Results from the Scottish National HAI Prevalence Survey

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Summary A national point prevalence survey was undertaken over the period of one calendar year in Scotland from October 2005 to October 2006. The prevalence of healthcare-associated infection (HAI) was 9.5% in acute hospitals and 7.3% in non-acute hospitals. The highest prevalence of HAI in acute hospital inpatients was found in the following specialties: care of the elderly (11.9%), surgery (11.2%), medicine (9.6%) and orthopaedics (9.2%). The lowest prevalence was found in obstetrics (0.9%). The most common types of HAI in acute hospital inpatients were: urinary tract infections (17.9% of all HAI), surgical site infections (15.9%) and gastrointestinal infections (15.4%). In non-acute hospitals one in ten inpatients in two specialties (combined) medicine (11.4%) and care of the elderly (7.8%) was found to have HAI, and one in 20 inpatients in psychiatry (5.0%) had HAI. In non-acute hospital patients, urinary tract infections were frequent (28.1% of all HAI) and similarly skin and soft tissue infection (26.8% of all HAI). When combined, these two HAI types affected 4% of all the inpatients in non-acute hospitals. This is the first survey of its kind in Scotland and describes the burden of HAI at a national level.

Introduction

Healthcare-associated infections (HAIs) are infections not present at the time the patient's healthcare begins, but which arise afterwards. There is evidence from several countries that HAIs are

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avoidable and costly to the health service and to patients.[1] [3] HAIs are also a source of discomfort, disability and distress to the individuals affected and can be fatal in some circumstances.

In Scotland, the Ministerial HAI Task Force (HAITF), led by the Chief Nursing Officer (CNO), is developing measures to reduce the burden of HAI. It requires robust, representative baseline data and trend information on the burden and cost of HAI in Scotland in order to assess the impact of the measures that are being put in place to reduce HAI and to assist in the development of future policy.

A rolling point prevalence HAI survey, in which a ward in each hospital is surveyed in one day, was selected as a feasible proposition and of acceptable cost if all HAI types in all acute hospitals and a sample of non-acute hospitals in Scotland were to be monitored.

The aims of the survey were:

To provide the HAITF with baseline information on the total prevalence of HAI in Scottish hospitals and its burden in terms of health service utilisation and costs. This information would be available to guide priority setting in the development of strategy and policy.

To develop a consistent methodology for prevalence surveys which, when repeated at intervals, would allow the impact of measures taken nationally to reduce the burden of HAI to be evaluated through an analysis of trends.

Methods

For the purposes of this survey, HAI was defined as infection arising $\geq$48 h after admission to hospital and which was considered not present or incubating on admission. A prevalent HAI was considered present when the patient had signs and symptoms that met one of the Centers for Disease Control and Prevention (CDC) definitions, or had one or more signs or symptoms included in one of the CDC definitions and was being treated for the infection (with therapy). CDC's HAI case definitions were adopted as these are widely used internationally.[4] These definitions comprehensively categorise HAI according to the organ/tissue system affected.

Data collection was undertaken on weekdays. All ward and patient data were entered onto a specially designed database held on a small portable 'tablet' personal computer (PC) while the data collectors were on the ward. All data collection on a ward was completed within one day.

Data collectors followed a standard procedure in their surveillance of a ward. Local nominated link members of the HAI control team introduced the data collectors onto the wards. Prior to commencing the inpatient data collection, data on ward characteristics on the day of data collection (ward type, bed numbers, staff numbers and types) were collected with assistance from the nurse in charge.

The data collectors sought information on eligible inpatients from all relevant sources including case records, all results of special examinations including microbiology reports, X-ray reports, temperature charts, prescribing records, nursing notes and, where necessary, through discussion with clinical staff and by direct clinical observation. The design of the survey required the data collector to make an initial decision based on this information as to whether the inpatients showed signs of a specific HAI, criteria for which were included and accessible on the PC. They were required to check every sign and symptom included in the relevant CDC HAI definition which was met by a patient they had decided had HAI. The decision as to the presence or absence of HAI was that of the data collector. They were able to seek further help from epidemiology consultants at HPS if they had any remaining doubts about the diagnosis of HAI according to the CDC definition.

Data were exported from each data collector's tablet PC on a weekly basis. The export procedure produced Microsoft Excel files. These were subsequently imported into a Microsoft Access database. Within the Microsoft Access database, algorithms were used to examine data consistency and validity. Algorithms were used to confirm that the criteria recorded met CDC HAI case definitions and with therapy definitions. Data quality and the performance of the data collection tool were monitored throughout the survey.

Inter-rater reliability (IRR) validation exercises were undertaken on two occasions during the survey to measure the consistency of data collection between data collectors. A crossover study design was adopted, requiring a sample of patients to be surveyed by the whole data collection team over the course of a single day. While the overall level of IRR was reassuringly high for the selected data items, these exercises revealed limitations to the assessment methodology in a dynamic healthcare setting. The validation recorded a 100% agreement for diagnosis of HAI type.

Results

In total, 13 754 inpatients were included in the Scottish National Prevalence Survey: 11 608 in all

45 acute hospitals and 2146 in a sample of 22 non-acute hospitals in Scotland. Bed occupancy was calculated to be ~80%, which is consistent with the level of 81 82% reported by the Information and Services Division over the last six years.[5] Age and gender distributions are given in Figures 1 and 2.

In acute hospitals, 1103 of the total of 11 608 inpatients were found to have HAI, giving an unadjusted overall prevalence of inpatients with HAI in acute hospitals of 9.5% (95% CI: 8.8 10.2). Of the 1103 inpatients with HAI, 126 (11.4%) had more than one infection. A total of 1243 HAIs which met the survey HAI case definition were found to be present, 831 (66.9%) fully meeting the CDC criteria and 966 (77.7%) meeting the criteria of 'one or more symptoms included in the survey definition and on antimicrobial therapy for HAI' ('with therapy'). Of the acute hospital cases, 44.6% met both HAI definitions.

In the non-acute hospital sample, 157 of 2146 inpatients were found to have HAI, giving a crude overall prevalence of inpatients with HAI of 7.3% (95% CI: 6.0 8.6). Seven of the 157 inpatients with HAI had more than one infection. Of the 164 HAIs diagnosed, 97 (59.1%) fully met the CDC incidence definitions and 144 (87.8%) met the 'with therapy' definition. Forty-seven percent of cases in non-acute hospitals met both infection definitions.

Among acute hospital inpatients, these data illustrate that all the CDC HAI categories contribute to the total burden of HAI (Table I). The main infection types in rank order were: urinary tract infection ($N = 222$); surgical site infection ($N = 197$); gastrointestinal infection ($N = 191$); eye, ear, nose, throat and mouth infections ($N = 155$); lower respiratory tract infections other than pneumonia ($N = 139$); skin and soft tissue infections ($N = 137$); pneumonia ($N = 109$). CDC combines eye, ear, nose, throat and mouth infections as a single major category of infection. They are grouped by anatomical location but in clinical practice the specialties are quite distinct. When the narrower infections are disaggregated the most common infection type is of the oral cavity (with 107 infections) and the other 48 are divided throughout the infection types. For this reason eye, ear, nose, throat and mouth infections will not be discussed as a single group.

The highest prevalence of HAI in acute hospital inpatients was found in the following specialties: care of the elderly (11.9%; 95% CI: 10.0 13.7%), surgery (11.2%; 95% CI: 9.5 12.9%), medicine (9.6%; 95% CI: 8.5 10.7%) and orthopaedics (9.2%; 95% CI: 7.3 11.1) (Table II). Obstetrics had a low HAI prevalence (0.9%).

The specialty distribution of non-acute hospital inpatients differs from that of acute hospital

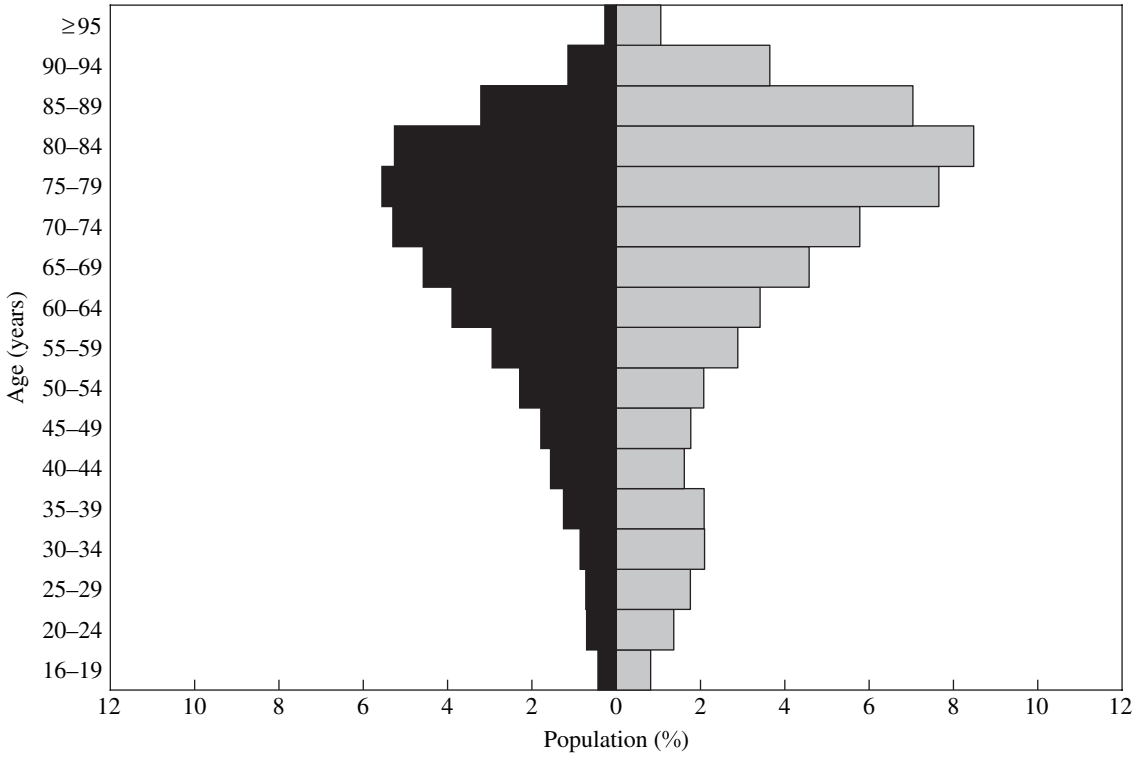

Figure 1 Acute hospitals: inpatients surveyed by age group and sex ($N = 11\,608$). Black bars, males; grey bars, females.

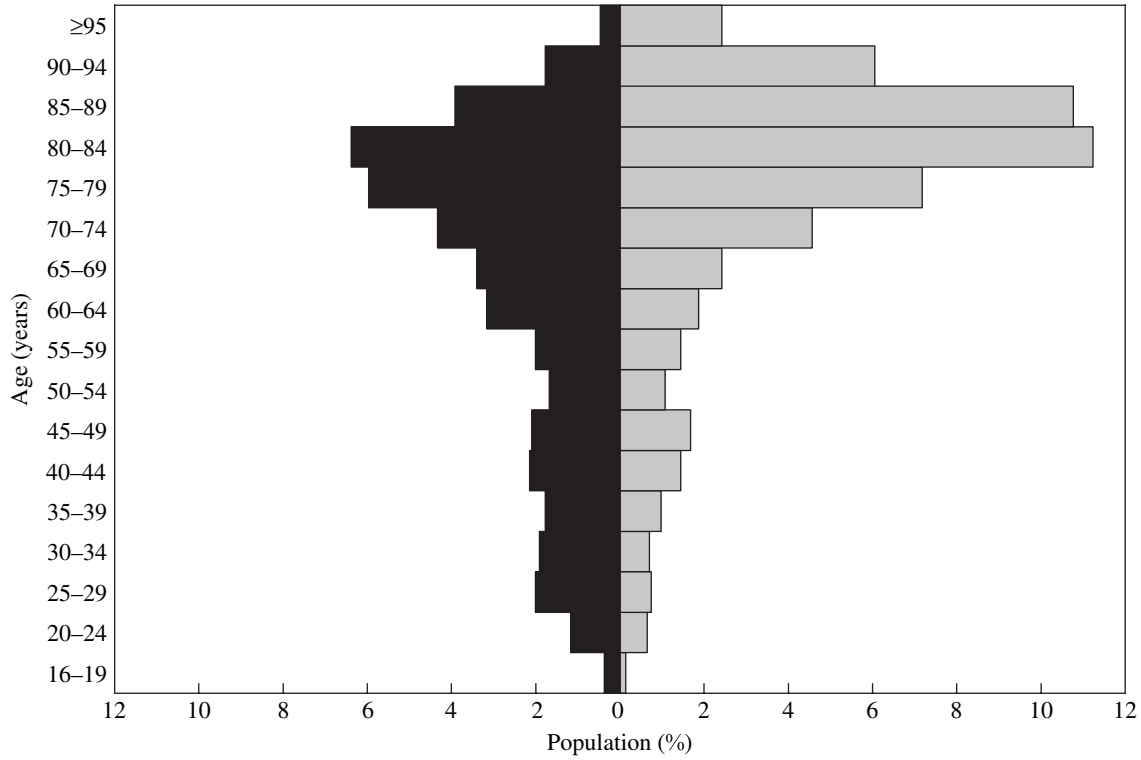

Figure 2 Non-acute hospitals: inpatients surveyed by age group and sex ($N = 2146$). Black bars, males; grey bars, females.

inpatients and therefore the pattern of HAI contributing to the burden of HAI is different (Table III): urinary tract infection ($N = 46$), skin and soft tissue infection ($N = 44$), eye, ear, nose, throat or mouth infection ($N = 22$), gastrointestinal infection ($N = 20$) and lower respiratory tract infection other than pneumonia ($N = 19$) made up 92% of infections. The only categories of HAI that were not found in non-acute hospital inpatients were bloodstream infections, central nervous system

Table I Acute hospitals: number and percentage of healthcare-associated infection (HAI) cases by HAI type

HAI type	Infections	
	No.	%
Bone and joint	6	0.5
Blood stream	55	4.4
Central nervous system	2	0.2
Cardiovascular system	11	0.9
Eye, ear, nose, throat or mouth	155	12.5
Gastrointestinal	191	15.4
Lower respiratory tract infection other than pneumonia	139	11.2
Pneumonia	109	8.8
Reproductive	17	1.4
Systemic	2	0.2
Surgical site	197	15.9
Skin and soft tissue	137	11.0
Urinary tract	222	17.9
Total	1243	100.0

Table II Acute hospitals: prevalence of healthcare-associated infection (HAI) in eligible inpatients by specialty

Specialty	Inpatients with HAI	HAI prevalence within specialty	95% CI	
	N	%	Lower	Upper
Care of the elderly	199	11.9	10.0	13.7
Dentistry	2	12.5	4.1	20.9
Gynaecology	10	4.8	1.2	8.4
Haematology	8	6.7	2.0	11.3
Medicine	491	9.6	8.5	10.7
Obstetrics	4	0.9	0.0	1.9
Oncology	12	8.8	2.0	15.7
Orthopaedics	105	9.2	7.3	11.1
Other	0	0.0	—	—
Psychiatry	9	3.5	0.3	6.7
Surgery	247	11.2	9.5	12.9
Urology	16	6.3	3.0	9.5
Total	1103	9.5	8.8	10.2

CI, confidence interval.

Table III Non-acute hospital: number and percentage of healthcare-associated infection (HAI) cases by HAI type

HAI type	Infections	
	No.	%
Bone and joint	1	0.6
Cardiovascular system	1	0.6
Eye, ear, nose, throat or mouth	22	13.4
Gastrointestinal	20	12.2
Lower respiratory tract infection other than pneumonia	19	11.6
Pneumonia	4	2.4
Reproductive system	2	1.2
Surgical site	5	3.1
Skin and soft tissue infection	44	26.8
Urinary tract infection	46	28.1
Total	164	100.0

infections and systemic infections. Although some more severe HAIs, which particularly affect acute hospital inpatients, e.g. pneumonias and surgical site infections, are very much less common, they do occur in non-acute hospitals.

If all respiratory tract infections are combined (lower respiratory tract infection and pneumonia) then this group makes up a large proportion of the total HAI. These two infection types are defined separately according to CDC grouping.

Overall in non-acute hospitals, one in ten inpatients in the medical specialties of medicine and care of the elderly (combined) were found to have HAI and one in 20 inpatients in the specialty psychiatry had HAI (Table IV); these comprised principally skin and soft tissue and urinary tract infections. The distribution of the HAI across the categories for the inpatients with HAI in all specialties is given in Table IV. The highest prevalence of HAI in non-acute hospital inpatients was found in the following specialties: medicine (11.4%; 95% CI: 8.6 14.1%), care of the elderly (7.8%; 95% CI: 4.7 10.9%), orthopaedics (7.1%) and psychiatry (5.0%; 95% CI: 3.5 6.4%). The numbers of patients in surgery and orthopaedics are small and therefore should be interpreted with caution.

Table IV Non-acute hospitals: prevalence of healthcare-associated infection (HAI) in eligible inpatients by specialty

Specialty	Inpatients with HAI	HAI prevalence within specialty	95% CI	
	No.	%	Lower	Upper
Care of the elderly	34	7.8	4.7	10.9
Medicine	64	11.4	8.6	14.1
Orthopaedics	1	7.1	—	—
Psychiatry	56	5.0	3.5	6.4
Surgery	2	40.0	—	—
Urology	0	0.0	—	—
Total	157	7.3	6.0	8.6

CI, confidence interval.

Discussion

This was the first prevalence survey of HAI in Scotland, which included acute and non-acute hospitals. The results indicate that all HAI types were distributed throughout the different specialties. At individual specialty level, all the HAI categories contribute to the burden of HAI. For example, 71% of the 247 HAI in surgical inpatients and 57% of the 105 HAI in orthopaedic inpatients were in categories other than surgical site infection. Among 'care of the elderly' inpatients, 68% had infections other than urinary tract infection and pneumonia. Dentistry specialty results should be interpreted with caution as the numbers are very small ($N = 2$).

The prevalence of HAI in patients in acute hospitals was found to be 9.5% (95% CI: 8.8 10.2). Differences between populations sampled and in survey methodology may render comparisons between the results of HAI prevalence surveys inappropriate.[6] These include differences in the populations studied (hospital type and practice, year of study, type and case mix of patients) and methodological issues, including HAI case definitions and their application in case ascertainment. It is coincidental, therefore, that this 9.5% prevalence estimate in acute hospitals is similar to that reported in UK surveys in 1980 and in 1993 1994.[7,8] The population studied in this Scottish survey was, however, older than those studied in these two UK studies. An HAI prevalence survey of acute hospitals was undertaken in England, Wales, Northern Ireland and the Republic of Ireland (the HIS survey in 2006) over a four-month (February to May) period during the year the Scottish survey was undertaken, which used the same HAI definitions.[9 13] In this survey of volunteer hospitals a prevalence of 7.6% (combined England, Wales, Northern Ireland and the Republic of Ireland) was reported in a survey of 75 765 patients in 273 acute hospitals. However, even in this survey there are differences in patient case mix and aspects of the methodology which mean

that a comparison of the unadjusted, overall HAI prevalence rate with that reported here should also be made with caution.

Some prevalence surveys concentrate on a subset of HAI types.[14,15] These often include four infections: pneumonias, urinary tract infections, surgical site infections and bloodstream infections. This survey found an overall prevalence in these infection types of 5%; nevertheless, these were not the most common and accounted for only about half of all HAIs identified.

Various studies have reported variation in HAI prevalence by specialty.[7,16 20] This survey found the highest prevalence of HAI in acute hospital inpatients in the following specialties: care of the elderly (11.9%), surgery (11.2%), medicine (9.6%) and orthopaedics (9.2%) (Table II). One implication of this observation is the importance of emphasising hospital-wide infection control policies and practice, such as standard precautions, which can reduce the prevalence of a wide range of HAIs.

The most commonly recorded HAIs among acute hospital patients in this study were, in order of proportions of all HAI found: urinary tract infections (17.9%), surgical site infections (15.9%), and gastrointestinal infections (15.4%); respiratory tract infections (11.2%), skin and soft tissue (11.0%) were also prominent.

The spectrum of HAI occurring in acute hospital patients is wide. This is also the case at the level of individual specialties. Most if not all types of HAI occur in patients in every specialty. However, as would be expected, patients in some specialties have a higher prevalence of HAI than others. It may be that frequent patient movement between wards as part of bed management may result in more widespread occurrence of HAI.

Multiple infections were found in 1.1% of all inpatients (or 11.4% of acute hospital inpatients with HAI). These findings reinforce the differences between inpatient populations in each healthcare environment, and, for similar reasons, emphasise that prevalence of patients with multiple infections reported in previous surveys should only be compared with caution. Meers *et al*. found that 5.6% of HAI inpatients had more than one HAI, but surveys in Germany, Italy, Switzerland and Slovenia suggest that this statistic can range from 4.1% to 21.2%.[7,15,18,19,21] This broad range is probably indicative of differences in survey methodology and diagnostic rigour, as much as differences in the surveyed populations.

The prevalence of HAI in patients in non-acute hospitals was found to be 7.3% (95% CI: 6.0 8.6), i.e. lower than that in acute hospitals. Differences in the specialty distributions and case mix in the acute and non-acute hospital populations may account for this difference.

There are few surgical patients in the non-acute hospital population, whereas psychiatric patients, a group with a relatively low prevalence of HAI (5%), make up just over 50% of the population. In other reports where HAI prevalence has been found to be similar or higher than that in acute hospitals, it is probable that differences in the population sampled, e.g. age and case-mix, and in methodology, account for the differing result.[22,23]

HAI infection type contributing to the burden of HAI in non-acute hospitals was different from that in acute care (Tables I and II). Among non-acute hospital patients urinary tract infections were frequent, but equally frequent were skin and soft tissue infections. Taken together these affected about 4% of the inpatients, and almost two-thirds of psychiatry HAIs were skin and soft tissue or urinary tract infections. Multiple HAI infections were found in 1.0% of non-acute inpatients (i.e. 4.5% of non-acute hospital inpatients with HAI had more than one infection).

In conclusion, this survey describes the prevalence of HAI in Scotland. It has established, for the first time, the burden and epidemiology of HAI in Scotland.

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Conflict of interest statement
None declared.

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