

units are at the greatest risk of acquiring HAIs and the higher rate of multiple episodes of HAIs, partly due to their serious primary disease, but also by exposure to life-saving multiple invasive procedures. The HAIs are a common problem in neurological patients and have relevant influence on morbidity, mortality, and associated costs.³⁻⁵ Prevention of HAIs improves the quality of patient care while reducing its cost. The search for available literature on the epidemiology of HAIs in neurology produced only a very limited number of relevant publications. The aim of this study was to assess data on the epidemiology of HAIs occurring in hospitalized patients in the neurology unit and to use them for internal quality management.

Methods. Dicle University Hospital is a 1050-bed tertiary referral center in the southeast of Turkey. The neurology unit has 12 rooms with 35 beds. This study was performed prospectively, from 1st January 1999 to 31st December 2004. This study was approved by Ethics Committee of the Dicle University Hospital. Active surveillance for HAIs were performed by the 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} A trained and experienced infection control team visited the neurology unit twice a week. General data were obtained including name, age, gender, reason for hospitalization and treatment for all patients. 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. As resources were limited it was not possible to carry out a post-discharge follow up. The infection rate was defined as the number of HAIs per 100 patients discharged during the period of surveillance. The incidence of HAI was calculated on the base of 1000 days of stay. The HAIs were classified as urinary tract infections, decubitus infection, pneumonia, bloodstream (the 4 most common forms), and other (catheter related local infection, diarrhea, sepsis and wound infection). The data of microorganisms were collected daily from the Hospital Core Laboratory and Infection Diseases Department Laboratory. The HAI group was compared with patients without infections with respect to mortality and length of hospital stay. The HAI was defined as occurrence of infection after hospital admission, without evidence that the infection was present or incubating (≤ 48 hours) on admission. The control group was defined as all inpatients without HAI at the neurology unit during the study period.

Results were analyzed using SPSS 10 (SPSS, Inc, Chicago, IL), and statistical analysis was performed using chi-square, a p -value of ≤ 0.05 was considered statistically significant.

Results. During the 6-year follow up period, 219 HAIs episodes were detected in 203 patients out of 3323 inpatients (Table 1). The overall incidence rates (HAI/100) and incidence densities (HAI/1000 days of stay) of HAIs were 6.6% and 4.4/1,000 patients-days (Figure 1). The type of patients is shown Table 2. The most common HAIs by primary site were urinary tract infection (44.2%) and decubitus infection (30.4%) (Table 3). The most prevalent microorganisms were *Escherichia coli* (27%), *Klebsiella species* (14%), *Pseudomonas aeruginosa* (13%), *Enterobacter species* (12%), coagulase-negative *Staphylococci* (10%) and *Staphylococcus aureus* (7%). The mean length of stay of patients with HAI was 28 ± 5 days, while that of patients without infections was 11 ± 1 days ($p=0.001$). Eighty-two patients died with HAIs, while 1330 died in the patients without infections. Mortality rates of cases with HAIs were not found statistically different in the patients without infections ($p=0.05$).

Table 1 - Hospitalized patients in a neurology unit from 1999-2004.

Year	No. of hospitalized patients	No. of hospitalized days	No. of HAIs patients	No. of HAIs
1999	502	8008	32	34
2000	543	8570	40	40
2001	562	7998	29	31
2002	564	8009	40	44
2003	522	8527	21	25
2004	630	9149	41	45
Total	3323	50261	203	219

HAI - healthcare-associated infections

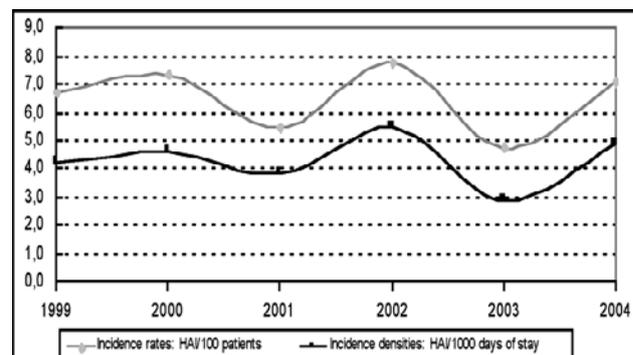


Figure 1 - The incidence rates and incidence densities of healthcare-associated infections.

Table 2 - The type of patients in a neurology unit.

Diagnosis on admission	n	(%)
Cerebral infarct	102	(50.2)
Cerebral hemorrhage	73	(36.0)
Subarachnoidal hemorrhage	8	(3.9)
Ischaemic encephalopathy	5	(2.5)
Encephalitis	4	(2.0)
Guillain-Barré syndrome	3	(1.5)
Metabolic encephalopathy	3	(1.5)
Epilepsy	3	(1.5)
Hemorrhagic infarct	2	(1.0)
Meningitis	1	(0.5)
Total	203	(100)

Table 3 - Healthcare-associated infections in a neurology unit: site-specific incidence rates and incidence densities.

Type of HAI	Number of infections	Percent of total infections	Incidence rates	Incidence densities
Urinary tract infection	96	44.2	2.9	1.9
Decubitus infection	66	30.4	2.0	1.3
Pneumonia	39	18.0	1.2	0.8
Bloodstream infection	11	5.1	0.3	0.2
Others*	7	2.3	0.2	0.1
Total	219	100	6.5	4.3

*Catheter related local infection, diarrhea, sepsis, wound infection, HAI - healthcare-associated infections

Discussion. The epidemiology of HAI in the neurologic intensive care unit is well documented in the literature, but there is less information in the neurology unit. The HAIs surveys have been a contributing factor to implementing infection control measures, such as infection control programs and incidence surveillance systems.⁸⁻¹² The data have also been used for political and administrative purposes, and as an argument for more resources for infection control in neurology units. The usual incidence rate of HAIs in the neurology unit is 8-27%, depending on the type and severity of the population under study and the definitions used.^{1,13-16} In this study, the overall incidence rates and incidence densities of HAIs were 6.6% and 4.4/1,000 patients-days. Compared with other studies, this study revealed low HAI rate and incidence densities. This can be explained partly by the short stay in the neurology unit and because a post discharge follow-up was not performed. Another reason for these low HAIs rates may be that our hospital was reorganized with better

hygienic conditions and close cooperation between the infection control team and neurology units' staff. It is important that the staff from the neurology unit and infection control team should work together to control HAIs successfully. No significant difference of mortality rates was shown between patients with HAI and without infections, since patients at terminal stage of their disease were followed up at the central intensive care unit in the hospital. Our control group was recruited from all inpatients from the neurology unit during the study period. A case-control study comparing control patients with the same clinical severity would be better.

Few data have been published on specific incidence rates and incidence density of urinary tract infection, soft tissue infections, and pneumonia specifically in neurology patients. Regardless of methodological differences, urinary tract infections and pneumonia were the most frequent HAIs.^{17,18} The order of incidence rates and incidence densities of site-specific infections may differ according to the neurology patients and settings.¹ Soft tissue infections and bloodstream infections are less common than urinary tract infections or pneumonia.^{19,20} Neurology patients should be considered at high risk for a urinary tract infection, because they are usually exposed to urethral catheterization. More than 80% of urinary tract infections are associated with an indwelling urinary catheter, and risk increases with duration of catheterization.²¹ Patients who have other infections at a remote body site, patients who are colonized with other microorganisms, who are on steroids or have undergone chemotherapy, and patients who have been in the hospital for a long time are more prone to more serious soft tissue infections. In our cases, decubitus infections were frequent due to length of time staying in the same position and inadequate care experience. The neurology unit has more elderly patients with neurological diseases, mostly strokes and diabetes, which may partially explain why these patients had more urinary tract infections. In this study, pneumonia and bloodstream infection were the third and fourth most common sites of infection. In mechanically ventilated patients, endotracheal intubation is an important predisposing factor for developing bacterial pneumonia and infections. Preventive strategies should include multiple measures related to protection of the patient, invasive medical devices, and microorganisms.^{17,11,22,23}

There are some limitations to this study. We could not record the device days during the study period and device-associated infection rates were not calculated. This information would be particularly interesting for comparison with units of other specialties.

The source of HAIs is generally microorganisms carried by healthy patients or resistant bacteria following cross-infection.²⁴ In studies carried out in Turkey and

abroad, the most common microorganisms isolated were Gram-negative bacilli, especially *Escherichia coli*.^{7,14,15,19,20} In neurology units and intensive care units, *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus epidermidis* and *Staphylococcus aureus* have been reported to be isolated most frequently.^{1,3} In this study, *Escherichia coli*, *Klebsiella species*, and *Pseudomonas aeruginosa* were the most commonly isolated HAIs pathogens, a result in agreement with the literature. However, HAI pathogens may differ between units and may differ according to site-specific infections over the course of time in the same unit.

The HAIs were controlled by patient isolation, education of healthcare personnel, and strict adherence to hand washing before and after contact with patients and to aseptic and antiseptic guidelines. Dicle University Hospital's infection control committee conducted an intensive educational program highlighting prevention of HAI's during the course of the study. This detailed surveillance study provided extensive information on the current status and trends of HAIs in neurology units. The results may contribute to the evaluation of infection control programs and the development of effective strategies in neurology units. This study underlines the necessity of interdisciplinary cooperation between infection control teams, infection disease clinics, and neurology units in order to bring these infections under control and, avoid HAIs.

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