# Infection control in Indonesian Hospitals

Duerink, D.O.

Chapter

# 2

## SURVEILLANCE OF HEALTHCARE-ASSOCIATED INFECTIONS IN INDONESIAN HOSPITALS

Offra Duerink, Djoko Roeshadi, Hendro Wahjono, Endang Sri Lestari, Usman Hadi, JanWille, Rianne de Jong, Nico Nagelkerke, Peterhans van den Broek, on behalf of the AMRIN study group

*Journal of Hospital Infection 2006 Feb; 62 (2): 219-29*

## ABSTRACT

A cross-sectional surveillance of healthcare-associated infections (HAI) and exposure to risk factors was done in two Indonesian teaching hospitals (hospital A and B), on internal medicine, surgery, obstetrics and gynaecology, paediatrics, a class department and intensive care units. General information, antibiotic use, culture results, presence of HAI (phlebitis, surgical site infections (SSI), urinary tract infections (UTI) and septicaemia) and risk factors were recorded. To check for inter-observer variation, a validation study was done in hospital B. In hospital A, 1 334 patients were included and in hospital B, 888. Exposure to invasive devices and surgery was 59%. In hospital A, 2.8% of all patients had phlebitis, 1.7% SSI, 0.9% UTI and 0.8% septicaemia, and in hospital B, 3.8% phlebitis, 1.8% SSI, 1.1% UTI and 0.8% 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 by the second team 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 we found a considerable difference in prevalence rates in the validation study. The surveillance method we used can be a feasible tool for hospitals in countries with limited healthcare resources to estimate their level of HAI and make improvements in infection control. The efficiency can be improved by targeting the surveillance, by including only patients with invasive procedures. Then, 90% of all infections are found while screening only 60% of patients.

## INTRODUCTION

The SENIC-study, carried out during the seventies of the previous century, 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 twenty to thirty years in hospitals in developed countries. Several methods of surveillance were evaluated and the sensitivity of these methods 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 like Nosocomial Infection Surveillance System (NISS) in the United States of America, Nosocomial Infection National Surveillance Service (NINSS) in the United Kingdom and 'Preventie van Ziekenhuisinfecties door Surveillance' (PREZIES) in the Netherlands.[4] The question is how well applicable the accepted surveillance methods are in countries with limited healthcare resources, such as Indonesia. The Indonesian healthcare-system is aware of the dangers of healthcare-associated infections (HAI). Several hospitals have doctors and nurses with training in infection control, although there are no fulltime infection control nurses (ICN). There are infection control committees, which communicate on a regional and national level. Surveillance of HAI is done, with focus on surgical site infections. So far, there are no published data on infection control in Indonesia. Therefore, a study was set up to investigate prevalence of HAI and to design a feasible and efficient method of surveillance in Indonesian hospitals.

## METHODS

A cross-sectional study of healthcare-associated infections (HAI) was performed in two Indonesian university hospitals on the island of Java. In this article, these hospitals will be referred to as hospital A and hospital B.

### Data-collection

The study was carried out by Dutch and Indonesian researchers and members of the local infection control committees. The HAI included were phlebitis, septicaemia (laboratory-confirmed bloodstream infections (LC-BSI) and clinical sepsis), urinary tract infections (UTI) and surgical site infections (SSI). For all infections except phlebitis, the CDC definitions of hospital infections were used.[3 5] Phlebitis includes patients with only inflammation of the iv-catheter site, either chemical or infectious in nature, and patients with fever and inflammation of the iv-catheter site. Surveillance was done in pairs by ward nurses with some experience in infection control, medical students and young doctors, who were trained by the researchers. The departments included were internal medicine, surgery, obstetrics and gynaecology, paediatrics, a class department and intensive care units (ICU).

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

The following information was gathered from written patient documentation: sex, age, temperature, diagnosis on admission, date of admission, surgical operations in 30 days preceding the survey, antibiotic use on study day, leukocyte count, erythrocyte sedimentation rate, c-reactive protein, urine sediment and culture results. Next, 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 needed to confirm the diagnosis. HAI originating from other hospitals were not recorded.

## Validation study

To check for inter-observer variation, a validation study was done 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, not aware of the results of the other team. One team was led by one of the researchers (D.O.D.), together with an experienced Indonesian ICN, the other team by the Dutch ICP (J.C.W.), together with one of the researchers (E.S.L.). Experienced and less experienced ICN 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 both 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 term used was: (prevalence study OR prevalence studies OR prevalence survey OR prevalence surveys) AND (nosocomial infection OR nosocomial infections OR hospital infection OR hospital infections). These search terms map to the MeSH heading “cross infection”. Only articles published from 1990 onward were included. Studies referred to in these articles were also included. ICU-only and single department-surveys, as well as surveys from long-term care facilities were excluded.

## Statistical analysis

Differences in population characteristics, as well as prevalence of HAI between different departments, hospitals and surveys were analyzed using the statistical package SPSS. Odds ratios (OR), significance and 95% confidence intervals (CI-95) were calculated.
Comparability of the results of both teams in the validation study was analyzed 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 HAI, variables associated with HAI were selected by univariate analysis. Next, backward stepwise logistic regression was performed with those variables, to identify variables that are independently, significantly associated with HAI.

## RESULTS

In hospital A, surveys were done in August and October 2001 and February 2002, and in hospital B in February, March and April 2002.
In total, 2 290 patients were seen; 1 392 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, 4 cases were excluded because of double entry and 6 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 on the first encounter with this specific patient was recorded and the second discarded. Cases with missing data were only excluded when there had not been a bedside visit.

### Demographic data

Hospital A is a 1 500-bed, and hospital B a 1 070-bed hospital. The fact that 60% of patients was included in hospital A reflects this size difference (Table 1).
Mean age of all patients was 33 years (hospital A 31 years, hospital B 37 years ($p<0.001$)), with a spread of newborn to 87 years. Sex and 'length of stay until 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 to 187 days.
One percent of patients in hospital A was admitted on ICU, and two percent of patients in hospital B (OR=2.0, CI-95=1.0-4.2). Compared with hospital B, a larger proportion of patients in hospital A were admitted on departments of surgery and internal medicine. The reason for this difference is the inclusion of a ‘class’ department in hospital B, with nursing class I and II beds. Mainly surgery and internal medicine patients are admitted on this department, so there is no real difference in patient distribution between both hospitals.
Admission diagnoses in both hospitals were roughly comparable. Only trauma was more frequently seen in hospital A (OR=2.4, CI-95=1.8-3.1).
Temperatures of 465 patients were not recorded, due to a misinterpretation of the study protocol. Of the remaining 1 757 patients, 7% (117 patients) had a temperature of more than 38$^{o}$C.
Cultures were ordered in 223 patients (10%). In 119 cases a result was found, which was positive in 72 cases. 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, CI-95 6.0-9.3).
Of all patients, 541 (24%) had undergone surgery in the month prior to inclusion in the study, 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, i.e. surgical operations in the month preceding the study or an intravenous or urinary catheter on the day of the study. Of these 1 302 patients, 70% had one invasive procedure, 22% two, 8% three and less than 1% four.

Table 1: Demographic data #

| | Hospital A | | | | | Hospital B | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | August 2001 | October 2001 | April 2002 | Total | | February 2002 | March 2002 | April 2002 | Total | |
| patients | 434 | 499 | 401 | 1 334 | | 291 | 304 | 293 | 888 | |
| male | 222 | 250 | 200 | 672 | (50) | 135 | 151 | 152 | 438 | (49) |
| age (years) * | 35 | 30 | 30 | 31 | | 40 | 38 | 39 | 39 | |
| length of stay (days) * | 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 & gynaecology | 47 | 66 | 66 | 179 | (13) | 58 | 60 | 57 | 175 | (20) |
| paediatrics | 58 | 90 | 89 | 237 | (18) | 33 | 28 | 40 | 101 | (11) |
| ICU | 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 † | 108 | 100 | 92 | 300 | (23) | 84 | 76 | 92 | 252 | (28) |
| - trauma | 72 | 96 | 53 | 221 | (17) | 28 | 28 | 21 | 77 | (9) |
| - others †† | 141 | 167 | 140 | 448 | (34) | 129 | 140 | 126 | 395 | (45) |
| - missing | 5 | 14 | 7 | 26 | (2) | 2 | - | 6 | 8 | (1) |
| temperature ($^{o}$C) * | 37.1 | 36.8 | 36.8 | 36.8 | | 36.9 | 37.0 | 37.0 | 37.0 | |
| antibiotic use 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 ** | 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=2 222
* Values shown are median values. † Neoplasms; malignant and benign, solid and haematological. †† The category 'others' chiefly consists of urinary tract, gastrointestinal tract and cardiovascular disorders, obstetrical and neurological diagnoses, and diabetes mellitus. ** Diagnostic tests available: leucocytes in blood, C-reactive protein, erythrocyte sedimentation rate, urine sediment.

## Prevalence of HAI

The overall prevalence of HAI in hospital A was 5.9% including phlebitis (CI-95 4.6-7.2), and 3.1% excluding phlebitis (CI-95 2.2-4.1) and in hospital B 8.3% including phlebitis (CI-95 6.5-10.2), and 4.5% excluding phlebitis (CI-95 3.1-5.9, Table 2). In hospital A there were four, and in hospital B two patients with two HAI. On top of the infections summarized in table 2, seven possible infections were found. These cases were suspect for HAI, but could not be proven using the CDC definitions, mostly because of lack of microbiology results. These cases are not included in the analysis as HAI.

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

Patients admitted in hospital B had a significantly higher number of HAI compared with patients in hospital A (OR = 1.5, CI = 1.1-2.1). However, the number of HAI found in hospital A in February 2002 was significantly lower than in August and

October 2001 (OR = 2.4, CI = 1.3-4.5). This low rate can be attributed mainly to the few phlebitis cases found in this survey (0.7%, compared with 3.2% in the total population, OR = 5.2, CI-95 = 1.6-16.7). When only the results of August and October 2001 are compared with the results of hospital B, there is no longer a significant difference. Then 65 (7.0%) HAI are found in hospital A and 74 (8.3%) HAI in hospital B (OR = 1.2, CI-95 = 0.9-1.7). Therefore, the third survey in hospital A was excluded from further analysis.
More patients in ICU have HAI, than patients in other departments (OR = 4.6, CI-95 = 2.2-9.5). There are no significant differences between the other departments.

Table 2: Prevalence of healthcare-associated infections

| | *Hospital A (n=1 334)* | | | | *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) |

## Validation study

The first team saw 296 patients and the second team 330 patients. The 228 patients, who were seen by both teams, were included (Table 3).
There are considerable differences between the results of both surveillance teams. Sex distribution was comparable, though 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, though 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 are significant differences in the number of HAI found by team 1 and team 2. Team 2 more frequently diagnosed SSI, especially deep SSI (p=0.01). Regarding patients scored by both teams as infected, the teams agreed on the type (superficial, deep and organ space) of the infections. Team 2 also found more UTI than team 1 (p=0.01), but less septicaemia (p=0.01).

Table 3: Validation study [#]

| | Team 1 | Team 2 | Correlation (Spearman) | Agreement (Kappa) |
|---|---|---|---|---|
| male | 118 | 116 | 0.929 | 0.929 |
| age (years) * | 36.2 | 36.6 | 0.984 | - |
| length of stay (days) * | 10.1 | 9.5 | 0.905 | - |
| | | | | |
| department of admission | | | 0.982 | 0.989 |
| internal medicine | 30 | 29 | | |
| surgery | 52 | 52 | | |
| obstetrics & gynaecology | 43 | 43 | | |
| paediatrics | 30 | 30 | | |
| ICU | 7 | 8 | | |
| class wards | 66 | 66 | | |
| | | | | |
| diagnosis on admission | | | 0.771 | 0.854 |
| infection | 35 | 40 | | |
| neoplasm [†] | 77 | 77 | | |
| trauma | 15 | 14 | | |
| others [††] | 98 | 97 | | |
| missing | 3 | - | | |
| | | | | |
| temperature (°C) * | 37.0 | 37.0 | 0.693 | - |
| Fever > 38 °C | 17 | 17 | 0.745 | 0.745 |
| antibiotic use study day | 127 | 114 | 0.803 | 0.798 |
| culture done | 23 | 22 | 0.680 | 0.679 |
| diagnostics done | 199 | 195 | 0.629 | 0.627 |
| | | | | |
| IV-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 |
| UTI | 2 | 8 | 0.493 | 0.391 |
| SSI | 4 | 6 | 0.604 | 0.591 |
| septicaemia | 0 | 2 | 0 | - |
| possible infection | 3 | 1 | -0.008 | -0.007 |

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

## Literature search

The literature search yielded 131 articles, 26 describing cross-sectional studies (Table 4).[6-32] Prevalence of HAI varies greatly, but HAI registered and infection diagnoses differ.[6 15] Most studies are from Western-European countries[7-10 13-15 17-19 21 24-27 29], three from Eastern Europe[16 28 31], three from the Middle East[22 23 30], three from other non-western countries[6 11 12 32] and one from New-Zealand[20]. There are no recently published cross-sectional studies from Southeast Asia. Twelve studies report on population characteristics like age and length of stay.[11-13 16 18 22-24 26-28 31]

Table 4: Cross-sectional studies of HAI

| | | | | | | | *HAI* | | |
|---|---|---|---|---|---|---|---|---|---|
| *country* | *year* | *patients* | *hospitals* | *phlebitis* | *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[#] | 2.2 | 1.5 | 2.4 |
| Spain[8] | 1990 | * | 74 | | 1.1 | 2.9 | 2.1 | 1.6 | |
| | 1991 | * | 74 | | 0.9 | 2.5 | 1.9 | 1.4 | |
| | 1992 | * | 74 | | 1.0 | 2.3 | 1.7 | 1.4 | |
| | 1993 | * | 74 | | 1.0 | 2.3 | 1.8 | 1.5 | |
| | 1994 | * | 74 | | 0.9 | 2.1 | 1.9 | 1.5 | |
| Norway[9] | 1991 | 14 977 | 76 | 0.1[†] | 0.4 | 2.1 | 1.0 | 1.3 | 1.4 |
| France[10] | 5-1992 | 1 220 | 8 | | 1.3 | 2.2 | 2.2 | 1.6 | 3.3 |
| | 11-1992 | 1 389 | 8 | | 1.0 | 2.2 | 0.9 | 1.9 | 2.2 |
| Mauritius[11] | 1992 | 1 190 | 4 | | 0.3 | 0.8 | 9 | 0.5 | |
| Brazil[12] | 1992 | 2 339 | 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 | 1 772 | 1 | | 0.2 | 0.5 | 1.4 | 4.5 | 2.8 |
| France[17] | 1996 | 236 334 | 830 | 0.3[††] | 0.5 | 2.7 | 0.8 | 1.6 | 1.7 |
| Switzerland[18] | 1996 | 1 349 | 4 | | 1.7 | 2.9 | 3.9 | 2.0 | |
| Norway[19] | 1996 | 7 708 | 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 | 5 819 | 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 | 3 925 | 14 | | 1.5 | 2.1 | 1.4 | 2.8 | 1.5 |
| Denmark[25] | 1999 | 4 651 | 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 | 9 467 | 59 | | 0.3 | 4.5[#] | 0.7 | 1.6 | 1.5 |
| Turkey[30] | 2001 | 13 269 | 29 | | 0.4 | 1.7 | | | |
| Slovenia[31] | 2001 | 6 695 | 19 | | 0.3 | 1.2 | 0.7 | 1.0 | 1.8 |
| Tanzania[32] | 2002 | 412 | 1 | | | 3.4 | 2.4 | 1.5 | 7.5[##] |

* Authors only provide mean number of patients included per year (n=23 871), but do not specify the exact number of patients per year. [†] Catheter-related infections
[††] Infections of peripheral intravenous-catheter site and tracheostomy infections
[#] Including asymptomatic bacteruria [##] Unspecified cases: 4.9%

## Indicators for finding HAI

Invasive procedures (surgical operations, urinary catheters and intravenous catheters), a body temperature of more than 38°C, a hospital stay of more than six days before the study, antibiotic use on the study day, laboratory and microbiology results, and ICU admission, are associated with HAI in univariate analysis (Table 5). So is hospital B, but this association is no longer significant when the third measurement in hospital A is excluded from the analysis. Age analyzed as a categorical variable was not significantly associated with HAI, but analysis as a (squared) continuous variable showed a higher prevalence in the very young and the very old. Therefore we decided to include age 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, 1 067 patients (59% of the hospital population) must be screened with a yield of 125 infections, i.e. 90% of HAI is detected in this way. The fourteen missed HAI were eleven cases of phlebitis, two LC-BSI and one clinical sepsis. When besides patients with invasive procedures, patients with microbiology results are screened, the number of patients to be seen increases from 1 067 to 1 097 (60% of the hospital population). Then, four more HAI are found (129, 93% of HAI). Inclusion of patients with invasive procedures and antibiotic usage results in 1 304 patients (72%) to be seen and 136 HAI (98%) detected.

Table 5: Indicators for HAI#

| | *number of patients (%)* | | *univariate* | *multivariate* |
|---|---|---|---|---|
| | HAI - | HAI + | OR (CI-95) | OR (CI-95) |
| male sex | 839 (49.8) | 71 (51.8) | 1.1 (0.8-1.5) | - |
| temperature above 38°C | 65 (3.9) | 32 (23.4) | 7.6 (4.8-12.1) | 5.9 (3.5-9.9) |
| diagnosis on admission infection | 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 devices/operations | 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 | 1 291 (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 iv-catheter | 688 (40.9) | 100 (73.0) | 3.9 (2.7-5.8) | - |
| presence urinary catheter | 208 (12.4) | 40 (29.2) | 2.9 (2.0-4.3) | - |
| antibiotic use | 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 | 1 021 (60.6) | 96 (70.1) | 1.5 (1.0-2.2) | ns |
| age under 1 | 135 (8.0) | 16 (11.7) | 1.5 (0.9-2.6) | 2.0 (1.1-3.6) |
| age over 60 | 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 & 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) | - |
| ICU | 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) | - |

# N = 1 821 (third measurement in hospital A excluded)

## DISCUSSION

This is the first study to report on HAI in Indonesia. One in fourteen hospitalized patients had one or more HAI. The prevalence of SSI in patients who underwent surgery was five to eight percent. Over half of these infections were deep or organ space infections. Three to four percent of patients had phlebitis, only one percent of patients was diagnosed with UTI and one to two percent with septicaemia. These rates appear to be comparable to studies described in the literature, although these studies are difficult to compare, as the infections recorded, infection definitions and patient populations vary. Also, phlebitis, often not infectious in nature, is mostly not included in surveillance of HAI. We choose to include it, as it is an important complication of intravenous therapy.

Despite choosing the infections that are expected to be the easiest to diagnose, we had difficulties in ascertaining HAI. Therefore, we suspect that the prevalence rates we present in our study are an underestimation of the true rate of HAI. This must be kept in mind when comparing our rates with published data. The main reasons for these difficulties are limited diagnostics and underreporting in medical records.

For UTI, but also for septicaemia, the low number of cultures limits the sensitivity of the study. We found doctor's orders for cultures in only ten percent of all patients. For half of these cases, we could not obtain a result. Of the culture results we found, one third showed no growth of microorganisms. Several factors may explain this low number of cultures. Firstly, in Indonesia, patients normally pay directly for diagnostics. 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 suspected. Only when empiric antibiotic therapy fails, cultures are taken. Problems in diagnosing infections because of few cultures often arise 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, Lithuania[16] where cultures were available in 41% and Brazil[12] where 73 of 328 HAI were confirmed by culture results.

SSI can be diagnosed solely on inspection. However, in some postoperative patients we were not allowed to remove dressings in order to inspect surgical wounds. Therefore, several SSI, 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 done 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 only red colouring 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 to 39 years, our population is relatively young. Populations in other studies are older: 37 to 52 years.[8 11] Median 'length of stay until survey' in our study is six days, which is comparable to other studies.[16 18 28 31] Few patients in our study stayed in ICU (1% in hospital A and 2% in hospital B), compared with 1 to 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 exposure in our study. We found urinary catheters in 12 to 15% of patients, while 5 to 20% of patients in other studies have urinary catheters.[18 29 31] In our study, 20 to 29% of patients underwent surgery, while other studies report 18 tot 38%.[12 18] Peripheral intravenous catheters were present in 38 to 46% of our population and varied from 9 to 46% in other studies.[18 31]
To validate the method used in our study, one of the surveys was done by two teams. The inter-observer variation turned out to be considerable. There was a significant difference between the prevalence of HAI found by the two teams. The level of agreement between the two teams as regards population characteristics is acceptable. Small differences between department, temperature, antibiotic use, laboratory and microbiology examination, surgical operations and presence of invasive devices as measured by the two teams are to be expected, as they can be different in the morning and afternoon. However, we feel that the agreement on temperature, laboratory and microbiology examination and surgical operations is too low to be entirely accountable to this time difference. The fact that agreement on sex, age, length of stay and diagnosis on admission is not 100%, suggests a suboptimal adherence to the study protocol.
Agreement between the two teams on HAI is very low. Only for SSI agreement is more than 50%, while for the other HAI, there is very little to no agreement.
We applied a method that is described to have a sensitivity of 90%, namely inspection of all medical records, looking for clues for infection like fever, antibiotic use and cultures.[2] Despite this, there is 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 are not fulltime ICN's may explain this difference. Their position is comparable to that of 'link nurses' in the European infection control system, and their experience in doing surveillance of HAI varies. Low sensitivity of surveillance carried out by personnel with limited experience is described before; ICP with four or more years of experience turned out to have a significantly higher sensitivity in diagnosing SSI than less experienced ICP.[33]
Although problems in detecting infections must be addressed, the method for cross-sectional surveillance of HAI we used, proved feasible. To see whether the efficiency of surveillance could be improved without compromizing the sensitivity too much, we looked for patient characteristics that were present in the majority of patients with HAI. Presence of invasive procedures is the most useful indicator to optimize surveillance: when only patients with invasive procedures are included, 90% of all HAI are found while only 59% of patients are screened. This will suffice for estimating levels of HAI and monitoring trends. Antibiotic use can be included as a selection criterion to increase sensitivity. Then, almost three quarters of the population must be screened, but no serious infections are missed.
The hospitals that participated in our study are representative for Indonesian university hospitals, and for Indonesian public hospitals in general. The results should not be generalized to private hospitals, because organization and patient populations of Indonesian private hospitals are different from public hospitals.
In conclusion, prevalence of HAI in Indonesia is comparable to those reported in other countries. The prevalence of SSI in operated patients 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 patients with invasive

devices or with recent surgery. Then, 90% of all infections are found while screening only 60% of patients. Further research needs to be targeted to surveillance with a highly sensitive and reliable method and to improvement of diagnosis of infections through better reporting in medical records and better use of laboratory resources. Reliability might be improved by appointing and training of fulltime ICN.

## ACKNOWLEDGEMENTS

We thank the deans of the Medical Faculties of the Airlangga University, Surabaya, Indonesia and the Diponegoro University, Semarang, Indonesia, and the directors of the Dr. Soetomo Hospital, Surabaya, and the Dr. Kariadi Hospital, Semarang, who have facilitated our work in these hospitals. We also thank the members of the Infection Control Committees, who have helped in organizing the surveillance. We gratefully acknowledge the contribution of Tjatur Junanto and colleagues, and Moch.Nadlir Fakhri, M.D., from the Dr. Soetomo Hospital, Surabaya, Indonesia, Sri Harmini and colleagues and Purnomo Hadi, M.D., Vera, M.D., Yenni Suryaningtyas, M.D., Upik Handayani, M.D., Krisma Irmajanti, M.D., from the Dr. Kariadi Hospital, Semarang, Indonesia, and Rozemarijn van der Meulen from the Radboud University Medical Center, who helped us in data-collection and data-entry.
This work was supported by the Royal Netherlands Academy of Arts and Sciences (KNAW), Science Programme Indonesia-the Netherlands (SPIN, project 99-MED-03).

## REFERENCES


1. Haley RW, Culver DH, White JW, Morgan WM, Emori TG, Munn VP, Hooton TM. The efficacy of infection surveillance and control programs in preventing nosocomial infections in US hospitals. *Am J Epidemiol* 1985; 121(2): 182-205.
2. Freemen J. Methodological issues in hospital epidemiology: I. Rates, casefinding, and interpretation. *Rev Infect Dis* 1981; 3: 658-667.
3. Garner JS, Jarvis WR, Emori TG, Horan TC, Hughes JM. CDC definitions for nosocomial infections, 1988. *Am J Infect Control* 1988; 16(3): 128-140.
4. van den Broek PJ. Historical Perspectives for the New Millenium. In: Wenzel RP, editor. *Prevention and Control of Nosocomial Infections*. 4 ed. Philadelphia: Lippincott Williams and Wilkins, 2003:3-13.
5. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Am J Infect Control* 1992; 20(5): 271-275.
6. Wagner MB, Petrillo V, Gay V, Fagundes GR. A prevalence survey of nosocomial infection in a Brazilian hospital. *J Hosp Infect* 1990; 15(4): 379-381.
7. EPINE Working Group. Prevalence of hospital-acquired infections in Spain. *J Hosp Infect* 1992; 20: 1-13.
8. Vaque J, Rosello J, Trilla A, Monge V, Garcia-Caballero J, Arribas JL, Blasco P, Saenz-Dominguez JR, Albero I, Calbo F, Barrio J, Herruzo R, Saenz-Gonzalez C, Arevalo JM. Nosocomial Infections in Spain: Results of Five Nationwide Serial Prevalence Surveys (EPINE Project, 1990 to 1994). *Infect Control Hosp Epidemiol* 1996; 17(5): 293-297.
9. Aavitsland P, Stormark M, Lystad A. Hospital-Acquired Infections in Norway: A National Prevalence Survey in 1991. *Scand J Infect Dis* 1992; 24: 477-483.
10. Sartor C, Sambuc R, Bimar MC, Gulian C, De Micco P. Prevalence surveys of nosocomial infections using a random sampling method in Marseille hospitals. *J Hosp Infect* 1995; 29: 209-216.
11. Jepsen OB, Jensen LP, Zimakoff J, Friis H, Bissoonauthsing CN, Kasenally AT, Fareed D, Johansen KS, Worning AM. Prevalence of infections and use of antibiotics among hospitalized patients in Mauritius. A nationwide survey for the planning of a national infection control programme. *J Hosp Infect* 1993; 25: 271-278.
12. Rezende EM, Couto BR, Starling CE, Modena CM. Prevalence of Nosocomial Infections in General Hospitals in Belo Horizonte. *Infect Control Hosp Epidemiol* 1998; 19: 872-876.
13. Emmerson AM, Entstone JE, Griffin M, Kelsey MC, Smyth ET. The Second National Prevalence Survey of Infection in Hospitals-overview of the results. *J Hosp Infect* 1996; 32: 175-190.
14. Emmerson AM, Entstone JE, Kelsey MC. The Second National Prevalence Survey of Infection in Hospitals: methodology. *J Hosp Infect* 1995; 30: 7-29.
15. Ruden H, Gastmeier P, Daschner FD, Schumacher M. Nosocomial and community-acquired infections in Germany. Summary of the results of the First National Prevalence Study (NIDEP). *Infection* 1997; 25(4): 199-202.
16. Valinteliene R, Jurkuvenas V, Jepsen OB. Prevalence of hospital-acquired infection in a Lithuanian hospital. *J Hosp Infect* 1996; 34: 321-329.
17. The French Prevalence Surveillance Study Group. Prevalence of nosocomial infections in France: results of the nationwide survey in 1996. *J Hosp Infect* 2000; 46: 186-193.

18. Pittet D, Harbarth S, Ruef C, Francioli P, Sudre P, Petignat C, Trampuz A, Widmer A. Prevalence and Risk Factors for Nosocomial Infections in Four University Hospitals in Switzerland. *Infect Control Hosp Epidemiol* 1999; 20(1): 37-42.
19. Andersen BM, Ringertz SH, Gullord TP, Hermansen W, Lelek M, Norman BI, Nystad MT, Rod KA, Roed RT, Smidesang IJ, Solheim N, Tandberg S, Halsnes R, Wenche Hoystad M. A three-year survey of nosocomial and community-acquired infections, antibiotic treatment and re-hospitalization in a Norwegian health region. *J Hosp Infect* 2000; 44: 214-223.
20. Graves N, Nicholls TM, Wong CG, Morris AJ. The prevalence and estimates of the cumulative incidence of hospital-acquired infections among patients admitted to Auckland District Health Board Hospitals in New Zealand. *Infect Control Hosp Epidemiol* 2003; 24(1): 56-61.
21. Scheel O, Stormark M. National prevalence survey on hospital infections in Norway. *J Hosp Infect* 1999; 41: 331-335.
22. Azzam R, Dramaix M. A one-day prevalence survey of hospital-acquired infections in Lebanon. *J Hosp Infect* 2001; 49: 74-78.
23. Metintas S, AkgunY, Durmaz G, Kalyoncu C. Prevalence and characteristics of nosocomial infections in a Turkish university hospital. *Am J Infect Control* 2004; 32: 409-413.
24. Gikas A, Pediaditis J, Papadakis JA, Starakis J, Levidiotou S, Nikolaides P, Kioumis G, Maltezos E, Lazanas M, Anevlavis E, Roubelaki M, Tselentis Y; Greek Infection Control Network. Prevalence study of hospital-acquired infections in 14 Greek hospitals: planning from the local to the national surveillance level. *J Hosp Infect* 2002; 50: 269-275.
25. Christensen M, Jepsen OB. Reduced rates of hospital-acquired UTI in medical patients. Prevalence surveys indicate effect of active infection control programmes. *J Hosp Infect* 2001; 47: 36-40.
26. Pavia M, Bianco A, Viggiani NM, Angelillo IF. Prevalence of hospital-acquired infections in Italy. *J Hosp Infect* 2000; 44: 135-139.
27. Lizioli A, Privitera G, Alliata E, Antonietta Banfi EM, Boselli L, Panceri ML, Perna MC, Porretta AD, Santini MG, Carreri V. Prevalence of nosocomial infections in Italy: result from the Lombardy survey in 2000. *J Hosp Infect* 2003; 54: 141-148.
28. Dumpis U, Balode A, Vigante D, Narbute I, Valinteliene R, Pirags V, Martinsons A, Vingre I. Prevalence of nosocomial infections in two Latvian hospitals. *Euro Surveill* 2003; 8(3): 73-78.
29. Zotti CM, Messori Ioli G, Charrier L, Arditi G, Argentero PA, Biglino A, Farina EC, Moiraghi Ruggenini A, Reale R, Romagnoli S, Serra R, Soranzo ML, Valpreda M, Hospital Coordinator Group. Hospital acquired infections in Italy: a region wide prevalence study. *J Hosp Infect* 2004; 56: 142-149.
30. Leblebicioglu H, Esen S, Turkish Nosocomial Urinary Tract Infection Study Group. Hospital-acquired urinary tract infections in Turkey: a nationwide multicenter point prevalence study. *J Hosp Infect* 2003; 53: 207-210.
31. Klavs I, Bufon Luznik T, Skerl M, Grgic-Vitek M, Lejko Zupanc T, Dolinsek M, Prodan V, Vegnuti M, Kraigher A, Arnez Z; Slovenian Hospital-Acquired Infections Survey Group. Prevalence of and risk factors for hospital-acquired infections in Slovenia-results of the first national survey, 2001. *J Hosp Infect* 2003; 54: 149-157.

32. Gosling R, Mbatia R, Savage A, Mulligan JA, Reyburn H. Prevalence of hospital-acquired infections in a tertiairy referral hospital in northern Tanzania. *Ann Trop Med Parasitol* 2003; 97(1): 69-73.
33. Ehrenkranz NJ, Shultz JM, Richter EL. Recorded criteria as a "gold standard" for sensitivity and specificity estimates of surveillance of nosocomial infection: a novel method to measure job performance. *Infect Control Hosp Epidemiol* 1995; 16(12): 697-702.