

Costs of Healthcare Associated Infections in countries the Latina American and Caribbean Region: A systematic literature review

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Background

- Healthcare-associated infections (HAI) are among the most common preventable health adverse event
 - Threat to patient safety
 - Associated with significant health burden globally
- Economic evidence is relevant for the estimation of the costs and economic burden of HAI
 - Information to mobilize donors and partners, society and decision makers
 - Useful inputs for cost-effectiveness of interventions to prevent and reduce HAI and related morbidity and mortality
- HAIs in hospitals impose significant economic consequences on the nation's healthcare system.

Background

- Limited data on costs of HAI in lower and middle income countries is available, being most evidence from developed countries as USA and Europe
- Given the low external validity of costing studies and taking into consideration differences in the healthcare system structure, one cannot use information generated in developed countries in LAC
- In 2000 PAHO published a standardized protocol for conducting studies on HAI costing, considering those with greater frequency and burden
- As a result, various costing studies have been published in LAC, in the past 10 years, using standardized methodology

Background

Relevant evidence

- Two recent studies in USA reported on
 - costs of HAI
 - its financial impact in the healthcare system
 - Benefits related to prevention of HAI, considering both disease and economic burden and impact of prevention interventions
- In both studies a systematic literature review of available evidence was performed

(ZIMLICHMAN et al., 2013; SCOTT II, 2009)

Background

CDC estimates, USA

- Scott et al, CDC study - uses results from the published medical and economic literature to provide a range of estimates for the annual direct hospital cost of treating HAI in the USA
- Overall annual direct medical costs of HAI to U.S. hospitals ranges from \$28.4 to \$33.8 billion in 2007
- Benefits of prevention range from a low of \$5.7 to \$6.8 billion (20 percent of infections preventable, CPI for all urban consumers) to a high of \$25.0 to \$31.5 billion (70 percent of infections preventable, CPI for inpatient hospital services).

SCOTT II, 2009

Background

Metanalysis and modelling, USA

- Zimlich et al. – systematic review to estimate attributable costs
- CDC data for HAI incidence, modelling to generate costs considering the US healthcare system perspective
- Costs and length of stay (LOS), by 5 major HAI, by site
- Total annual costs for 5 major infections = USD 9.8 billion
- Cost per case
 - Central line-associated bloodstream infections (CLA-BSI) = \$ 45,814
 - Ventilator-associated pneumonia (VAP) = \$ 40,144
 - Surgical site infections (SSI) = \$ 20,785
 - Clostridium difficile infections (Clos) = \$ 11,285
 - Catheter-associated urinary tract infections (CA-UTI) = \$ 896

Rationale

- A systematic review of the literature will fully describe the available evidence on HAI costs in LAC, allowing better country, sub-regional and region cost estimates
 - Taking in to consideration variability within region and available studies
 - Through an assessment of the methods used, comparability of results will be allowed
 - Taking in to consideration rigorous criteria for quality asesment of the available evidence
- Such studie will generate evidence
 - Region specific estimates
 - To support estimation of the economic burden of ISS in the region, together with surveillane and epidemiologic data collected by countries
 - To support cost-effectiveness studies of selected interventions to prevent and control ISS in the Region

Health Economic Studies

1. What is the cost of a given disease/condition?
2. What is the cost of a given intervention?
3. How does benefits provided by this intervention relates to its costs?

Types of Economic Studies

- Economic Burden
 - Cost of illness analysis
- Program Cost analysis
- Full economic evaluation or Cost-consequence analysis
 - Cost-benefit
 - Cost-effectiveness
 - Cost-utility

Economic Burden Studies

- Estimates total costs of a disease or condition:
 - Direct cost: Medical and non-medical
 - Indirect cost: Productivity losses
- Generally reported as:
 - Annual total cost
 - Average patient lifetime cost
- Shows potential benefits of prevention
- Questions:
 - What are the costs of a BSI?
 - What are the costs of BSI to country X?
 - What is the additional cost of a patient with antibiotic resistant BSI when compared to a patient with susceptible BSI for a hospital/healthcare system/society?

Types of cost

- Direct
 - Medical
 - Non medical
- Indirect
- Intangible

- Average Cost
- Incremental Cost

Study Perspectives

- Societal
- Healthcare System
- Hospital
- Patient
- Industry
- Health Maintenance Organization (HMO)

The perspective will determine what costs will be considered in the analysis

	Perspective		
	Individual	Healthcare system	Society
Physician	- or +	+	+
Antibiotics	- or +	+	+
Transport to hospital	+	-	+
Workloss due to illness or time spent caring for sick	+	-	+

Systematic Literature Review Study Team

- Dra Cristiana Toscano
 - Professor, Epidemiologist, Health economist
 - Federal University of Goiás, Brazil
- Prof Martha Martinez
 - Professor, Librarian
 - Gonçalo Muniz Institute, Oswaldo Cruz Foundation, Bahia, Brazil
- Prof Ana Laura Zara
 - Colaborator, Epidemiologist
 - Federal University of Goiás, Brazil
- Dra Valeska Stempliuk
 - Pan-American Health Organization – PAHO



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Objectives

- Assess the cost and additional length of stay (LOS) of healthcare care associated infections in countries in the Latin American and Caribbean Region, considering the following priority infection sites
 - surgical site infections (SSI)
 - catheter associated urinary tract infections (CA-UTI)
 - ventilator associated pneumonia (VAP)
 - central line associated bloodstream infection (CVC-BSI)

Methods

- Systematic Literature Review
- PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (www.prisma-statement.org)
- Study protocol registered in PROSPERO (International prospective register of systematic reviews)

Methods – Study Design

- Databases Searched
 - PUBMED, LILACS, EMBASE
- Study Period
 - No restriction of date
- Language
 - No restriction
- Infection Sites
 - Central line–associated bloodstream infections (CLA-BSI)
 - Ventilator-associated pneumonia (VAP)
 - Surgical site infections (SSI)
 - Catheter-associated urinary tract infections (CA-UTI)

Methods

Inclusion criteria

- **Study population**
 - Pacientes hospitalizados
- **Comparator**
 - Hospitalizaed pacientes without HAI
- **Outcomes of interest**
 - Main: Incremental costs related to HAI
 - Secondary: Incremental length of stay (LOS), antimicrobial use (in DDD) and mortality associated with HAI
- **Location**
 - Countries in the LAC Region
- **Study Designs**
 - Observational cohort, case control and cross-sectional
 - Longitudinal before-after and quasi-experimental
 - Systematic Review and Metanalysis

Methods

Exclusion criteria

- Studies design to assess risk factors for HAI and therefore only consider information prior to HAI diagnosis (regarding LOS and ATB use)
- Population: Infections acquired in the community
- Study design: Case series
- Comparator: Lack of comparison among patients with and without HAI (and therefore unable to estimate incremental outcomes)

Search Strategy and Terms

LAC countries and Region

1. Anguilla[All Fields] OR "Antigua and Barbuda"[MeSH] OR Antigua[All Fields] OR Argentina[All Fields] OR Argentin*[TIAB] OR Aruba[TIAB] OR Aruba[AD] OR Bahamas[All Fields] OR Barbados[All Fields] OR Belize[All Fields] OR bonnaire[All Fields] OR "San Eustaquio"[All Fields] OR eustatius[All Fields] OR chile[All Fields] OR "Costa Rica"[All Fields] OR Cuba[All Fields] OR "Curacao"[All Fields] OR Dominica[All Fields] OR Grenada[All Fields] OR Granada OR guadalupe[All Fields] OR Guadeloupe[All Fields] OR "Turks and Caicos Islands"[All Fields] OR "United States Virgin Islands"[MeSH Terms] OR Virgin Islands[All Fields] OR Jamaica[All Fields] OR Martinique [All Fields] OR "Puerto Rico"[All Fields] OR "Saint Kitts and Nevis" [All Fields] OR St. Kitts [All Fields] OR Saint Lucia [All Fields] OR "Saint Vincent and the Grenadines"[All Fields] OR "Saint-Martin" [All Fields] OR "Sint Maarten"[AD] OR "suriname"[MeSH Terms] OR Surinam[All Fields] OR "Trinidad and Tobago" [All Fields] OR "Trinidad Tobago"[All Fields] OR Uruguay[MeSH] OR Uruguay*[All Fields] OR Haiti[All Fields] OR "Brazil"[MeSH Terms] OR Brazil*[All Fields] OR Brasil[All Fields] OR colombia*[All Fields] OR Colombia[All Fields] OR Dominican*[All Fields] OR "Dominican Republic"[All Fields] OR "El Salvador"[All Fields] OR Guyana[All Fields] OR Guiana[All Fields] OR Honduras[All Fields] OR Honduran*[TIAB] OR Mexico[All Fields] OR mexic*[TIAB] OR Panama[All Fields] OR paraguay*[TIAB] OR Paraguay[All Fields] OR Venezuela*[TIAB] OR Venezuela[All Fields] OR Bolivia*[TIAB] OR Bolivia[All Fields] OR Ecuador[All Fields] OR Equator[AD] OR Equatorial[TIAB] OR Guatemala[All Fields] OR Guatemal*[TIAB] OR Nicaragua[All Fields] OR Nicaragua*[TIAB] OR Peru[All Fields] OR Peruvian[TIAB] OR ("cayman"[All Fields] AND "islands"[All Fields]) OR "cayman islands"[All Fields] = 457855



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Search Strategy and Terms

LAC countries and Region

2. "Caribbean Region"[MeSH Terms] OR Caribbe* OR "west indies"[All Fields] OR "montserrat"[All Fields] OR "Latin America"[Mesh] OR ("latin"[All Fields] AND "america"[All Fields]) OR Antilles OR "Antillas" OR "Netherlands Antilles"[MeSH Terms] OR "Southern Cone" OR "South America"[All Fields] OR "South American"[All Fields] OR "Central America"[All Fields] OR Centroamerica* OR "America Central" OR "America del Sur" OR Sulamerica OR Sudamerica = **78913**

LAC REGION = #1 OR #2

Search Strategy and Terms

Catheter-associated urinary tract infections (CA-UTI)

CATHETER ASSOCIATED URINARY TRACT INFECTIONS

1. Catheter-Related Infections[MESH] OR "urinary catheterization"[MeSH Terms] OR "Urinary Tract Infections/economics"[Mesh] OR urinary catheter*[TIAB] OR ((Ureteral OR Urethral OR Foley) AND catheter*) OR CAUTI = 26874

COST AND ADDITIONAL LENGTH OF STAY

2. "Economics"[MeSH] OR "economics" [Subheading] OR cost[TIAB] OR costs[TIAB] OR "Treatment Costs"[TIAB] OR "Direct Service Cost"[TIAB] OR "Hospital Cost"[TIAB] OR "Drug cost" OR "Cost Analyses"[TIAB] = **915903**

OR

3. "Length of Stay"[Mesh] OR "length of stay"[TIAB] OR "length of hospitalization"[TIAB] OR "hospitalization length"[TIAB] OR "duration of stay"[TIAB] = 93432

#1 AND (#2 OR #3) AND (LAC REGION) = 78 (CAUTI)

Search Strategy and Terms

Central line–associated bloodstream infections (CLA-BSI)

CENTRAL LINE ASSOCIATED BLOODSTREAM INFECTION

1. “Catheterization, Central Venous/adverse effects”[MESH] OR “Central Venous Catheters/adverse effects”[MESH] OR (Central Line*[TIAB] AND (Bloodstream infecti* OR BSI)) OR CABSI OR ("central venous" AND catheter*) = **21413**

COST AND ADDITIONAL LENGTH OF STAY

2. “Economics”[MeSH] OR "economics" [Subheading] OR cost[TIAB] OR costs[TIAB] OR “Treatment Costs”[TIAB] OR “Direct Service Cost”[TIAB] OR “Hospital Cost”[TIAB] OR “Drug cost” OR “Cost Analyses”[TIAB] = **915903**

OR

3. "Length of Stay"[Mesh] OR "length of stay"[TIAB] OR "length of hospitalization"[TIAB] OR "hospitalization length"[TIAB] OR "duration of stay"[TIAB] = 93432



#1 AND (#2 OR #3) AND (LAC REGION) = 77 – DUPLICADOS = 51

Search Strategy and Terms

Ventilator-associated pneumonia (VAP)

VENTILATOR-ASSOCIATED PNEUMONIA

1. "pneumonia, ventilator-associated"[MeSH Terms] OR "respiration, artificial"[MeSH Terms] OR "Ventilators, Mechanical"[Mesh] OR ("pneumonia"[All Fields] AND "ventilator"[TIAB] AND "associated"[TIAB]) OR ("respiration"[TIAB] AND "artificial"[TIAB]) OR ((Mechanical OR Pulmonary) AND (Ventilat* OR Respirators)) OR Ventilator[TIAB] OR Ventilators[TIAB] OR Respirator[TIAB] OR Respirators[TIAB] OR intubated*[TIAB] OR VAP = 150194

COST AND ADDITIONAL LENGTH OF STAY

2. "Economics"[MeSH] OR "economics" [Subheading] OR cost[TIAB] OR costs[TIAB] OR "Treatment Costs"[TIAB] OR "Direct Service Cost"[TIAB] OR "Hospital Cost"[TIAB] OR "Drug cost" OR "Cost Analyses"[TIAB] = **915903**

OR

3. "Length of Stay"[Mesh] OR "length of stay"[TIAB] OR "length of hospitalization"[TIAB] OR "hospitalization length"[TIAB] OR "duration of stay"[TIAB] = 93432

#1 AND (#2 OR #3) AND (LAC REGION) = 472 – DUPLICADOS = 443

Search Strategy and Terms

Surgical site infections (SSI)

SURGICAL SITE INFECTIONS

1. "Surgical Wound Infection"[Mesh] OR surgical site infection*[TIAB] OR (("Postoperative"[TIAB] OR post-operative OR postsurgical[TIAB] OR post-surgical[TIAB]) AND infection*[TIAB]) OR wound infection*[TIAB] OR SSI[TIAB] = **79106**

COST AND ADDITIONAL LENGTH OF STAY

2. "Economics"[MeSH] OR "economics" [Subheading] OR cost[TIAB] OR costs[TIAB] OR "Treatment Costs"[TIAB] OR "Direct Service Cost"[TIAB] OR "Hospital Cost"[TIAB] OR "Drug cost" OR "Cost Analyses"[TIAB] = **915903**

OR

3. "Length of Stay"[Mesh] OR "length of stay"[TIAB] OR "length of hospitalization"[TIAB] OR "hospitalization length"[TIAB] OR "duration of stay"[TIAB] = 93432

Search Strategy and Terms

Cross Infections

CROSS INFECTION

Cross infection[MeSH] OR bacteremia[mh] OR "Infectious Disease Transmission, Professional-to-Patient"[MeSH] OR ("nosocomial"[tiab] OR hospital) AND "infection"[TIAB]) OR "nosocomial infection"[TIAB] OR "hospital-acquired"[TIAB] OR ("healthcare-associated"[TIAB]) = **282472**

COST AND ADDITIONAL LENGTH OF STAY

"Costs and Cost Analysis"[MeSH] OR "economics" [Subheading] OR "Economics, Medical"[MeSH] OR cost[TIAB] OR costs[TIAB] OR "Treatment Costs"[TIAB] OR "Direct Service Cost"[TIAB] OR "Hospital Cost"[TIAB] OR "Drug cost" OR "Cost Analyses"[TIAB] = 706589

OR

3. "Length of Stay"[Mesh] OR "length of stay"[TIAB] OR "length of hospitalization"[TIAB] OR "hospitalization length"[TIAB] OR "duration of stay"[TIAB] = 93432



#1 AND (#2 OR #3) AND (LAC) = 411 – DUPL. = 206

Methods

Data retrieval and analysis

- Two independent investigators performed the review of titles and abstracts to identify studies to be included in the review
- Two independent investigators performed the Reading of the full articles, data extraction and assessment of study methodology and quality
- A third reviewer was consulted if consensus was not reached
- Descriptive analysis of main outcome results and study methods was performed

Methods

Variables extracted and considered

- 1) Study characterization: author, country, contact details, year of publication, study design, hospital characterization and site where study was conducted (number of bed, type of ward); study location and period; sample size;
- 2) Epidemiologic characterization: patient characterization (type of infection, underlying illness/cause of hospitalization, average age, sex); number of cases and controls; all reported outcomes; outcome definition, secondary outcomes; diagnostic criteria and comorbidities; definition used for AIHs; reported AIH prevalence or incidence;
- 3) Economic characterization: study perspective; guidelines used for costing; costing methods used; cost components/categories (direct hospital costs, indirect costs) and cost items considered; cost data sources; currency and exchange rate; discount rate; adjustment for inflation; year of reported costs; sensitivity analysis

Methods

Data quality assessment

- Data extraction considered all relevant economic data as recommended by current guidelines
 - Xu X, Grossetta Nardini HK, Ruger JP. Micro-costing studies in the health and medical literature: protocol for a systematic review. *Syst Rev.* 2014 May 21;3:47. doi: 10.1186/2046-4053-3-47.
- The following standardized criteria for for economic evaluation studies were considered for the evaluation of studies regarding their methodological quality
 - SIGN - Scottish Intercollegiate Guidelines Network (SIGN). Harbour RT, Forsyth L (2008) SIGN 50: a guideline developer's handbook Edinburgh: Scottish Intercollegiate Guidelines Network; Standardized criteria costing studies. Available at: <http://www.sign.ac.uk/guidelines/fulltext/50/index.html> and <http://www.sign.ac.uk/pdf/sign50annexc.pdf> (pg 12).
 - CHEERS - Don Husereau D, Drummond M, Petrou S et al. Consolidated Health Economic Evaluation Reporting Standards (CHEERS) statement. *BMJ* 2013; 346: f1049

Results

- A total of **1.794 citations were identified:**
 - 399 duplicates were excluded
 - 1.395 title and abstract revisión performed in
 - 142 papers obtained for full reading
- Full Reading of 142
 - resulted in inclusión of 122 studies
- Reported results on
 - XX BSI
 - YY SSI
 - ZZ UTI
 - WW VAP

Identification

PubMed = 1.283 Lilacs = 254 Embase = 257
TOTAL = 1794

Selection

Duplicates
(n = 399)

Total no duplicates
(n = 1.395)

Selected for full article
review
(n = 142)

Excluded by title and
abstract review
(n = 1.245)

Eligibility

Excluded after full text
reading
(n = 20)

Reasons for exclusion (20):
• xxx

Inclusion

Included in Review
(n = 122)

Results

Table studies by country

Results

Table studies by site

Results

Table studies by outcome presented

Results

Table studies by design

Results

Surgical site infections (SSI)

- \$ and LOS

Results

Catheter associated urinary tract infections (CA-UTI)

- \$ and LOS

Results

Ventilator associated pneumonia (VAP)

- \$ and LOS

Results

Central line associated bloodstream infection (CVC-BSI)

- \$ and LOS

Discussion

Lack of consistency in Cost Estimates

- Cost estimates will depend
 - assessment is at the individual or multiple institutions
 - figures are based on comparison of a resistant versus susceptible patient/infection or they are total costs of care (resistant versus nothing)
 - figures include hospital costs only, look at patient costs, or incorporate productivity costs (i.e. consider the health care or the 'societal' perspective),
 - methods used to estimate costs
 - focused on one or multiple disease areas
 - preventative control measures are included
- Lack of consistency generates problems in assessing the true scale of the problem

Healthcare related infections

Priority research questions

- Impact HAI on healthcare expenditure → interventions are urgently needed
- Studies of the cost-effectiveness of these new interventions
 - Economic benefits of novel interventions need to be quantified.
 - Reliable and detailed information on the economic burden and costs of HAI in LAC is needed

Economic Research and HAI

- What is needed?
 - Economic burden
 - Cost of program/interventions
 - Cost-effectiveness of interventions
- How results will be used?
- What methods should be used?
 - Considering suitability for each need
- Standardize methodology for consistency and comparability
- Research networks for collaboration

Conclusions

- **First** Systematic Literature Review of HAI costs in LAC.
- Several studies available, using adequate methods and allowing for comparison among countries and within sub-regions
- Importance of locally generated HAI cost data
- In combination with surveillance and epidemiology data on HAI from countries → burden of HAI, economic burden of HAI can be generated
 - Important for movilización of resources, decisión makers and society
 - Important as baseline for the future assessment of th eimpact of interventions to reduce HAI