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A Long-period Survey on Nosocomial Infections in Ilam University Hospitals, Iran

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Abstract: A long-period survey was carried out in three University Hospitals in Ilam-Iran in during Feb. 1997 to Jan. 2003, to determine the incidence of nosocomial infections (NIs) by site of infection, Hospital department and micro-organisms. Hospitals (N- 3) with more than 100 beds were studied. By classification sampling of 88473 hospitalized patients in three Hospitals of Ilam city, 5572 patients were selected and follow-up for nosocomial infections. Demographic and Clinical data were recorded from medical chart review by two investigators. The overall prevalence of NIs was 7.75% (CI: 6-9.5%). Of 5572 patients, the most frequent site of NIs were the urinary tract infections (29.7% of NIs), followed by surgical wound infections (27.3%) and bloodstream infections (16.7%). Greatest prevalence rate was found in the Surgery department (11.6%), followed by the adult ICU (8.2%). The Positive cultures were found in 89.9% of the cases. Where only one micro-organism was isolated the most frequently isolated pathogen from all sites of infections was *Coagulase-negative Staphylococci* (17.8%), followed by *Escherichia coli* (15.7%) and *Staphylococcus aureus* (13.1%). According to the results, there was significant difference between nosocomial infections and age groups (p = 0.044). This survey showed that NIs occurred in Ilam University Hospitals at a rate similar to that reported in European countries. These findings provide baseline information for further surveillance in association with prevention programmes in Ilam University Hospitals.

Key words: Nosocomial infections, long-period survey, Ilam, Iran

INTRODUCTION

Nosocomial infections (NIs) are a major worldwide public health problem. They constitute an important cause of mortality, morbidity, prolonged hospital stay and increase of treatment costs (Daschner, 1982). Studies on the nosocomial infections in various countries have shown that 2.5% to 21% of patients become infected during hospitalization (Emmerson *et al*., 1996; EPINE Working Group, 1992; Mayon-White *et al*., 1988; Mertens *et al*., 1987; Rezend *et al*., 1998).

Each year, In the USA, nosocomial infections are cause 25000 death (Edmond *et al*., 1999). In addition, the NIs may be cause prolonged hospital stay from 1 to 30 days. This will cause financial problems in the hospitals, so that each 1 million NIs will be cause of one billion $ loss (Edmond *et al*., 1999). Many hospitals have instituted infection control programmes, but the effectiveness of the policies used has not been adequately studied (Haley *et al*., 1985).

Surveillance has been widely accepted as the primary tool in the control of hospital-acquired infections (HAIs) and is rapid and inexpensive way for first estimation of the magnitude of NIs problems in hospitals, especially those with limited resources (French and Cheng, 1991). Many research reports have indicated that nosocomial infection frequencies, as well as types of infections, can differ remarkably from one hospital to another (EPINE Working Group, 1992; Mayon-White *et al*., 1988; Mertens *et al*., 1987; Rezend *et al*., 1998). A survey carried out in Belgium in 1984, registering surgical wound infections, bacteraemia and urinary tract infection, showed an overall prevalence of 9.3% (Edmond *et al*., 1999). Two surveys conducted in 1992 in Marseille university hospitals, showed prevalence of 7.1 and 8.6%, respectively (Sartor *et al*., 1995). Prevalence varies from 8.5% (1990) and 7.2% (1994) in Spain to 10% in France (1993) and 3.6% in Germany (1996) EPINCAT study group, 1990; Hauer *et al*., 1996; Quenon *et al*., 1993). It should, therefore, be

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acknowledged that hospitals remain potentially hazardous and that targeted preventive measures are likely to be cost-effective (Haley *et al*., 1981).

The gold standard for surveillance is prospective, on-site, continuous, hospital-wide surveillance; however, these incidence surveys require exhaustive resources (Pittet *et al*., 1999).

Few hospitals in Iran have implemented infection control programs and infection control has not been given great attention. This study was confined to three Ilam University hospitals with this study; we had the opportunity to obtain correct data on frequency of Nis.

MATERIALS AND METHODS

Data collection, criteria and definitions: The study was conducted over a period of 72 months (from Feb. 1997 to Jan. 2003) at the three University hospitals in Ilam, Iran. In the present study, by classification sampling of 88473 hospitalized patients in three hospitals of Ilam city, 5572 patients were selected and follow-up for nosocomial infections. Demographic and clinical data for all the hospitalized patients were obtained from the medical and nursing records, temperature monitoring charts, X-ray, laboratory reports, doctors' and nurses' progress notes. Five major infection sites were studied: urinary tract infections, lower respiratory tract infections, surgical wound infections, intravenous catheter site infections and bacteraemia. For each infection site, the definitions criteria and detailed data recording instruction used, were those of the Centers for Disease Control (CDC) (Department of Health, Human Services, 1988; Haley *et al*., 1980). An infection was defined as nosocomial when it originated in the hospital environment; i.e. was not present or incubating on admission and which appeared 48 h or more after admission. Surgical site infection was recorded if at least one sign or symptom of infection was present (i.e., pain, or tenderness, localized swelling, redness or heat) in the absence of an isolated organism. A Culture-positive result was obtained from pus or through drain from a closed incision. Intravenous catheter infections were notified as an inflammation and redness with pus at the exit site of the catheter. For Urinary Tract Infections (UTI), two different conditions were applied to define NIs; bacteruria without symptoms with positive urine culture (100 000 bacteria mL^{-1}) and when urine catheter was present one week before the day of the survey. In the absence of a urinary catheter, two consecutive positive urine cultures with the same micro-organism were recorded. The definition of lower respiratory tract infections (pneumonia) was based on radiological examination (abnormal parenchyma opacity) confirmed by microbiological findings. Bacteraemia was identified by isolation of a pathogen from a blood culture sample taken within the last five days.

The variables recorded included: The data that was collected for this survey were: age, sex, date of admission, clinical data and name of hospitals, hospital department and hospital stay on the day of the survey.

Bacterial culture and isolation: The last part of data was collected from bacteriological findings. The samples were different according to the clinical data and infection site. For the urinary tract infections, Midstream urine samples were collected using sterilized bottles. Urine samples were immediately transported to the laboratory. With a calibrated wire loop, urine was streaked on blood agar and incubated at 37°C for 24 h. Biochemical analysis of urine was carried out by the dipstick method. For microscopy, 5-7 mL of urine was centrifuged and the sediment was studied. Colonies were identified by biochemical tests. Growth was considered significant if 10^5 mL^{-1} bacteria were present. In the cases of Intravenous catheter infections and surgical site infection samples were collected from pus or through drain from a closed incision with sterile syringe or sterile swab and inoculated into thioglycolate broth media. In the pneumonia, the samples were 0.5 mL of purulent sputum or aspirated materials of trachea, bronchia, bronchioles or pleura that added to the thioglycolate media. Inoculated thioglycolate broth media was incubated in 37°C for 24-96 h and if during this period growth was observed, 0.1 mL of media was transferred to blood agar and after isolation of organism the biochemical testes were used for diagnosis. In bacteremia, 5-10 mL of blood was added to the blood culture bottles including enriched media. The blood samples were incubated at 37°C for 1-5 days and if during this period growth was observed, 0.1 mL of media was transferred to blood agar, EMB agar and chocolate agar media and after isolation of organism the biochemical testes were used for diagnosis.

Statistical methods: Data were validated and analysed using Statistical Package for Social Sciences Software (SPSS). The comparison of prevalence by gender, age groups, sites of infection, different hospital and different hospital department, was done using the Chi-squared test.

RESULTS AND DISCUSSION

Patient population: During Feb. 1997 to Jan. 2003, 5572 hospitalized patients were surveyed for nosocomial infections in three hospitals. 2882 of these patients were male (51.7%) and 2690 (48.3%) were female. 2574 patients

Table 1: Prevalence ratio of patients with nosocomial infections according to age group

	Infected patients		Non-infected patients		Total	
Age	No.	%	No.	%	No.	%
0-10	34	4.6	696	95.4	730	13.1
11-20	30	5.6	510	94.4	540	9.7
21-30	58	6.3	862	93.7	920	16.5
31-40	72	8.3	790	91.7	862	15.6
41-50	86	8.8	894	91.2	980	17.6
51-60	78	9.8	716	90.2	794	14.2
61-70	52	10.7	434	89.3	486	8.7
>70	22	8.5	238	91.5	260	4.6
Total	432	7.75	5140	92.25	5572	100

(46.2%) were admitted in Mostafa Khomeini hospital, 2376 patients (42.6%) were admitted in Imam Khomeini hospital and 622 patients (11.2%) were admitted in Taleghani hospital.

Patients in internal medicine represented 30.5%, surgery 25.8%, Obstetrics and Gynaecology 15.5%, paediatric 12%, intensive care unit 10.9% and 5.3% in the Ear, nose, throat (Table 3). Patients who were less than 10 years old represented 13.1% of the population, whereas 4.6% were older than 70 years (Table 1).

Prevalence of Nis: Of the 5572 patients studied, the prevalence of NI was 7.75% (CI: 6-9.5%) (Table 2). The highest rate of NIs was 10.7% and this was found in age group of 61-70 years (Table 1). There was significant association between prevalence and age. NIs were observed in 7.1% of men and 8.5% of women but no significant association was shown between NIs and sex (Table 2).

Comparison of infected and non-infected patients By hospital department, Site infection and isolated micro-organisms: The prevalence varied between the different department categories. The highest rate of NIs was 11.6% and this was found in Surgery Department, followed by Intensive care unit (8.2%) (Table 3). Urinary tract infections were the most frequent site (29.7%) identified, followed by surgical wound infections (27.3%) (Table 4). The highest rate of NIs was observed in Mostafa Khomeini hospital (9.5%) and there was a significant difference (p = 0.0048) among Ilam city hospitals (Table 2). Positive cultures were found in 89.9% of the cases. The diagnosis in urinary tract infections was confirmed by culture in 128/128 (100%), surgical wound infections in 112/118 (94.9%), bacteremia in 62/72 (86.1%), Intravenous catheter infections in 36/46 (78.3%) and in Lower respiratory tract infections in 50/68 (73.5%) of patients. More than one micro-organism was isolated in 15.2% of HAI episodes with identified pathogens. Where only one micro-organism was isolated the most frequently isolated pathogen from all sites of infections was *Coagulase-negative Staphylococci* (17.8%), followed by *Escherichia coli* (15.7%) and *Staphylococcus aureus* (13.1%) (Table 5). *E. coli* was the most common single micro-organism in urinary tract infections (32.8%), *Pseudomonas aeruginosa* in pneumonias (26%), *Coagulase-negative Staphylococci* in surgical wound infections and Bacteremia (28.6%) and (30.7%), respectively. *Enterococcus* spp and *Acinetobacter* spp were the second most frequently organisms in urinary tract infections and bacteremia, respectively.

Table 2: Prevalence of nosocomial infections among three hospitals in Ilam

	Gender					
	Men		Women		Total	
Results	Infected patients	Non-infected patients	Infected patients	Non-infected patients	Infected patients	Non-infected patients
Hospitals	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Imam Khomeini	90 (5.7)	1496 (94.3)	52 (6.6)	738 (93.4)	142 (6)	2234 (94)
Mostafa Khomeini	92 (9.6)	870 (90.4)	152 (9.4)	1460 (90.6)	244(9.5)	2330(90.5)
Taleghani	22 (6.6)	312 (93.4)	24 (8.3)	264(91.7)	46 (7.4)	576 (92.6)
Total	204 (7.1)	2678 (92.9)	228 (8.5)	2462 (91.5)	432 (7.75)	5140 (92.25)

Table 3: Comparison of the prevalence of nosocomial infections by hospital department

	Results					
	Infected patients		Non-infected patients		Total	
Department	No.	(%)	No.	(%)	No.	(%)
Intensive Care Unit	50	8.2	560	91.8	610	10.9
Obstetrics and Gynaecology	62	7.2	800	92.8	862	15.5
Surgery	166	11.6	1270	88.4	1436	25.8
Internal disease	98	5.8	1602	94.2	1700	30.5
Ear, Nose, Throat	24	8.2	270	91.8	294	5.3
Paediatric	32	4.8	638	95.2	670	12.0
Total	432	7.75	5140	92.25	5572	100.0

Table 4: Prevalence of nosocomial infections according to site of infection

	Results	
	Infected patients	
Site of infection	No.	%
Lower respiratory tract infections	68	15.7
Urinary tract infections	128	29.7
Bacteremia	72	16.7
Surgical wound infections	118	27.3
Intravenous catheter site infections	46	10.6
Total	432	100.0

During the past 20 years, the number of published reports on surveillance of HAIs has increased significantly (Emmerson *et al*., 1996; EPINE Working Group, 1992; Mayon-White *et al*., 1988; Mertens *et al*., 1987; Haley *et al*., 1985). studies in various countries have shown that the prevalence of NIs in hospitals is between 2.5-21% regardless of the surveillance system or set of definitions used (Emmerson *et al*., 1996; EPINE Working Group, 1992; Mayon-White *et al*., 1988; Mertens *et al*., 1987; Rezend *et al*., 1998; Haley *et al*., 1985).

Although point prevalence surveys are easy to perform and demand few resources as a surveillance tool and are often the method chosen to provide baseline information about the occurrence of hospital infections and to help in establishing priorities for their control but these surveys have specific limitations. The duration and conditions under study influence prevalence rates (Freeman and McGowan, 1981). Also, seasonal variations and possible epidemic peaks can influence point prevalence to an unknown extent (Jepson and Mortensen, 1980). In addition, a certain degree of uniformity in the diagnostic approach is required. In Iran, a routine approach to common Microbiological specimen collection and antibiotic susceptibility testing of isolates is not frequent in most hospital laboratories.

This prevalence study was not performed hospital wide but only in selected areas of three University hospitals in Ilam and it was the main limitation of this study.

Several special characteristics of this study need to be considered. First, it was a long-period prevalence study and it had not limitations of point prevalence study because results of point prevalence studies are underestimating. Second, we used standard protocol for specimen collection, culture and microbiological methods so we had high positive cultures in compare with point studies that researchers have not involved in specimen collection and microbiological tests.

The overall prevalence rates of NIs in our study ranged from 5.7 to 9.6% (7.75%) among the hospitals. This value does not diverge greatly from those reported in other recent European studies (Quenon *et al*., 1993; EPINCAT study group, 1990; Hauer *et al*., 1996; Sartor *et al*., 1995; Andersen, 1992; Emmerson *et al*., 1996). On the other hand, the rate in Ilam was higher than that in Germany, 3.8% Hauer *et al*., 1996).

The distribution of HAIs, according to the site of infection in Table 4, showed that Like other studies, urinary tract infections (29.7%) were the most frequent in the current survey and surgical-wound infections (27.3%) represented the second most common NIs in Ilam (Mertens *et al*., 1987; Andersen, 1992; Lagarda and Romero, 1983). The prevalence rates of this type of HAI range between 11 and 22% in the Literature (Emmerson *et al*., 1996; EPINE Working Group, 1992; Mertens *et al*., 1987).

To reduce the prevalence rate of surgical-wound infections, it is necessary that ongoing surveillance be carried out in each hospital, including post discharge follow-up, to study associated risk factors, improve aseptic technique and prophylactic antibiotic use and evaluate the surgical techniques used.

Table 5: Distribution of isolated micro-organisms according to different types of Nosocomial infections

	Different types of Nis					
Isolated Micro-organisms	Urinary tract infections No. (%)	Pneumonia No. (%)	Surgical wound infections No. (%)	Bacteremia No. (%)	Intravenous catheter infections No. (%)	Total No. (%)
Staphylococcus aureus	3(2.3)	9(18.0)	23(20.5)	11(17.8)	5(13.9)	51(13.1)
Coagulase- negative Staphylococci	10(7.8)	0(0.0)	32(28.6)	19(30.7)	8(22.0)	69(17.8)
Escherichia coli	42(32.8)	0.(0.0)	8(7.1)	6(9.7)	5(13.9)	61(15.7)
Pseudomonas aeruginosa	14(10.9)	13(26.0)	3(2.7)	2(3.2)	1(2.8)	33(8.5)
Enterococcus spp	25(19.5)	0(0.0)	0(0.0)	3(4.8)	0(0.0)	28(7.2)
Klebsiella spp	8(6.3)	11(22.0)	2(1.8)	2(3.2)	1(2.8)	24(6.2)
Acinetobacter spp	7(5.5)	0(0.0)	11(9.8)	16(25.8)	4(11.0)	38(9.8)
Enterobacter spp	3(2.3)	0(0.0)	2(1.8)	1(1.6)	0(0.0)	6(1.6)
Other Enterobacteriacea	2(1.6)	0(0.0)	1(0.9)	1(1.6)	0(0.0)	4(1.0)
Gram - negative bacteria	1(0.8)	2(4.0)	2(1.8)	0(0.0)	1(2.8)	6(1.6)
Other gram-positive bacteria	1(0.8)	2(4.0)	4(3.6)	1(1.6)	1(2.8)	9(2.3)
NIs with several micro-organisms	12(9.4)	13(26.0)	24(21.4)	0(0.0)	10(28.0)	59(15.2)
All NIs with identified Micro-organisms	128(100)	50(100)	112(100)	62(100)	36(100)	388(100)

There was a significant relation between age and nosocomial infections (p = 0.0044) and this agrees with the Nicholls and Morris (1997). By this study, we have found out the most important prevalence was in the Surgery Department (11.6%), followed by ICU (8.2%), but Nicholls reported that the most of the infections happened in ICU (Nicholls and Morris, 1997). Rezend reported that the most infections were seen in the open-heart surgery, paediatric and orthopaedic wards (Rezend *et al*., 1998).

In our results, the percentage of NIs supported by microbiological studies was higher than other papers that published (EPINE Working Group, 1992; Moro *et al*., 1986; Nicholls and Morris, 1997; Gikas *et al*., 1999; Gastmeier *et al*., 1999). Many other recently conducted national HAI surveys in European countries reported low proportions (32.0-61.2%) (Gastmeier *et al*., 1998; EPINE Working Group, 1992; Moro *et al*., 1986; Lagarda and Romero, 1983; Gikas *et al*., 1999). This is because laboratory investigation is not requested for all cases (Gastmeier *et al*., 1999). In our study we used a standard protocol for collection and culturing clinical samples and all cases were sent for microbiological tests.

The most frequently isolated micro-organisms in our survey were similar to those in published results of other European surveys (Moro *et al*., 1986). As shown in similar surveys, gram-negative organisms were predominant, *coagulase-negative staphylococci*, however, were the single most frequently isolated organisms (17.8%) (Moro *et al*., 1986; EPINE Working Group, 1992; Mertens *et al*., 1987; Danchaivijitr *et al*., 1992). Over the last decade, *coagulase-negative staphylococci* have been recognized as true pathogens and not just contaminants; the emergence of *coagulase-negative staphylococci* has been associated with the increased use of intravascular devices, in particular central venous catheters, in medical care (Pottinger *et al*., 1997).

The present study they represent the first causal agent of surgical-wound infections, Bacteremia and Intravenous catheter site infections. A relatively high prevalence of *Acinetobacter* spp. among micro-organisms isolated in bloodstream infections identified (25.8%, 16 isolates among 62 episodes) was unexpected.

In summary, this survey showed that NI occurred in Ilam University hospitals at a rate similar to that reported in European countries. These findings provide baseline information for further surveillance in association with prevention programmes in Ilam University hospitals.

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