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Good infection prevention practices in three Brazilian hospitals: Implications for patient safety policies

Zenewton A. da Silva Gama[a,*], Pedro J. Saturno Hernández[b], Marise Reis de Freitas[c], Maria Clara Padoveze[d], Cecília O. Paraguai de Oliveira Saraiva[e], Laiane G. Paulino[f], Sibele Ferreira de Araújo[f]

[a] Departamento de Saúde Coletiva, Universidade Federal do Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil
[b] Centro de Investigación en Calidad y Encuestas, Instituto Nacional de Salud Pública, Cuernavaca, Morelos, Mexico
[c] Departamento de Infectologia, Universidade Federal do Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil
[d] Departamento de Enfermagem em Saúde Coletiva, Universidade de São Paulo, São Paulo, São Paulo, Brazil
[e] Doutoranda do Programa de Pós-graduação em Enfermagem, Universidade Federal do Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil
[f] Curso de Gestão em Sistemas e Serviços de Saúde, Universidade Federal do Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil

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ABSTRACT

Objective: Healthcare-associated infections (HAI) are a serious patient safety problem. There are effective preventive practices, but little information on adherence in Brazilian hospitals. This study aims at assessing adherence to good HAI prevention practices.
Methods: A cross-sectional observational study was conducted at 3 different types of hospitals (public-federal, public-state and private) in Rio Grande do Norte state, Brazil. A total of 19 structure and process indicators were measured based on 7 National Quality Forum Patient Safety Practices.
Results: Overall adherence was low, but higher in the private hospital, followed by the public-federal and public-state institutions. There was adequate maintenance of central venous catheters and high vaccine coverage against the influenza virus among health professionals. However, hand hygiene adherence was low, and surgical antibiotic prophylaxis and prevention of multidrug-resistant bacteria transmission, urinary tract infection by urinary catheter and associated with mechanical ventilation were inadequate.
Conclusions: Despite the availability of evidence-based recommendations, there is ample room for improvement in adherence to safe practices in the hospitals under study, contributing to the heightened risk of unnecessary harm to patients.

Introduction

Healthcare associated infections (HAI), which cause unnecessary harm, have become a serious public health problem worldwide [1]. In addition to their biological nature, they involve historical, social and financial questions that influence safety in healthcare institutions and pose a challenge to providing qualified care [1].

According to the Centers for Disease Control and Prevention (CDC), two million people contract HAI every year in the United States, causing approximately 100,000 deaths at a cost of USD 4.5–6.5 billion [2]. Worldwide the burden of HAI is a public health concern, mainly in low and middle income country where HAI may be 20 times higher than in high-income countries [3]. Studies performed in low and middle income countries demonstrated higher rates compared to those obtained by the Centers for Diseases Prevention and Control (CDC), EUA, nearly 5-folder higher [4]. In Brazil, one study found an adverse event incidence of 8.4% in hospitalized patients, HAI being the second most frequent (20% of the cases) after surgical events (24.6%) [5]. A multi-state survey performed in Brazil with a team of trained data collectors detected an overall HAI prevalence rate of 10.8% [6].

A number of public policies were created as a response to global initiatives [7]. These include the National Patient Safety Program (PNSP) to monitor and prevent healthcare harm [8], and the National Program for the Prevention and Control of Healthcare-related Infections (PNPCIRAS), whose primary aim is to reduce the incidence of HAI and microbial resistance nationwide [9]. These

* Corresponding author at: Departamento de Saúde Coletiva, Campus Lagoa Nova - UFRN. Av. Sen. Salgado Filho, s/n, CEP 59078-970, Natal/RN, Brazil.
E-mail address: zgama@ufrnet.br (Z.A. da Silva Gama).

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represent regulatory landmarks and incentives to prevent these incidents in Brazil.

Despite the consensus regarding the importance of these programs for the epidemiological surveillance of result indicators such as general and specific HAI rates, studies demonstrate the need to complement monitoring with evidence-based infrastructure and process indicators [10,11]. The justification for this is because the incidence of IRAS is an indirect fact about the quality of care, since it does not directly indicate which practices have failed and should be corrected [9,12].

Monitoring these indicators facilitates decision making by health system administrators and regulators, since it demonstrates what can be included in the action plans for the dissemination and implementation of good HAI prevention strategies [9–13].

Although government initiatives disseminate evidence-based protocols and practices in order to improve healthcare quality and patient safety, many services continue to face difficulties in implementing them. Among the main reasons cited is the lack of infrastructure and human resources, which limit full compliance with recommended national and international good practices [11]. However, even with an adequate infrastructure, insufficient monitoring and feedback of good practice indicators can impair the efforts to improve HAI prevention because scant information hinder the decision-making process.

The level of adherence to evidence-based practices for prevention of HAI is still little known in the Brazilian scenario. Therefore, this study intends to evaluate and compare the adherence to good practices of HAI prevention in three hospitals with different types of administration (private, public with direct administration and public with indirect administration).

Methods

This study uses a cross-sectional observational design. It is part of a larger project to construct and validate the good practice indicators for patient safety (ISEP-Brazil Project), based on National Quality Forum (NQF) [2] prevention recommendations and ISEP-Spain indicators [14,15]. The general project was developed at the *Universidade Federal do Rio Grande do Norte (UFRN)* (Brazil) in partnership with the *Unidad de Salud Pública da Universidad de Murcia* (Spain) and data collection occurred in 2014.

Three hospitals (private, public-state and public-federal) in the city of Natal, Rio Grande do Norte (RN) state, Brazil, took part in the study. The federal institution is a general 240-bed teaching public hospital, indirectly managed by a federal university and with no emergency care unit. The private facility, a general 87-bed non-profit establishment managed by a medical cooperative, has an emergency care unit and level 2 accreditation from the Qualisa Management Institute. The state entity, a general 325-bed public hospital, directly managed by State Health Department of Rio Grande do Norte, has an emergency care unit and is a reference trauma care center. At the time of assessment, all the participant hospitals had in place a hospital infection control committee (HICC) and a patient safety service.

A total of 19 good patient safety practice indicators (10 for infrastructure and 9 for process) were measured with respect to HAI prevention, as described in Table 1. The indicators were previously validated and reflect seven evidence-based NQF recommendations [14].

Depending on their type, the process indicators had different study populations and samples at each hospital. The study unit for the adherence to hand hygiene indicator was the physical contact between health professionals and patients, with a sample of 100 intensive care unit and 100 general ward cases. The population for the vaccination against influenza indicator consisted of all the health professionals in the hospital who completed an online questionnaire. The study unit of the contact precautions indicator was the physical contacts with patients in such precautions associated with multidrug-resistant microrganisms; a sample of 50 study units each were assessed in both intensive care unit (ICU) and general ward through direct observation. The study population to assess the risk of multidrug-resistant bacterial infection was a group of elderly individuals (60 years of age or older) who had been discharged the previous year; the sample consisted of 17 randomly selected medical records. Antimicrobial prophylaxis for surgery was assessed in three random samples of 17 cases (orthopedic, colon and rectal and other surgeries), totaling 51 cases per hospital. With regard to safe maintenance of central venous catheter (CVC), we included all inpatients with a CVC at the day of data collection. For urinary catheter removal up to 48 h postoperative; the sample consisted of 34 cases for each hospital.

The dependent variables are the compliance results of the quality indicators, which demonstrated the quality of infection prevention, evidenced by adherence to science-based good practices. The independent variable potentially related to compliance with the indicators was the hospital, according to the typo of institutional administration, namely, private, public-state or public-federal.

The details on data collection for each indicator are described in Table 1. The audit was performed to assess the indicators for the presence of protocols, policies, guidelines and continuous inservicer education program. The hospitals were asked in advance to provide a copy of relevant documents as verifiers of compliance to the indicators assessed.

With respect to direct observation (indicators of infrastructure, adherence to hand hygiene, adherence to contact precautions, and safe CVC maintenance), the observers were previously trained and the health professionals were unaware of the aspects being assessed. The indicator of practice to maintain the normothermia during colon and rectal surgery was assessed through interviews with healthcare workers.

The sample sizes of the indicators evaluated by using medical records were defined according to lot quality assurance sampling (LQAS) and the kappa statistic was applied to verify acceptable inter-observer reliability [16–18].

The LQAS method was used to demonstrate whether there was lot acceptance in the three indicators measured via medical records (Table 1). Binomial distribution principles were used to establish a standard of 85% and threshold of 55%. The decision number for a sample of 17 is 12, the minimum required to accept indicator compliance.

Data analysis was conducted according the type of indicator. The absolute frequency was used for the infrastructure indicator. The response “Yes” was considered whenever all requirements of a given indicator were met; “Partial” was considered for those that not fulfilled any elements within a given indicator; and “No” when requirements were not met or relevant documents were not provided. For sample-based process indicators with more than 30 study units, the compliance percentage and 95% confidence interval were calculated.

The project was approved by the UFRN Research Ethics Committee under protocol no. 437.559.

Results

Adherence to prevention practices

Assessment of compliance with the indicators of good HAI prevention practices is presented in Tables 2–5.

Table 1
Characteristics of good practice indicators for patient safety assessed in three hospitals. Rio Grande do Norte, Brazil, 2014.

Good practice	Indicator	Type	Data source	Outcome
Hand hygiene	Hand hygiene protocol	Structure	Audit	Yes or no
	Continuing education	Structure	Audit	Yes or no
	Health professionals' adherence	Process	Direct observation	% adherence
	Hand hygiene resources	Structure	Direct observation	Yes or no
Influenza prevention	Influenza vaccination for health professionals guidelines	Structure	Audit	Yes or no
	Health professionals vaccinated against influenza	Process	Survey	% of professionals vaccinated
Prevention of multidrug-resistant microorganisms dissemination	Written prevention policy	Structure	Audit	Yes or no
	Adherence to contact precautions	Process	Direct observation	% adherence
	Screening for infection or colonization of inpatients	Process	Medical records	% adherence
Central venous catheters	Guidelines to prevent CVC- associated infections	Structure	Audit	Yes or no
	Safe maintenance of the CVC	Process	Direct observation	% of failures
Patient care on mechanical ventilation	Protocol for patient care on mechanical ventilation	Structure	Audit	Yes or no
Prevention of surgical site infection	Antibiotic prophylaxis protocol	Structure	Audit	Yes or no
	Preoperative skin and mucosa preparing protocol	Structure	Audit	Yes or no
	Antibiotic prophylaxis appropriateness	Process	Medical records	% adherence
	Maintaining perioperative normothermia in colon and rectal surgeries	Process	Interview	Yes or no
Prevention of catheter-associated urinary infection	Catheter-associated urinary infection prevention protocol	Structure	Audit	Yes or no
	In-service training on inserting and maintaining urinary catheters	Structure	Audit	Yes or no
	Urinary catheter removal within 48 h postoperative	Process	Medical records	% adherence

Table 2
Compliance with good practice indicators of hand hygiene and prevention of multidrug resistant microorganisms in three hospitals. Rio Grande do Norte, Brazil, 2014.

Indicators	Private	Public-state	Public-federal	Overall
1.Good practice: hand hygiene				
1.1 Hand hygiene infrastructure				
Sinks in the ICU/Wards	Yes/Yes	Yes/No	Yes/Yes	3 of 3/2 of 3
Soap and Alcohol gel in the ICU/ Wards	Yes/Yes	Yes/Yes	Yes/Yes	3 of 3/3 of 3
Dispenser in the ICU/ Wards	Yes/Yes	Yes/No	Yes/Yes	3 of 3/2 of 3
Towels in the ICU/ Wards	Yes/Yes	Yes/Yes	Yes/Yes	3 of 3 /3 of 3
1.2 Hand hygiene protocol	Yes	Yes	Yes	3 of 3
1.3 Continuing education in hand hygiene	No	Yes	Yes	2 of 3
1.4 Health professionals' adherence to hand hygiene	33% (n = 200)	14% (n = 200)	10% (n = 200)	19% (16–22)
Adherence in the ICU (95%CI)	40%	4%	12%	19% (14–23)
Adherence in the Wards (95%CI)	25%	23%	8%	19% (14–23)
2.Good practice: prevention of multi-drug resistant microorganisms dissemination				
2.1 Prevention policies	No	No	No	0 out of 3
2.2 Adherence to contact precautions	27% (n = 100)	0% (n = 100)	9% (n = 100)	12% (8–16)
Adherence in the ICU (95%CI)	58%	14%	42%	38% (32–43)
Adherence in the Ward (95%CI)	76%	28%	50%	51% (45–57)
Patient isolated in a private room in the ICU/ Ward	50%/100%	10%/10%	100%/100%	47%/80%
Alerts on the door or medical chart in the ICU/ Ward	50%/100%	10%/100%	65%/100%	40%/80%
Adherence to hand hygiene before and after contact in the ICU/ Ward	34%/52%	4%/4%	28%/20%	22%/25%
Putting on gloves when entering the room and removing them before leaving the ICU/ Ward	80%/72%	34%/14%	76%/32%	60%/39%
Putting on an apron when entering the room and removing it before leaving the ICU/ Ward	74%/56%	12%/10%	40%/10%	42%/25%
2.3 Screening of infection/colonization by multidrug-resistant bacteria at admission	LQAS: 3 of 17	LQAS: 0 of 17	LQAS: 8 out of 17	22% (10–33)

Table 3
Compliance with good practice indicators to prevent influenza and patient care on mechanical ventilation in three hospitals. Rio Grande do Norte, Brazil, 2014.

Indicators	Private	Public-State	Public-Federal	Overall
3. Good practice: prevention of influenza				
3.1 Influenza vaccination for health professionals guidelines	No	No	No	0 of 3
3.2 Health professionals vaccinated against influenza	89% (n = 55)	88% (n = 83)	85% (n = 70)	88% (83-92)
4. Good practice: patient care on mechanical ventilation				
4.1 Care protocol for patients on mechanical ventilation.	Partial	Partial	No	0 of 3
Pneumonia prevention	Yes	Yes	–	2 of 3
Pressure ulcer prevention	Yes	Yes	–	2 of 3
Peptic ulcer prevention	No	No	–	0 of 3
Venous thromboembolism	Yes	Yes	–	2 of 3
Dental care	No	No	–	0 of 3

Assessment of hand hygiene practices revealed that, despite compliance with the infrastructure indicators, adherence was low at all three participating hospitals (Table 2).

None of the hospitals complied with the infrastructure indicator regarding the element of "an institutional policy for the prevention of multidrug-resistant microrganisms". With respect to the process, there was low adherence to contact precautions with patients in isolation in both the ICU and general ward and none of the institutions achieved the LQAS standard (Table 2).

Although the hospitals assessed had no guidelines with respect to the immunization of health professionals against the influenza virus, there was good adherence at the three hospitals (Table 3).

Adequacy of antibiotic prophylaxis in surgeries was observed in 71% of the cases, with the most common failure related to inadequate antimicrobial indication and to adequate time of administration. Another failure was related to the control of normothermia in surgical patients of colon and rectum, which was only partially performed by the private hospital (Table 4).

Table 4
Compliance with good practice indicators of surgical site infection prevention in three hospitals. Rio Grande do Norte, Brazil, 2014.

Indicators	Private	Public-state	Public-federal	Overall
5. Good practiced: prevention of surgical site infection				
5.1 Protocol for antibiotic prophylaxis.	Yes	No	Yes	2 of 3
5.2 Preoperative skin and mucosa preparing protocol.	Partial	No	Yes	1 of 3
Skin antisepsis	Yes	–	Yes	2 of 3
No hair removal or without a razor blade	No	–	Yes	1 of 3
5.3 Use of the antibiotic prophylaxis protocol in surgeries in the composite indicator[a]	86% (n = 29)	67% (n = 51)	61% (n = 51)	71% (63–79)
% of failures in each indicator element: Indication for prophylaxis	7%	0%	0%	2% (0–3,6)
Appropriate antibiotic	0%	25%	16%	18% (11–24)
Adequate dose	0%	0%	0%	0
Adequate moment	7%	18%	14%	16% (9–23)
Adequate duration	0%	0%	14%	6% (1–10)
5.4 Maintaining perioperative normothermia in colon and rectal surgery	Partial	No	No	0 of 3
Temperature monitoring during surgery	Yes	–	–	1 of 3
Temperature monitoring after surgery	No	–	–	0 of 3
Use of warming mattress/blanket/pad	Yes	–	–	1 of 3
Warmed intravenous or irrigation fluids	Yes	–	–	1 of 3
Warm air inhalation	No	–	–	0 of 3

[a] The composite indicator to antibiotic prophylaxis is composed by five elements: "indication for prophylaxis" "appropriate antibiotic" and adequate "dose", "moment" and "duration"; these last three elements were only assessed if the two first were compliant.

Table 5
Compliance **to** good practices indicators: bloodstream infection prevention associated with the central venous catheter (CVC) and urinary infection prevention associated with the catheter in three hospitals. Rio Grande do Norte, Brazil, 2014.

Indicators	Private	Public-State	Public-Federal	Overall
6. Good practice: blood stream infection prevention related to the central venous catheter				
6.1 Guidelines for prevention of infections associated with the CVC	Yes	Partial	No	1 of 3
Measures taken during insertion	Yes	No	–	1 of 3
Maintenance measures after insertion	Yes	Yes	–	2 of 3
6.2 Safe maintenance of the CVC	LQAS: 5 of 7[a]	LQAS: 13 of 17[a]	LQAS: 11 of 11[a]	82% (70-95)
7. Good practice: urinary tract infection prevention related to the urinary catheter				
7.1 Protocol to prevent urinary infection associated with the catheter	Yes	No	No	1 of 3
7.2. In-service training on the insertion and maintenance of urinary catheters	No	Yes	No	1 of 3
7.3 Urinary catheter removal up to 48 h postoperative	Not assessed	LQAS: 10 of 17	LQAS: 2 of 17	35% (19–51)

[a] Complies with the quality standard tested in the LQAS (Standard 85%; Threshold 55%).

Two of the three hospitals (private and public-state) had a protocol to prevent CVC-related bloodstream infection. However, the compliance regarding it was considered "partial" in the public-state hospital because its content did not addressed the good practices for the CVC insertion. With respect to adherence to safe catheter maintenance, overall compliance was high (Table 5), even at the federal hospital, which had no specific guidelines.

Only the private hospital had an infection prevention protocol related to the urinary catheter; however no in-service continuous education was offered. In contrast, the public-state hospital had no written protocol, but provided in-service education. None of participants hospitals achieved the requirements regarding the urinary catheter removal up to 48 h postoperative. This indicator was not assessed in the private hospital due to insufficient number of medical records to fit the minimum sampling.

Inter-hospital comparison of adherence

The variability in compliance with the indicators of good infection prevention practices between the three hospitals evaluated was evident in the results described above and Tables 2–5. Both the infrastructure and process indicators showed better compliance at the private hospital, followed by the public-federal and public-state institutions.

Discussion

This study demonstrates the current status of HAI prevention practices in three of the largest hospitals in a large city in Northeast Brazil. Although there are a number of highly recommended national and international evidence-based practices, most have not been introduced into the routine of these hospitals.

Patient safety was evaluated by using good practices indicators, which are still rarely used by health services and were not yet incorporated by national health policies. Based on the Donabedian triad (Structure, Process and Results) [19], the structure and process indicators are easier to interpret and compare than results indicators, since they do not need to be risk-adjusted. Undoubtedly, as the scientific evidence support them is increasing, their relevance raises [14,16].

In the prevention and control of HAI, these kind of indicators complement those of the results from infection surveillance [12,20]. Their analysis might aid to identify the factors that contribute to the increased risk of infections and that should be addressed to ensure good quality of care [21].

Studies demonstrate that a significant percentage of HAI cases are preventable [1,11,22]. This prevention depends on the adherence of professionals to good practices such as hand hygiene (HH) which is considered the simplest, effective and low-cost practice [22]. On spite of its importance, the adherence to HH has been one of the greatest challenges for health services [22]. This was confirmed in the present study by the low adherence of the three hospitals, no matter the existence of institutional protocols and national recommendations from both PNCIRAS and the PNSP [8,9]. Our data are consistent with other studies demonstrating that adherence to this practice remains scarce worldwide [23–25].

The availability of HH resources is indispensable for healthcare workers compliance [2]. The WHO underscores that if sinks or alcohol gel dispensers are not readily accessible and if HH is not performed, the risk of HAI rises signficantly [26]. However, this study demonstrated that although the public-federal hospital has an ade-

quate infrastructure and is a certifiedteaching institution, less the adherence was lower than the other two. Thus, adequate physical infrastructure and guidelines are essential, but not sufficient to promote the best quality of care.

The physical infrastructure to isolate infected patients poses a challenge during times of high prevalence of multidrug-resistant bacteria, mainly in the ICUs of Brazilian hospitals. As known, the strict adherence to contact precautions is considered a crucial preventive practice to avoid transmission of microorganisms of epidemiologic relevance [27]. Despite this, the adherence to this practice was less than 50% in the three hospitals. The results were similar with respect to wearing gloves and an apron when entering the isolation room, as well as removing them. Nevertheless professionals kept these items on after leaving the room. By doing this, professionals can re-contaminate their hands while removing gloves and aprons or touching the external surfaces with these contaminated devices [27].

The lack of screening for multidrug-resistant bacterial infection or colonization within 24 h of patient admission demonstrated flaws in the safety culture and may be due to lack of policies addressing this issues.

The results on vaccine coverage against the influenza virus was considered good, since it achieved the goal recommended by the Ministry of Health of Brazil and other countries, which is at least 80% [28,29]. This finding may be related to national vaccination campaigns aimed at groups at greater risk, including health professionals, and other institutional policies.

We detected about 71% of adherence to the surgical antibiotic prophylaxis, even in the hospital with no written protocol. A study conducted in a hospital in Middle-West Brazil detected adequate prescriptions in 25% of the cases assessed, far below our results. However, in that study, the authors detected 100% compliance in terms of the adequate moment of prophylaxis administration [30]. Our data regarding the control of patient normothermia during colon and rectal surgery was similar to a study in Spain [31]. The lack of guidelines likely contributed to these results.

The National Quality Forum (NQF) recommends that hospitals adopt specific guidelines to guarantee adherence to safe practices to prevent CVC-associated infection, primarily focused on barriers during CVC insertion and aseptic maintenance [2]. It is noteworthy that 82% of observations performed have identified safe CVC maintenance, despite the absence of guidelines in two of hospitals. Other factors, such as awareness campaigns could contributed to this favorable results. Nevertheless, the existence of protocols is a guiding element and should not be neglected. Another Brazilian study [32] reported overall compliance 51.5% below the level found here. Safe maintenance of CVC is of paramount importance, since it contributes to the non-colonization of microorganisms after CVC insertion [33].

Several studies show that introducing evidence-based practices and continuing in-service education for health professionals is effective in reducing infection [34,35]. In addition to education, audit and feedback of process of CVC insertion and maintenance can reduce infections by 40% or more [36].

According to national data, catheter-related urinary tract infection accounts for 30–50% of HAI at health services. The prolonged use of urinary catheter, often without adequate assessment, may harm the patient, raise treatment costs and extend hospital stays [37,38]. The literature reports that the longer the catheter use, the greater the incidence of urinary tract infection [37,38]. Unfortunately, none of the participant hospitals achieved the standard of quality with respect to urinary catheter removal up to 48 h postoperative. Besides, we observed a lack of written protocols and in-service training addressed to prevent catheter-related urinary infections.

Incorporating structure and process indicators monitoring and feedback is an important strategy for national programs to improve overall adherence to good practices in health services. More recently, the Integrated Plan for the Sanitary Management of Patient Safety [39], incorporated this kind of strategy by using indicators validated in the ISEP-Brazil Project. This represents a step forward in public policies to prevent HAI and to ensure patient safety. However, it remains challenging the implementation of routine use of such indicators due to poor countrywide patient safety culture and weakness in local organizational capacities for quality improvement.

The World Health Organization (WHO) recommend the use of monitoring and feedback as one of the core components for programs aimed to prevent HAI, including indicators of structure and process [40]. According the WHO guidelines, several studies have also demonstrated that the interventions were more effective when approaches are integrated in a multimodal strategy [40]. Multidimensional strategies have been proved to be effective also in low and middle income countries [41,42]. In Brazil, a statewide program implemented tailored interventions in 77 hospitals, including indicators of process, and achieved favorable results to reduce central line-associated bloodstream infections [43].

Our objective was not to assess the result indicators of HAI incidence or adverse events, which may represent a study limitation. Whenever possible, compatible process indicators were used. As such, there are points requiring immediate action, given that the results indicated risks to patient safety. Thus, is advisable to establish an action plan to the micromanagement of care systems, organizational learning and the implementation of safe practices.

In regards to the potential of generalizing the results, the research was carried out at only three hospitals in a specific region. Although they are the largest hospitals of each type in the area, the estimates are not necessarily representative of other hospitals with the same management framework. Other similar studies with a larger sample of hospitals, are therefore, recommended.

Conclusion

Despite the available evidence-based recommendations to prevent HAI, there is still significant room for improvement for adherence to safety procedures at the hospitals evaluated. Noncompliance with these well proven practices may contribute to unnecessary risk of harm related to healthcare.

The gaps identified in infrastructure and processes at the participant hospitals point out to the need of general improvement, regardless of type of administration. This should encourage those in charge for the continuous improvement of healthcare quality to implement effective HAI prevention and control programs. There is a clear need for authorities to establish systematic monitoring and feedback of good practices in healthcare settings, since they are of utmost importance to achieve the goals of preventing HAI.

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