Journal of Hospital Infection 84 (2013) 120–125

Available online at www.sciencedirect.com

Journal of Hospital Infection

journal homepage: www.elsevierhealth.com/journals/jhin

Infections acquired in intensive care units: results of national surveillance in Belgium, 1997–2010

K. Mertens*, I. Morales, B. Catry

Scientific Institute of Public Health, Brussels, Belgium

ARTICLE INFO

Article history:
Received 23 August 2012
Accepted 10 February 2013
Available online 29 April 2013

Keywords:
Healthcare-associated infection
Surveillance
Bloodstream infection
Pneumonia
Intensive care unit
Invasive device use

SUMMARY

Background and aim: To describe the methodology and output of the Belgian surveillance for infections acquired in intensive care units (ICUs) between 1997 and 2010.

Methods: Since 1997, ICUs in acute care hospitals in Belgium have been encouraged by federal law to participate in a national multi-centre prospective observational surveillance programme. A protocol and software tool for data collection was developed, and the case definitions and methodology follow those of the European Centre for Disease Prevention and Control.

Findings: For 2010, 18 hospitals provided data on 59 observation quarters, 6478 ICU patients and 52,593 ICU patient-days. The mean incidence rates of ICU-acquired pneumonia and intubation-associated pneumonia were 13 per 1000 patient-days and 12 per 1000 intubation-days, respectively. The mean incidence rates of ICU-acquired bloodstream infections, central vascular catheter (CVC)-associated bloodstream infections and CVC-associated primary bloodstream infections were 3.2 per 1000 patient-days, 2.6 per 1000 catheter-days and 2.3 per 1000 catheter-days, respectively. Between 1997 and 2010, stable trends in ICU-acquired pneumonia and bloodstream infections were observed, together with decreasing trends for intubation-associated pneumonia and CVC-associated bloodstream infections, and a stable trend for CVC-associated primary bloodstream infections.

Conclusions: In Belgium, national surveillance of ICU-acquired infections allows acute care hospitals to track the incidence of infections at local level, enabling comparison with national and European reference data. Between 1997 and 2010, the incidence of ICU-acquired infections increased and the incidence of device-associated infections decreased.

Introduction

The risk of acquiring a healthcare-associated infection (HAI) is higher in intensive care units (ICUs) than other hospital wards due to the patients' severe underlying health conditions, and increased exposure to medical interventions and invasive devices.[1–3] The association of infection with morbidity and mortality in ICUs is also substantially higher compared with other wards.[4] Surveillance of HAIs is defined as continuous and systematic collection, analysis and interpretation of data on the occurrence of these infections, their risk factors and outcome parameters. Surveillance is widely acknowledged as a valuable component in a strategy for the prevention and control of HAIs.[5–7] This paper aims to describe

* Corresponding author. Address: Healthcare-associated Infections and Antimicrobial Resistance, Operational Direction Public Health and Surveillance, Scientific Institute of Public Health, J. Wytsmanstraat 14, 1050 Brussels, Belgium. Tel.: +32 2 642 57 95; fax: +32 2 642 54 10.
E-mail address: karl.mertens@wiv-isp.be (K. Mertens).

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http://dx.doi.org/10.1016/j.jhin.2013.02.017

the methodology and output of the Belgian surveillance for bloodstream infections and pneumonia in ICUs between 1997 and 2010.

Materials and methods

Legal context

The protocol for the national surveillance of ICU-acquired infections was developed in 1997 by the National Programme of Healthcare-associated Infections (NSIH) of the Scientific Institute of Public Health in close collaboration with the Belgian Society of Internal Medicine, and launched with a financial incentive to encourage participation. In 2004, the protocol was modified according to the European project 'Hospitals in Europe Link for Infection Control through Surveillance' (HELICS).[8]

Since 2007, Belgian surveillance of HAIs has been encouraged by federal law, and includes, as well as the surveillance of ICU-acquired infections, seven other HAI surveillance protocols. The objective of national surveillance is: (1) to provide the necessary standards, definitions and tools for the organization of surveillance and the follow-up of results within the healthcare setting (local objective); and (2) to set up a national database of surveillance data (national objective). This enables participating hospitals or wards to compare their results with those from the national population (benchmarking), and allows national stakeholders (Belgian Antibiotic Policy Coordination Committee) to monitor national trends.[9]

Data collection

Collection of infection data is performed prospectively and over a minimum observation period of three months. Relevant infections are pneumonia, bloodstream infections, urinary tract infections and catheter-related infections. An infection is defined as an ICU-acquired infection when it occurs at least two days after admission to an ICU. Infections occurring after discharge from an ICU are excluded as organizing this type of surveillance is extremely time consuming. Device-associated infections are defined as cases with a relevant invasive device *in situ* during the two days preceding the onset of infection, with relevant devices being endotracheal intubation for pneumonia and central vascular catheters (CVCs) for bloodstream infections. For bloodstream infections, the origin of the infection (unknown, catheter, secondary) is encoded, thus allowing calculation of the number of primary bloodstream infections (catheter or unknown origin). Case definitions are those implemented in 2004 by the HELICS project, and subsequently adopted by the European Centre of Disease Prevention and Control (ECDC) in 2007.

Surveillance data also include denominators that can be collected in two ways. In the light version of the protocol, aggregated denominators such as patients admitted and patient-days are specified directly, whereas in the standard version, they are calculated through data on each individual patient staying in the ICU for more than two days (for whom risk factors and outcome variables at admission, during hospital stay and at discharge are recorded, irrespective of development of an infection). All surveillance data entry is performed by means of the locally installed NSIHwin software, which was developed by the NSIH programme, is updated regularly and is freely available to participants.

Output variables and analysis

Both the light and standard versions of the protocol allow calculation of the cumulative incidence (number of newly infected patients out of the total number of patients) and the incidence density (number of new infections per 1000 patient-days) for each infection type, as well as the incidence densities of intubation-associated pneumonia per 1000 intubation-days, CVC-associated bloodstream infections per 1000 CVC-days, and CVC-associated primary bloodstream infections per 1000 CVC-days. The standard version of the protocol allows finer adjustment of the incidence of infection for the case mix of the ICU population and the degree of usage of invasive devices. In this paper, indicators for the incidence of infection, mean length of ICU stay and use of invasive devices have been aggregated nationally and annually using the annual pooled database mean. Participating hospitals receive a confidential feedback report shortly after sending their data to the NSIH programme.

Cohort analysis

In order to analyse the evolution of particular indicators within a stable group of hospitals, a cohort of hospitals that participated in at least half of all surveillance periods was established. A trend analysis was performed on the database mean of the incidence density for each type of infection, and using a logistic regression model for the linear (on the logarithmic scale) trend of the daily odds of infection on patient- or device-day-discretized data, using year as a single ordinal predictor. To correct for variability in the incidence of infection between hospitals, separate models were fitted for the hospital mean, including a cluster effect on the hospital, and fit by the generalized estimating equations technique.[10] Similar trend analyses were performed on the mean length of ICU stay using linear regression, and for the daily odds of invasive device use (intubation and CVCs) using logistic regression. Each model's coefficient for the annual trend was recalculated to represent the change for the whole period (1997—2010).

All data were analysed using STATA (StataCorp LP, College Station, TX, USA).

Results

In total, 18 acute care hospitals participated in the NSIH-ICU surveillance in 2010, encompassing 59 observation quarters, 6478 ICU patients, 52,593 ICU patient-days, 12,792 intubation-days and 24,763 CVC-days. Although participation has decreased steadily since 1998, the number of surveillance periods illustrates relatively intense or continuous monitoring by participating units (Figure 1). Participation denotes the number of hospitals, with several hospitals including data for more than one ICU (data not shown).

Figure 2 shows the annual evolution of mean length of ICU stay, use of invasive intubation and use of CVCs. The mean length of ICU stay increased substantially over the years, from 6.5 days in 1997 to 8.1 days in 2010. A relatively stable trend was seen for use of invasive intubation, from 318 to 389 days