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Incidence of healthcare-associated infections in a tertiary care hospital: results from a three-year period of electronic surveillance

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SUMMARY

Background: Point prevalence surveillance is widely used to monitor healthcare-associated infections (HAIs). Incidence surveillance offers more accurate information than point prevalence surveillance, but is more time consuming. Electronic surveillance systems may allow for more widespread incidence surveillance.

Aim: To determine the incidence of HAI in a tertiary care hospital in Finland over a three-year period from 2011 to 2013 using an automated electronic IS programme, linked to all of the hospital's electronic databases.

Methods: The programme identified cases of HAI prospectively from initiation of antibiotic treatment. All of the cases were verified manually after discharge. In order to evaluate the sensitivity of the electronic method for the identification of surgical site infections, the medical records of all patients who underwent cardiac surgery or total joint arthroplasty were evaluated retrospectively.

Findings: In total, 78,211 patients, covering 321,974 patient-days, were admitted to the wards during the study period, and 29,694 antibiotic treatment initiations were registered. After manual review, 5089 (17.1%) of these were found to be for HAIs. The total time needed to undertake the surveillance for the whole hospital (353 hospital beds) was 255 days, which is the approximate total annual working time for one nurse. Sensitivity evaluation showed that the number of surgical site infections identified by manual and electronic methods was identical. The three-year incidence of HAI was 15.8 per 1000 patient-days and 4.9% of all discharged patients.

Conclusions: Continuous electronic incidence surveillance based on initiation of antibiotic treatment may be a practical means of measuring hospital-wide incidence of HAI, but this method still requires personnel resources.

Introduction

Healthcare-associated infections (HAIs) are an important cause of increased morbidity, mortality and cost in health care.[1] Most studies concerning the number of HAIs are point prevalence surveys, which cannot provide real-time information.[2] Point prevalence surveys conducted in Europe have

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shown that the prevalence of HAI ranges from 4.4% to 14.8%.[3–6] Compared with point prevalence surveillance, incidence surveillance is more effective for following trends and detecting differences in infection rates. It is also more reliable for interhospital and interunit comparisons. However, incidence surveillance is more labour-intensive, time-consuming and expensive than point prevalence surveillance. Therefore, incidence surveillance is usually only undertaken for a limited period of time, and it is often limited to specific HAIs or high-risk units.[7–9]

In the USA, the incidence of HAI is estimated to be 1.6–6% in discharged patients[4,5,10] and 2.5–13 HAIs per 1000 patient-days.[11,12] Only a few studies on the incidence of HAI have been performed in Europe. These studies were conducted in a few hospital wards and for relatively short periods of time. The incidence observed in these studies was 4.3–7.8% of all discharged patients[6,13] and 6.9–17 HAIs per 1000 patient-days.[3,14] No incidence studies have been performed in Finland. National point prevalence surveys were conducted in 2005 and 2011, and the prevalence rates were 8.5% and 7.4%, respectively. In 2005, the calculated incidence of HAI (Rhame–Sudderth formula) was 5.7%.[15]

HAIs are usually poorly identified through hospital administrative data.[15–18] Manual medical record reviews can also be inaccurate, and up to two-thirds of HAIs may be missed. Therefore, electronic surveillance systems that use multiple sources of information have been developed in order to obtain accurate information using fewer personnel.[2,16,19–22]

The aim of this study was to analyse the incidence of HAI in internal medicine wards (IMWs), surgical wards (SWs) and haematology-oncology wards (HOWs) in a tertiary care teaching hospital in Finland. Data generated by an automated electronic incidence surveillance programme over a three-year study period were used.

Methods

A cohort study was conducted for three years among patients hospitalized in the IMWs, SWs and HOWs at Oulu University Hospital, which is a tertiary care teaching hospital in Finland. The study included all adult wards: five IMWs with 106 beds, eight SWs [i.e. thoracic, vascular, plastic, orthopaedic ($N = 2$), gastrointestinal, urology and neurosurgery] with 204 beds, and two HOWs with 43 beds. In total, there were 15 wards with 353 hospital beds. The study was conducted from 1st January 2011 to 31st December 2013.

Oulu University Hospital uses fully electronic medical records; administrative patient data; pharmacy prescribing data; and surgical, laboratory and radiological databases. The presence of devices (e.g. catheters) was not recorded systematically in the medical records; consequently, there are no statistics regarding central-line-days in this study.

The incidence of HAI was recorded using the computer program SAI (Neotide, Vaasa, Finland), which was linked to all of the electronic databases in the hospital. All admissions were registered to this infection database online through linkage with the administrative patient data system. All microbiological examinations and surgical procedures were also registered to the infection database.

HAI case findings were based on the initiation of antibiotic treatment. The SAI program used the World Health Organization's Anatomical Therapeutic Chemical (ATC) classification system codes to determine the initiation of antibiotics. When one of the pre-programmed antibiotics [ATC codes J01–J06 (anti-infectives for systemic use), A01AB04 (oral amphotericin B) and A07AA (intestinal antibiotics)] was added to the patient's medical list, the program automatically opened an inquiry form, which had to be completed with information regarding the reason for starting the patient on antibiotics. Clinicians were required to indicate whether the antibiotic medication was started for an HAI acquired at Oulu University Hospital, an HAI acquired at another hospital or primary healthcare ward, a community-acquired infection, or a cause other than infection (including prophylaxis). For the diagnosis of HAI, the patient needed to have been hospitalized for over 48 h and should not have had any symptoms or signs suggesting that the infection was present at the time of admission. The classification of HAI was defined according to modified criteria established by the US Centers for Disease Control and Prevention (CDC).[23] HAIs treated without antibiotic medication (e.g. some virus infections) could be registered in the infection database through a link in the medical record. The incidence of HAI was defined as the number of HAIs per 1000 patient-days and the number of HAI patients per all discharges (%).

In each ward, two infection control link nurses (ICLs) were trained to check all of the registered antibiotic initiations after patient discharge. ICLs are nurses who participate in infection control training sessions organized by infection control nurses eight to 10 times per year. All ICLs received one day of training in use of the electronic incidence surveillance programme. ICLs changed the origin of the infection or the classification of the infection if the registration performed at the initiation of antibiotics was not accurate. If the criteria for infection were not fulfilled, the ICLs registered the reason for initiation of antibiotics as 'other than infection'; reasons included prophylaxis, prolonged postoperative antibiotics, and suspicions of infection that were not verified. The Department of Infection Control performed random quality checks on registrations approved by the ICLs, and feedback was given if necessary.

For cases in which antibiotics were started and the electronic form was closed without provision of the required information, the system recorded the lack of information in an error list so that these potential infections could be checked later. In the verification process, possible previous admissions and surgeries were always checked and considered during HAI evaluation. If the patient was re-admitted because of a previously treated HAI, the antibiotics started during the re-admission were linked to the previous infection, so that only one registration was made per infection.

Feedback regarding the surveillance results was provided annually to all departments and surgeons. In order to evaluate the sensitivity of the electronic method with respect to identification of surgical site infections (SSIs), the medical records of all patients who underwent cardiac surgery (CS) or total joint arthroplasty (TJA) were evaluated retrospectively.

Results

Over the three-year study period, 78,211 patients with 321,974 patient-days were admitted to the wards, and 29,694 antibiotic treatment initiations were registered on the SAI

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