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Research Article

Surveillance of nosocomial infections at a Saudi Arabian military hospital for a one-year period

Übersicht über nosokomiale Infektionen in einem saudi-arabischen Militärkrankenhaus im Laufe eines Jahres

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Abstract

The objectives of the current study are to define how many and what kind of nosocomial infections are occurring, what are the causative microbes and what kind of drugs can be used in treatment of infection at Al-Hada Armed Forces Hospital, Taif, Saudi Arabia during the year 2004. A prospective study was implemented for all cases admitted at Al-Hada Armed Forces Hospital during the period 1st January, 2004 till 31st December, 2004 and which developed infection. Determination of nosocomial infections was performed using standardized CDC criteria. A total of 1382 patients had developed infection during hospital admission and were included in the study. Of them, 668 (48.3%) had nosocomial infection and 714 (51.7%) had community-acquired infection. Among those who developed nosocomial infections, 216 (32.3%), 172 (25.7%) and 124 (18.6%) had respiratory tract (RTI), urinary tract (UTI) and blood stream infections (BSI) respectively. Surgical site infection (SSI) was reported in 86 cases (12.9%). The overall nosocomial infection rate along the study period was 4.98 per 100 discharged patients. Gram-positive organisms were reported in 31.8%. MRSA (Methicillin-resistant S. aureus) was the commonest (10.2%), followed by coagulase negative staphylococci (8.5%) and MSSA (Methicillin-susceptible S. aureus, 7.4%). While Gram-negative organisms were reported in 66.2%, E. coli was the commonest (22.3%), followed by Pseudomonas aeruginosa (17.6%) and Klebsiella pneumoniae (9.9%). Acinetobacter spp. and MRSA were highly sensitive to Imipenem (88.6%) and Vancomycin (98.5%) respectively. E. coli were highly sensitive to most of the antimicrobial agents except ampicillin (26.6%).

Conclusions: Pneumonia, urinary tract infections, and blood stream infections made up the great majority of nosocomial infections. There is a need for further risk assessment associated with main types of infection.

Keywords: nosocomial infections, surveillance, antibiotic, sensitivity, microorganisms, Saudi Arabia

Zusammenfassung

Die vorliegende Studie hatte zum Ziel, im Al-Hada Armed Forces Hospital (Taif, Saudi Arabien) über den Zeitraum eines Jahres (2004) hinweg die Zahl und die Art der nosokomialen Infektionen zu erfassen, die Erreger zu bestimmen und zu beschreiben, welche Antibiotika zur Behandlung der Infektionen benutzt werden können.

In einer prospektiven Studie wurden alle Fälle erfasst, bei denen die in das Al-Hada Armed Forces Hospital im Jahre 2004 (1. Januar 2004 bis 31. Dezember 2004) eingewiesenen Patienten eine Infektion entwickelten. Die Klassifizierung als nosokomiale Infektion wurde nach den standardisierten Kriterien der CDC durchgeführt. Insgesamt haben 1382 Patienten Infektionen während des Hospitalaufenthaltes entwickelt und wurden in die Studie einbezogen. Von diesen hatten 668

(48,3%) nosokomiale Infektionen und 714 (51,7%) erworbene Infektionen. Unter den Patienten mit nosokomialen Infektionen hatten 216 (32,3%) Infektionen der oberen Atemwege, 172 (25,7%) Harnwegsinfektionen und 124 (18,6%) eine Bakterieämie (Sepsis). Im chirurgischen Bereich wurden 86 Fälle (12,9%) von Infektionen beobachtet. Die gesamte nosokomiale Infektionsrate lag während der Studiendauer bei 4,98 pro 100 entlassenen Patienten. Grampositive Bakterien wurden in 31,8% der Fälle gefunden. MRSA war am häufigsten (10,2%), gefolgt von koagulase-negativen Staphylokokken (8,5%) und MSSA (7,4%). Gramnegative Bakterien wurden in 60,2% der Fälle berichtet. E-Coli war der am häufigsten gefundene Keim (22,3%), gefolgt vom Pseudomonas aeruginosa (17,6%) und Klepsiellapneumonie (9,9%). Acinetobacter spp. und MRSA waren hoch sensitiv für Imipenem (88,6%) und Vancomycin (98,5%). E-Coli waren hochsensitiv für die meisten antimikrobiellen Substanzen, ausgenommen Ampicillin (26,6%).
Schlussfolgerung: Pneumonien, Harnwegsinfektionen und Bakterieämien machten den größten Teil der nosokomialen Infektionen aus. Die Bewertung des Risikos, das mit den Haupttypen der nosokomialen Infektionen verbunden ist, sollte noch genauer erfolgen.

Schlüsselwörter: nosokomiale Infektionen, Überwachung, Antibiotika, Sensitivität, Mikroorganismen, Saudi Arabien

Introduction

The National Nosocomial Infections Surveillance (NNIS) defines a nosocomial infection as a localized or systemic condition that results from adverse reaction to the presence of an infectious agent(s) or its toxin(s) and that was not present or incubating at the time of admission to the hospital [1]. Nosocomial infections have been recognized for over a century as a critical problem affecting the quality of health care and a principal source of adverse healthcare outcomes [2]. In developed countries, it constitutes from 5% to 10% of patients admitted to acute care hospitals [3], [4]. The attach rate for developing countries can exceed 25% [5]. Such hospital-acquired, or nosocomial, infections add to the morbidity, mortality, and cost expected from the patient's underlying diseases [6], [7].

The development of a nosocomial infection is a chain of events, which is influenced by the microbe, transmission route, and the patient himself [2]. The organisms causing most nosocomial infections usually come from the patient's own body (endogenous flora) [1]. They also can come from contact with staff (cross-contamination), contaminated instruments and needles, and the environment (exogenous flora) [1].

Most nosocomial infections are inevitable risks related to treatment. Due to the improvements in the treatments of serious diseases, there are more and more patients whose resistance to infection is severely reduced [2]. Simultaneously, modern treatments necessitate the use of intravenous catheters, urinary catheters, respirators, hemodialysis, complicated operations, cortisone therapy and other factors, which depress resistance mechanisms and make patients susceptible to infections [8]. Most nosocomial infections are not related to outbreaks but occur consistently as sporadic cases [9]. Surveillance for nosocomial infections is the cornerstone of prevention and control [10]. The objectives of the current study are to define how many and what kind of nosocomial infections are occurring, what are the causative microbes and what kind of drugs can be used in treatment of infection at Al-Hada Armed Forces Hospital, Taif, Saudi Arabia during the year 2004 as a model of a high standard hospital from a developing country.

Material and methods

Study setting and design

A prospective study was implemented for all patients admitted to Al-Hada Armed Forces Hospital during the period January 1, 2004 to December 31, 2004 and who subsequently developed infection. Al-Hada Hospital is a 400-beds acute care facility located in Al-Hada valley (about 10 miles northwest of Taif, Saudi Arabia). It is administered by the Medical Service Department (MSD) of the Saudi Arabian Ministry of Defense and Aviation (MODA). It serves members of the Royal Family as well as uniformed military personnel, their dependents and other entitled personnel. Surveillance was done by a combination of analyzing laboratory reports and repeated ward visits by the infection control practionner. A written form was used for surveillance and filled in by the infection control nurse.

Criteria for diagnosis

Generally, the information used to determine the presence and classification of an infection was a combination of clinical findings and results of laboratory and other tests (x-ray, ultrasound, computed tomography (CT) scans,

Table 1: Distribution of the study population according to age, sex, and type of infection (Al-Hada Armed Forces Hospital 2004)

	Nosocomial infections							CAI	Total
	UTI No. (%) N=172	RTI No. (%) N=216	SSI No. (%) N=86	OWI No. (%) N=42	BSI No. (%) N=124	Others No. (%) N=28	Total No. (%) N=668	No. (%) N=714	No. (%) N=1382
Age in years*									
< 1	25 (14.5)	32 (14.8)	30 (34.9)	12 (28.6)	54 (43.6)	6 (21.4)	159 (23.8)	129 (18.1)	287 (20.8)
1-15	17 (9.9)	36 (16.7)	3 (3.5)	0 (0.0)	2 (1.6)	2 (7.2)	60 (9.0)	77 (10.8)	137 (9.9)
16-45	23 (13.4)	28 (13.0)	18 (20.9)	15 (35.7)	7 (5.6)	7 (25.0)	98 (14.6)	121 (16.9)	219 (15.9)
46-65	39 (22.7)	26 (12.0)	20 (23.3)	4 (9.5)	32 (25.8)	7 (25.0)	128 (19.2)	115 (16.1)	243 (17.6)
>65	68 (39.5)	94 (43.5)	15 (17.4)	11 (26.2)	29 (23.4)	6 (21.4)	223 (33.4)	272 (38.1)	495 (35.8)
Sex**									
Male	106 (61.6)	152 (70.4)	60 (69.8)	30 (71.4)	56 (45.2)	16 (57.1)	420 (62.9)	420 (58.8)	840 (60.8)
Female	66 (38.4)	64 (29.6)	26 (30.2)	12 (28.6)	68 (54.8)	12 (42.9)	248 (37.1)	294 (41.2)	542 (39.2)

* P<0.05 ** P>0.05 CAI: community-acquired infections UTI: urinary tract infection RTI: respiratory tract infection SSI: surgical site infection OWI: other wound infection BSI: blood stream infection

Table 2: Distribution of the study population according to ward and type of infection (Al-Hada Armed Forces Hospital 2004)

	Nosocomial infections							**CAI**	**Total**
	UTI No. (%) N=172	RTI No. (%) N=216	SSI No. (%) N=86	OWI No. (%) N=42	BSI No. (%) N=124	Others No. (%) N=28	Total No. (%) N=668	No. (%) N=714	No. (%) N=1382
Ward*									
MICU	18 (10.5)	38 (17.6)	8 (9.3)	2 (4.8)	10 (8.1)	0 (0.0)	76 (11.4)	68 (9.5)	144 (10.4)
BU	10 (5.8)	12 (5.6)	2 (2.3)	0 (0.0)	0 (0.0)	0 (0.0)	24 (3.6)	26 (3.6)	50 (3.6)
SICU	18 (10.5)	64 (29.6)	16 (18.6)	2 (4.8)	14 (11.3)	6 (21.4)	120 (18.0)	74 (10.4)	194 (14.0)
Labour & postpartum	6 (3.5)	2 (0.9)	2 (2.3)	0 (0.0)	0 (0.0)	0 (0.0)	10 (1.5)	30 (4.2)	40 (2.9)
Nursery	6 (3.5)	0 (0.0)	0 (0.0)	2 (4.8)	2 (1.6)	0 (0.0)	10 (1.5)	32 (4.5)	42 (3.0)
FMW	12 (7.0)	6 (2.8)	0 (0.0)	0 (0.0)	10 (8.1)	4 (14.3)	32 (4.8)	60 (8.4)	92 (6.7)
NICU	0 (0.0)	16 (7.4)	10 (11.6)	6 (14.3)	42 (33.9)	2 (7.1)	76 (11.4)	30 (4.2)	106 (7.7)
Pediatrics	16 (9.3)	6 (2.8)	2 (2.3)	0 (0.0)	6 (4.8)	0 (0.0)	30 (4.5)	68 (9.5)	98 (7.1)
Nephrology	12 (7.0)	4 (1.9)	10 (11.6)	6 (14.3)	12 (9.7)	2 (7.1)	46 (6.9)	58 (8.1)	104 (7.5)
MSW	18 (10.5)	18 (8.3)	14 (16.3)	4 (9.5)	2 (1.6)	4 (14.3)	60 (9.0)	54 (7.6)	114 (8.2)
FSW	8 (4.7)	8 (3.7)	6 (7.0)	2 (4.8)	2 (1.6)	2 (7.1)	28 (4.2)	76 (10.6)	104 (7.5)
Orthopedics	2 (1.2)	0 (0.0)	2 (2.3)	14 (33.2)	0 (0.0)	4 (14.3)	22 (3.3)	26 (3.6)	48 (3.5)
MMW	24 (14.0)	22 (10.2)	8 (9.3)	0 (0.0)	8 (6.5)	0 (0.0)	62 (9.3)	82 (11.5)	144 (10.4)
VIP	16 (9.3)	14 (6.5)	4 (4.7)	4 (9.5)	10 (8.1)	4 (14.3)	52 (7.8)	26 (3.6)	78 (5.6)
Others	6 (3.5)	6 (2.8)	2 (2.3)	0 (0.0)	6 (4.8)	0 (0.0)	20 (3.0)	4 (0.6)	24 (1.7)

* P<0.05 CAI: community-acquired infections UTI: urinary tract infection RTI: respiratory tract infection SSI: surgical site infection OWI: other wound infection BSI: blood stream infection
MICU: Medical Intensive Care Unit BU: Burn Unit SICU: Surgical Intensive Care Unit FMW: Female Medical Ward NICU: Nursery Intensive Care Unit MSW: Male Surgical Ward FSW: Female Surgical Ward MMW: Male Medical Ward VIP: Very Important Persons

biopsies, magnetic resonance imaging (MRI), or endoscopic procedures).

Nosocomial infection was defined as infection obtained more than 48 hours after being admitted to a hospital, while infection obtained within 48 hours of being admitted to a hospital was defined as community-acquired infection.

The diagnosis of UTI was done according to the two criteria defined by the CDC (Centers for Disease Control and Prevention) in the USA [11].

Blood stream infection was defined as a patient with a clinically important blood culture positive for a bacterium or fungus [5].

The criteria for diagnosis of pneumonia were clinical (fever, cough, and development of purulent sputum) in combination with radiological evidence of a new or progressive pulmonary infiltrate with culture of sputum or tracheal specimens [11].

Surgical site infections (superficial incisional infections, infections of the deep incision space and organ space infections) were diagnosed according to CDC [12].

Different strains of bacteria were isolated and identified using standard methods [13]. An antibiotic sensitivity test was done according to Kirby-Bauer disc diffusion technique [14]. Data was analyzed using SPSS (Statistical Package for the Social Sciences) version 11. A chi-square test was utilized to test for the association between categorical variables. The nosocomial infection rate was calculated by dividing the number of cases by the total number of discharged patients.

Results

The 1382 patients that developed infection following hospital admission were included in the study. Of them, 668 (48.3%) had nosocomial infection and 714 (51.7%) had community-acquired infection. Among those who developed nosocomial infections, 216 (32.3%), 172 (25.7%) and 124 (18.6%) had respiratory tract (RTI), urinary tract (UTI) and blood infections (BI) respectively. Surgical site infection (SSI) was reported in 86 cases (12.9%).

Regarding age, 23.8% of nosocomial infections were below the age of one year and 33.4% above the age of 65 years as compared to 18.1% and 38.1% respectively for those having community-acquired infection (P<0.05). In both types of infection (nosocomial and community-acquired), males outnumbered females (62.9% and 58.8% respectively) (P>0.05) (Table 1).

As shown in Table 2, the infection in the hospital was mostly reported in the Surgical Intensive Care Unit "SICU" (14%), followed by Medical Intensive Care Unit "MICU" and Male Medical Ward "MMW" (10.4% for each). Nosocomial infection was mostly reported in the SICU (18%), followed by the MICU and the Neonatal Intensive Care Unit "NICU" (11.4% for each) while community-acquired

Table 3: Distribution of infection cases by time and type of infection (Al-Hada Armed Forces Hospital 2004)

Month	No. of infection cases			No. of discharged patients	Nosocomial infection rate/100 discharged patients
	Nosocomial	Community - acquired	Total		
January	85	55	140	1097	7.75
February	51	36	87	971	5.25
March	62	62	124	1103	5.62
April	35	38	73	851	4.11
May	62	83	145	1310	4.73
June	39	83	122	1190	3.28
July	78	43	121	1197	6.52
August	44	95	139	1262	3.49
September	71	50	121	1126	6.31
October	46	55	101	1183	3.89
November	43	51	94	953	4.51
December	52	63	115	1163	4.47
Total	668	714	1382	13,406	4.98

infection was mostly reported in the MMW (11.5%), followed by the Female Surgical Ward "FSW" (10.6%) and the SICU (10.4%). Regarding the nosocomial infection cases, UTI was reported mostly in the MMW (14% of cases), RTI and SSI were reported mostly in the SICU (29.6% and 18.6% of cases respectively) while bacteraemia was reported mostly in the NICU (33.9% of cases). From Table 3, it is obvious that the overall nosocomial infection rate within the study period (January 1 - December 31, 2004) was 4.98 per 100 discharged patients. It was highest during January (7.75 per 100 discharged patients), and lowest during June (3.28 per 100 discharged patients). The overall rate of infection occurring in the hospital (nosocomial and community-acquired) was 10.31 per 100 discharged patients.

Table 4 indicates the various isolates (n=1438) identified from 1382 patients. Gram-positive organisms were reported in 31.8%. MRSA was the commonest (10.2%), followed by co-agulase negative staphylococci (8.5%) and Staphylococcus aureus (7.4%) while Gram-negative organisms were reported in 66.2%. E. coli was the commonest (22.3%), followed by Pseudomonas aeruginosa (17.6%) and Klebsiella pneumoniae (9.9%). Candida was reported in only 2% of organism isolates.

Table 4: Organism isolates (n=1438) identified from 1382 patients

Isolated organism	No.	%
Gram-positive organisms	**456**	**31.8**
Staphylococcus aureus	106	7.4
Enterococcus faecalis	40	2.8
Coagulase negative staphylococci	122	8.5
Streptococcus spp.	42	2.9
Methicillin–resistant staphylococci (MRSA)	146	10.2
Gram-negative organisms	**950**	**66.2**
Escherichia coli	320	22.3
Psudomonas aeruginosa.	252	17.6
Enterobacter spp.	54	3.8
Klebsiella pneumonia.	142	9.9
Acinetobacter spp.	90	6.3
Proteus spp.	42	2.9
Serratia spp.	22	1.5
Citrobacter	12	0.8
Others	16	1.1
Fungus	**28**	**2.0**
Candida	28	2.0
Total	**1434***	

*4 cases with missing data

Table 5 shows that E. coli were the most prevalent isolates from urinary tract infections (47.7%), followed by K. pneumoniae (15.1%) and P. aeruginosa (8.1%). In noso-

Table 5: Distribution of commonly reported organisms by site of nosocomial infection

Organisms	Site of infection					
	UTI No.(%) (n=172)	RTI No.(%) (n=216)	Blood stream infection No.(%) (n=124)*	SSI No.(%) (n=86)	Other wounds No.(%) (n=42)	Others No.(%) (n=28)
E. coli	**82 (47.7)**	14 (6.5)	**18 (15.0)**	**22 (25.6)**	**6 (14.3)**	2 (7.1)
K. pneumonia	**26 (15.1)**	14 (6.5)	**28 (23.3)**	6 (7.0)	**6 (14.3)**	0 (0.0)
P. aeruginosa	**14 (8.1)**	**96 (44.4)**	6 (5.0)	10 (11.6)	**6 (14.3)**	**6 (21.4)**
Candida	10 (5.8)	2 (0.9)	2 (1.7)	2 (2.3)	0 (0.0)	0 (0.0)
Proteus	10 (5.8)	2 (0.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Citobacter	8 (4.7)	0 (0.0)	0 (0.0)	2 (2.3)	0 (0.0)	0 (0.0)
MRSA	2 (1.2)	**32 (14.8)**	4 (3.3)	**16 (18.6)**	**14 (33.3)**	**8 (28.6)**
Acintobacter	2 (1.2)	**26 (12.0)**	10 (8.3)	6 (7.0)	**6 (14.3)**	**6 (21.4)**
MSSA	6 (3.5)	8 (3.7)	10 (8.3)	**12 (14.0)**	2 (4.8)	2 (7.1)
Enterobacter	6 (3.5)	8 (3.7)	8 (6.7)	2 (2.3)	2 (4.8)	0 (0.0)
Serratia	0 (0.0)	6 (2.8)	2 (1.7)	0 (0.0)	0 (0.0)	2 (7.1)
E. feacalis	2 (1.2)	0 (0.0)	4 (3.3)	4 (4.7)	0 (0.0)	2 (7.1)
Streptococcus	0 (0.0)	4 (1.9)	8 (6.7)	0 (0.0)	0 (0.0)	0 (0.0)
CNS	2 (1.2)	0 (0.0)	**20 (16.7)**	4 (4.7)	0 (0.0)	0 (0.0)
Others	2 (1.2)	4 (1.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)

UTI: urinary tract infection RTI: respiratory tract infection SSI: surgical site infection *missed 4 cases
MRSA: Methicillin-resistant S. aureus MSSA: Methicillin-susceptible S. aureus
CNS: coagulase negative staphylococci

comial RTI, they were P. aeruginosa (44.4), MRSA (14.8%) and Acinetobacter spp. (12%). Regarding nosocomial blood stream infections, the commonest reported organisms were K. pneumoniae (23.3%), coagulase negative Staphylococci (16.7%) and E. coli (15%). In surgical site infections, the organisms encountered commonly were E. coli (25.6%), MRSA (18.6%) and S. aureus (14%).
Anti-microbial sensitivity patterns were studied for various organisms. Tables 6 and 7 point out some conclusions. Acinetobacter spp. and MRSA were highly sensitive to Imipenem (88.6%) and Vancomycin (98.5%) respectively. E. coli were highly sensitive to most of the antimicrobial agents except ampicillin (26.6%).

Discussion

Here we present an overall description of the system affected by infection and causative organisms with further information on antibiotic resistance in a Saudi Arabian military hospital.
Nosocomial infections are widespread. They are important contributors to morbidity and mortality. They will become even more important as a public health problem with increasing economic and human impact because of: 1) increasing number and crowding of people, 2) more frequent impaired immunity (age, illness and treatments), 3) new microorganisms, and 4) increasing bacterial resistance to antibiotics [15]. They are a major cause of preventable disease and death in developing countries.
Because patients are highly mobile and hospital stays are becoming shorter, patients often are discharged before the infection becomes apparent (are symptomatic). In fact, a large portion of nosocomial infections in hospitalized patients - and all from ambulatory care facilities - becomes apparent only after the patients are discharged. As a consequence, it is often difficult to determine whether the source of the organism causing the infection is endogenous or exogenous.

Table 6: Antibiotic sensitivity of Gram-positive isolates

	MSSA	E. faecalis	CNS	Streptococci sp.	MRSA
Amikacin *	96	10	122	16	110
% sensitivity	97.9	80.0	72.1	100.0	34.0
Ampicillin *	76	22	84	18	90
% sensitivity	86.8	72.7	28.6	88.9	2.2
Augmentin *	100	16	122	18	134
% sensitivity	94.0	75.0	21.3	100.0	1.5
Aztreonam *	94	16	104	20	122
% sensitivity	95.7	75.0	46.2	90.0	8.2
Carbencillin *	94	16	106	20	112
% sensitivity	93.6	75.0	37.7	100.0	1.8
Cefozolin *	98	16	110	20	128
% sensitivity	93.9	75.0	43.6	80.0	6.3
Cefazidime *	90	18	96	18	106
% sensitivity	91.1	77.8	41.7	88.9	3.8
Ceftriaxone *	90	18	108	18	108
% sensitivity	91.1	77.8	48.1	100.0	7.4
Cefaroxime *	92	18	108	18	112
% sensitivity	91.3	77.8	46.3	88.9	8.9
Ciprofloxacin *	96	32	118	16	100
% sensitivity	95.8	56.3	71.2	87.5	18.0
Cotrimoxasole *	92	20	108	32	102
% sensitivity	95.7	70.0	46.3	50.0	23.5
Gentamycin *	90	30	106	18	104
% sensitivity	93.3	80.0	58.5	100.0	17.3
Imipenem *	82	14	88	18	94
% sensitivity	95.1	71.4	59.1	100.0	8.5
Nalidixic acid *	100	4	48	10	46
% sensitivity	30.0	0.0	62.5	100.0	8.7
Nitrofurantoin *	30	6	40	10	42
% sensitivity	93.3	33.3	70.0	100.0	9.5
Piperacillin *	72	16	62	16	88
% sensitivity	91.7	62.5	67.7	100.0	18.2
Chloramphenicol*	38	30	48	32	86
% sensitivity	100.0	93.3	83.3	100.0	37.2
Erythromycin *	50	24	72	28	94
% sensitivity	96.0	25.0	27.8	64.3	19.1
Tetracycline *	52	32	62	30	86
% sensitivity	92.3	37.5	64.5	60.0	14.0
Oxacillin *	56	8	72	10	104
% sensitivity	89.3	50.0	19.4	80.0	0.0
Rifampicin *	22	30	68	16	88
% sensitivity	100.0	33.3	85.3	100.0	77.3
Vancomycin *	2	30	76	24	130
% sensitivity	100.0	100.0	100.0	100.0	98.5
Penicillin *	72	26	78	30	98
% sensitivity	2.8	53.8	5.1	33.3	0.0
Clindamycin *	44	6	56	10	58
% sensitivity	100.0	33.3	60.7	100.0	17.2
Minocyclin *	52	8	74	8	96
% sensitivity	100.0	25.0	89.2	100.0	77.1

* Number of isolates MSSA: Methicillin-susceptible S. aureus
CNS: Coagulase negative staphylococci MRSA: Methicillin-resistant S. aureus

Table 7: Antibiotic sensitivity of Gram-negative isolates

	E. Coli	P. aeruginosa	Enterobacter	K. pneumonia	Acinetobacter	Proteus	Serratia	Citrobacter	Others
Amikacin *	310	246	52	138	90	38	22	8	14
% sensitivity	98.7	90.2	92.3	82.6	28.9	100.0	100.0	75.0	100.0
Ampicillin *	316	108	54	136	88	42	22	12	14
% sensitivity	26.6	77.8	7.4	5.9	4.5	57.1	0.0	0.0	28.6
Augmentin *	318	166	54	140	90	42	22	12	14
% sensitivity	64.8	83.1	11.1	60.0	8.9	90.5	18.2	0.0	42.9
Aztreonam *	312	240	54	140	88	40	22	8	14
% sensitivity	89.1	75.0	55.6	72.9	13.6	95.0	100.0	25.0	71.4
Carbencillin *	292	152	52	132	86	40	20	12	14
% sensitivity	74.0	80.3	23.1	60.6	7.0	70.0	10.0	0.0	42.9
Cefozolin *	306	150	50	136	84	40	22	10	14
% sensitivity	81.0	84.0	44.0	70.6	11.9	95.0	81.8	0.0	57.1
Cefazidime *	308	202	52	132	84	42	22	10	12
% sensitivity	80.5	77.2	69.2	69.7	14.3	95.2	100.0	40.0	83.3
Ceftriaxone *	294	142	52	132	84	38	22	10	10
% sensitivity	76.2	83.1	84.6	66.7	16.7	89.5	100.0	40.0	80.0
Cefaroxime *	310	144	50	132	84	42	22	8	10
% sensitivity	81.3	80.6	56.0	66.7	11.9	90.5	27.3	0.0	60.0
Ciprofloxacin *	304	220	52	132	88	40	18	10	12
% sensitivity	75.0	70.0	80.8	81.8	27.3	90.0	88.9	40.0	83.3
Cotrimoxasole *	304	134	52	122	88	42	18	10	8
% sensitivity	58.6	85.1	80.8	62.3	27.3	71.4	100.0	0.0	50.0
Gentamycin *	302	192	52	120	84	38	18	10	8
% sensitivity	82.1	82.3	88.5	73.3	21.4	84.2	100.0	20.0	75.0
Imipenem *	304	218	50	128	88	38	18	8	8
% sensitivity	94.1	73.4	88.0	92.2	88.6	94.7	100.0	100.0	100.0
Nalidixic acid *	178	44	28	68	56	24	10	10	4
% sensitivity	85.4	77.3	85.7	61.8	3.6	83.3	100.0	40.0	100.0
Nitrofurantoin *	194	46	34	70	54	26	12	8	6
% sensitivity	91.8	82.6	58.8	68.8	7.4	61.5	100.0	75.0	10.0
Piperacillin *	290	206	48	118	82	34	18	4	10
% sensitivity	82.1	88.3	79.2	61.0	41.5	100.0	100.0	50.0	60.0
Chloramphenicol*	88	34	6	52	28	10		4	4
% sensitivity	88.6	94.1	100.0	96.2	14.3	80.0		50.0	100.0
Erythromycin *	56	26	2	22	12	4		5	2
% sensitivity	85.7	92.3	100.0	90.9	0.0	100.0		0.0	100.0
Tetracycline *	198	92	26	84	60	22	4	10	10
% sensitivity	85.9	89.1	84.6	66.7	10.0	100.0	100.0	0.0	80.0
Oxacellin *	24	8		16	4	4			
% sensitivity	91.7	75.0		87.5	0.0	100.0			
Rifampicin *	8	4		14	4				
% sensitivity	100.0	50.0		100.0	0.0				
Vancomycin *	12	2		12	2				
% sensitivity	83.3	100.0		100.0	0.0				
Cefofaxime *	4			2	2		2	2	
% sensitivity	100.0			100.0	0.0		100.0	100.0	
Penicillin *	14	6		12	4	2			
% sensitivity	71.4	33.3		85.7	0.0	100.0			
Clindamycin *	38	14		14	6	4			2
% sensitivity	100.0	85.7		85.7	0.0	100.0			100.0
Minocyclin *	30	12		14	6	4			
% sensitivity	93.3	83.3		85.7	0.0	100.0			

* Number of isolates

In the current study, nosocomial pneumonia was the most common infection, while in United States it was reported as the second most common after UTI [16]. Recently, we have reported that nosocomial urinary tract infection "NUTI" was the most common reported infection. We studied related risk factors [17], and recommended reducing the NUTI rate at Al-Hada Armed Forces Hospital. The findings of the current study could be a reflection of these recommendations (shorter duration of catheter use, more attention to catheter hygiene, increased antibiotic use).

The highest rates of nosocomial infections were observed in intensive care units, which are also the units in which the most severely ill patients are treated and in which the highest mortality rates are observed. Similar findings were found in other studies [18], [19], [20], [21].

The overall nosocomial infection rate was 5% of patients admitted, which is comparable with those reported in most of the developed countries [3],[4] . This could be attributed to the fact that Al-Hada Armed Forces Hospital is a highly standard hospital (i.e. in terms of equipment and medical staff) and has strong programs both for surveillance and for prevention and control of infection. Comparatively, a lower figure of 4% has been reported in a maternity hospital in Saudi Arabia [22].

The Study on the Efficacy of Nosocomial Infection Control (SENIC) project provided the strongest scientific basis to date for the assertion that surveillance is an essential element of an infection control program and improves the outcomes of patients [23]. In this work, Gram-negative bacteria caused 66.7% of the infection. A comparable figure has been reported recently in Saudi Arabia [22].

Numerous studies have evaluated pathogens associated with nosocomial pneumonia. However, variations in patient populations and methods used to obtain and analyze specimens, as well as differences in the definition used for nosocomial pneumonia, have led to variable results. Generally, the pathogens associated with bacterial

pneumonia are Gram-negative bacilli (especially Pseudomonas species) [24], [25], [26].
Recent studies [24], [25], [26] however, are beginning to show an increase in the prevalence of Gram-positive pathogens (often Methicillin-resistant S. aureus), particularly in long-stay, tertiary hospitals, in which most patients are in the ICU and on a ventilator. Our finding supports the results of these studies.
In the current study, Escherichia coli was the most common infecting organism in patients with UTI. It was responsible for approximately half of cases. The same has been reported by others [27], [28]. The causes of bacteraemia were similar to those seen in other large series [29], [30]. The trend for coagulase-negative staphylococci [31] may reflect a change from regarding these organisms as skin contaminants to being clinically significant [29]. We found no shift to Gram-positive organisms as reported elsewhere [29], [30], [31].
In this study, S. aureus was the most common cause of surgical site infections. Methecillin-resistance was documented in 16 (57.1%) of 28 S. aureus isolates followed by Echerichia coli. The same findings has been mentioned elsewhere [32], [33].
As most surgical site infections become manifest after patient has been discharged from the hospital [34], in this study, we depend on post-discharge reporting by surgeons, a procedure which we find acceptable, since the majority of patients will return for follow-up to Al-Hada Hospital.
Antibiotic resistance is influenced by the antibiotic (mechanism of action and molecular composition) and type of resistance [35]. Resistance can develop by chromosomal mutation, acquisition of plasmids, transposons or antibiotic resistance genes, or interspecies genetic transformation [36].
Antibiotic resistance, regardless of the antibiotic and bacteria will occur with sufficient time and drug use. Widespread antibiotic use causes selection pressure: resistant strains survive while susceptible ones are eliminated [35], [36], [37].
Increased antibiotic use in hospitals is often associated with increased frequency of resistance [38]. The rise in antibiotic resistance emphasizes the importance of sound hospital infection control, rational prescribing policies, and the need for new antimicrobial drugs and vaccines.
The choice of antimicrobial drugs is central to the management of infection. Selection of a suitable antibiotic is fairly straightforward when the microorganism responsible is known. However, when this is not the case, a choice based on current epidemiologic data has to be made and empirical antibiotic treatment is prescribed. This should be followed by conventional culture techniques, whereby the specific antibiotic-sensitivity patterns of the causative organisms are established and the antimicrobial therapy can subsequently be modified if necessary for those patients who have positive cultures [5].
Because more than 90% of nosocomial infections do not occur in recognized epidemics [39], surveillance principally measures the endemic rates of nosocomial infections. This is important to remember when one attempts to devise a prevention or control strategy to reduce the infection rate.

Conclusions

The distribution of nosocomial infections by site is different from that previously reported in Al-Hada Armed Forces Hospital, Saudi Arabia, largely as a result of anticipated low rate of urinary tract infection. Pneumonia, urinary tract infections, and blood stream infections made up the great majority of nosocomial infections. There is a need for further risk assessment associated with main types of infection.

Acknowledgements

I thank the microbiology laboratory staff in Al-Hada Armed Forces Hospital for reporting isolates to the Epidemiology and Research Unit of the Preventive Medicine Department. I also would like to thank Mr. Timothy Richards for the revision of the English text.

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Please cite as

Abdel-Fattah MM. Surveillance of nosocomial infections at a Saudi Arabian military hospital for a one-year period. GMS Ger Med Sci. 2005;3:Doc06.

This article is freely available from

http://www.egms.de/en/gms/2005-3/000024.shtml

Received: *2005-02-02*
Published: *2005-09-01*