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## Surveillance Programme for Healthcare Associated Infections in the State of São Paulo, Brazil. Implementation and the first three years' results<sup>☆</sup>

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### SUMMARY

Governmental programmes should be developed to collect and analyse data on healthcare associated infections (HAIs). This study describes the healthcare setting and both the implementation and preliminary results of the Programme for Surveillance of Healthcare Associated Infections in the State of São Paulo (PSHAISP), Brazil, from 2004 to 2006. Characterisation of the healthcare settings was carried out using a national database. The PSHAISP was implemented using components for acute care hospitals (ACH) or long term care facilities (LTCF). The components for surveillance in ACHs were surgical unit, intensive care unit and high risk nursery. The infections included in the surveillance were surgical site infection in clean surgery, pneumonia, urinary tract infection and device-associated bloodstream infections. Regarding the LTCF component, pneumonia, scabies and gastroenteritis in all inpatients were reported. In the first year of the programme there were 457 participating healthcare settings, representing 51.1% of the hospitals registered in the national database. Data obtained in this study are the initial results and have already been used for education in both surveillance and the prevention of HAI. The results of the PSHAISP show that it is feasible to collect data from a large number of hospitals. This will assist the State of São Paulo in assessing the impact of interventions and in resource allocation.

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### Introduction

Healthcare associated infections (HAIs) occur worldwide and affect both developed and resource-poor countries. The impact of HAIs on public health is a subject of increasing concern, due to the increasing numbers of hospitalised patients in crowded facilities, many of whom have impaired immunity, the emergence of new micro-organisms, and the increase in antibiotic resistance.<sup>1</sup>

The Centers for Disease Control and Prevention (CDC, Atlanta, GA, USA) estimate that HAIs infect about two million people in the

USA annually.<sup>2</sup> The World Health Organization recommends that health authorities should develop national or regional programmes to support hospitals in reducing the risk of HAIs.<sup>1</sup>

In Brazil, although infection control committees (ICCs) have been mandatory for hospitals since 1997, legal constraints do not warrant infection control measures to be correctly applied in healthcare facilities.<sup>3,4</sup> Brazil is a large country with about 200 million inhabitants; São Paulo is the most populous state. A survey conducted by the São Paulo Health Department in 2002 revealed that only 69.0% of hospitals in the State had an ICC and that most hospitals had never reported HAI rate data to a governmental agency.

Based on such findings, a statewide system for monitoring HAI was developed. The initial goals were: to review the main characteristics of healthcare settings, to ensure correct HAI diagnosis and surveillance in healthcare settings, and to provide a standard for benchmarking HAI rates in the State of São Paulo.

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Here we describe the characterisation of healthcare settings and the implementation and preliminary results of the Programme for Surveillance of Healthcare Associated Infections in the State of São Paulo (PSHAISP), Brazil.

## Methods

This study reports on the data from the PSHAISP collected prospectively by the participating hospitals from 2004 to 2006, which was analysed by the Centro de Vigilância Epidemiológica (CVE) and fed back to the participants on an annual basis, by means of a written report and at an open meeting.

### Setting

The State of São Paulo has about 40 million inhabitants, distributed as follows: 10 million in the capital (São Paulo City); 10 million in the metropolitan area (38 municipalities in the area surrounding the capital); and 20 million distributed among the other cities in the interior of the State. The State Health Department had 24 administrative regions (AR) by the time PSHAISP was implemented. The CVE is a centre for health surveillance, which deals with disease prevention and control.

### Characterisation of healthcare settings

The national database from the Brazilian Health Ministry providing information on the number, personnel and resources of healthcare settings – Cadastro Nacional de Estabelecimentos de Saúde (CNES) – was searched to identify the characteristics of healthcare settings in the State of São Paulo. This database is freely available on the Internet (<http://cnes.datasus.gov.br/>).

### Surveillance activities

The PSHAISP was implemented in April 2004 and was aimed at all acute-care hospitals or long term healthcare facilities. Each and every hospital in the State was invited to join the programme. Data were sent monthly from the hospitals to the municipalities' health department, then to their corresponding AR, and finally to the CVE by email. The infection control personnel were responsible for the data collection. The surveillance system design was inspired by the CDC National Nosocomial Infection Surveillance (NNIS) system with adaptations to facilitate access and to encourage healthcare establishments to participate.<sup>5</sup> The CDC definitions for HAI were adopted.<sup>6</sup>

The PSHAISP focused on four components:

- Acute hospitals
  - Surgical units to collect data on surgical site infection (SSI) in clean surgery. The results were reported for selected surgical specialties and were expressed as a percentage.
  - Intensive care units (ICUs) to collect data on device-related infections, i.e. ventilator-associated pneumonia (VAP), central venous catheter-related bloodstream infection (CRBSI) and urinary catheter-related urinary tract infection (CRUTI). The ICU component also included data on the micro-organisms isolated from blood cultures. The participating hospitals were encouraged to use national standard to microbiology procedures.
  - High risk nursery (HRN) to collect data on VAP and CRBSI covering four different birth weights, i.e.  $\leq 1000$  g, 1001–1500 g, 1501–2500 g, and  $>2500$  g.

- For long term care facilities (LTCFs)
  - This component collected data on scabies, pneumonia and gastroenteritis in hospitals caring for patients with chronic diseases, most of whom had psychiatric disorders. The rates were expressed as number of infections per 1000 patient-days. The results of the reported data from the LTCF component are not presented here.

### Education

In December 2003, the CVE and the non-governmental professional association of infection control – Associação Paulista de Estudos e Controle de Infecção Hospitalar (APECIH) – held a meeting with the participating hospital infection control practitioners and related professionals who work at the AR health surveillance departments. The main purpose of the meeting was to present the statewide HAI surveillance programme, discuss the methodology for data collection and encourage adherence to the PSHAISP. During the implementation of the system, the CVE provided training courses for HAI diagnosis and surveillance. Guidelines for surveillance were made available on the CVE website homepage. Educational efforts continue to be held on a yearly basis.

### Data analysis

The reported data for each component were distributed in percentiles. The criteria for inclusion in the present study were  $>250$  clean surgical procedures annually,  $>500$  patients per day for a period of one year for the ICU component and  $>50$  patients per day for a period of one year for the HRN component. For the LTCF component, the inclusion threshold was  $>500$  patients per day for a period of one year.

## Results

### Characterisation of healthcare settings

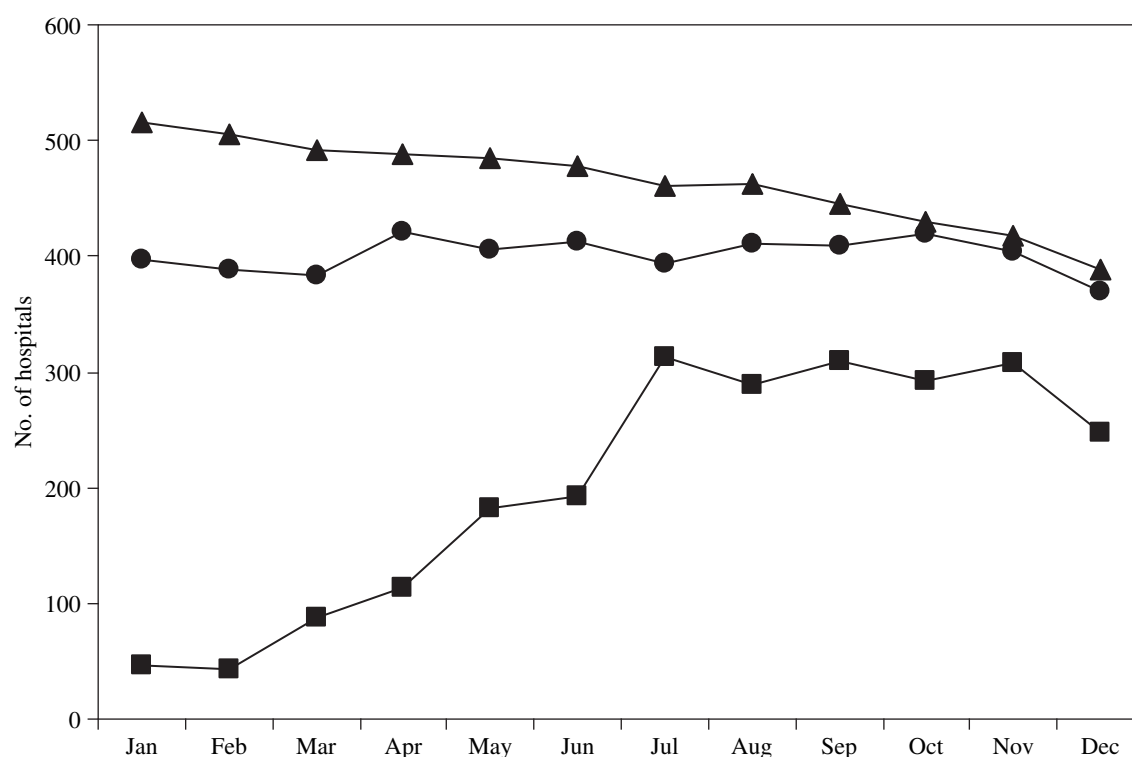
At the time of database searching, there were 118 826 healthcare facilities in the whole country spread across 27 states, and about 18.0% of them were located in São Paulo. These institutions represented a variety of healthcare facilities. For the purposes of this study, we focused on healthcare settings classified as 'hospital' in the CNES, i.e. healthcare settings with medium and high complexity care for inpatients, which comprised 896 institutions in the State of São Paulo, of which 718 were general and 178 specialised hospitals. Approximately one-third were privately funded and the remainder were public facilities.

The State of São Paulo comprises 645 cities, 46.0% with no facility classified as hospital. On the other hand, 32.1% of all hospitals in the state were located in the metropolitan area of São Paulo City ( $N=288$ ). Distributed over 114 cities there were 394 hospitals with at least one ICU, most of which were located in the capital and some of the larger cities. The northern part of the state had a smaller number of ICUs. Most ICUs had 10 beds or fewer and they were generally medical–surgical units and not highly specialised, except for some larger university hospitals.

There were a few paediatric ICUs, comprising of 1135 beds, mostly located in larger cities. There were 1555 HRN beds, 73.2% distributed in a larger geographical area around the São Paulo City metropolitan area.

### Healthcare associated infections

Among the 896 hospitals in the State, the participation rate increased from 51.1% ( $N=457$ ) in the first year, to 59.6% ( $N=534$ ) and 60.9% ( $N=546$ ) respectively in 2005 and 2006 (Figure 1).



**Figure 1.** Monthly distribution of the number of hospitals participating in the Programme for Surveillance of Healthcare Associated Infections in the State of São Paulo. ■, 2004; ●, 2005; ▲, 2006.

Hospitals usually reported data for at least five months in a year either consecutively or interrupted. The surgical component was the most frequently reported. Many hospitals participated in more than one component. The proportion of hospitals fulfilling the inclusion criteria for the present study varied over the years (Table I). The number of clean surgical procedures reported was: 216 863 (2004), 431 446 (2005) and 520 385 (2006). Following the criteria above, 91.8% of the surgical procedures reported in 2004 and 97.1% in 2006 were included in the analysis.

In the first year of the study, hospitals from 22 out of 24 AR joined the PSHAISP. In 2006, all the AR had at least one hospital reporting data to the programme.

In the whole State the pooled SSI rates for clean surgery varied from 0.0 to 10.1%. The 90th percentile for the pooled SSI rates remained around 2.5% during the three years (Figure 2). The most frequent included specialties were the orthopaedic, general surgery, gynaecology, vascular surgery, and plastic surgery, which were covered by more than 70% of the hospitals. Higher SSI rates

were found in the AR surrounding the metropolitan area of São Paulo City, and those with the highest rates were cardiac and neurosurgery, in which the 90th percentile reached 10.14% and 7.12%, respectively.

The proportion of hospitals reporting an ICU component ranged from 45.1% to 52.0% in the studied period (Table I). The median number of patient-days per year was 1786 (2004), 2877 (2005), and 3436 (2006). The range over the whole period was 506 to 54 980 patient-days. There was a considerable range in the number of beds in each ICU among the participating hospitals and there was also a wide variation in device utilisation rates as shown on Table II. Figure 3 outlines device-associated infections for the studied period.

Micro-organisms isolated from blood cultures associated with CRBSI in ICU were reported by the participating hospitals. *Staphylococcus epidermidis* and other coagulase-negative staphylococci were the most frequent micro-organisms during the study period, ranging from 29.0% to 29.9%. Other micro-organisms reported were

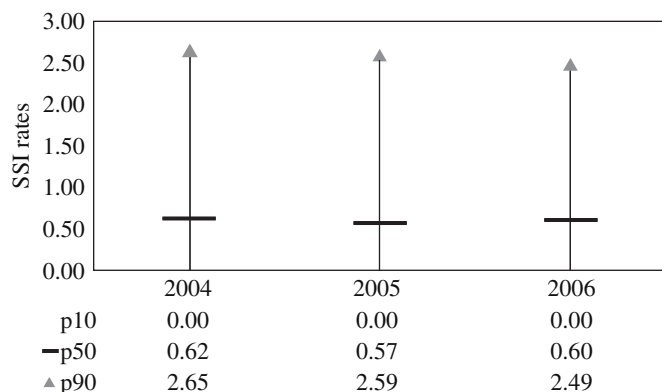
**Table I**

Number of participating hospitals<sup>a</sup> in the Programme for Surveillance of Healthcare Associated Infections in the State of São Paulo<sup>b</sup> according to the surveillance components, 2004–2006

Surveillance components	Participating hospitals						Hospitals included in the study					
	2004		2005		2006		2004		2005		2006	
	N	%	N	%	N	%	N	%	N	%	N	%
Acute care hospitals												
Surgical unit	377	82.5	456	85.4	457	83.7	205	44.9	300	56.2	326	59.7
Intensive care unit	206	45.1	275	51.5	284	52.0	137	30.0	213	39.9	241	44.1
High risk nursery	83	18.2	124	23.2	137	25.1	54	11.8	110	20.6	123	22.5
Long term care hospitals												
All inpatients	29	6.3	50	9.4	52	9.5	25	5.5	50	9.4	52	9.5

<sup>a</sup> Total number of hospitals in the State of São Paulo, Brazil: 896; total numbers of participating hospitals were: 457 (2004), 534 (2005), 546 (2006). Hospitals could participate in more than one component.

<sup>b</sup> Inclusion criteria: >250 clean surgical procedures per year or >500 patients per day in one year.



**Figure 2.** Percentile distribution of surgical site infection (SSI) rates at the hospitals participating in the Programme for Surveillance of Healthcare Associated Infections in the State of São Paulo, 2004–2006.

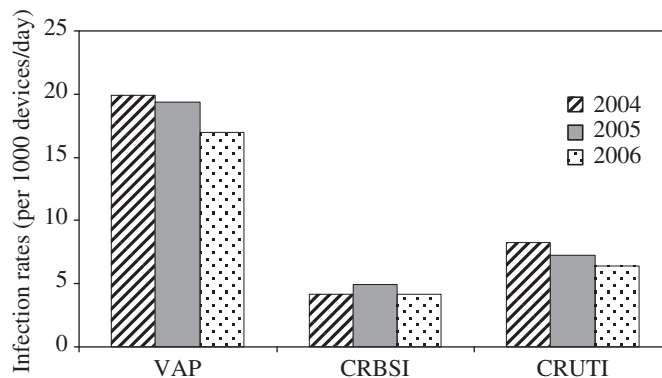
*Staphylococcus aureus* (18.2–19.8%), *Pseudomonas aeruginosa* (7.0–7.7%), *Candida* spp. (5.6–6.3%), *Klebsiella pneumoniae* (5.8–7.2%), and *Acinetobacter baumannii* (5.0–5.8%). At least 50.0% of the participating hospitals reported methicillin-resistant *S. aureus* (MRSA) (40.0–50.0%). Although the presence of MRSA was reported by several ICUs in the State, cases occurred sporadically in the majority of the institutions. Endemic MRSA, defined by persistent reporting, was restricted to larger university hospitals. Other patterns of antimicrobial resistance were also reported: extended-spectrum  $\beta$ -lactamase-positive *K. pneumoniae*; imipenem-resistant *P. aeruginosa* and *A. baumannii*. Larger university hospitals accounted for most of these patterns of resistance.

The HRN component was reported by 18.0–25.0% of hospitals participating (Table I). Data from these units in the year 2006 are shown in Table III.

## Discussion

Many industrialised countries have established governmental systems for HAI surveillance at national or regional levels.<sup>7–14</sup> There are also multicentre initiatives to obtain data from a pool of hospitals to promote local benchmarking for HAI.<sup>15–18</sup>

Surveillance data regarding HAI in developing countries are limited, although the presumed risk is high, exceeding 25% of admissions in some places.<sup>19</sup> In Brazil, there was no governmental system at either national or regional level until the beginning of the present study. A major limitation for surveillance system implementation is the poor information technology resources available in many public and private hospitals, limiting the forwarding of online data to the CVE. To overcome this limitation, the PSHAISP used a data manager software system known to be widespread in hospitals. The enormous number of hospitals in the State of São



**Figure 3.** Distribution of ventilator-associated pneumonia (VAP), central venous catheter-related bloodstream infection (CRBSI), and urinary catheter-related urinary tract infection (CRUTI) reported rates at the hospitals in the Programme for Surveillance of Healthcare Associated Infections in the State of São Paulo, 2004–2006.

Paulo poses a challenge to establish a disease surveillance system. Despite this, the combination of educational efforts and a low cost surveillance system that was easier to feed and interpretate encouraged greater participation on a regular basis. In a country with limited resources, these are critical in encouraging participation in infection prevention and control programmes at local level.

The data reported here are the initial results from a system that is due for improvements. It seems that the reported rates are similar to other studies which show high rates for VAP and CRBSI in developing countries.<sup>15–17,20,21</sup> The huge incidence of coagulase-negative staphylococci in CRBSI can be perhaps explained by both poor laboratory or blood culture collection techniques and difficulties in following the CDC criteria.

It is probable that many hospitals underreported SSI rates, a flaw that reflects failures in surveillance carried out by local infection prevention and control practitioners, and it must be emphasised that the majority of hospitals did not carry out any post-discharge surveillance. On the other hand, data from some specialties like cardiac and neurosurgery suggested the need for a surgical infection prevention programme led by the CVE. Underreporting may also explain the large number of HRN units without any ventilator or primary bloodstream infection.

The surveillance system has continued with some improvements after 2006. To improve the quality of surveillance data, desirable further steps would include an investigation on the quality of surveillance protocols in the participating hospitals and efforts to ensure the accuracy of data.

The present data show that the incidence of multidrug-resistant pathogens (such as MRSA) is a matter of concern in hospitals in the State. Further details about the methodology of culture collection and specimen processing among the participating hospitals is required to explore this further.

**Table II**  
Distribution of the percentiles for device utilisation ratios of mechanical ventilation, central line and urinary catheters reported by hospitals participating in the Programme for Surveillance of Healthcare Associated Infections in the State of São Paulo, 2004–2006

	Mechanical ventilation			Central line			Urinary catheter		
	2004	2005	2006	2004	2005	2006	2004	2005	2006
Percentile									
10th	0.21	0.19	0.22	0.21	0.21	0.22	0.42	0.41	0.41
25th	0.32	0.31	0.33	0.36	0.32	0.37	0.57	0.56	0.56
50th	0.43	0.42	0.45	0.52	0.48	0.53	0.70	0.68	0.70
75th	0.53	0.54	0.56	0.62	0.64	0.68	0.78	0.79	0.80
90th	0.61	0.64	0.65	0.78	0.76	0.76	0.86	0.86	0.88
No. of units included	137	213	241	137	213	241	137	213	241
Total no. of patient-days	470 713	612 855	828 044	470 713	612 855	828 044	470 713	612 855	828 044

**Table III**

Percentiles of the distribution of device utilisation ratios and device-associated infections by birth category in high risk babies from 123 participating hospitals in the Programme for Surveillance of Healthcare Associated Infections in the State of São Paulo, 2006

Birth weight category	Device utilisation ratio					Device-associated infection rates				
	10th	25th	50th	75th	90th	10th	25th	50th	75th	90th
	Mechanical ventilation					VAP				
≤1000 g	0.26	0.41	0.60	0.72	0.82	0.0	0.0	5.57	16.82	26.81
1001–1500 g	0.12	0.19	0.33	0.48	0.58	0.0	0.0	0.0	13.22	27.78
1501–2500 g	0.05	0.10	0.20	0.32	0.52	0.0	0.0	0.0	17.86	35.71
≥2500 g	0.07	0.13	0.22	0.39	0.52	0.0	0.0	0.0	12.50	30.04
	Umbilical and central line					CRBSI				
≤1000 g	0.22	0.39	0.52	0.73	0.93	0.0	0.0	9.39	24.44	52.23
1001–1500 g	0.11	0.24	0.42	0.61	0.80	0.0	0.0	13.00	34.08	53.14
1501–2500 g	0.08	0.15	0.29	0.42	0.65	0.0	0.0	10.99	28.09	48.28
≥2500 g	0.07	0.16	0.31	0.45	0.65	0.0	0.0	8.88	23.28	49.43

VAP, ventilator-associated pneumonia; CRBSI, catheter-related bloodstream infection.

The results of the PSHAISP show that it is feasible to collect data from a large number of hospitals to provide an overview of the HAI magnitude in the State of São Paulo. This will aid in the planning and assessment of statewide preventive initiatives, including educational efforts, hygiene audits and the appropriate allocation of resources.

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### Conflict of interest statement

None declared.

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None.

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