

Original

Hospital costs associated with nosocomial infections in a pediatric intensive care unit



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ABSTRACT

Objective: To estimate the additional cost attributable to nosocomial infection (NI) in a pediatric intensive care unit (PICU) and related factors.

Methods: A prospective cohort study was conducted in all children admitted to the PICU of a tertiary-care pediatric hospital between 2008 and 2009. Descriptive and bivariate analyses were conducted of total direct costs due to PICU stay and medical procedures in patients with and without NI. A log-linear regression model was performed to determine the factors associated with higher total cost.

Results: A total of 443 patients were studied and the prevalence of NI was 11.3%. The difference in the median total cost was €30,791.4 per patient between groups with and without NI. The median cost of PICU length of stay in patients with NI was almost eight times higher than the median cost of patients without NI. In patients with NI, the highest costs related to medical procedures were associated with antibiotics, enteral and parenteral feeding, and imaging tests. In the multivariate model, the factors associated with higher cost were infection, the performance of cardiovascular surgery, urgent admission, a higher pediatric risk mortality score, and the presence of immunosuppression. By contrast, older children and those with surgical admission generated lower cost.

Conclusions: NI was associated with an increase in total cost, which implies that the prevention of these infections through specific interventions could be cost-effective and would help to increase the safety of healthcare systems.

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Coste asociado a la infección nosocomial en una unidad de cuidados intensivos pediátricos

RESUMEN

Objetivo: El objetivo del estudio es estimar el coste adicional atribuible a la infección nosocomial (IN) en una Unidad Pediátrica de Cuidados Intensivos (UCIP) y sus factores asociados.

Método: estudio de cohortes prospectivo de todos los pacientes ingresados en una UCIP de tercer nivel entre 2008 y 2009. Se realizó un análisis descriptivo y bivalente del coste total asociados a estancia en UCIP y procedimientos en pacientes con y sin IN. Mediante regresión lineal múltiple, se estimaron los factores asociados al incremento del coste total.

Resultados: se estudiaron 443 pacientes, la incidencia de IN fue 11,3%. La diferencia de las medianas en el coste total fue de 30.791,4€ por paciente entre los grupos con y sin IN. El coste mediano de la estancia de pacientes con IN fue casi ocho veces mayor que el coste mediano de los pacientes sin IN. En pacientes con IN, el coste asociado a procedimientos más elevado fue el de antibióticos, nutrición enteral y parenteral y pruebas de imagen. En el modelo multivariante los factores asociados con un mayor coste fueron: presencia de infección nosocomial, cirugía cardiovascular, tipo ingreso urgente, mayor índice pronóstico de mortalidad al ingreso y la presencia de inmunosupresión. Por el contrario, los de mayor edad y aquellos ingresados por cirugía presentaron un menor coste.

Palabras clave:

Unidad de Cuidados Intensivos Pediátricos

Infección nosocomial

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Regresión

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Conclusiones: La IN está asociada al incremento del coste total, lo que implica que la prevención de estas infecciones mediante intervenciones específicas podría resultar costo-efectiva, redundando en sistemas de salud más seguros.

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Introduction

In Pediatric Intensive Care Units (PICU), the prevalence of nosocomial infection (NI) is variable, ranging from 10 to 33%^{1,2}, and incidence rates from 5.9 to 15 per 1,000 patient-days^{3,4}. This is explained by the greater complexity of these patients affected by a variety of medical and surgical pathologies¹.

NI is also considered one of the most costly problems for hospitals. The most important direct NI-associated cost comes from the increase in the excess of length of stay (LOS)⁵. Therefore, most reports focus on NI-related costs due to LOS, as it is quite easy to translate such costs to currency value, applying the local cost per hospitalization day⁶. Further studies also have taken into account the costs of diagnostic and medical procedures, derived from or due to the infection, as the most accurate way to calculate the NI-attributable cost^{7–10}.

The study of NI-associated cost has evolved in time with the introduction of new cost estimation methods^{11–13}. The most common comparative method used to analyse the cost of NI, is the prospective or retrospective observational study of the hospital environment¹⁴.

Few studies have assessed the impact of NI on total costs in PICU¹⁵, some of them have analysed the cost attributable to any type of NI in PICU^{7,11,12,16}, others have focused only on nosocomial primary bloodstream infection^{8,9}. The average cost attributable to NI described in literature ranges between €1,510¹⁷–53,085⁹ per patient.

The Spanish Public Healthcare System is a tax-financed system that offers universal coverage, which is different from privately-funded healthcare systems, where most of the published reports on NI-related cost have been performed^{5,7}. The lack of previous Spanish reports about NI costs in PICU and the actual economical crisis in this country, justifies the present paper. The aim of the study is to estimate the cost attributable to nosocomial infection in a pediatric intensive care unit and its related factors.

MATERIAL AND METHODS

Study Design

Prospective cohort study between September 2008 and July 2009. The study was carried out in a 16-bed multidisciplinary PICU of a tertiary-care university hospital of the Andalusian Public Health System. This Unit is a regional referent institution for highly complex procedures, and offers assistance to patients older than 28 days of age and also to neonates during the cardiovascular surgery postoperative period. All patients admitted in the PICU for less than 24 hours were excluded (a total of 426 patients were excluded). Nine patients remained hospitalized at the end of the study.

Variables

The dependent variable was total cost (only took into account the costs incurred in the PICU), which included the sum of the following cost items: PICU LOS, invasive mechanical ventilation, imaging and microbiological tests, enteral and total

parenteral nutrition, antibiotherapy, consumables (central line, urinary catheter) and structure costs.

The following independent variables were collected: a) Sociodemographic and admission variables: Age, sex, type and cause of PICU admission and cause of discharge; b) Clinical variables: Presence of NI, classified according the definitions of the Centers of Disease Control and Prevention¹⁸; c) Risk factors for NI¹: factors related to patient's intrinsic characteristics and factors related to surgery and other procedures made during PICU stay.

Sources of information

The consumption of different resources (LOS, special feeding formulas and parenteral nutrition, days of mechanical ventilation, imaging and microbiological tests, antibiotherapy and consumables) was obtained from medical records and direct observation, all of which were validated with PICU pediatrician.

The cost of imaging procedures was obtained from the Andalusian Official Bulletin Board¹⁹. Cost of consumables, those related to PICU stay, nutrition, mechanical ventilation and antibiotherapy were obtained from the hospital accounting system. Costs of microbiological tests were obtained from an external reference laboratory²⁰. All costs were updated to the present-day currency in Spain, the Euro (2009).

Costs estimation

1) The estimation of PICU LOS (it includes the costs of PICU staff, consumable goods, catering, instruments and tools, inversions, cleaning, office material, conservation and repair, professional services and supplies for the PICU) was calculated according to the method suggested by Brazzi et al.²¹ 2) The average cost per day of enteral feeding and total parenteral nutrition was calculated and attributed to each patient. 3) The average cost of invasive mechanical ventilation was calculated per patient according to the cost of acquisition, usage and lifespan. 4) For the estimation of the structure costs we used the method suggested by Mason et al.²², which means add 25% to the direct cost. All of them were validated with PICU pediatrician.

Data were collected from the clinical records by trained personnel in epidemiological surveillance and tabulated in a spreadsheet which was specifically designed for this study. The data collection model applied included consumable goods used per patient. These data were classified according to whether they were attributable or not to NI, depending on the most prevalent NI types. The criteria considered to attribute procedures to NI are shown in Table 1. Finally, the project was approved by the hospital Ethics Committee.

Statistical Analysis

NI definition, and infection rates (with 95% confidence intervals) proposed by the National Nosocomial Infections Surveillance System were estimated²³. The chi-squared test was used to compare proportions (NI presence or absence).

NI costs were calculated from the hospital perspective. As a result, we only considered direct tangible costs of PICU for global NI (includes bloodstream infection, pneumonia, urinary tract infection and surgical site infection). In order to calculate average cost,

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