



In-Hospital Patient-level Costing Methodologies: A Systematic Review

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INTRODUCTION

Value Equation = $\frac{\text{Health Outcomes}}{\text{Costs}}$ → Growing attention
→ Less attention

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On average, for every USD 100.00 spent on healthcare, USD 38.40 goes to hospitals in OECD countries currently². **In the setting of the healthcare costs crisis, hospitals should be a priority.**

The aim of the present study is to identify and to describe the costing methods applied in hospitals to measure individual cost per patient.

This Systematic Review is part of the results of the MR Impact Project, which is a Brazilian collaborative research platform coordinated by five hospitals - Hospital Israelita Albert Einstein, Hospital Alemão Oswaldo Cruz, Hospital Moinhos de Vento, Hospital Sírio Libanês and Instituto de Pesquisa do Hospital do Coração - in a partnership with the National Sanitary Vigilance Agency (ANVISA) and the Ministry of Health. The project aims to investigate the national impact of infections caused by multidrug-resistant organisms.

METHODS

Search Strategy

The literature search was performed using **MEDLINE (via PubMed), Scopus and Web of Science databases.**

Terms: **Hospital Costs AND Cost Allocation AND Economics NOT Treatment* NOT National Health Programs NOT Cost of Illness NOT Cost-Benefit Analysis.**

Studies published **until August 20, 2019 and no language restrictions.**

Titles and abstracts were screened for eligibility, and potentially relevant studies were selected for full-text reading.

Two independent reviewers (ILB and TCSN) assessed eligibility. **Disagreements** were resolved by the assessment of a **third reviewer (AJP).**

Study Selection

Included studies: assessed individual patient's cost during an entire hospital length-of-stay.

Excluded studies: estimated patients' costs, calculated mean patients' costs, assessed costs of a single condition or intervention, evaluated only one hospital's department/sector or were based on a national healthcare perspective.

This present report follows **PRISMA statement recommendations** [Moher D et. al. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. BMJ 2009;339:b2535].

RESULTS

Figure. Study selection flowchart

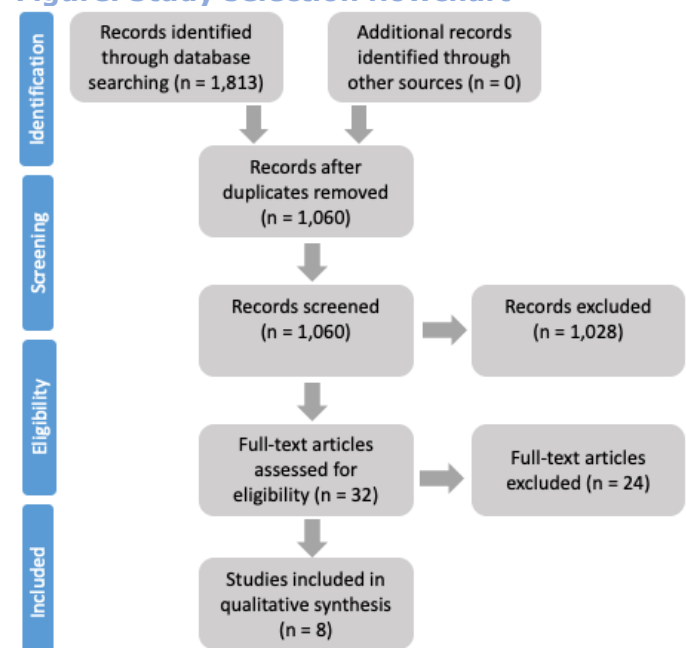


Table. Summary of the results (n = 8 studies)

General study features	
Data Collection period	One year or more in 6 studies ³⁻⁸ , two weeks in 1 study ⁹ and not informed in 1 ¹⁰ .
Outpatients and inpatients	2 studies included outpatients and inpatients ^{8,9} , 4 included only inpatients ^{3,5,6,10} and in 2 was not available ^{4,7} .
Number of hospitals analyzed	5 studies analyzed only one hospital ^{3,6,7,9,10} , 1 analyzed five hospitals ⁸ , another seven hospitals ⁴ and another 146 hospitals ⁵ .
Country	5 were conducted in high-income countries (Australia ⁵ , Canada ⁶ , Japan ¹⁰ and United States ^{3,4}) and 3 in low-income countries (Dominican Republic ⁹ , India ⁸ and Iran ⁷).
Size of the hospitals	In all studies, large hospitals were included (≥ 150). 1 study also added medium-sized hospitals ⁸ and other study added small (< 50 beds) and medium-sized hospitals (50-149 beds) ⁵ .
Teaching hospitals	2 of the studies analyzed teaching hospitals and non-teaching hospitals simultaneously ^{4,5} , 3 studies only analyzed teaching hospitals ^{3,6,9} and 3 studies did not report ^{7,8,10} .
Type (Public/private)	2 studies were done in public hospitals ^{8,9} , 1 study was conducted in public and private hospitals ⁵ , 1 study included only one nonprofit hospital ⁶ and in 4 studies it was not reported ^{3,4,7,10} .
Costing method applied	
Method	TCS (Traditional Costing System or Absorption Costing) was applied in 4 studies ^{5,7,9,10} , the ABC (Activity-Based Costing) in 2 ^{6,7} , CCR (Cost-to-Charge Ratios) also in 2 ^{3,4} , RVUs (Relative Value Units) in 1 and the Economic Costing ⁸ also 1.
Number of Methods Applied	Two costing methods were simultaneously applied, and their different results compared in 2 studies ^{4,7} .
Personnel costs - Level of Detail	4 studies detailed the personnel cost per professional group (physician, nursing, support team, administrative team and others) ⁷⁻¹⁰ .
Personnel costs - Allocation at the patient level	3 studies by trace ⁶⁻⁸ ; in 1 study, ratios ¹⁰ ; in another, direct measurement ⁹ ; and in 3 studies, it was not informed ³⁻⁵ .
Drugs and materials - Level of Detail	5 studies did not classify drugs and materials as high-cost or not ^{3,7-10} , in 2 studies the differentiation was made ^{5,6} and in 1 it was not informed ⁴ .
Drugs and materials - Allocation at the patient level	Trace in 3 studies (administrative data) ^{6,7,9} , in 2 was ratios (as allocation proportionally to the time of service) ^{3,8} , in 1 was direct allocation (identification of the cost of the item consumed by patient) ¹⁰ and 2 were not informed ^{4,5} .
Depreciation and Maintenance - Level of Detail	Aggregated in 3 studies ^{7,9,10} , in 2 it was presented per building ^{5,8} , equipment, asset e others and in 3 it was not informed ^{3,4,6} .
Depreciation and Maintenance - Allocation at the patient level	Allocated at the patient level in 3 studies by trace (administrative data, such as location of the machines ⁷⁻⁹), in 1 study the allocation was proportional to the personnel cost ¹⁰ and in 4 it was not informed ³⁻⁶ .

DISCUSSION

TCS was the most common costing method to measure individual cost per patient. ABC and CCR were the second most common methods. These results are based on very

few studies, since our systematic review found only 8 eligible studies.

Measuring patient-level costs, in an entire hospital **is challenging, but the included studies suggest that it can be done** by hospitals regardless of type (public, private or non-profit), size (small, medium or large), location (developed or developing country), with or without previous cost system, using different strategies.

Costing methods applied in the studies

The costing methods are in continuous evolution and there is no evidence that any methodology is superior, different methodologies can be used.

TCS - most used method in the included studies. Is easily understood and applied, requires less financial investment and is widely used, but it can result in lower accuracy.

ABC - activities and resources involved are considered for costing and the indirect costs are tracked and allocated individually, however it requires time from managers and significant expenses for implementation and maintenance.

CCR - costing method specific to the health sector and does not require significant expenses or managerial time, however the accuracy is questionable.

Economic Costing - appeared in one study, requires careful assessment of opportunity costs and some costs that do not appear in accounting cost reports can be included.

RVU - appeared in one study, it is based on the complexity of the procedure, volume of resources consumed and the duration of care.

TDABC - was not applied in the included studies. This method is particularly used to measure detailed costs of specific procedures or clinical conditions, along a full cycle of treatment (long term) 11.

Challenges in measuring hospital cost at the patient level

- The **costs for implementation can be relatively high** while (depending on the specific context) the benefits of the information can be modest, systems can be expensive, and a large volume of records require checking, validations and investigations.
- It is necessary to **routinely record information on consumption per patient by different departments** (pharmacy, laboratory, nutrition and others). **Staff resistance**

due to changing processes may also occur.

- The **myth that charges or reimbursements can replace costs** (cost depends on the use of resources per patient).

Limitations

Misinterpretation about study and cost methodologies (**incomplete description or lack of standardization** - 16 articles were excluded after full reading for presenting incomplete methodology).

CONCLUSION

Despite the creation of new costing methodologies, this systematic review indicates that there is a **low adoption of patient-level costing techniques by hospitals. Incomplete description and lack of standardization in the reports**, make difficult to verify the accuracy of the methods across organizations.

The **TCS was the most common method** of measuring individual patients' cost. In the setting of Value-Based Healthcare, patient-level costing urges as a need, and **more studies are needed to investigate the causes of the low adoption of innovative costing techniques and to advance the dialogue on good practices in the description of the applied costing method.**

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