

**BIBLIOGRAPHICAL REVIEW ON COST OF
“PATIENT SAFETY FAILINGS”
IN NOSOCOMIAL INFECTIONS.
SUMMARY.**



GOBIERNO
DE ESPAÑA

MINISTERIO
DE SANIDAD
Y CONSUMO

Plan de **Calidad**
para el **Sistema Nacional**
de Salud



Bibliographical review on cost of “Patient Safety Failings” in nosocomial infections. Summary

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Introduction

Nosocomial or hospital-acquired infections are one of the most important adverse events for healthcare institutions. In Spain they are the second most frequent adverse event in hospitals, after medication-related adverse events, with a prevalence rate, according to the nationwide nosocomial infection study EPINE, of 6.68%.

The World Health Organization (WHO) defines nosocomial infections as infections that occur during or as a result of hospitalization, not present or incubating at the time of patient admission. A series of factors can influence the appearance of these infections: microbes, patient vulnerability, environmental factors and bacterial resistance.

In Spain the EPINE study shows that ICUs record the highest rate of incidence of nosocomial infections, in excess of 30%, whilst hospital wards record below average incidence rates.

According to the EPINE study, 56% of nosocomial infections in Spanish hospitals are preventable. These infections are one of the costliest problems facing healthcare organisations.

Determining the cost of nosocomial infections can help to raise awareness on the part of both management and personnel of their economic impact. It can also help to establish priorities for implementation of measures or programmes designed to reduce the incidence of these infections in the different healthcare organisations.

Objective

The key objective of this bibliographical review was to determine the cost of all kinds of nosocomial infections and to evaluate the methodologies used to calculate these costs.

An additional objective was to compile data on the recommendations made by the authors for economic assessment of nosocomial infections.

Methodology

Methodology used: **location and selection** of studies and their subsequent **evaluation**.

Location of articles via a search strategy in three databases: MEDLINE, EMBASE (*Excerpta Medica Database*) and EconLit. Primarily databases of scientific articles in medicine and economics. Search limited to the period 2000 to 2007.

Selection of articles based on type, context and object of study. Figure 1 summarises the study selection process.

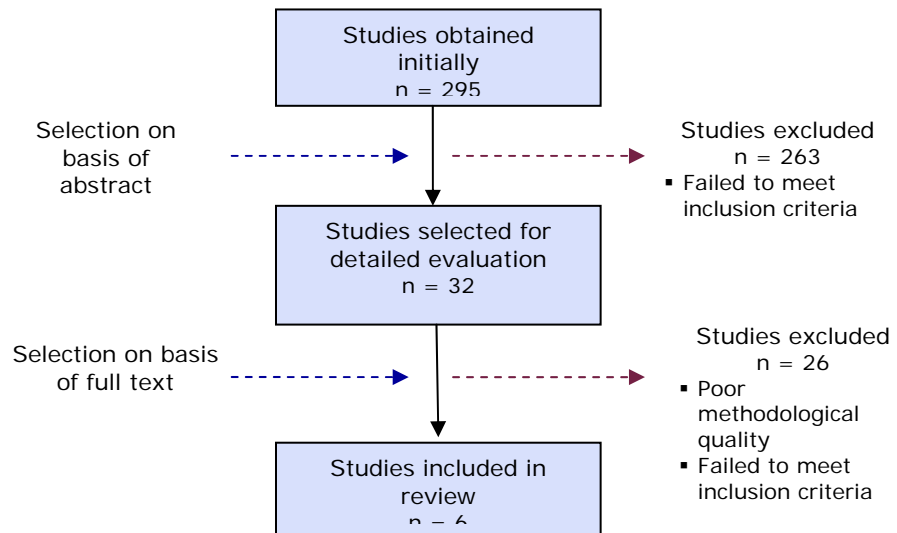


Figure 1. Selection of studies for subsequent evaluation

Initially 32 studies were selected that clearly met the inclusion criteria; however, after analysis of the full text, only six met all the inclusion criteria and presented an acceptable quality level.

The studies selected were **evaluated** on the basis of the following criteria: the purposes of the review; the suitability of the type of articles sought for the purposes of the review; the suitability of the search strategy and databases used; and the form of evaluation of the studies selected for review and of the results of the studies selected.

Results

The results are presented in four sections: description of the reviews; results relating to the cost of nosocomial infections; key methodological characteristics of the reviews; and recommendations by the authors for economic assessment of hospital-acquired infections.

1. Description of reviews

Table 1 defines the framework of each of the reviews selected.

Review	Population	Type of infection	Type of study
Gleizes <i>et al</i>, 2006	Paediatric patients (under 5 years)	Nosocomial rotavirus infection	Case-control studies
Safdar <i>et al</i>, 2005	Intensive Care Unit patients	Ventilator-associated pneumonia	Case-control studies
Saint <i>et al</i>, 2000	Hospital patients	Local and systemic venous catheter-related infection	Case-control studies
Saint, 2000	Hospital patients	Nosocomial catheter-related urinary tract infection	Case-control studies
Stone <i>et al</i>, 2002	Hospital patients	Nosocomial infection	Cost analysis studies, with or without control group
Stone <i>et al</i>, 2005	Hospital patients	Nosocomial infection	Cost analysis studies, with or without control group

Table 1. Context of selected studies

The aim of review of all the studies was to regroup the existing evidence on costs attributed to nosocomial infections, examine the cost of measures designed to control nosocomial infections and determine the incidence rates of these infections or mortality rates attributed to these infections, *inter alia*.

To assess the cost of nosocomial infections, Gleizes *et al* (2006), Safdar *et al* (2005), Saint (2000) and Saint *et al* (2000) include all studies that present a comparative case-control methodology. In the case of Gleizes *et al* (2006), Saint (2000) and Saint *et al* (2000) there is no explicit mention of the quality of the studies selected; instead, the general inclusion criteria prevail, as argued by Safdar *et al* (2005).

2. Cost of nosocomial infections

The most important direct cost derives from the increase in length of hospital stay, in addition to costs relating to antibiotherapy and the tests necessary to diagnose the infection.

Table 2 depicts the costs obtained in the reviews selected for infections such as ventilator-associated pneumonia, nosocomial urinary tract infection, bacteraemia, central venous catheter-related infection, methicillin-resistant *Staphylococcus aureus* (MRSA) infection, surgical site infection and nosocomial rotavirus infection.

Review	Type of infection	Increase in cost per patient suffering infection
Safdar <i>et al</i> , 2005	Ventilator-associated pneumonia	<ul style="list-style-type: none"> ▪ USD10,019 – 13,647 ▪ 6.10 days' stay ▪ Mortality OR: 2.03
Stone <i>et al</i> , 2002	Nosocomial pneumonia	▪ USD17,677 (SD: 20,455)
Stone <i>et al</i> , 2005	Ventilator-associated pneumonia	▪ USD9,969 (SD: 2,820)
Stone <i>et al</i> , 2005	Nosocomial urinary tract infection	▪ USD1,006 (SD: 503)
Saint, 2000	<ul style="list-style-type: none"> ▪ Nosocomial urinary tract infection ▪ Urinary catheter-associated bacteraemia 	<ul style="list-style-type: none"> ▪ USD667 ▪ USD2,836
Stone <i>et al</i> , 2002	Bacteraemia	▪ USD38,703 (SD: 3,122)
Stone <i>et al</i> , 2005	Bacteraemia	▪ USD36,441 (SD: 37,178)
Saint <i>et al</i> , 2000	<ul style="list-style-type: none"> ▪ Venous catheter-related local infection ▪ Central venous catheter-related bacteraemia 	<ul style="list-style-type: none"> ▪ USD400 ▪ USD6,000 – 10,000
Stone <i>et al</i> , 2002	MRSA infection	▪ USD35,367 (SD: 2,915)
Stone <i>et al</i> , 2002	Surgical site infection	▪ USD15,646 (SD: 13,820)
Stone <i>et al</i> , 2005	Surgical site infection	▪ USD25,546 (SD: 37,078)
Gleizes <i>et al</i> , 2006	Nosocomial rotavirus infection	▪ EUR2,500

* SD: Standard deviation

Table 2. Costs attributed to nosocomial infections

Safdar *et al* estimated that the increase in direct cost due to **ventilator-associated pneumonia** was between USD10,019 and USD13,647. This increase in cost corresponded to an increase of 5 to 7 days in the length of patient stay in the ICU, the diagnostic tests conducted and the antibiotics administered.

Urinary tract infection related **bacteraemia** was also connected to an increase in mortality rates. Saint (2000) refers to Bryan & Reynolds (1984) to note that 12.7% of patients who suffer from this infection die as a result.

Saint *et al* (2000) estimate the increase in cost resulting from a local **venous catheter**-related infection, corresponding to the diagnostic tests conducted (haemoculture and catheter-tip culture), insertion of a new venous catheter and intravenous or oral antibiotherapy.

According to the estimate made in the bibliographical review conducted by Stone *et al* (2002) of the cost of nosocomial infections, **methicillin-resistant Staphylococcus aureus** (MRSA) infection is the second most costly type of nosocomial infection.

The review conducted by Gleizes *et al* (2006) on the cost of nosocomial **rotavirus** infections in children under five in six big European countries does not include a combination of economic results. The authors simply present

the results obtained in the studies selected, concluding that the extra cost associated with nosocomial rotavirus infections may amount to up to Euros 2,500 per patient affected.

3. Methods of assessment of cost of nosocomial infections

The six reviews selected present the costs of nosocomial infections in three different ways. Below we describe in detail the different methodologies used for both cost combination and adjustment and micro-cost analysis.

3.2.1 Cost combination and adjustment

The economic cost data taken from each of the studies that make up the review were regrouped according to the type of infection and subjected to two different standardisation processes.

The costs were all converted into the same currency (in this case US dollars). They were then updated in line with the Consumer Price Indexes (CPI) published monthly by the US Bureau of Labor Statistics.

This gave us a single standard cost of nosocomial infection, resulting from a combination of studies conducted at different times in different countries.

3.2.2 Cost estimate: analysis of micro-costs

Analysis of micro-costs is the calculation of the “extra” cost that a nosocomial infection implies, that is, the additional tests and examinations, the additional medication and the increased length of hospital stay that may be directly attributed to the onset of infection (Charvet-Protat, 2000).

The end result is the estimated “extra” cost of a nosocomial infection. However, all the authors are keen to point out that the total estimated cost obtained by this method excludes other direct costs that may be attributed to the infection, as well as indirect costs.

4. Recommendations for assessment of cost of nosocomial infections

The recommendations for making a Reference Case include:

- Adopting a social perspective.
- Presenting the results in terms of quality-adjusted life years (QALYs).
- Including the decrease in net cost and savings and discounting the future costs and future QALYs.
- Including a sensitivity analysis.

Finally, the authors also recommend continued development of mathematical models for cost analysis (Stone *et al*, 2002), although they also underline the difficulties involved in developing these models and the

need to provide healthcare professionals with the necessary knowledge for this purpose.

Conclusions

The first conclusion to be drawn from this bibliographical review is the wide range of the existing studies, in terms of both the methodology used to calculate the cost and the type and context of infections studied. Nevertheless, these studies may serve as a guideline for assessment of the potential economic impact of nosocomial infection related adverse events in a hospital environment.

Contributions

On the basis of the results contained in the different reviews analysed, we have adapted the costs to the Spanish national health system.

To do so, we have calculated the cost in Euros of each type of nosocomial infection as of January 2005¹. Table 3 contains the results obtained, that is, the estimated costs in Euros for 2005 of each type of nosocomial infection.

It is important to note that these estimates have been made on the basis of costs obtained in studies conducted in the United States; these costs will not necessarily be equivalent to costs in the Spanish national health system. In addition, only average costs have been taken as reference values, and some of these average costs showed very high standard deviations. The resultant figures should, therefore, be read with due precaution.

¹ The costs have been calculated as of January 2005 as the latest data available for subsequent calculation of the overall cost for the Spanish national health system correspond to 2005.

Type of nosocomial infection	Cost in Euros (2005) per patient affected
Ventilator-associated pneumonia	EUR9,633 – 15,293
Nosocomial pneumonia	EUR18,681
Urinary catheter-related bacteraemia	EUR3,957
Urinary tract nosocomial infection	EUR930-972
Bacteraemia	EUR37,399
Venous catheter-related bacteraemia	EUR8,372 – 13,587
Venous catheter-related local infection	EUR558
MRSA infection	EUR37,398
Surgical site nosocomial infection	EUR24,685

Table 3. Costs (in Euros) of nosocomial infections

It is also important to note that, as there are no data available on the preventability of each type of nosocomial infection, the general rate of 56.6% of avoidable infection has been used. But this percentage may vary considerably according to certain characteristic features such as, for example, the type of unit (medical or surgical) in which the infection appears (MSC, 2006).

Moreover, the cost of nosocomial infections is also underestimated as a result of a lack of analysis of the indirect and “intangible” costs of hospital-acquired infections.

We should also point out that, in a health system such as the Spanish one, the additional costs entailed by the presence of a nosocomial infection have an adverse impact on other patients and other health services. The funds allocated to meet the cost of a nosocomial infection are funds that are lost to other healthcare services.

Regarding the methods of assessment of the economic impact, we can conclude that it is important to conduct rigorous cost studies, and that for this purpose the different guides published for assessment of economic analysis may be useful. Making the economic assessment studies more uniform is also key, to facilitate comparison of results between studies.

Analysis of the indirect and intangible costs of nosocomial infections should be one of the main objectives in future studies, as these costs are currently unknown.

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