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The accuracy and validity of a weekly point-prevalence survey for evaluating the trend of hospital-acquired infections in a university hospital in Turkey[☆]

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SUMMARY

Objective: To evaluate the validity of a weekly point-prevalence survey (WPS) by comparing it with a prospective-active incidence survey (PIS).
Methods: WPS and PIS were conducted at a tertiary referral hospital between January and December 2006. Each Wednesday, an infection control team reviewed all clinical records of patients with hospital-acquired infections (HAIs) by WPS. Routine PIS was conducted with daily visits by the same team. The Rhame and Sudderth formula was used for converting the data between WPS and PIS.
Results: During the study period, 1287 HAIs were detected in 37 466 patients by WPS. The mean observed prevalence and calculated prevalence were 5.42% and 5.45%, respectively. The reanimation intensive care unit (ICU) (49.4%) and burns unit (27.6%) had the highest prevalence rates. Pneumonia (0.94%) and urinary tract infections (0.37%) were the most frequent infections. Overall 602 HAIs were detected in 545 patients by PIS. The mean observed incidence and calculated incidence were 2.42/1000-admissions and 2.41/1000-admissions, respectively. The Critical care ICU (37.0/1000-admissions) and burns unit (24.8/1000-admissions) had the highest incidences of HAI. Pneumonia (0.64/1000-admissions) and urinary tract infections (0.37/1000-admissions) were the most frequent infections.
Conclusions: This study confirms a close relationship between prevalence and incidence data. WPS may be a useful method for following HAIs when PIS cannot be performed.

1. Introduction

Hospital-acquired infections (HAIs) are an important cause of morbidity and mortality, as well as significantly increased hospital stays, additional antibiotic utilization, and healthcare costs.[1–6] The surveillance of HAIs is a crucial component of a qualified infection control program and is widely accepted as a primary step in the control of HAIs.[1,6–13] The difficulties associated with surveillance of HAIs have led to a variety of methodological approaches, which many experimental studies have tested.[9,13,14] For example, the incidence survey is regarded as the most powerful method, and a gold standard for evaluating the burden of HAIs. However, incidence studies are expensive because data have to be collected over a long period and require more experienced investigators.[6,8,11] However, point-prevalence studies are less expensive and time-consuming, and can be performed more easily than incidence studies.[6–8,13–16] In addition, these studies increase awareness of the problem at hospitals and are widely accepted and recommended by many investigators, particularly when they can be repeated at regular intervals.[7,10,17]

The repeated prevalence survey is used to evaluate an infection control program, follow the trends of HAIs, measure the adverse effects and costs of HAIs, and determine the rate of device and antibiotic usage.[8,16] In developing countries, because of limited resources, the repeated point-prevalence survey may be a good alternative for the surveillance of HAIs.

The aim of this study was to determine the trend and extent of HAIs by weekly point-prevalence survey (WPS), and examine the accuracy and validity of WPS by comparing this method with a prospective-active incidence survey (PIS).

2. Methods

2.1. Setting

This study was performed across all departments of Dicle University Hospital (DUH) between January and December 2006.

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DUH is an 1150-bed tertiary referral center, and the largest hospital in the southeast of Turkey. The hospital is 25 years old and has 33 separate clinics, including a reanimation intensive care unit (ICU) and a burns unit. Annually, about 40 000 patients are treated at DUH, and in 2006, the proportion of hospitalized patients was 77%.

During 2006, WPS and PIS were conducted across all departments of the hospital by the central infection control committee, and all hospitalized patients were included in the study. For WPS data collection, the central infection control committee was composed of a surveillance team, including a specialist physician, two resident physicians, and two infection control nurses. The team was experienced and trained in HAIs. Hospital wards were classified into two general types: surgical and internal clinics. The Critical care ICU and the burns unit were classified as surgical clinics. Subsequently, the team was divided into two groups including a resident physician and a nurse, and employed to record HAI data in both the surgical and internal clinics. This study was directed by the specialist physician, who was a member of the central infection control committee.

2.2. Definitions and data collection

The diagnosis of HAIs was made according to the Centers for Disease Control and Prevention criteria[18] and the National Nosocomial Infections Surveillance System methodology.[19] Asymptomatic bacteriuria was not categorized as an HAI.

Each Wednesday during the prevalence study, WPS was performed by the team. On this day the team reviewed the clinical and laboratory records of all hospitalized patients. Patients were detected according to positive cultures, symptoms of infection, and antibiotic treatment for HAIs. Patient data were recorded on a standard form, including the total number of hospitalized patients and the number and types of HAI. The rates of HAI in all clinics were then calculated. PIS was performed based on patient clinical and laboratory records by the same team with daily visits to all departments of the hospital. Positive cultures from patients were obtained from the central microbiology laboratory by the team. Subsequently, the team visited all patients at the bedside with their clinic physician and nurses. All cases with HAI were recorded on a standard form. If a patient had symptoms and signs of infection, the medical and nursing notes, microbiology reports, temperature, and antibiotic treatment charts were reviewed. Urinary tract infections, pneumonia, surgical site infections, bacteremia, sepsis, burn infections, wound infections, catheter-related infections, intraperitoneal infections, abscess, empyema, meningitis, and orthopedic prosthesis infections were recorded by both WPS and PIS. The team filled out a worksheet for each patient diagnosed with HAI. The data recorded on the standard forms were then transferred to a Microsoft Office Excel 2003 spreadsheet (Microsoft Corp., Redmond, WA, USA).

2.3. Interconversion of incidence and prevalence data

The Rhame and Sudderth formula[20] was used for converting the data from incidence to prevalence, and vice versa. According to this formula, the prevalence rate of HAIs was calculated as follows: $P = I \times [(LN - INT)/LA]$, where P is prevalence, I is incidence, LN is the length of hospitalization of patients having one or more HAI, INT is the average interval between admission and onset of the first HAI for patients having one or more HAI, and LA is the average length of hospitalization of all the hospitalized patients during the study period.

2.4. Statistical analysis

For each week during the study period, HAI prevalence was calculated as the ratio of the number of HAIs to the total number of hospitalized patients on the day of the WPS. The mean prevalence for the year was calculated by averaging the weekly prevalences. The mean prevalences were presented with a range (minimum–maximum) of observed prevalences. Mean prevalence for the year was also calculated as 'biweekly' and 'monthly' (by considering only data from every second or every fourth week, respectively). The incidence of HAIs was calculated as the ratio of the number of HAIs to the number of patient admissions (per 1000-admissions) in 2006. Statistical analyses were carried out using SPSS software, version 13.0 (SPSS Inc., Chicago, IL, USA).

3. Results

During the study period, 1287 HAIs were detected in 37 466 patients by WPS. According to WPS results, the mean weekly observed prevalence rate of HAIs was 5.42% (range 1.9–8.4%) over the study period. According to the biweekly and monthly results, the mean observed prevalence rates of HAIs were 5.5% (range 3.2–8.4%) and 5.4% (range 3.2–7.1%), respectively. Figure 1 shows the trend of weekly mean prevalence rates of HAIs for internal clinics and surgical clinics during the study period. According to WPS results, pneumonia (0.94%), urinary tract infections (0.37%), and bacteremia (0.35%) were the most frequent infections (Table 1). The Critical care ICU had the highest prevalence rate (49.4%), followed by the burns unit (27.6%), neurology (10.5%), and the general surgery ICU (8.4%) (Table 2).

During the same study period, a total of 40 100 patients with 249 000 admissions were examined by PIS. A total of 602 HAIs

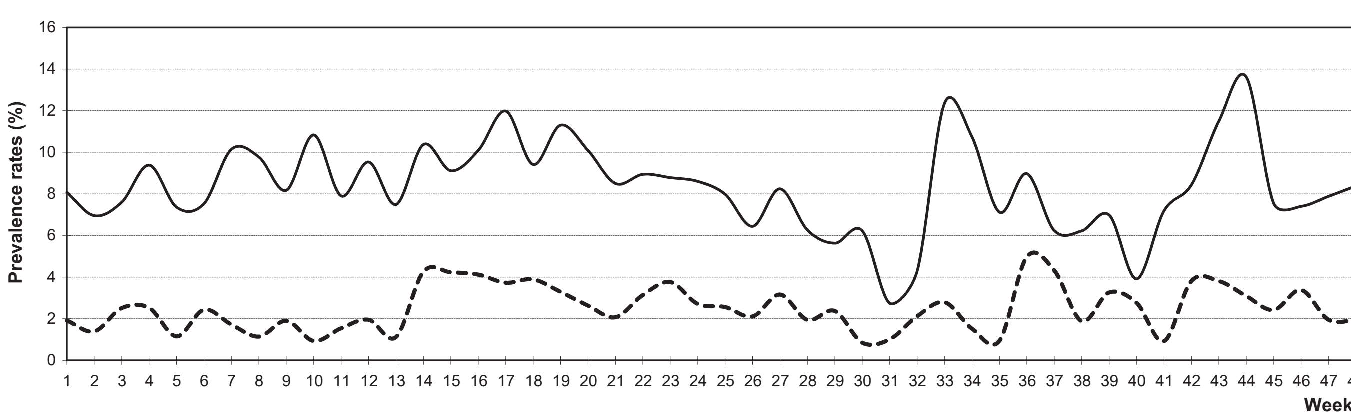

Figure 1. The trend of weekly mean prevalence rates of hospital-acquired infections (HAI) for internal clinics and surgical clinics during the weekly point-prevalence survey study.

Table 1
Infection type, prevalence rate (%), and incidence (per 1000-admissions) of hospital-acquired infections (HAIs) according to weekly point-prevalence survey (WPS) and prospective-active incidence survey (PIS)

Type of HAI	WPS		PIS	
	HAI count	Prevalence rate[b], range (min–max)	HAI count	Incidence
Pneumonia	397	0.94 (0.2–1.9)	160	0.64
Urinary tract infection	169	0.37 (0.0–1.2)	93	0.37
Surgical site infection	149	0.33 (0.0–1.1)	54	0.22
Bacteremia	137	0.35 (0.0–1.1)	51	0.20
Burn infection	116	0.27 (0.0–1.1)	49	0.20
Wound infection	106	0.26 (0.0–1.3)	60	0.24
Sepsis	92	0.27 (0.0–0.9)	49	0.20
Catheter	31	0.07 (0.0–0.8)	53	0.21
Other[a]	90	0.19 (0.0–1.1)	33	0.13
Total	1287		602	

[a] Other: intraperitoneal infections, abscess, empyema, meningitis, and prosthesis infections.
[b] The prevalence rate of HAI type was calculated as the mean value of weekly prevalence rates of HAI types.

were detected in 545 patients by the survey method. The mean observed incidence of HAIs was 2.42/1000-admissions. The most frequent infections were pneumonia (0.64/1000-admissions), urinary tract infections (0.37/1000-admissions), and wound infections (0.24/1000-admissions) (Table 1). The Critical care ICU had the highest incidence of HAIs (37.0/1000-admissions), followed by the burns unit (24.8/1000-admissions), neurology (8.8/1000-admissions), and the general surgery ICU (8.0/1000-admissions) (Table 2).

Table 2
The mean prevalence rates (%) of hospital-acquired infections (HAI) according to weekly point-prevalence survey (WPS), and the incidences (per 1000-admissions) of HAI according to prospective-active incidence survey (PIS) for each hospital department.

Clinic	WPS	PIS		
	Prevalence rate[c], range (min–max)	HAI count	Admission days	Incidence
Surgical				
Pediatric surgery	1.9 (0.0–12.5)	13	6858	1.9
Chest surgery	5.2 (0.0–17.8)	26	7662	3.4
Cardiovascular surgery	1.8 (0.0–14.3)	9	4014	2.2
Orthopedic	2.8 (0.0–10.8)	33	11 295	2.9
Neurosurgery	7.1 (0.0–22.6)	29	5659	5.1
General surgery ICU	8.4 (0.0–23.3)	26	3258	8.0
Burns unit	27.6 (0.0–55.0)	54	2181	24.8
Plastic surgery	8.3 (0.0–25.0)	22	4080	5.4
Critical care ICU	49.4 (14.3–75.0)	61	1651	37.0
Other[a]	0.7 (0.0–8.3)	56	65 255	0.9
Internal				
Breast infection	1.1 (0.0–6.7)	8	10 174	0.8
Pediatric	1.2 (0.0–3.2)	55	36 904	1.5
Neurology	10.5 (0.0–20.0)	82	9276	8.8
Physical therapy	3.1 (0.0–16.8)	13	5342	2.4
Infectious diseases	2.3 (0.0–16.7)	5	5412	0.9
Hematology	4.4 (0.0–20.8)	35	9536	3.7
Nephrology	6.6 (0.0–16.7)	37	9043	4.1
Oncology	2.4 (0.0–13.1)	7	5052	1.4
Other[b]	0.6 (0.0–6.7)	31	44 971	0.7

ICU, intensive care unit.
[a] Other: gynecology, ophthalmology, otorhinolaryngology, urology, and general surgery.
[b] Other: dermatology, cardiology, psychiatric, endocrinology, gastroenterology, and hepatology.
[c] The prevalence rate of HAI was calculated as the mean value of weekly prevalence rates of HAIs for each clinic.

The average length of hospitalization of patients having one or more HAIs was 31 days. The average interval between admission and onset of the first HAI for patients having one or more HAIs was 13 days. The average length of hospitalization of all hospitalized patients during the study period was 8 days. According to the Rhame and Sudderth formula, the calculated prevalence and calculated incidence were 5.45% and 2.41/1000-admissions, respectively, for all departments of the hospital. In the study, the observed prevalence and calculated prevalence, and the observed incidence and calculated incidence were found to be almost the same by WPS and PIS, according to the Rhame and Sudderth formula.

4. Discussion

In this study, only trends and types of HAI were examined using WPS, and the results were compared with PIS. Furthermore, the data of both methods were converted from one to the other using the Rhame and Sudderth formula. Previous studies have generally been made monthly, have been multicenter, and have been specific to a single time.[1–4,7,8,11,15–17,21,22] However, these studies did not compare WPS with PIS. Only the study of Petitti et al.[23] was performed weekly, but it was not compared with PIS.

In this study, we found almost the same results for biweekly and monthly observed mean prevalence rates of HAIs recorded by WPS. These results may indicate that biweekly and monthly point-prevalence surveys have equal validity and that point-prevalence survey studies can be performed at monthly intervals. In the present study, the observed prevalence rate of HAIs detected by WPS was similar to the prevalence rate calculated by the Rhame and Sudderth formula using the data of PIS. In addition, the frequency and type of HAIs showed close similarity between WPS and PIS. The HAI rates in the chest surgery, neurosurgery, burns unit, Critical care ICU, neurology, hematology, and nephrology clinics, where HAIs are the most frequent, showed similar frequencies by the two methods. Furthermore, we found a close similarity between the observed incidence of HAIs detected by PIS and the incidence calculated by the Rhame and Sudderth formula using the data of WPS. Results similar to those of our study have been reported by Gastmeier et al.[22] who also used the Rhame and Sudderth formula. This similarity may demonstrate that the repeated point-prevalence survey is a proper, reliable, and valid method for following HAIs. Furthermore, the Rhame and Sudderth formula is suitable for converting data between prevalence and incidence. In contrast, Haore et al.[15] and Rossello-Urgell and Rodriguez-Pla[24] reported that the Rhame and Sudderth formula is not acceptable for converting data between prevalence and incidence, and thus, they did not recommend converting data between prevalence and incidence.

In previous point-prevalence survey studies,[4,6,8,21–23] the observed prevalence of HAIs has been reported to be between 3.5% and 11.6%. We found the observed prevalence to be 5.42%, which is compatible with previous studies. During the study period, the highest prevalence rates of HAIs, shown in Figure 1, in the surgical clinics were due to the accumulation of patients with HAIs in the Critical care ICU and the burns unit. These units had the highest prevalence rates over the study period. Similarly, the reasons for the high prevalence rates in the internal clinics were the high prevalence rates of HAIs in the neurology, hematology, nephrology, and oncology clinics. Generally, HAIs are frequently seen in these surgical and internal departments because patients in poor general condition from tertiary referral hospitals are accepted here. On the other hand, the lowest prevalence rates in the surgical clinics were due to the low prevalence rates of HAIs in the Critical care ICU and burns unit. Similarly, the lowest prevalence rates in the internal clinics were due to the low prevalence rates of HAIs in the neurology, nephrology, and oncology clinics. All the surgical and internal departments mentioned above should be carefully followed in terms of HAIs.

The results of the present study indicate that shorter intervals, such as weekly or biweekly, may provide a better means to observe fluctuations in or outbreaks of HAIs. Thus, WPS may be an available method to determine epidemics of HAIs. In the present study, no epidemic of HAIs was found during the study period. According to our observations of the data for each department over the study period, the prevalence rates did not show remarkable elevations that could be considered as outbreaks of HAIs.

This study demonstrates that WPS is an alternative method for evaluating the trend and extent of HAIs. It may also be used to evaluate the trend of HAI types. Urinary tract infections, surgical site infections, hospital-acquired pneumonia, and other HAIs may be investigated by this method. Gastmeier et al.[22] investigated urinary tract and surgical site infections using this method. However, only trends and type of HAIs were investigated in our study. In addition, WPS may provide data on whether or not seasonal alterations affect the trend of HAIs. Over the study period, no significant features resulting from seasonal alterations were found.

Patients with HAI may be reported as marked by repetition when a repeated point-prevalence survey is performed at less than 4-week intervals. In this study, these cases were not resolved. If new recorded cases were detected by WPS, new infection types, rates, and cases could easily be detected, which could provide a better analysis of HAIs such as the accumulation of HAI types.

The results of this study indicate that the repeated point-prevalence survey may be an alternative method for following HAIs because it is easily applied in hospitals, especially where PIS cannot be performed. Moreover, the repeated point-prevalence survey is more cost-effective than PIS. For instance, this study was performed by two physicians and two nurses in an 1150-bed tertiary referral hospital. Petitti et al.[23] also reported that WPS is a reliable surveillance method for following HAIs.

The limitation of this study is that the Rhame and Sudderth formula was not used to convert the data of weekly, biweekly, and monthly prevalence and incidence. The Rhame and Sudderth formula was used to convert only the data of prevalence and incidence for a 48-week period.

In conclusion, this study has shown the accuracy and validity of WPS. The Rhame and Sudderth formula is suitable for converting data between prevalence and incidence. WPS is an effective and practical method for evaluating the trend and extent of HAIs. However, although some authors do not recommend that WPS be routinely performed, this method can be used in developing countries, especially those with limited resources.

Conflict of interest: All authors declare no conflict of interest, ethics rules infringements, or any financial support relevant to this study.

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