Prevalence of device use and transmission based precautions in nineteen large Australian acute care public hospitals: Secondary outcomes from a national healthcare associated infection point prevalence survey

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Abstract

Background: The use of invasive devices increases the risk of healthcare associated infections (HAI). The recent national HAI point prevalence survey secondary outcomes aimed to estimate the prevalence of patients with an indwelling urinary catheter device and vascular access devices; and also identify prevalence of those managed under transmission based precautions (TBP); and those colonised or infected with a multi drug resistant organism (MDRO).

Methods: A point prevalence study was conducted in large acute care Australian public hospitals. All data were collected by two trained Research Assistants. Surveillance methodology was based on the European Centre for Disease Prevention and Control PPS Protocol. Data was also collected on prevalence of TBPs and MDROs.

Results: A total of 2767 acute adult inpatients were sampled across 19 hospitals. The prevalence of peripheral vascular, central vascular and urinary catheters devices was 55.2% (95% CI: 53.3%–57.1%), 14.8% (95%CI: 13.5%–16.1%) and 20.7% (95%CI: 19.2%–22.3%) respectively.

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Of the 2767 patients sampled 285 (10.3%, 95%CI: 9.2%–11.5%) were documented as either being infected or colonised with a MDRO, and 781 (11.8%) patients were being managed under the hospital TBP policy.

Conclusion: This is the first national study to describe the prevalence of devices, TBPs and MDROs in Australian healthcare settings. In an era where device use should be constantly reviewed to minimise risk of HAI, and the increasing challenges of managing patients with MDROs, this data can serve as a benchmark for future studies.

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Highlights

- New national data on invasive device prevalence.
- Prevalence higher than that reported in European studies.
- Broad variation in prevalence of patients in transmission based precautions.
- Variable availability of single rooms present challenges managing patient with resistant organisms.

Introduction

The association of invasive devices and healthcare associated infections (HAI) is well established. It is suggested that approximately 50% of all urinary tract infections (UTIs) are associated with the presence of a urinary catheter, and up to 64% of bloodstream infections are associated with a vascular device [1]. We recently reported on a healthcare associated infection point prevalence survey (PPS) in Australian hospitals that identified that bloodstream and urinary tract infections represented almost 30% of all HAIs. It also identified that 11.8% of patients were being managed in transmission based precautions [2].

Recent international and Australian guidelines promote increased caution on the use of invasive devices, including regular review of indications for their ongoing use [1,3]. Whilst prevalence data on urinary and vascular device use has been published internationally [4–7], little has been published in Australia [8,9]. Improved knowledge of device prevalence would be beneficial when assessing effectiveness of quality improvement measures, planning research and of interest in the context of procurement.

With the emergence of patients with multi-drug resistant organisms (MDROs), a constant challenge for infection prevention teams is the management of patients under transmission based precautions (TBP). Both national and jurisdictional guidelines for the management of patients with an MDRO refer to the use of TBP, most commonly contact precautions [3,6,10]. Implementing TBPs comes with its own burden of extra healthcare resources including use of personal protective equipment, special cleaning, and in some instances single room placement. The role of contact precautions in preventing the spread of MDROs is well-established, although there is a lack of high quality evidence supporting its use, particularly if active screening is not implemented [11,12]. Furthermore evidence demonstrates that when patients are being managed in contact precautions, they are less satisfied with their healthcare and are less likely to be visited by healthcare workers [11,13]. International data suggests that 10%–25% of inpatients are managed in contact precautions [11]. In Australia, the prevalence of patients managed under TBPs is unknown.

In 2018, the first national HAI PPS for 34 years was undertaken in nineteen large acute care facilities across Australia [2]. Data was also collected on device use, multi drug resistant organism and transmission based precautions.

The secondary aims of the HAI PPS were to estimate the prevalence of patients with an indwelling urinary catheter device and vascular access devices; and those colonised or infected with a multi drug resistant organism; and those managed under transmission based precautions.

Method

The surveillance methodology used in this PPS has been described in detail elsewhere [2,14]. In brief, we conducted a PPS based on the European Centers for Disease Control and Prevention (ECDC) standardised methodology for PPS on HAIs [15]. This was undertaken in a sample of large Australian acute care public hospitals over a 4 month period. Following an expression of interest, hospitals were purposefully selected based on the following criteria: public sector, classified as either Principal Referral or Group A hospital [16], willingness to participate, executive support, presence of an intensive care unit, availability of a resource to assist the research assistants on days of data collection, and broad jurisdictional representation.

In each participating hospital, all acute care inpatient wards were included with the exception of non acute wards, paediatric wards, neonatal ICUs, rehabilitation, accident and emergency departments. Each eligible ward had the following data collected; total number of beds, number of single rooms, number of patients being managed in TBPs, type of TBP and indication.
Patient selection and data

Consistent with the ECDC protocol [15], in each ward meeting the above inclusion criteria, all patients admitted to the ward before or at 0800 on the first survey day, and not discharged from the ward at the time of the survey were eligible. Patients who meet the following criteria on the eligible wards were excluded: patients under 18 years of age (in any hospital ward or unit), patients undergoing same day treatment or surgery, patients seen at outpatient department, patients in the emergency room, dialysis patients (outpatients). As well as basic demographic information and data on a potential HAI, each patient was surveyed for presence of a device (and type), and presence of a MDRO (and type).

Data collection and analysis

Two Research Assistants were recruited to collect all data. Both underwent 4 weeks of training in data collection methodology and use of data collection tools. The Research Assistants also underwent a competency based assessment prior to data collection. Data was collected on mobile devices and entered into a secure online web-based survey tool. Descriptive statistics were used to analyse the data. The prevalence of devices and multi drug resistant organism and was estimated from the proportion with a devices or a MDRO in the patient sample. The prevalence of patients in TBP was estimated from the proportion of patients in TBP in the ward sample. Data were analysed using Stata V14.2 (StataCorp, College Station, Texas, USA).

Results

Hospital data

Data was collected from 19 hospitals (10 Principal Referral hospitals; 9 Group A hospitals) with representation from each Australian state and territory, except for Northern Territory, from 6th August 2018 to 29th November 2018. The total bed size (acute and non acute) of participating hospitals ranged from 110 to 970 (IQR: 252–589). Large variation in infection prevention staffing was observed, with the mean ratio of full time effective infection prevention staff per 100 beds was 0.9 (range 0.3–1.7).

Ward data

Data was sourced from 281 wards classified into 33 different ward types. There were 6623 patient beds across all wards. Of all patient beds, 3069 (46.3%) beds were in a single room of which 2522 (82%, or 38% of all hospital beds) had a dedicated bathroom. The proportion of single rooms across hospitals ranged from 16.0% to 100.0% (IQR: 27.9%–47.3%)

Patient characteristics

A total of 2767 acute adult inpatients were sampled. The median age of patients was 67, ranging from 18 to 104 (IQR: 49–79). Emergency (non-elective) admissions accounted for 2330 (84.2%) of all patients.

Devices

A summary of patients with a device and device prevalence by hospital type are presented in Fig. 1 and Table 1.

Peripheral vascular devices

Individual hospital prevalence of peripheral vascular devices ranged from 43.3% to 71.4%. Prevalence was higher in Group A hospitals (Table 1). The unit specialty with the highest prevalence rate was Cardiology 67.7% (136/201), the lowest was Neurology 33.7% (30/89).

Central vascular devices

The overall prevalence of central venous catheters was 14.8% (410/2767), with individual hospitals ranging from 3.3% to 23.8%. Prevalence in Principal Referral hospitals was almost double that in Group A hospitals (Table 1).

The unit specialties with the highest prevalence rates were the Intensive Care Unit 60.6% (103/170), Haematology/Oncology unit 43.2% (86/199) and Nephrology 24.1% (21/87).

In relation to HAI, of the 38 bloodstream infections identified, 7 (18.4%) met the criteria of device (central vascular device) associated HAI.

Indwelling urinary catheter

The overall prevalence of indwelling urinary catheters was 20.7% (573/2767). Individual hospital prevalence ranged from 12.6% to 28.6%. The unit specialties with the highest prevalence rates were the Intensive Care Unit 76.5% (130/170), Obstetrics/Maternity 32.3% (43/133) and Neurology 28.1% (25/89).

Of the 66 urinary tract infections identified, 51 (77.3%) met the criteria of device associated HAI.
Table 1  Overall device prevalence and by hospital category.

<table>
<thead>
<tr>
<th>Device</th>
<th>Overall Prevalence (95% CI)</th>
<th>Hospital category [16]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral vascular device</td>
<td>55.2% (53.3%–57.1%)</td>
<td>53.5% (51.3%–55.6%)</td>
</tr>
<tr>
<td>Central venous catheter</td>
<td>14.8% (13.5%–16.1%)</td>
<td>16.5% (14.9%–18.2%)</td>
</tr>
<tr>
<td>Indwelling urinary catheter</td>
<td>20.7% (19.2%–22.3%)</td>
<td>21.2% (19.4%–23.0%)</td>
</tr>
<tr>
<td>Invasive ventilation</td>
<td>2.0% (1.5%–2.6%)</td>
<td>2.2% (1.6%–2.9%)</td>
</tr>
<tr>
<td></td>
<td>(Hospital n = 10)</td>
<td>(Hospital n = 9)</td>
</tr>
<tr>
<td>Prevalence Principal Referral</td>
<td></td>
<td>60.5% (56.8%–64.2%)</td>
</tr>
</tbody>
</table>

Invasive ventilation

The overall prevalence of invasive ventilation was 2.0% (55/2767), all patients were in ICU. Individual hospital prevalence ranged from 0% to 4.2%. Prevalence was higher in Principal Referral hospitals (Table 1).

Transmission based precautions

Of the 6623 beds across eligible wards, a total of 781 (11.8%) accommodated patients who were being managed according to the hospital TBP policy. Hospital prevalence of patients in TBP ranged from 3.7% to 25.6% (IQR: 7.3%–14.5%). Overall the most common indications for placement in TBP was presence of methicillin resistant Staphylococcus aureus (MRSA) (30.8%), vancomycin resistant Enterococcus (VRE) (30.5%) and Gram negative organisms (20.8%).

Of the patients being managed in TBP 642 (82.2%) were in contact precautions, 110 (14.1%) in droplet precautions, and 29 (3.4%) in airborne precautions. This pattern was similar for most hospitals, however one hospital had more patients in droplet precautions than contact precautions.

Multi resistant organisms

Of the 2767 patients sampled 285 (10.3%, 95%CI: 9.2%–11.5%) were documented as either being infected or colonised with a MDRO. The most common MDRO’s present within the cohort was VRE 113 (34.3%), MRSA 101 (30.7%) and extended spectrum beta lactamase 67 (20.4%). The prevalence of patients sampled across hospitals with a MDRO ranged from 32.0% to 1.4% (Fig. 2).

Higher prevalence of MDROs was identified in patients who had been in hospital greater than 9 days 7.7% v 17.5% [p < 0.001], those in haematology oncology units (16.6% v 9.8% [p = 0.002]) and those over 50 years of age (11.1% v 8.0% [p = 0.022]).

Discussion

This is the first Australian multicentre study that has identified the prevalence of peripheral vascular, central vascular and urinary catheter devices. Furthermore, it has generated new knowledge on the use of TBPS and the prevalence of MDROs. This provides new insight with important implications on the prevention and management of healthcare associated infections in Australia.
demonstrated in the proportion of patients in contact precautions and healthcare worker compliance with contact precautions [13].

Whilst each hospital is obliged to follow local policy, given the high prevalence of contact precautions in some study sites, it would appear significant resources are being dedicated for a practice where compliance is often uncertain. The use of contact precautions for newly emerged epidemic pathogens is clearly warranted. However, this effectiveness is likely to decline over time with waning compliance, and particularly if routine active screening is not implemented. In this context, it may be worthwhile for institutions to reassess the use of contact precautions, particularly where there are competing needs for single rooms. Infection prevention staffing resources must be considered. Ward staff may require education, daily assessment of the ongoing need for contact precautions and compliance measurement, all impact on infection prevention resources. In our sample, the mean infection prevention FTE per 100 beds was 0.9. Although this is slightly higher than previously reported, this may be because no private facilities were included in this study, whereas the previous study identified lower FTE in the private sector [20]. Given the increased resources for contact precautions, challenges of compliance and the uncertainty of effectiveness, a review of the application of contact precautions in specific populations is warranted, and has been implemented in at least one Australian hospital [21].

Fig. 2 Proportion of patients surveyed with a multi-resistant organism by type and hospital category (n = 2767). MRSA – methicillin resistant Staphylococcus aureus; VRE – vancomycin resistant Enterococcus; CPE- carbapenemase-producing Enterobacteriaceae; SBL- extended spectrum beta lactamase; Cdiff- Clostridium difficile; GN- gram negatives; Agg - Aggregate.

Regardless of whether contact precautions are used for all patients with an MDRO, the burden of MDROs identified in patients included in our study is worth with noting in the context of risk. There is strong evidence that admission to a room previously occupied by a patient with a MRDO increases the risk of acquisition in the newly admitted patient. Thus, prevention measures, such as improving routine hospital cleaning and cleaning on patient discharge, become important in the context of reducing subsequent infection with an MDROs, such a VRE [22,23].

Limitations of this study included the potential for selection bias, as hospitals were not randomly selected. Second, the hospital sample was limited to large public adult hospitals that may not be representative of smaller, specialist and private hospitals. Third, limited patient-level risk factors were collected, preventing adequate patient-level risk adjustment.

For the first time in Australia, we have provided a data on the prevalence of device use, patients in TBPs and those with MDROs. The data can now be used to inform infection prevention and research priorities for the future.

Ethical considerations

The study was approved by the Alfred Health Human Research Ethics Committee (HREC/17/Alfred/203) through the National Mutual Assessment process for all states and territories except for Tasmania for which a separate approval was obtained from the Tasmanian Health and Medical Human Research Committee (H0016978) for participating Tasmanian hospitals. Site specific authorisation was granted for each participating hospital.

Authorship statement

PLR and BGM developed the study concept and supervised data collection. All authors were involved in the study design. PLR and ACC analysed the data with input from all authors. PLR drafted the initial manuscript. BGM provided input on early drafts. All authors made contributions to the final draft of the manuscript and were involved in revising it critically for important intellectual content.
Conflict of interest

There are no conflicts to declare.

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