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Major Article

A multicenter point prevalence survey of healthcare–associated infections in Pakistan: Findings and implications

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Background: Healthcare–associated infections (HAIs) are seen as a global public health threat, leading to increased mortality and morbidity as well as costs. However, little is currently known about the prevalence of HAIs in Pakistan. Consequently, this multicenter prevalence survey of HAIs was conducted to assess the prevalence of HAIs in Pakistan.

Methods: We used the methodology employed by the European Centre for Disease Prevention and Control to assess the prevalence of HAIs in Punjab Province, Pakistan. Data were collected from 13 hospitals using a structured data collection tool.

Results: Out of 1,553 hospitalized patients, 130 (8.4%) had symptoms of HAIs. The most common HAI was surgical site infection (40.0%), followed by bloodstream infection (21.5%), and lower respiratory tract infection (14.6%). The prevalence of HAI was higher in private sector hospitals (25.0%) and among neonates (23.8%) and patients admitted to intensive care units (33.3%). Patients without HAIs were admitted mainly to public sector hospitals and adult medical and surgical wards.

Conclusions: The study found a high rate of HAIs among hospitals in Pakistan, especially surgical site infections, bloodstream infections, and lower respiratory tract infections. This needs to be addressed to reduce morbidity, mortality, and costs in the future, and further research is planned.

Healthcare–associated infections (HAIs) are seen as a global public health threat, increasing mortality and morbidity in association with infectious disease and increasing the length of stay in hospitals and overall healthcare costs. In Europe alone, HAIs are believed to cause 16 million extra hospital days each year, with costs estimated to exceed €7 billion annually.[1] Preventing HAIs could save an estimated $25-$35.1 billion per year in the United States.[2] The prevalence of HAIs is substantially higher in lower- and middle-income countries (LMIC), with concerns involving available facilities, personnel, and techniques.[3] The reported prevalence of HAIs in high-income countries is 7.5%, although others have reported rates of 5.7%-7.1% in Europe and 4.5% in the USA, whereas in LMIC countries prevalence rates of 5.7%-19.2% are seen.[4-7] In Australia, an estimated 175,000 cases of HAIs occur annually.[8] In Europe and North America, it is reported that 12%-32% of healthcare–associated bloodstream infections result in death.[9] However, the exact burden of HAI in each country is still unknown.

Several studies have reported the effectiveness of interventions to help prevent HAIs.[2,10-12] Strategies for handling the substantial issue of HAIs are dependent on infection prevention and control programs that emphasize the use of good hygiene following standard precautions, the initiation of antibiotic stewardship programs, and the

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Conflicts of interest: None to report.

Ethics approval and consent to participate: The study design was nonexperimental and involved neither patient examination nor any intervention (advised or made). Prior to conducting the study, application for ethical clearance was sought from the human ethics division of the university college of pharmacy (HEC/1000/PUCP/1925HAI). Subsequent approval to conduct the study in the identified hospitals was obtained from hospital management. All collected data were anonymized during the time of data collection and verified for accuracy before transmission to the investigators by the data collectors at the health facility.

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appropriate use of indwelling devices and screening, in combination with decolonization.[12] Effective infection control measures, including hand and environmental hygiene, sterilization of devices, screening, and vaccination programs, should be adopted to minimize risk of HAIs. Surveillance of HAIs is a critical component of any infection control strategy to identify problems, assess control programs, and prioritize resources.[5]

Prospective surveillance is the recommended method for screening HAIs. However, this method can be expensive and is intended for common types of infections, such as ventilator-associated infections. However, cross-sectional prevalence surveys are not only cost-effective but are also a quick method for assessing the burden of all types of HAIs within hospitals as a prelude to initiating future programs.[5,6] Point prevalence surveys are of evident benefit for defining rates of HAIs, particularly in hospitals with limited resources. Moreover, data from point prevalence surveys can be transformed into incidence data, which are important for observing the trends in HAIs.[13] Emphasizing interventions to prevent infections would be not only beneficial for hospitals but would also have a high public health impact, with HAIs considered to be a significant outcome indicator within hospitals.[14] Assessing the prevalence of HAIs through point prevalence and other surveys helps detect priority areas for initiation of infection prevention and control programs in hospitals.[5] We are aware that several point prevalence surveys have been conducted to monitor emerging trends in the prevalence of HAIs.[5,6] However, to the best of our knowledge, no published data are available on the prevalence of HAIs in Pakistan. Consequently, this survey was initiated to assess the prevalence of HAIs in Pakistan as a first step. The findings can be used as a baseline for future prevalence studies as well as for initiating future measures to reduce HAI rates in the future, if pertinent.

METHODS

Study design

A multicenter point prevalence survey of HAIs was conducted among hospitals in Pakistan using the methodology employed by the European Centre for Disease Prevention and Control.[5] This methodology provides a standardized tool for hospitals to estimate the prevalence of HAIs and to identify targets for quality improvement.

Study settings

The complete lists of all hospitals of Punjab were acquired from the office of the Director General of Health Services, Department of Health, Government of Punjab, Pakistan. The study centers were included by selecting 13 hospitals from the different geographic regions of Punjab, Pakistan. In case of refusal of the first hospital, the next healthcare setting from the list was selected, and so on, as hospital participation was solely voluntary. Healthcare facilities providing only nursing care, rehabilitation centers, and psychiatric centers were not included. Punjab was chosen for this initial study as a representative region of Pakistan.

Instrument of measure

A structured and validated questionnaire with ward and patient level data was used for data collection.[5] The ward data form included the department specialty, total bed capacity, the total number of patients, and patients with HAIs. Different parameters in the patient data form were collected from patient profiles. These included demographic variables, clinical patient data, reason for admission and hospitalization, causative microorganisms, reason for antimicrobial prescribing, prescribed antimicrobials and their dosage regimen, and any HAIs.

Inclusion and exclusion criteria

The sample comprised all inpatients that stayed overnight in the hospital. Data were collected from patients who were showing symptoms of HAIs. Patients staying in long-term care units, including dialysis centers, and patients in emergency and outpatient departments were not included in the survey.

Case definition

The HAI case definitions were adopted from the European Centre for Disease Prevention and Control protocol.[5] HAI is an infection occurring in a patient during the process of care in a hospital or other healthcare facility that was not present or incubating at the time of admission. For the purposes of this protocol, an infection was defined as active on the day of the survey when signs and symptoms were present on the date of the survey, *or* signs and symptoms were no longer present, but the patient was still receiving treatment for that infection on the date of the survey. An active infection was defined as healthcare−associated when the onset of signs and symptoms was day 3 of the current admission or later, *or* signs and symptoms of an active surgical site infection were present at admission or started before day 3 and the surgical site infection occurred within 30 days of a surgical intervention.

Data collection

The data were collected by using a structured data collection tool. All patients admitted on the ward at 8 AM the day of survey were counted in the denominator, whereas all inpatients showing symptoms of HAIs were included in the numerator, and the patient forms were filled in for these patients only. The details of variables from the patient's medical case notes and prescribing charts were recorded after discussing with nursing staff and physicians. The data were checked for both completeness and accuracy to rule out missing or inconsistent data. If necessary, pertinent physicians or pharmacists were requested to review the patient medical records again for clarification. All the data were transferred to the computer. Up to 2 weeks was taken to collect the data from all wards of a single hospital. To minimize the effect of movement of patients between wards and within the hospital, each ward was completely surveyed within 1 day. The data collection process was completed September 2017-February 2018.

Statistical analysis

Data were analyzed using the latest version of Microsoft Excel (Microsoft, Redmond, WA) and SPSS Version 22 (International Business Machines Corporation, Armonk, NY). On categorical variables, descriptive statistics (frequency and percentages) were applied. Crosstabs was applied to check any association between the variables. Binary logistic and multinomial logistic regression analysis was performed to check for likely confounding effects. Age groups were categorized in different groups, with the oldest age group serving as the reference to which other age groups were compared. Patients in charity hospitals, surgical departments, and neonatal medical wards were also used as a reference. Risk of HAIs among female patients was compared by using male patients as the reference. These groups were kept in the logistic model if they were associated with an HAI after adjustment at the 0.05 significance level. Odds ratios with 95% confidence intervals were also calculated.

RESULTS

Thirteen hospitals participated in this point prevalence survey. The survey was conducted in 3 private, 3 charity, and 7 public sector

Table 1
Distribution of HAIs

Variables	LRTI N (%)	SSI N (%)	BSI N (%)	UTI N (%)	BJ N (%)	OBGYN N (%)	GI N (%)
Hospital type							
Public	8 (42.1)	26 (50.0)	9 (32.1)	7 (63.6)	2 (25)	—	1 (11.1)
Private	8 (42.1)	10 (19.2)	6 (21.4)	1 (9.1)	3 (37.5)	2 (66.7)	3 (33.3)
Charity	3 (15.8)	16 (30.8)	13 (46.4)	3 (27.3)	3 (37.5)	1 (33.3)	5 (55.6)
Department							
ICU	7 (36.8)	3 (5.8)	10 (35.7)	2 (18.2)	—	—	2 (22.2)
Medical	12 (63.2)	12 (23.1)	17 (60.7)	6 (54.5)	4 (50.0)	3 (100)	5 (55.6)
Surgical	—	37 (71.2)	1 (3.6)	3 (27.3)	4 (50.0)	—	2 (22.2)
Age group							
< 1 mo	4 (21.1)	—	6 (21.4)	—	—	—	—
> 1 mo-18 y	3 (15.8)	7 (13.5)	5 (17.9)	1 (9.0)	1 (12.5)	—	1 (11.1)
> 18 y-65 y	8 (42.1)	43 (82.7)	14 (50.0)	7 (63.6)	5 (62.5)	3 (100)	7 (77.8)
> 65 y	4 (21.1)	2 (3.8)	3 (10.7)	3 (27.3)	2 (25.0)	—	1 (11.1)
Sex							
Female	4 (21.1)	27 (51.9)	14 (50.0)	5 (45.5)	5 (62.5)	3 (100)	3 (33.3)
Male	15 (78.9)	25 (48.1)	14 (50.0)	6 (54.5)	3 (37.5)	—	6 (66.7)
Wards							
Adult ICU	7 (36.8)	3 (5.8)	4 (14.3)	2 (18.2)	—	—	2 (22.2)
Adult MW	5 (26.4)	9 (17.3)	7 (25.0)	5 (45.5)	4 (50.0)	3 (100)	1 (11.1)
Adult SW	—	36 (69.2)	1 (3.6)	3 (27.3)	4 (50.0)	—	2 (22.2)
Oncology	3 (15.8)	4 (7.7)	10 (35.7)	1 (9.1)	—	—	4 (44.4)
Neonatal ICU	—	—	6 (21.1)	—	—	—	—
Neonatal MW	4 (21.1)	—	—	—	—	—	—
Total	19 (14.6)	52 (40.0)	28 (21.5)	11 (8.5)	8 (6.2)	3 (2.3)	9 (6.9)

BJ, bone and joint; *BSI*, bloodstream infection; *GI*, gastrointestinal tract; *HAIs*, healthcare–associated infections; *ICU*, intensive care unit; *MW*, medical ward; *OBGYN*, obstetrics and gynecology; *LRTI*, lower respiratory tract infection; *SSI*, surgical site infection; *SW*, surgical ward; *UTI*, urinary tract infection.

hospitals, including secondary, tertiary, and specialized healthcare facilities. The total number of beds in these 13 hospitals was 2,347. Of these, 1,553 beds were occupied (66.2%). Out of these hospitalized patients, 130 (8.4%) were showing the symptoms of HAIs at a range of 3.5%-29.7% in the different hospitals. A detailed distribution of HAIs is given in Tables 1 and 2. The most common HAIs were surgical site infections (40.0%), with the highest prevalence among patients in the adult age group > 18 years-65 years (82.7%) who were in surgical departments (69.2%). The second most common HAI was bloodstream infections (21.5%), and the third most common was lower respiratory tract infections (LRTIs) (14.6%). Other HAIs included urinary tract infections, gastrointestinal infections, bone and joint infections, and obstetric and gynecologic infections. Patients with bloodstream and gastrointestinal infections were admitted to adult medical wards of charity hospitals, whereas patients with urinary tract infections were admitted to adult medical wards of public sector hospitals. Variables, including hospital type, department, age group, sex, and ward, were analyzed through binary logistic and multinomial logistic regression models (Table 2). The prevalence of HAI was higher among private sector hospitals (25.0%) compared with charity (16.9%) and public sector hospitals (4.6%). The burden of HAI was also much higher among patients admitted to the intensive care unit (33.3%) compared with patients admitted to medical wards (6.8%) and surgical wards (7.6%). Likewise, neonates (23.8%) were among the groups most highly afflicted with HAIs compared with other age groups. Patients without HAIs were admitted mainly to public sector hospitals and adult medical and surgical wards.

DISCUSSION

HAIs are key outcome parameters in healthcare systems and reducing the threat of HAIs is indispensable to reducing morbidity, mortality, and costs associated with hospitalized patients. The reported prevalence of HAIs in this study (8.4%) is higher than values mentioned in most of the previous studies involving high-income countries but not those involving LMICs.[4-6] In addition, the burden of HAI in Pakistan was lower than the reported prevalence rates in some other countries.[15,16] The high prevalence rate of HAIs in Pakistan can potentially be due to lack of infection control and prevention programs typically seen in Pakistani hospitals, as well as high bed occupancy rates. Studies have also reported higher prevalence rate of HAIs in patients admitted to intensive care units, which may be due to the high use of invasive devices and the high frequency of serious illness.[15,17,18] This is similar to our findings. However, the prevalence in our study of hospital-acquired surgical site infections, septicemia, LRTIs, and other HAIs is different from the findings reported in other countries.[4-6,19] However, substantial differences in surveyed populations, healthcare facilities, skill of

Table 2
Risk factors of HAIs

	HAIs N (%)	Without HAIs N (%)	OR (CI)	*P* value
Hospital type				
Public	53 (4.6)	1,108 (95.4)	2.778 (1.58-4.87)	.000
Private	33 (25.0)	99 (75.0)	0.388 (0.20-0.74)	.004
Charity	44 (16.9)	216 (83.1)	Ref	—
Department				
ICU	24 (33.3)	48 (66.7)	0.164 (0.09-0.29)	.000
Medical	59 (6.8)	803 (93.2)	1.100 (0.70-1.60)	NS
Surgical	47 (7.6)	572 (92.4)	Ref	—
Age group				
< 1 mo	10 (23.8)	32 (76.2)	0.350 (0.14-0.85)	.021
> 1 mo-18 y	18 (9.3)	176 (90.7)	1.100 (0.70-1.50)	NS
> 18 y-65 y	87 (7.5)	1,078 (92.5)	1.130 (0.90-1.90)	NS
> 65 y	15 (9.9)	137 (90.1)	Ref	
Sex				
Female	61 (7.7)	729 (92.3)	0.840 (0.60-1.20)	NS
Male	69 (9.0)	694 (90.1)	Ref	—
Wards				
Adult ICU	18 (26.6)	45 (71.4)	0.400 (0.10-1.30)	NS
Adult MW	34 (5.8)	744 (95.6)	3.501 (1.15-10.62)	.027
Adult SW	46 (7.6)	562 (92.4)	1.900 (0.60-5.80)	NS
Oncology	22 (33.3)	44 (66.7)	0.320 (0.09-1.03)	.049
Neonatal ICU	6 (66.7)	3 (33.3)	0.080 (0.01-0.46)	.004
Neonatal MW	4 (13.8)	25 (86.2)	Ref	—

CI, confidence interval; *HAIs*, healthcare–associated infection; *ICU*, intensive care unit; *MW*, medical ward; *NS*, nonsignificant; *OR*, odds ratio; *Ref*, reference; *SW*, surgical ward.

the surgeon, and surveillance methods often do not permit direct comparison of outcomes.

Surgical site infections were the most frequent HAI detected in this study—significantly higher than seen in some other published studies[5,6,19] and lower than seen in Ethiopia.[16] We believe this high rate is due to a lack of guidelines for surgical site infection prophylaxis and poor infection control programs among the study hospitals, and we will be exploring this further in future research. We will also be looking at the length of administration of any antibiotic given to prevent surgical site infections, as a high percentage has been given among LMICs both postoperatively and for a number of days beyond agreed guidance.[20,21] Bloodstream infections were the second most common HAIs in this study. However, the prevalence was less than that reported in some other studies.[22,23] As microbiology laboratory reports are the primary source for diagnosis of bloodstream infections, the low rate in this study may be due to the inadequacy of microbiological documentation. We will be following this up in future studies as well. LRTIs were the third most frequent HAI detected in this study. One reason for this high rate could be the fact that this survey was conducted in the autumn and winter months, during which the incidence of nosocomial respiratory tract infections is higher. Furthermore, inadequate hand hygiene and overcrowded hospital wards might also be causative factors.[24] Hospital-acquired pneumonia surveillance could help provide a better understanding of this and also pave the way to implementing more focused interventions to fight against this high-cost infection.[25] This will be the subject of future research in hospitals in Pakistan as well. Moreover, surveillance and prevention of *Clostridium difficile* have also become a recent focus, as this is a major threat associated with HAIs.[6] Although *C difficile* infections were not identified in this study because of a lack of laboratory findings, gastrointestinal infections were noted, especially in patients who were receiving intensive chemotherapy, and we will be looking at this more closely in the future.

We are aware that this survey has several limitations. Being a cross-sectional study, we are aware that point prevalence surveys can underestimate the burden of HAIs. Second, the investigators in the prevalence survey were not qualified infectious disease specialists; therefore, potential misclassification of infections could be expected. Third, most hospitals do not have their own microbiological laboratory, and susceptibility testing was only carried out occasionally. The date of onset of infection and duration of hospital stay were also not noted in this prevalence survey. In addition, patients who were hospitalized earlier and then readmitted may not have been included, consequently underrating the actual prevalence of that particular infection. Last, the results of this prevalence survey may have been influenced by seasonal variations; there was a high rate of LRTIs since it was conducted during the autumn and winter months. Despite these limitations, we believe the data have made an appreciable contribution to understanding the pattern of HAIs in the Pakistani population. Overall, we believe the findings of this survey are robust and provide a baseline for enhancing surveillance skills and structure and for raising awareness of the importance of preventing HAIs in the future. The important features of this methodology are its cost-effectiveness and simplicity, both of which are indispensable for conducting such surveys on a regular basis among LMIC.

CONCLUSIONS

The study found a high rate of HAIs among hospitals in Pakistan, especially surgical site infections, bloodstream infections, and LRTIs. This needs to be addressed to reduce morbidity, mortality, and costs in the future, and further research is planned. Overall, repeated point prevalence surveys are needed across Pakistan to further assess trends in the epidemiology and potential causes of HAIs to assist in the initiation of appropriate interventions. Further research is planned.

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