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Surveillance of Nosocomial Infections in Dicle University Hospital: a Ten-Year Experience

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Aim: The main objective was to recognize the evaluation of surveillance program on the nosocomial infections (NIs) in Dicle University Hospital (DUH)

Materials and Methods: A prevalence study was performed prospectively, at the DUH from 1997 to 2006. Active surveillance for NIs were performed by infection control team, using the criteria proposed by the Centers for Diseases Control and Prevention (CDC) and National Nosocomial Infections Surveillance System (NNIS) methodology. This team includes infection control doctor and two nurses, who visited hospital units three times a week. All cases with NI were recorded using a standard data collection form.

Results: During ten years of follow up period, 3382 NI episodes were detected in 3075 patients out of 250209 inpatients. The overall incidence rates (NI/100) and incidence densities (NI/1000 days of stay) of NIs were 1.4% (range 0.8-2.5/100) and 1.7/1000 patients-days (range 0.7-2.5/1000), respectively. NIs were seen frequently in intensive care unit (20.1 episodes per 1000 bed-days), burn unit (14.5 episodes per 1000 bed-days), and neurology (3.7 episodes per 1000 bed-days). The most common NIs according to the primary sites were urinary tract infection (24%), bloodstream infection (22%), pneumonia (13%) and surgical site infection (13%). The most prevalent microorganisms were *Escherichia coli* (26%), *Pseudomonas aeruginosa* (15%), *coagulase-negative staphylococci* (14%) and *Staphylococcus aureus* (13%). Amikacin and meropenem were the most effective agents against Gram-negative bacteria. Meticillin resistance among *S. aureus* isolates was 67% and all were sensitive to vancomycin.

Conclusions: This study represents that the rate of NIs reduced with appropriate interventions. Surveillance and constant monitoring are effective along with educating the staff about infection control practices.

Key Words: nosocomial infection, surveillance, infection control

Dicle Üniversite Hastanesi'nde Nozokomiyal İnfeksiyon Surveyansı: 10 Yıllık Deneyim

Amaç: Dicle Üniversitesi Hastanesi'nde (DÜH) nozokomiyal infeksiyon (Nİ) surveyans programının değerlendirilmesi amaçlanmıştır.

Yöntem ve Gereç: Bu prevelans çalışması DÜH'de 1997-2006 yılları arasında prospektif olarak yapıldı. Nİ'ler İnfeksiyon Kontrol Ekibi tarafından aktif surveyansla, Centers for Diseases Control and Prevention (CDC) ölçütlerine göre National Nosocomial Infections. Surveillance System (NNIS) metoduyla izlendi. İnfeksiyon kontrol doktoru ve iki hemşireden oluşan ekip haftada iki gün klinikleri ziyaret etti. Bütün Nİ'li hastalar standart bilgi formuna kaydedildi.

Bulgular: On yıl boyunca, 250209 hastane yatışında, 3075 hastada 3382 Nİ atağı tespit edildi. Tüm insidans oranları (Nİ/100) ve insidans dansitesi (Nİ/1000 hastanede kalış günü) sırasıyla % 1.4 (0.8-2.5/100) ve 1.7/1000 hasta günü (0.7-2.5/1000) olarak bulundu. Nİ'ler sıklıkla yoğun bakım ünitesinde (1000 yatak gününe 20.1 atak), yanık ünitesinde (1000 yatak gününe 14.5 atak) ve nöroloji servisinde (1000 yatak gününe 3.7 atak) görüldü. Yerleşim yerine göre en fazla üriner sistem infeksiyonları (%24), kan dolaşım infeksiyonları (% 22), pnömoni (% 13) ve cerrahi alan infeksiyonları (% 13) görüldü. En sık görülen mikroorganizmalar *Escherichia coli* (% 26), *Pseudomonas aeruginosa* (% 15), *koagülaz-negatif stafilokoklar* (%14) ve *Staphylococcus aureus* (%13) idi. Amikasin ve meropenem Gram-negatif bakterilere karşı en etkili ajanlardı. *S. aureus* izolatları içerisinde metsilin direnci % 67 bulundu ve tamamı vankomisin duyarlıydı.

Sonuç: Bu çalışma uygun müdahalelerle Nİ oranlarının azaltılabileceğini göstermektedir. DÜH 'ta surveyans çalışmaları yoğun bakım ünitesi, yanık ünitesi ve nöroloji servisine odaklanmalıdır. Gram-negatif hastane patojenleri kullanılan antibiyotiklerin bazısına yüksek oranda dirençlidir. DÜH'de üriner sistem infeksiyonları en sık rapor edilen Nİ'dir

Anahtar Sözcükler: nozokomiyal infeksiyon, sürveyans, infeksiyon kontrolü

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Introduction

Nosocomial infections (NIs) continue to be a major problem, causing high morbidity, mortality and significantly increasing the length of hospitalization and cost of treatment (1-3). Surveillance of NIs are an essential part of the infection control programme. The best management of infections is to prevent patients from becoming infected. Successful infection control measures depend on education of healthcare workers (HCWs), surveillance of the prevalent microorganisms and their antimicrobial resistance patterns, and an efficient interdisciplinary collaboration (4,5). The surveillance activities are part of infection control efforts to improve the quality of hospital care.

This is the first long term surveillance study that provided extensive information on the present status and trends of NIs at a university hospital in Turkey. The main purpose was to recognize the evaluation of surveillance program on the NIs.

Materials and Methods

Dicle University Hospital (DUH) is an 1150-bed tertiary referral center in the southeast of Turkey. The hospital has 33 separate units, including burn unit and core intensive care unit (ICU).The ICU started with four beds in 2004 and than improved to eight beds in 2005. In 2006, medical ICU started to service with eight beds.

The surveillance method was active, prospectively, laboratory and patient based. This study was performed between 1st January 1997 and 31st December 2006. Active surveillance for NIs were performed by infection control team, using the criteria proposed by the Centers for Diseases Control and Prevention (CDC) and National Nosocomial Infections Surveillance System (NNIS) methodology (6,7). This team includes infection control doctor and two nurses, who visited hospital units three times a week. All cases with NI were recorded using a standard data collection form. The form included the patients' name, age, sex, underlying conditions, risk factors for NIs, interventions at the hospital, reason for hospitalization and treatment profile. Medical and nursing notes, microbiology reports, temperature charts and antibiotic treatment charts were reviewed to determine if a patient had symptoms and signs of infection. The infection control team filled out a worksheet for every patient. It was not possible to carry out a post-discharge follow up for all patients because of lack of resources.

NIs were classified as urinary tract infections (UTIs), surgical site infections (SSIs), pneumonia, bloodstream infections (BSIs) (the 4 most common forms), and other (central nervous system infections, gastrointestinal system infections, eye infections, catheter related local infections, obstetrics and gynecological infections and prosthesis infections).

The data of nosocomial microorganisms were collected daily from Hospital Core Laboratory and Infection Diseases Department Laboratory. Incidence rate was defined as the number of NIs per 100 patients discharged during the period of surveillance. The incidence density of NI was calculated on the base of 1,000 days of stay.

Establishing the Infection Control Program at DUH

An infection control program was introduced in January 1996. In the first step, a review of patient care practices and equipment in DUH was undertaken to identify potential sources of NIs, including the staff, particularly their hands, and equipment used in patient care. Antibiotic use and intravenous catheter care were also reviewed. Educational sessions were held with the staff in turn, monthly to the department members who resided in the unit and assisted in caring for their own hospitalized patients. Emphasis was placed initially on personal hygiene of the staff, particularly hand-washing, nail care, and bathing. Ward physicians were given refresher training on early recognition and culturing of patients with suspected NIs, and appropriate antibiotic therapy.

In 1997, as the second step, an Infection Control Committee was established comprising the Hospital Director, Head of Microbiology, Nursing Supervisor, two infection control doctor and two nurses. The Committee took further measures to prevent NIs including hand-washing, management of waste disposal, restriction to visitors, isolation programs for the patients, training the workers on care of intravenous and urinary catheters and training the staff on disinfection and sterilization procedures.

The third step of the infection control program started in 1998. Two infection control doctors and two infection control nurses began to assemble groups including three to four persons from the staff and other

caregivers on the ward to reinforce NI control messages. A log book of these sessions was maintained, including documentation of the issues discussed. Emphasis was further placed on increasing awareness of the importance of NI control and personal hygiene. Hand-washing was highlightened as the most important measure to prevent NIs.

Results

During ten-year follow up period, 3,382 NI episodes were detected in 3,075 patients out of 250,209 inpatients. The overall incidence rates (NI/100) and incidence densities (NI/1000 days of stay) of NIs were 1.4% (range 0.8-2.5/1000) and 1.7/1,000 patients-days (range 0.7-2.5/1000), respectively (Figure 1).

NIs were frequently seen in ICU (20.1 episodes per 1000 bed-days), burn unit (14.5 episodes per 1000 bed-days), and neurology (3.7 episodes per 1000 bed-days). More detailed information about the distribution of NIs by the departments has been given in Table 1. The most common NIs by primary site were UTI (24%) and BSI (22%) (Table 2). The most prevalent microorganisms were *Escherichia coli* (26%), *Pseudomonas aeruginosa* (15%), *coagulase-negative staphylococci* (CNS) (14%) and *Staphylococcus aureus* (13%) (Table 3). Amikacin and meropenem were the most effective agents against Gram-negative bacteria (Figure 2). Meticillin resistance among *S. aureus* (MRSA) isolates was 67% and all were sensitive to vancomycin (Figure 3).

Discussion

Preventing NIs requires an organized hospitalwide infection control program and intensive surveillance. The successful infection control programs were associated with reduction in NIs as compared with hospitals lacking an infection control program (8-13). Although the most effective programs reduce the rate of NIs, these infections continue to be a problem even in hospitals with every successful programs. Epidemiological finding of NIs reports varies among countries and even among different hospitals in the same country (1, 3, 8, 9). The usual rate of NIs is 1.5-27%, depending on the type of hospital and severity of the population under study and the definitions used (8-14). This study represented that the rate of NIs in our hospital is at a quite low level. Our hospital does not have high risky services and departments such as transplantation unit. At the same time, some of the oncology cases have being transferred to other speciality centers in the country. These factors may have contributed to the low infection rate. Our rates of NIs showed an increase in the last three years. These results may be related with the establishment of new central ICU and medical ICU.

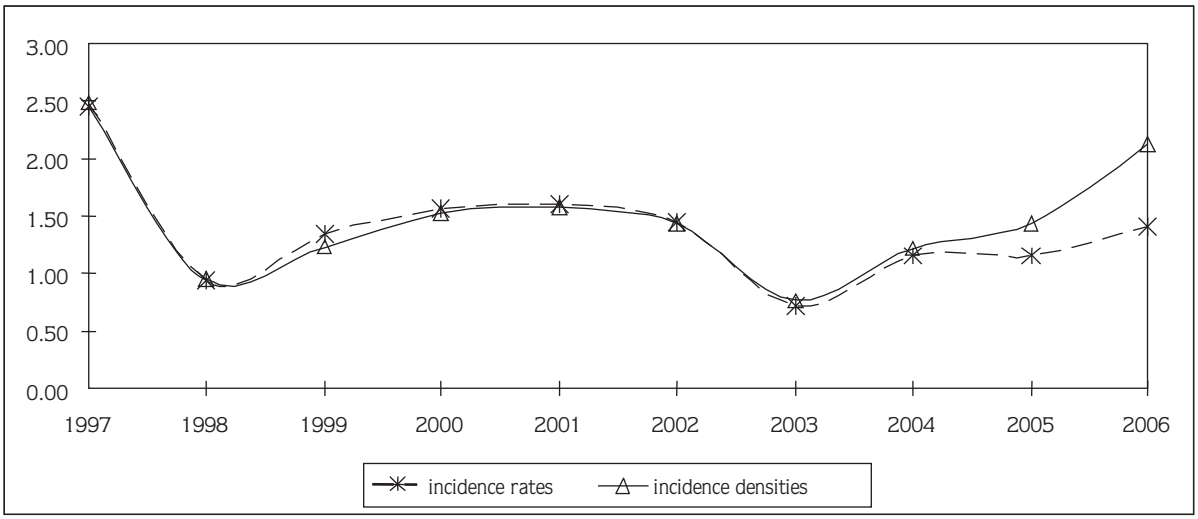

Figure 1. The overall incidence rates and densities of NIs.

Table 1. Incidence rates and densities of NIs according to the departments for 1997-2006.

Unit	NIs count	Incidence rate	Incidence densities
ICU	162	46.4	20.1
Burn unit	274	15.4	14.5
Neurology	316	5.1	3.7
Urology	276	3.0	2.5
Orthopedics	331	2.6	2.2
Neurosurgery	217	2.6	2.2
Infectious disease	85	1.8	2.0
General surgery	305	2.3	2.0
Internal medicine	686	1.7	1.9
Cardiovascular surgery	167	1.6	1.6
Plastic surgery	48	1.7	1.1
Pediatrics	268	0.7	0.9
Pediatric surgery	63	0.7	0.8
Dermatology	11	1.0	0.6
Cardiology	31	0.2	0.5
PMR*	44	0.8	0.5
Respiratory diseases	40	0.5	0.5
Otorhinolaryngology	11	0.3	0.4
OG**	45	0.2	0.2
Other***	2	0.1	0.2
Total	3382	1.4	1.7

*Physical Medicine and Rehabilitation;**Obstetrics and Gynecology; ***Ophthalmology; Psychiatry

Table 2. The types and rates of NIs according to infections sites.

Type of NIs	Number of infections	Percent of total infections	Incidence rates	Incidence densities
Urinary tract infection	801	24	0.32	0.35
Bloodstream infection	734	22	0.29	0.32
Pneumonia	454	13	0.18	0.20
Surgical site infections	426	13	0.17	0.19
Soft tissue infections	356	11	0.14	0.15
Sepsis	147	4	0.06	0.06
Others*	464	14	0.19	0.20
Total	3382	100	1.35	1.47

*(central nervous system infections, gastrointestinal system infections, eye infections, catheter related local infection, obstetrics and gynecological infections and prosthesis infections).

Table 3. The distribution of NIs microorganisms for 1997-2006.

Bacteria	Total	%
E. coli	529	25.8
P. aeruginosa	312	15.2
CNS	277	13.5
S. aureus	271	13.2
Klebsiella spp.	215	10.5
Enterobacter spp.	176	8.6
Acinetobacter spp.	87	4.2
Other	184	9.0
Total	2051	100.0

At the beginning of that longtime surveillance studies (in 1997); there was not an efficient infection control program at the hospital. The NI rates in 1997 were found 2.5%; while during 1998-2003, the rates dropped approximately to 1% as a result of some interventions. After the establishment of hospital infection control program; a periodical and repetitive education program for HCWs has been performed. The education program emphasized on handwashing, adherence to the infection control practices, sterilization and disinfection

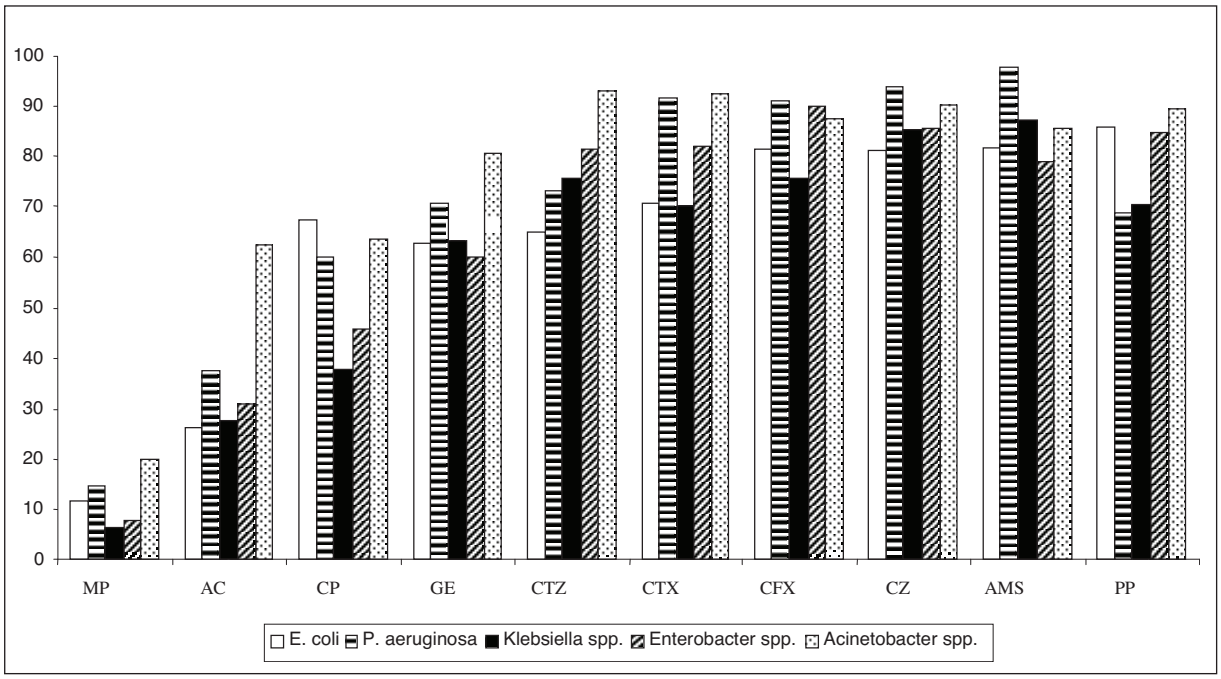

Figure 2. Antibiotic* resistance of major Gram-negative bacteria from NIs.
*MP: meropenem;AC: amikacin; CP:ciprofloxacin; GE:gentamicin; CTZ:ceftazidime; CFX: cefotaxime; CZ:cefazolin; AMS:ampicillin/sulbactam;AM:ampicillin;PP: piperacillin.

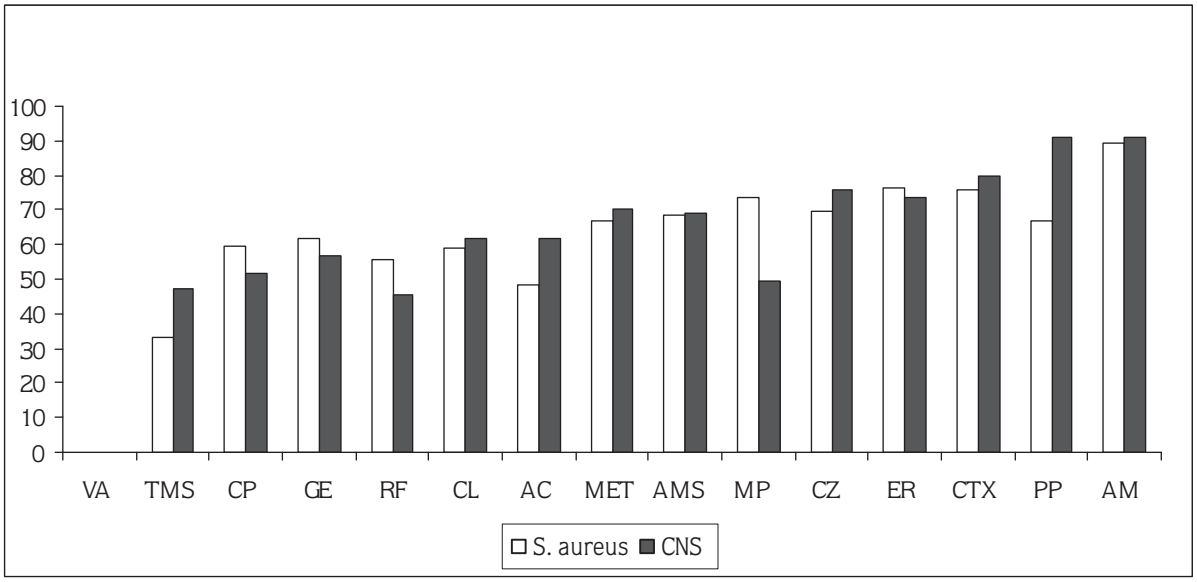

Figure 3. Antibiotic* resistance of major Gram-positive bacteria from NIs.
*VA: vancomycin; TMS: trimethoprim/sulfamethoxazole; CP: ciprofloxacin; GE: gentamicin; RF: rifampicin; CL: clindamycin; AC: amikacin; MET: meticillin; AMS: ampicillin/sulbactam; MP: meropenem; CZ: cefazolin; ER: erythromycin; CTX: ceftriaxone; PP: piperacillin; AM: ampicillin; CTZ: ceftazidime; CFX: cefotaxime.

procedures. The low rate of NIs should be related with the steady NI control program during that time.

NIs were seen frequently in burn units and ICUs. NIs are frequent medical complications affecting patients in these units. Invasive diagnostic and therapeutic procedures have contributed NIs at burn units and ICUs (15-17). Similarlly, NIs were found major problems and life threatening reasons for our burn unit patients. The rate of NIs among burn cases might be extremely high in developing countries (11). This is partially due to limited primary care, overcrowding in that unit or to low socioeconomic situation. A successful infection control measure depends on a specifically-built burn unit, well-educated burn unit workers, surveillance of the bacteria prevalent in the burn unit and their antimicrobial resistance patterns, and an efficient hospital infection control program.

Each hospital should develop its own infection control guidelines depending on the facilities available. It is important that the staff from hospital units especially high risk area and infection control unit should work together for controlling infections successfully. A good team effort supports to avoid infections and can help to solve the problems. The education of the HCWs and follow up of a program are important for prevention of NIs.

Urinary tract infection, pneumonia, BSI and SSI were found the to be four most frequent types of infection in this study, as supported by most previous studies (15,18-21). At the beginning of that surveillance study, UTI was accounted for the majority of NIs. The Hospital Infection Control Committee began an intensive educational program highlightening prevention of NIs in 1998. These infections were controlled with patient isolation, education of HCWs, and promotion for adherence to hand washing before and after contact with patients.

In order to perform surveillance of NIs, the results of routine culture results must be carefully collected and evaluated (15). The causative agents in NIs could be bacterial, viral, fungal, or even parasitic. The most common pathogens included *E. coli,* staphylococci, *P. aeruginosa, Klebsiella spp.,* and *Enterobacter spp.* (22, 23). In this study, Gram-negative bacteria of the enterobacteriaceae family were the most common causative agents and *S. aureus* and CNS followed these microorganisms. DUH was faced with a remarkable dissemination of antimicrobial-resistant Gram-negative and positive bacteria. Emerging resistance in *E.coli, P. aeruginosa, Klebsiella spp., Enterobacter spp., Acinetobacter spp.* and *S. aureus* are a significant problem that requires immediate attention. Amikacin and meropenem were the most effective agents against Gram-negative bacteria. MRSA isolates was 67% and all were sensitive to vancomycin. Efforts to control the increase in emerging resistance should aim at both the control of antimicrobial use, and the prevention of nosocomial transmission of resistant bacteria (24).

This study gives important information on the epidemiology of NIs at a tertiary care hospital. The data indicates that the prevalence of NIs has been reduced over years with appropriate interventions. Surveillance and constant monitoring is necessary along with educating the staff about infection control practices. The routine application of standard infection control practices may reduce the incidence of NIs. Although it is impossible to eliminate NIs completely, it is possible to reduce them to a minimum with appropriate infection control programs in all hospitals.

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