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Surveillance of healthcare-associated infections in Indonesian hospitals

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Summary A cross-sectional surveillance of healthcare-associated infections (HAIs) and exposure to risk factors was undertaken in two Indonesian teaching hospitals (Hospitals A and B). Patients from internal medicine, surgery, obstetrics and gynaecology, paediatrics, a class department and intensive care were included. Patient demographics, antibiotic use, culture results, presence of HAI [phlebitis, surgical site infection (SSI), urinary tract infection (UTI) and septicaemia] and risk factors were recorded. To check for interobserver variation, a validation study was performed in Hospital B. In Hospitals A and B, 1334 and 888 patients were included, respectively. Exposure to invasive devices and surgery was 59%. In Hospital A, 2.8% of all patients had phlebitis,

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1.7% had SSI, 0.9% had UTI and 0.8% had septicaemia. In Hospital B, 3.8% had phlebitis, 1.8% had SSI, 1.1% had UTI and 0.8% had septicaemia. In the validation study, the prevalence as recorded by the first team was 2.6% phlebitis, 1.8% SSI, 0.9% UTI and no septicaemia, and that recorded by the second team was 2.2% phlebitis, 2.6% SSI, 3.5% UTI and 0.9% septicaemia. This study is the first to report on HAI in Indonesia. Prevalence rates are comparable to those in other countries. The reliability of the surveillance was insufficient as a considerable difference in prevalence rates was found in the validation study. The surveillance method used is a feasible tool for hospitals in countries with limited healthcare resources to estimate their level of HAI and make improvements in infection control. Efficiency can be improved by restricting the surveillance to include only those patients with invasive procedures. This can help to detect 90% of all infections while screening only 60% of patients.

Introduction

The SENIC study, carried out during the 1970s, showed that infection control in hospitals is effective when the control programme meets a number of prerequisites.[1] Surveillance, i.e. registration of nosocomial infections and feedback of the results, is one of the elements contributing to the effectiveness of such a programme. The methodology of surveillance was developed over the last 20–30 years in hospitals in developed countries. Several methods of surveillance have been evaluated and their sensitivity estimated.[2] The Centers for Disease Control and Prevention (CDC) were the first to develop definitions for nosocomial infections in 1988.[3] National surveillance institutes have arisen such as the Nosocomial Infection Surveillance System in the USA, the Nosocomial Infection National Surveillance Service in the UK and 'Preventie van Ziekenhuisinfecties door Surveillance' in The Netherlands.[4]

The question is, how applicable are these accepted surveillance methods in countries with limited healthcare resources, such as Indonesia? Indonesian healthcare workers are aware of the dangers of healthcare-associated infections (HAIs). Several hospitals have doctors and nurses who are trained in infection control, although there are no fulltime infection control nurses (ICNs). Infection control committees exist, and these communicate on a regional and national level. Surveillance of HAI is undertaken with a focus on surgical site infections (SSIs). To date, there are no published surveillance data on infections in Indonesian hospitals. Therefore, a study was set up to investigate the prevalence of HAI and to design a feasible and efficient method of surveillance in Indonesian hospitals.

Methods

A cross-sectional study of HAIs was performed in two Indonesian university hospitals on the island of Java. In this article, these hospitals will be referred to as Hospitals A and B.

Data collection

The study was carried out by Dutch and Indonesian researchers and members of the local infection control committees. The HAIs included were phlebitis, septicaemia [laboratory-confirmed bloodstream infections (LC-BSIs) and clinical sepsis], urinary tract infections (UTIs) and SSIs. For all infections except phlebitis, the CDC definitions of hospital infections were used.[3,5] Phlebitis was defined as inflammation of the intravenous catheter site, either chemical or due to infection, and fever and inflammation of the intravenous catheter site. Surveillance was undertaken by pairs of ward nurses with some experience in infection control, medical students and junior doctors who were trained by the researchers. The departments included were internal medicine, surgery, obstetrics and gynaecology, paediatrics, a class department and intensive care.

Each ward was visited three times with an interval of two to six months. All patients present on the study day were included. Each survey could take up to three weeks to finish, but all individual wards were completed within one day.

The following information was gathered from written patient documentation: sex; age; temperature; diagnosis on admission; date of admission; surgical operations within 30 days preceding the survey; antibiotic use on study day; leukocyte

Table I Demographic data

	Hospital A				Hospital B			
	August 2001	October 2001	April 2002	Total	February 2002	March 2002	April 2002	Total
Patients	434	499	401	1334	291	304	293	888
Male	222	250	200	672 (50)	135	151	152	438 (49)
Age (years)[a]	35	30	30	31	40	38	39	39
Length of stay (days)[a]	6	7	6	6	6	5	6	6
Internal medicine	116	113	91	320 (24)	44	51	40	135 (15)
Surgery	206	226	145	577 (43)	80	83	69	232 (26)
Obstetrics and gynaecology	47	66	66	179 (13)	58	60	57	175 (20)
Paediatrics	58	90	89	237 (18)	33	28	40	101 (11)
Intensive care unit	7	4	10	21 (2)	5	8	8	21 (2)
Class department	-	-	-	-	71	74	79	224 (25)
Diagnosis on admission								
Infection	108	122	109	339 (25)	48	60	48	156 (18)
Neoplasm[b]	108	100	92	300 (23)	84	76	92	252 (28)
Trauma	72	96	53	221 (17)	28	28	21	77 (9)
Other[c]	141	167	140	448 (34)	129	140	126	395 (45)
Missing	5	14	7	26 (2)	2	-	6	8 (1)
Temperature (°C)[a]	37.1	36.8	36.8	36.8	36.9	37.0	37.0	37.0
Antibiotic use on study day	170	280	226	676 (51)	167	159	165	491 (55)
Culture result available	18	33	25	76 (6)	20	9	14	43 (5)
Diagnostics available[d]	100	249	267	616 (46)	248	273	247	768 (87)
Intravenous catheter	260	192	160	612 (46)	110	106	120	336 (38)
Urinary catheter	70	76	56	202 (15)	29	39	35	103 (12)
Operations	136	151	102	389 (29)	72	60	42	174 (20)
Clean	53	46	27	126 (9)	28	23	29	80 (9)
Clean-contaminated	57	82	61	200 (15)	36	35	11	82 (9)
Dirty	26	23	14	63 (5)	8	2	2	12 (1)

All numbers shown are absolute numbers, with percentages in parentheses. $N = 2222$.

[a] Values shown are median values.

[b] Neoplasms: malignant and benign, solid and haematological.

[c] The category 'Other' chiefly consists of urinary tract, gastrointestinal tract and cardiovascular disorders, obstetrical and neurological diagnoses, and diabetes mellitus.

[d] Diagnostic tests available: leucocytes in blood, C-reactive protein, erythrocyte sedimentation rate, and urine sediment.

count; erythrocyte sedimentation rate; C-reactive protein; urine sediment; and culture results. The presence of intravenous and urinary catheters, and infections was determined during bedside visits. In the case of a suspected HAI, a culture of the infection site was requested when necessary to confirm the diagnosis. HAIs originating from other hospitals were not recorded.

Validation study

To check for interobserver variation, a validation study was performed in Hospital B. A Dutch infection control professional (ICP) with extensive experience in and knowledge of surveillance of HAI participated in this validation study. Two teams were formed. Each team visited the same wards on the same day, unaware of the results of the other team. One team was led by one of the researchers (DOD), together with an experienced Indonesian ICN, and the other team was led by the Dutch ICP (JCW), together with one of the researchers (ESL). Experienced and less experienced ICNs and two Dutch medical students were equally divided amongst the two teams. Demographic data, risk factors and prevalence of HAI of all patients were compared between the teams. Patients that were seen by only one of the teams were excluded from analysis.

Literature search

To be able to compare our results with published data, we performed a literature search using PubMed. The search terms used were: prevalence study OR prevalence studies OR prevalence survey OR prevalence surveys AND nosocomial infection(s) OR hospital infection(s). These search terms map to the MeSH heading 'cross infection'. Only articles published from 1990 onwards were included and studies referred to in these articles were also included. Surveys based entirely in intensive care, single department surveys, and surveys from long-term care facilities were excluded.

Statistical analysis

Differences in population characteristics and the prevalence of HAI between different departments, hospitals and surveys were analysed using the statistical package SPSS. Odds ratios (OR), significance and 95% confidence intervals (95% CI) were calculated.

Comparability of the results of both teams in the validation study was analysed by making cross-tabulations of the results and then calculating the level of agreement by Spearman's correlation and Cohen's kappa measure.

To identify indicators for finding the majority of HAIs, variables associated with HAI were selected by univariate analysis. This was followed by backward stepwise logistic regression to identify variables that were independently, significantly associated with HAI.

Results

In Hospital A, surveys were performed in August and October 2001 and February 2002. Surveys in Hospital B took place in February, March and April 2002.

In total, 2290 patients were seen; 1392 in Hospital A and 898 in Hospital B. In Hospital A, 58 cases were excluded; 27 because of double entry and 31 because of missing data. In Hospital B, four cases were excluded because of double entry and six because of missing data. Double entries occurred when patients were included twice in the same survey, usually as a result of a transfer to another ward. In these cases, information from the first encounter with the specific patient was recorded and information from the second encounter was discarded. Cases with missing data were only excluded when there had not been a bedside visit.

Demographic data

Hospital A has 1500 beds and Hospital B has 1070 beds. Patient demographics are shown in Table I. The mean age of all patients was 33 years [Hospital A, 31 years; Hospital B, 37 years ($P<0.001$)], with a range of 0–87 years. Sex and length of hospital stay before the survey were equally distributed. Mean length of stay until inclusion was 10.3 days, with a median of six days and a range of 0–187 days.

One percent of patients in Hospital A were admitted to the intensive care unit (ICU), compared with 2% of patients in Hospital B (OR 2.0, 95% CI 1.0-4.2). Compared with Hospital B, a larger proportion of patients in Hospital A were admitted to surgical and internal medicine wards. The reason for this difference was the inclusion of a 'class' department in Hospital B, with nursing class I and II beds. Mainly surgery and internal medicine patients were admitted to this department, so there was no real difference in patient distribution between the two hospitals.

Patient diagnoses on admission were similar in both hospitals. Only trauma was seen more frequently in Hospital A (OR 2.4, 95% CI 1.8–3.1).

Table II Prevalence of hospital-acquired infections (HAIs)

	Hospital A ($N=1334$)				Hospital B ($N=888$)			
	August 2001	October 2001	April 2002	Total	February 2002	March 2002	April 2002	Total
Phlebitis	20	14	3	37 (2.8)	11	14	9	34 (3.8)
UTI	7	3	2	12 (0.9)	3	5	2	10 (1.1)
SSI	4	7	8	19 (1.4)	5	5	5	15 (1.7)
Superficial	1	3	5	9 (0.7)	2	3	2	7 (0.8)
Deep	1	1	2	4 (0.3)	0	2	2	4 (0.5)
Organ space	2	3	1	6 (0.4)	3	0	1	4 (0.5)
Septicaemia	5	5	1	11 (0.8)	10	4	1	15 (1.7)
Clinical sepsis	5	5	1	11 (0.8)	4	4	1	9 (1.0)
LC-BSI	0	0	0	0 (0)	6	0	0	6 (0.7)
Total HAI	36 (8.3)	29 (5.8)	14 (3.5)	79 (5.9)	29 (10.0)	28 (9.2)	17 (5.8)	74 (8.3)

UTI, urinary tract infection; SSI, surgical site infection; LC-BSI, laboratory-confirmed bloodstream infection.

The temperatures of 465 patients were not recorded due to a misinterpretation of the study protocol. Of the remaining 1757 patients, 7% (117 patients) had a temperature of more than 38 °C.

Cultures were requested in 223 patients (10%). In 119 cases, a result was found, and this was positive in 72 cases. The results of diagnostic tests (leucocytes in blood, erythrocyte sedimentation rate, C-reactive protein and urine sediment) were more often available in Hospital A than in Hospital B (OR 7.4, 95% CI 6.0–9.3).

Of all patients, 541 (24%) had undergone surgery in the month prior to inclusion in the study, and 346 of them stayed in the surgical department. This means that of 807 patients in the surgical department, 461 (57%) were either waiting for an operation or undergoing non-invasive treatment.

Of all patients, 60% had one or more invasive procedures such as a surgical operation in the month preceding the study, or an intravenous or urinary catheter on the day of the study. Of these 1302 patients, 70% had one invasive procedure, 22% two, 8% three and less than 1% had four invasive procedures.

Prevalence of HAI

The overall prevalence of HAI in Hospital A was 5.9% including phlebitis (95% CI 4.6–7.2), and 3.1% excluding phlebitis (95% CI 2.2–4.1). Prevalence in Hospital B was 8.3% including phlebitis (95% CI 6.5-10.2), and 4.5% excluding phlebitis (95% CI 3.1-5.9, Table II). There were four and two patients with two HAIs in Hospitals A and B, respectively. In addition to the infections summarized in Table II, seven possible infections were found. These cases were suspect for HAI but could not be proven using the CDC definitions, mainly because of a lack of microbiology results. These cases are not included in the analysis as HAIs.

The prevalence of SSI in patients operated on in the month prior to the study was 5.1% in Hospital A (19 SSIs in 372 patients) and 8.9% in Hospital B (15 SSIs in 169 patients) (OR 1.7, 95% CI 0.8–3.4). Of these 34 infections, 16 (47%) were superficial, eight were deep, and 10 were organ space infections. The prevalence of SSI was 5.3% after both clean and clean-contaminated surgery and 12% after dirty surgery.

Patients admitted in Hospital B had a significantly higher number of HAIs compared with patients in Hospital A (OR 1.5, 95% CI 1.1–2.1). However, the number of HAIs found in Hospital A in February 2002 was significantly lower than in August and October 2001 (OR 2.4, 95% CI 1.3–4.5). This low rate can be attributed mainly to the few phlebitis

Table III Validation study

	Team 1	Team 2	Correlation (Spearman)	Agreement (Kappa)
Male	118	116	0.929	0.929
Age (years)[a]	36.2	36.6	0.984	-
Length of stay (days)[a]	10.1	9.5	0.905	-
Department of admission			0.982	0.989
Internal medicine	30	29		
Surgery	52	52		
Obstetrics and gynaecology	43	43		
Paediatrics	30	30		
Intensive care unit	7	8		
Class wards	66	66		
Diagnosis on admission			0.771	0.854
Infection	35	40		
Neoplasm[b]	77	77		
Trauma	15	14		
Other[c]	98	97		
Missing	3	-		
Temperature (°C)[a]	37.0	37.0	0.693	-
Fever >38 °C	17	17	0.745	0.745
Antibiotic use on study day	127	114	0.803	0.798
Culture done	23	22	0.680	0.679
Diagnostics done	199	195	0.629	0.627
Intravenous catheter	98	97	0.884	0.884
Urinary catheter	28	26	0.959	0.959
Operations	31	32	0.761	0.761
Phlebitis	6	5	0.162	0.162
Urinary tract infection	2	8	0.493	0.391
Surgical site infection	4	6	0.604	0.591
Septicaemia	0	2	0	-
Possible infection	3	1	−0.008	−0.007

N=228; the 228 patients were seen by both teams.
[a] Mean values. All other values are absolute numbers.
[b] Neoplasms: malignant and benign, solid and haematological.
[c] The category 'Other' chiefly consists of urinary tract, gastrointestinal tract and cardiovascular disorders, obstetrical and neurological diagnoses and diabetes mellitus.

cases found in this survey (0.7%, compared with 3.2% in the total population, OR 5.2, 95% CI 1.6-16.7). When only the results from August and October 2001 are compared with the results of Hospital B, there is no significant difference; 65 (7.0%) HAIs in Hospital A and 74 (8.3%) HAIs in Hospital B (OR 1.2, 95% CI 0.9-1.7). Therefore, the third survey in Hospital A was excluded from further analysis.

More patients in the ICUs had HAIs than patients in other departments (OR 4.6, 95% CI 2.2-9.5). There were no significant differences between the other departments.

Validation study

The first team saw 296 patients and the second team saw 330 patients. The 228 patients who were seen by both teams were included in the study (Table III).

There were considerable differences between the results of the two surveillance teams. Sex distribution was comparable, although Team 1 identified seven patients as male whom Team 2 identified as female or vice versa. Both teams identified 13 patients with fever, but disagreed on eight other patients. Length of stay preceding the study, age and diagnosis on admission correlated well, although not 100%. Team 1 found significantly more culture results and leukocyte count results than Team 2, while Team 2 found more urine sediments. The same percentage of patients in both groups had intravenous catheters and urinary catheters, but Team 2 found considerably more patients who underwent surgery in the month preceding the study.

There were significant differences in the number of HAIs found by Team 1 and Team 2. Team 2 diagnosed SSI more frequently, especially deep SSI ($P=0.01$). Patients identified as infected by both teams received the same SSI classification (superficial, deep and organ space) by both teams. Team 2 also found more UTIs than Team 1 ($P=0.01$), but less septicaemia ($P=0.01$).

Literature search

The literature search yielded 131 articles, 26 of which described cross-sectional studies (Table IV).[6-32] The prevalence of HAI varied greatly and the type of HAI studied and the method of diagnosis differed.[6,15] Most studies were from Western European countries,[7-10,13-15,17-19,21,24-27,29] with three studies from Eastern Europe,[16,28,31] three studies from the Middle East,[22,23,30] three studies from non-Western countries[6,11,12,32] and one study from New Zealand.[20] No recently published cross-sectional studies from South-east Asia were found. Only 12 studies reported population characteristics such as age and length of stay.[11-13,16,18,22-24,26-28,31]

Indicators for finding HAI

Invasive procedures (surgical operations, urinary catheters and intravenous catheters), body temperature >38 °C, hospital stay of more than six days before the study, antibiotic use on the study day, laboratory and microbiology results, and ICU admission were found to be associated with HAI in an univariate analysis (Table V). Age analysed as a categorical variable was not significantly associated with HAI, but when age was analysed as a (squared) continuous variable, there was a higher prevalence of HAI in the very young and the very old. Therefore, age was included in the multivariate analysis.

Multivariate analysis identified invasive procedures, age, fever, microbiology results, and a hospital stay of more than six days before the study as independent indicators for HAI.

By limiting the surveillance to patients with one or more invasive procedures, 1067 patients (59% of the hospital population) must be screened for a yield of 125 infections, i.e. 90% of HAI is detected in this way. The 14 missed HAIs were 11 cases of phlebitis, two LC-BSIs and one clinical sepsis. When screening patients with microbiology results in addition to those with invasive procedures, the number of patients seen increased from 1067 to 1097 (60% of the hospital population). As a result, four more cases of HAI were detected (129, 93% of HAI). When patients with invasive procedures and antibiotic usage were included, 1304 patients (72%) were seen and 136 HAIs (98%) were detected.

Discussion

This is the first study to report surveillance data on HAIs in Indonesia. One in 14 hospitalized patients had one or more HAIs. The prevalence of SSI in patients who underwent surgery was 5–8%. Over half of these infections were deep or organ space infections. Three to four percent of patients had phlebitis, 1% had UTI and 1–2% had septicaemia. These rates appear to be comparable with previous studies, although these studies are difficult to compare as the definitions of recorded infections and the patient populations may vary. In addition, phlebitis, which is often not due to infection, is often not included in the surveillance of HAI. It was decided to include it in this study as it is an important complication of intravenous therapy.

Despite choosing the infections that are thought to be the easiest to diagnose, there were difficulties in ascertaining HAI. Therefore, the prevalence rates presented in this study are likely to be an underestimation of the true rate of HAI. This must be kept in mind when comparing these rates with other published data. The main reasons for these difficulties are limited diagnostic tools and under-reporting in medical records.

For UTIs and septicaemia, the low number of cultures limits the sensitivity of the study. Doctors were found to request cultures in only 10% of all patients. For half of these cases, a culture result could not be obtained. In one-third of cultures, no micro-organisms were detected. Several factors may explain this low number of cultures. Firstly, in Indonesia, patients normally pay directly for diagnostic tests. Therefore, microbiological tests are only performed when patients can afford to pay. Secondly, it is not common practice in these hospitals to take cultures when an infection is clinically suspected. Cultures are only taken when empiric antibiotic therapy fails. Problems in diagnosing infections occur because few cultures are taken in countries with limited healthcare resources. Out of 834 patients in Lebanon, only 28 culture results were available.[22] The same limitations were reported for Slovenia,[31] where urine cultures were available in 35% of patients. In Lithuania,[16] 41% of cultures were available, and in Brazil,[12] 73 of 328 HAIs were confirmed by culture results.

SSIs can be diagnosed solely on inspection. However, in some postoperative patients, the

Table IV Cross-sectional studies of hospital-acquired infections (HAIs)

Country	Year	Patients	Hospitals	Phlebitis	HAI				
					BSI	UTI	SSI	RTI	Others
Brazil[6]	1987-1988	397	1		4.3	1.5	1.5	5.0	4.0
Spain[7]	1990	38 489	123		1.0	2.8[a]	2.2	1.5	2.4
Spain[8]	1990	[b]	74		1.1	2.9	2.1	1.6	
	1991	[b]	74		0.9	2.5	1.9	1.4	
	1992	[b]	74		1.0	2.3	1.7	1.4	
	1993	[b]	74		1.0	2.3	1.8	1.5	
	1994	[b]	74		0.9	2.1	1.9	1.5	
Norway[9]	1991	14 977	76	0.1[c]	0.4	2.1	1.0	1.3	1.4
France[10]	5-1992	1220	8		1.3	2.2	2.2	1.6	3.3
	11-1992	1389	8		1.0	2.2	0.9	1.9	2.2
Mauritius[11]	1992	1190	4		0.3	0.8	9	0.5	
Brazil[12]	1992	2339	11		1.5	1.8	2.7	2.8	
UK[13,14]	1993-1994	37 111	157		1.1	2.4	1.1	2.6	3.5
Germany[15]	1994	14 966	72		0.3	1.5	0.5	0.7	0.6
Lithuania[16]	1994	1772	1		0.2	0.5	1.4	4.5	2.8
France[17]	1996	236 334	830	0.3[d]	0.5	2.7	0.8	1.6	1.7
Switzerland[18]	1996	1349	4		1.7	2.9	3.9	2.0	
Norway[19]	1996	7708	11	0.3	0.5	2.4	1.5	1.9	1.7
	1997	12 318	14	0.2	0.4	2.1	1.4	1.5	1.5
	1998	12 222	14	0.1	0.4	1.7	1.1	0.9	1.2
New Zealand[20]	1996-1999	5819	3		1.2	1.5	1.7		5.1
Norway[21]	1997	12 755	71		0.8	2.1	1.7	1.5	
Lebanon[22]	1997	834	14	1.2	0.5	1.2	1.9	2.0	
Turkey[23]	7-1998	307	1		3.3	3.9	6.8	1.0	0
	12-1998	313	1		1.9	3.5	4.8	0.3	1.3
Greece[24]	1999	3925	14		1.5	2.1	1.4	2.8	1.5
Denmark[25]	1999	4651	48		0.4	2.1	2.0	1.4	2.1
Italy[26]	1999	888	2		0.2	0.5	0.5	0.2	0.3
Italy[27]	2000	18 667	88		0.6	1.6	0.7	1.1	0.9
Latvia[28]	Not given	1291	2		0.2	0.9	3.5	1.0	0.2
Italy[29]	2000	9467	59		0.3	4.5[a]	0.7	1.6	1.5
Turkey[30]	2001	13 269	29		0.4	1.7			
Slovenia[31]	2001	6695	19		0.3	1.2	0.7	1.0	1.8
Tanzania[32]	2002	412	1			3.4	2.4	1.5	7.5[e]

UTI, urinary tract infection; SSI, surgical site infection; BSI, bloodstream infection; RTI, respiratory tract infection.

[a] Including asymptomatic bacteruria.

[b] Authors only provide mean number of patients included per year (N=23 871), but do not specify the exact number of patients per year.

[c] Catheter-related infections.

[d] Infections of peripheral intravenous catheter site and tracheostomy infections.

Table V Indicators for hospital-acquired infections (HAIs)

	Number of patients (%)		Univariate OR (95% CI)	Multivariate OR (95% CI)
	HAI−	HAI+		
Male sex	839 (49.8)	71 (51.8)	1.1 (0.8-1.5)	-
Temperature >38 °C	65 (3.9)	32 (23.4)	7.6 (4.8-12.1)	5.9 (3.5-9.9)
Infection diagnosed at admission	341 (20.3)	40 (29.2)	1.6 (1.1-2.4)	ns
Length of stay >6 days	853 (50.7)	87 (63.5)	1.6 (1.1-2.3)	1.6 (1.1-2.4)
Any invasive device or operation	943 (56.1)	123 (89.8)	6.9 (3.9-12.1)	6.2 (3.5-11.3)
No invasive devices/operations	740 (43.9)	14 (10.2)	0.2 (0.1-0.3)	-
1 Invasive device/operation	667 (39.7)	65 (47.4)	5.1 (2.9-9.3)	-
2 Invasive devices/operations	203 (12.1)	42 (30.7)	10.9 (5.9-20.4)	-
3 Invasive devices/operations	66 (3.9)	15 (10.9)	12.0 (5.6-26.0)	-
4 Invasive devices/operations	7 (0.4)	1 (0.7)	7.6 (0.9-65.5)	-
Any operation in last 30 days	391 (23.2)	52 (38.0)	2.0 (1.4-2.9)	-
No operation in last 30 days	1291 (76.7)	85 (62.0)	0.5 (0.3-0.7)	-
1 Operation in last 30 days	380 (22.6)	48 (35.0)	1.9 (1.3-2.8)	-
2 Operations in last 30 days	10 (0.6)	4 (2.9)	6.1 (1.9-19.8)	-
3 Operations in last 30 days	1 (0.1)	0 (0)	0.0 (-)	-
Presence of intravenous catheter	688 (40.9)	100 (73.0)	3.9 (2.7-5.8)	-
Presence of urinary catheter	208 (12.4)	40 (29.2)	2.9 (2.0-4.3)	-
Antibiotic use on study day	840 (49.9)	100 (73.0)	2.8 (1.9-4.2)	ns
Culture result available	74 (4.4)	20 (14.6)	3.7 (2.2-6.3)	2.8 (1.5-5.1)
Laboratory result available	1021 (60.6)	96 (70.1)	1.5 (1.0-2.2)	ns
Age under 1 year	135 (8.0)	16 (11.7)	1.5 (0.9-2.6)	2.0 (1.1-3.6)
Age over 60 years	239 (14.2)	27 (17.7)	1.5 (1.0-2.3)	1.7 (1.1-2.8)
Internal medicine	332 (19.7)	32 (23.4)	1.2 (0.8-1.9)	-
Surgery	617 (36.6)	47 (34.4)	0.9 (0.6-1.3)	-
Obstetrics and gynaecology	273 (16.2)	15 (10.9)	0.6 (0.4-1.1)	-
Paediatrics	230 (13.7)	19 (13.9)	1.0 (0.6-1.7)	-
Intensive care unit	22 (1.3)	10 (7.3)	6.0 (2.8-12.8)	ns
Class department	210 (12.5)	14 (10.2)	0.8 (0.5-1.4)	-

OR, odds ratio; CI, confidence intervals. $N=1821$ (third measurement in Hospital A excluded).

authors were not allowed to remove dressings in order to inspect surgical wounds. Therefore, several SSIs, especially superficial infections, may have been missed. Phlebitis can also be diagnosed solely on inspection, but there appears to be a problem in interpretation of the definitions. This is most clearly the case in the third survey in Hospital B. The rate of HAI in general, and the number of phlebitis cases in particular, turned out to be smaller than in the other surveys. This survey was performed by nurses who participated in the first two surveys. The researchers did not participate in data collection. After the survey, all cases were discussed. It turned out that the more severe phlebitis cases were included but the milder cases with reddening of the skin were not recognized as healthcare-associated problems. The fact that the definition for phlebitis is not clearly standardized and validated may have contributed to this difference.

Comparing HAI in different cross-sectional surveys is difficult because there are major differences between the study populations. With a mean age of 31–39 years, the present study population was relatively young. Populations reported in other studies were older: 37–52 years.[8,11] Median length of hospital stay before the survey in the present study was six days, which is comparable with other studies.[16,18,28,31] Few patients in the present study stayed in an ICU (1% in Hospital A and 2% in Hospital B), compared with 1–45% in other studies.[13,24] Exposure to invasive devices and surgery is rarely reported, but the studies that do mention it report percentages roughly comparable to the present study. This study found urinary catheters in 12–15% of patients, while 5–20% of patients in other studies had urinary catheters.[18,29,31] In this study, 20–29% of patients underwent surgery, while other studies report 18–38%.[12,18] Peripheral intravenous catheters were present in 38–46% of the present study population, and varied from 9% to 46% in other studies.[18,31]

To validate the method used in the present study, one of the surveys was performed by two teams. The interobserver variation turned out to be considerable. There was a significant difference in the prevalence of HAI found by the two teams. The level of agreement between the two teams in terms of the population characteristics was acceptable. Small differences between department, temperature, antibiotic use, laboratory and microbiology examinations, surgical operations and presence of invasive devices as measured by the two teams were to be expected, as they can be different in the morning and afternoon. However, it is the authors' opinion that the agreement on temperature, laboratory and microbiology examinations and surgical operations was too low to be entirely accountable for the difference. The fact that agreement on sex, age, length of stay and diagnosis on admission is not 100% suggests suboptimal adherence to the study protocol.

Agreement between the two teams on HAI was very low. Only for SSI did agreement reach more than 50% The method applied had previously been described to have a sensitivity of 90%, namely inspection of all medical records, recording of fever, antibiotic use and cultures.[2] Despite this, there was a significant difference in the number of infections found by the two teams, indicating a problem with reliability. Apart from the low number of cultures and very widespread use of antibiotics, the fact that the nurses participating in the study were not fulltime ICNs may explain this difference. Their position is comparable to that of 'link nurses' in the European infection control system, and their experience in performing surveillance of HAI varied. Low sensitivity of surveillance carried out by personnel with limited experience has been described before; ICPs with four or more years of experience turned out to have a significantly higher sensitivity in diagnosing SSIs than less experienced ICPs.[33]

Although problems in detecting infections must be addressed, the method for cross-sectional surveillance of HAI used in the present study was feasible. To see whether the efficiency of surveillance could be improved without compromising the sensitivity, the authors looked for patient characteristics that were present in the majority of patients with HAI. The presence of invasive procedures is the most useful indicator to optimize surveillance; when only those patients with invasive procedures were included, 90% of all HAIs were found while only 59% of patients were screened. This will suffice for estimating levels of HAI and monitoring trends. Antibiotic use can be included as a selection criterion to increase sensitivity; almost three-quarters of the population must be screened, but no serious infections are likely to be missed.

The hospitals that participated in this study were representative for Indonesian university hospitals and for Indonesian public hospitals in general. The results should not be generalized to private hospitals because the organization and patient populations of Indonesian private hospitals are different from public hospitals.

In conclusion, the prevalence of HAI in Indonesia is comparable with that in other countries. The prevalence of SSI in surgical patients in Indonesia is rather high.

The described method of cross-sectional surveillance of clinical infections provides a feasible method to assess the prevalence of HAI in a country with limited healthcare resources. The efficiency can be improved by including only those patients with invasive devices or who have undergone surgery recently. This enables 90% of all infections to be found while screening only 60% of patients. Further research needs to focus on surveillance using a highly sensitive and reliable method, and improvement of the diagnosis of infections through better reporting in medical records and better use of laboratory resources. Reliability might be improved by appointing and training fulltime ICNs.

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