workforce covered by OPRA reporters was then factored up to allow for the denominator survey response rate (68%). The numerator data (estimated cases reported to OPRA during 2005–2007) were factored up to allow for non-response of the reporting physicians (annual average response rate: 90%).

Results

Cross-checking between data sources identified 636 dermatologists and 898 chest physicians, who were either on the EPIDERM/SWORD database and/or the NHS CEA eligibility register (Table 1). The majority (98% of the

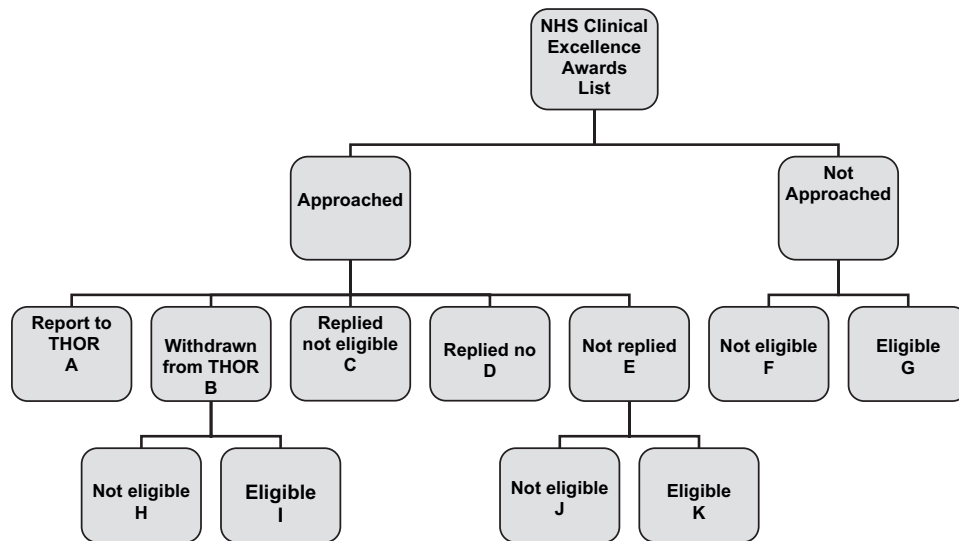


Figure 2. Methodology used to determine THOR participation rate for eligible reporters. Eligible = A + D + G + I + K and THOR participation rate for eligible reporters = A/(A + D + G + I + K).

Table 1. Proportion of GB chest physicians and dermatologists estimated to be eligible to report to THOR in 2005

	Chest physicians	Dermatologists
Total physicians	898	636
Approached to report to THOR	857	623
A: Report to THOR as of December 2005	452	261
H: Withdrawn from reporting—not eligible	120	104
I: Withdrawn from reporting—eligible	24	11
C: Replied ‘no’ to approach—not eligible	83	49
D: Replied ‘no’ to approach—eligible	23	25
J: Did not reply to approach—assumed not eligible	50	73
K: Did not reply to approach—assumed eligible	105	100
Not approached to report to THOR	41	13
F: Assumed not eligible	15	7
G: Assumed eligible	26	6
THOR participation rate for eligible physicians	452/(452 + 23 + 26 + 24 + 105) = 72%	261/(261 + 25 + 6 + 11 + 100) = 65%

The letters prefixing the text in column one correspond to the letters in the flowchart depicted in Figure 2.

dermatologists and 95% of the chest physicians) had been approached to report to THOR and participation rates were high for eligible dermatologists (65%) and chest physicians (72%).

The main reason for physicians withdrawing from reporting was because they were no longer eligible, typically because they had either retired or were no longer seeing patients of working age. A smaller proportion withdrew for reasons that did not affect their eligibility, for example ‘too busy to report’. This study also identified 186 dermatologists and 196 chest physicians with ‘unknown’ eligibility for THOR reporting, either because they had been approached but had never replied or because they had never been approached. To estimate the proportion of these unknown dermatologists or chest physicians eligible to report, the first step was to assign

all those with a registration date on or before 1969 to the ineligible category on age grounds. The ratio of eligible to ineligible of those for whom eligibility was known was then estimated (i.e. following the annotation in Table 1: the ratio of A + I + D to H + C). This ratio was applied to the remaining ‘unknowns’ resulting in 57 and 67% of the dermatologists and chest physicians, respectively, assumed eligible to report to THOR.

The methodology outlined in Figure 2 was applied to the ‘ordinary centres’, and suggested 66% of skin cases and 72% of respiratory cases were captured by THOR. For super centres, we identified one or more reporters in 90% of the skin super centres and a reporter in each of the respiratory super centres. Focus group meetings with key physicians suggested that THOR reporters in super centres captured ~80% of eligible cases seen. Taken

in conjunction with case capture rates for ordinary centres (at this stage ignoring cases missed due to non-response of THOR participants), it was estimated that more than two-thirds of all eligible GB work-related skin and respiratory cases were reported to EPIDERM and SWORD during 2005 (Table 2).

Cases 'missing' due to 'non-response' by participating physicians were then estimated by calculating the reporter response rates, separately for each year (and each scheme) and adjusting the cases accordingly (annual average reporter response rates: EPIDERM 90%, SWORD 82%).

Between 2005 and 2007, an annual average of 2416 incident cases of work-related skin disease were reported to EPIDERM, and 2857 incident cases of work-related respiratory disease were reported to SWORD (Table 3). The effects of adjustment for non-participation and non-response are shown for total cases and for skin and respiratory diagnoses with an annual average of ≥ 50 cases. Most skin cases were contact dermatitis (68%), while the majority of respiratory cases were benign pleural plaques (44%). The effect of adjustment for non-participation and non-response on the annual average incidence rates (estimated using the LFS annual average 2005–2007 GB workforce as the denominator) is also shown.

A comparison of clinical specialist-reported work-related skin and respiratory disease incidence rates with SWI- and OP-derived incidence rates is provided in Table 4.

Table 2. Proportion of clinical specialist-diagnosed GB cases captured by SWORD and EPIDERM in 2005

	SWORD	Epiderm
'Super centres'		
Cases reported to THOR ^a	340	635
Cases that could be reported to THOR ^b	425	794
'Ordinary centres'		
Cases reported to THOR ^a	2932	1773
Cases that could be reported to THOR ^c	2932/0.72 = 4072	1773/0.66 = 2686
All centres		
Cases reported to THOR	340 + 2932 = 3272	635 + 1773 = 2408
Cases that could be reported to THOR	425 + 4072 = 4497	794 + 2686 = 3480
Case capture rate	3272/4497 = 73%	2408/3480 = 69%

^aCases reported by 'sample' reporters are multiplied by 12 and added to the cases reported by 'core' reporters.

^bAssuming that 80% of the eligible cases seen in the super centres are reported to THOR.

^cAssuming that 72% of eligible GB chest physicians and 66% of eligible GB dermatologists report to THOR.

Discussion

From this study, we estimated that 62% of cases were captured by EPIDERM and 60% of cases were captured by SWORD (from 65 and 72% of eligible reporters, respectively) after adjusting for response rates of participating physicians, during 2005–2007. We also found excellent coverage ($\geq 90\%$) in each of the skin and respiratory super centres. This is the first report describing the incidence of WRIH in GB, where adjustments have been made to account for cases (in relation to the corresponding denominator) captured (and missed) by THOR. Assuming that each clinical specialist has an equal chance of being a reporter, and knowing the fraction of physicians participating, weighting factors could be applied to estimate total incident cases.

A number of limitations apply to this approach for missing case adjustment; errors may have occurred when matching physicians between THOR and the NHS CEA registers. Additionally, NHS CEA registers may not contain the details of all GB specialists practising in 2005, as there appears to be a 1-year time lag between physicians achieving specialist accreditation and being listed as eligible for a CEA [14]. Additionally, we applied the standard NHS retirement age of 60 years to adjust crude incident rate estimations, but retirement

Table 3. Crude and adjusted annual average estimated cases and incidence rates (per 100 000 employed) of work-related skin and respiratory disease reported by specialists to THOR, 2005–2007

	Cases		Incidence rate per 100 000 employed	
	Crude ^a	Adjusted ^b	Crude ^a	Adjusted ^b
Contact dermatitis	1635	2632	5.8	9.4
Neoplasia ^a	605	974	2.2	3.5
Contact urticaria	93	150	0.3	0.5
Total skin	2416	3891	8.6	13.9
Benign pleural plaques	1257	2099	4.5	7.5
Mesothelioma	758	1267	2.7	4.5
Asthma	359	599	1.3	2.1
Pneumoconiosis	194	325	0.7	1.2
Lung cancer	96	160	0.3	0.6
Total respiratory	2857	4722	10	17

^aNo adjustment for non-participation and non-response.

^bAdjusted for non-participation and non-response.

Table 4. GB incidence rates (per 100 000 employed)

	SWI	Occupational physician	Clinical specialist
Total skin	38	13	14
Total respiratory	52	6	17

before (or perhaps more likely after) age 60 years would affect our adjusted rates. Alternatively, estimation of total eligible physicians may be slightly inaccurate because a physician reports, unbeknown to us, as part of a group (i.e. via a group leader who reports to THOR). A study to investigate group reporting is ongoing. We have also applied the assumption that all diagnoses have an equal chance of being reported, which is unlikely in reality, and requires additional investigation beyond the scope of this study.

Incidence rates were also adjusted for missing cases arising from non-response of the participating physicians. This assumes that a non-response was not influenced by the number of cases physicians could have reported. However, non-responders may genuinely have seen no reportable cases (although reporters are encouraged to respond with 'I have no cases to report' in this circumstance). As such, the 'unadjusted' and 'adjusted' rates may be considered as the two 'extreme' ends of the scale for incident cases of WRIH.

Some cases may be missed because a physician returns fewer cases as membership time in THOR increases due to reporting fatigue. A study investigating the change per year in incidence of specialist-diagnosed, skin and respiratory disease found some evidence of fatigue, measured by physicians' increased tendency to return 'nil reports' (or to not respond at all) as membership time increased but also noted the difficulties associated with measuring such a phenomenon [15].

The classification of reporting physicians into those within ordinary centres and super centres may also be too crude. In reality, there may be a spectrum of clinical involvement in WRIH; however, physicians seeing more cases might be disproportionately inclined to participate in THOR (but they could also suffer from a greater degree of 'fatigue').

The annual weighting up factor of 12 for cases reported by sample reporters is also significant: if too high, then we may overestimate the number of cases captured by THOR and vice versa. The results of a randomized controlled trial investigating this suggested that estimated annual incidence would be higher by 25% if 1 month in 12 sampling was used (with weighting) compared to continuous sampling [16]. However, there was also some evidence that this was due to under reporting by core reporters (due to fatigue) rather than over reporting by sample reporters, therefore a weighting up of sample cases by 12 may be reasonable.

To put the clinical specialist-reported incidence rates in context, they have been compared with SWI- and OPRA-derived rates. The methodology associated with the latter is under development and not discussed here, and rates should be interpreted with caution. A simplistic assumption is that clinical specialist rates would be the lowest (as they only see the more 'severe' cases), that OP rates would be higher and that SWI- (patient)

reported rates would be higher still. However, this study suggests that OP-derived respiratory and skin incidence rates are the lowest. This may be due to sampling error due to small sample size: only 12% of the cases reported to OPRA (2005–2007) were skin or respiratory diagnoses; most were mental ill-health (46%) or musculoskeletal (36%). However, the aim of this comparative exercise was (primarily) to assess clinical specialist incidence rates, which seem plausible, especially if data relating to onward referrals from GPs are considered. THOR-GP data suggest that ~14% of work-related skin disease and 37% of work-related respiratory disease, as seen by GPs, are referred on to clinical specialists [17]. Work is in progress to link specialist and GP-derived incidence rates using information on referral rates within THOR-GP.

Despite the limitations, we feel that this study provides significant improvements in estimating numbers of cases captured by THOR, enabling more accurate estimations of GB incidence rates for specialist-reported WRIH. The good participation rates, national coverage and enthusiasm of reporting physicians make THOR an important national observatory and source of information on WRIH. Furthermore, when taking into account the invaluable data generated by THOR-GP (including additional information on injury, work-related sickness absence and on patterns of referral to clinical specialists), it is clear that THOR schemes provide a very powerful and constantly improving programme to determine the incidence and burden of WRIH and injury in GB. Further work to triangulate incidence rates within THOR and make comparisons with external data is in progress.

Key points

- Approximately two-thirds of eligible Great Britain dermatologists and chest physicians were participating in EPIDERM and SWORD, respectively, in 2005.
- There was one or more THOR reporter in each of the skin and respiratory super centres.
- This method has provided a significant improvement in the surveillance-based method to estimate the number of cases of work-related ill-health captured by THOR.

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Conflicts of interest

None declared.

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