‘Real-time’ burden of community and healthcare-related infections in medical and rehabilitation patients in a public hospital in Auckland, New Zealand

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ABSTRACT

AIMS: To determine the prevalence and spectrum of infections on admission, or acquired during hospitalisation (HAI) at Waitakere Hospital, Auckland.

METHODS: A questionnaire was completed on two separate days for all adult in-patients admitted to medical and rehabilitation wards for greater than 24 hours. Information obtained included patient characteristics, the presence and type of infection on admission or acquired during hospitalisation, as well as information on indwelling devices.

RESULTS: Infection was the admitting diagnosis in 81 (41%) of 195 patients reviewed, with lower respiratory tract infection (LRTI) diagnosed in 50%, urine infections in 22% and cellulitis 18%. Only 40% LRTIs were supported by radiology or microbiological criteria. Twenty-five HAIs occurred in 21 patients (cumulative and point prevalence of 10.7% and 5.0% respectively). Urinary tract infection (UTI) was the most common HAI in 13 patients (62%), including 4 catheter-related infections. Patients with HAI were older and appeared to have had longer hospital stays, and higher urinary catheter usage.

CONCLUSIONS: This study highlights the ongoing high burden of infections contributing to hospitalisation of adult patients in a developed country. The prevalence of HAI, patient characteristics and risk factors are comparable to previous studies in similar settings.

Infection, either on admission to hospital or acquired during inpatient stay (hospital-acquired infection, HAI), continues to be a common diagnosis requiring healthcare provision. Baker et al recently reported that in New Zealand, infection-related admissions to hospital were rising. In New Zealand, it is estimated that about 10% of inpatients will develop an HAI sometime during their hospital admission. HAIs result in additional costs largely related to longer lengths of stay, as well as extra costs for diagnostic tests and treatment. Graves et al, in 2003, estimated that the annual cost to New Zealand hospitals from HAIs in medical and surgical patients is between $50 and $85 million.

The main purpose of our study was to determine the prevalence and spectrum of infections at the time of hospital admission or those acquired during hospitalisation. The study population were adult medical patients admitted to general medical or rehabilitation wards at Waitakere Hospital. This 135-bed hospital provides acute general medical and rehabilitation services to a population of approximately 250,000 in West Auckland. There are 92 general medical and 45 rehabilitation beds.

Methods

A survey of all adult patients was performed on two separate days, in late
winter (29 August) and late spring (19 November), 2013. All 6 medical and 3 rehabilitation teams were instructed to complete a study questionnaire incorporating questions on patient demographics, co-morbidities, the reason for admission and presence of infection on admission, information about indwelling devices, and details about any HAI present either at the time of evaluation, or occurring at any stage during the current hospitalisation.

HAI was diagnosed if an infection occurred on or after the third calendar day of hospitalisation (where admission day is considered first calendar day), as per standard CDC/NHSN definition. http://www.cdc.gov/nhsn/PDFs/pscManual/2PSC_IdentiifyingHAIss_NHSNcurrent.pdf

Patients admitted for less than 24 hours were excluded from the study. Admission to a rehabilitation ward was considered a continuum of the current hospitalisation if patients were transferred from another inpatient service.

The diagnosis of infection were based on clinical criteria by the respective medical teams and microbiologic and/or radiologic confirmation was not required (except in bloodstream infections, urinary tract infections and C. difficile). These responses were used to calculate outcome measures-point prevalence and cumulative prevalence.

Point prevalence was defined as presence of an active HAI at the time of performing the survey.

Cumulative prevalence was defined as HAI diagnosed at any time during the current hospital stay (including patients in point prevalence analysis).

Denominator for both measures was the total number of inpatients present on the respective survey days.

Infection was categorised as **lower respiratory tract (LRTI)** (including acute bronchitis, COPD exacerbation, clinically-suspected pneumonia with or without the presence of new infiltrate on chest x-ray, exacerbation of bronchiectasis, etc); **urinary tract (UTI)** (uncomplicated cystitis to urosepsis with (a) pyuria, with or without fever or urinary symptoms, and growth of at least $10^5$ CFU/ml of up to two different bacteria, or (b) pure growth of single bacterial species $>10^5$ CFU/ml, regardless of symptoms, treated by clinician as UTI, or (c) Mixed culture of $>10^5$ CFU/ml and pyuria in a symptomatic patient treated as UTI); **skin and soft tissue (SSTI)** (cellulitis, abscess, infected ulcers); **Influenza-like illness (ILI)** (acute onset fever with headache, myalgia’s, sore throat, coryza); **gastrointestinal** (including C. difficile, gastroenteritis); and others.

This study was registered and approved by the Awhina Knowledge and Research Centre of the Waitemata District Health Board.

Statistical analysis was performed using Microsoft Analyse-it software.

**Results**

A total of 271 patients were in hospital during the two study days, including 49 new admissions. Hospital occupancy was 99% on both days. One hundred and ninety-five patients (98 in August, 97 in November), consisting of 127 medical and 68 rehabilitation-ward patients were included. Seventy-six patients had been in hospital less than 24 hours and were excluded. Data from both periods were combined. The mean patient age was 73.5 years (range 17–98 years), and females predominated (65%). Common co-morbidities included ischaemic heart disease (n=63), diabetes (n=50) and chronic lung disease (n=32). Fifteen patients had advanced dementia.

Ethnicity data revealed that 72% of respondents were New Zealand Europeans, 12% Pacific peoples, 3.6% Māori and 3.6% Asian. Data were missing for 8.7% of participants. Patients were predominantly admitted from the community (75%) or long-term care facilities (20%).

The length of stay before the study day assessment was available only for the August cohort. This was a mean of 5.5 days (range 2–29 days) for medical patients and 12.5 days (range 2–30 days) for rehabilitation patients.

No significant differences in demographic characteristics were observed between the August and November cohorts.

**Infection as admitting diagnosis**

Overall, 85 episodes of infection were documented in 81 (41%) patients at the time of admission; 71 as the primary reason for admission, and 10 as secondary
Figure 1: Spectrum of 85 infections seen on hospital admission

![Graph showing the spectrum of infections seen on hospital admission.](image)

LRTI: lower respiratory tract infection, UTI: urinary tract infection

Table 1: Characteristics and spectrum of hospital acquired infections in 21 patients

<table>
<thead>
<tr>
<th>No.</th>
<th>Age (Yr.)</th>
<th>Reason for admission</th>
<th>HAI type</th>
<th>Location at acquisition</th>
<th>Duration of stay before HAI (days)</th>
<th>Indwelling device</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>91</td>
<td>Rehab. post hip arthroplasty</td>
<td>UTI</td>
<td>Rehab.</td>
<td>2</td>
<td>None</td>
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<tr>
<td>2</td>
<td>93</td>
<td>Reduced mobility</td>
<td>UTI</td>
<td>Rehab</td>
<td>10</td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>81</td>
<td>Stroke, UTI</td>
<td>LRTI-HA</td>
<td>Gen Med</td>
<td>2</td>
<td>None</td>
</tr>
<tr>
<td>4</td>
<td>80</td>
<td>Pneumonia</td>
<td>UTI</td>
<td>Gen Med</td>
<td>10</td>
<td>IDC</td>
</tr>
<tr>
<td>5</td>
<td>94</td>
<td>Mechanical fall</td>
<td>UTI</td>
<td>Rehab</td>
<td>17</td>
<td>IDC, IVL</td>
</tr>
<tr>
<td>6</td>
<td>83</td>
<td>UTI, pneumonia, cellulitis</td>
<td>C. difficile</td>
<td>Gen Med</td>
<td>40</td>
<td>IDC, IVL</td>
</tr>
<tr>
<td>7</td>
<td>81</td>
<td>UTI</td>
<td>LRTI-HA</td>
<td>Gen Med</td>
<td>4</td>
<td>IVL</td>
</tr>
<tr>
<td>8</td>
<td>98</td>
<td>Cellulitis</td>
<td>LRTI-HA</td>
<td>Rehab</td>
<td>5</td>
<td>IDC</td>
</tr>
<tr>
<td>9</td>
<td>70</td>
<td>Reduced mobility</td>
<td>LRTI-HA</td>
<td>Gen Med</td>
<td>4</td>
<td>IDC</td>
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<tr>
<td>10</td>
<td>88</td>
<td>Cardiac</td>
<td>Wound</td>
<td>Rehab</td>
<td>48</td>
<td>IDC</td>
</tr>
<tr>
<td>11</td>
<td>85</td>
<td>Collapse</td>
<td>Wound PPM UTI</td>
<td>Gen Med</td>
<td>20</td>
<td>IVL</td>
</tr>
<tr>
<td>12</td>
<td>88</td>
<td>COPD exacerbation</td>
<td>UTI</td>
<td>Gen Med</td>
<td>11</td>
<td>IDC</td>
</tr>
<tr>
<td>13</td>
<td>84</td>
<td>Cellulitis</td>
<td>UTI</td>
<td>Gen Med</td>
<td>25</td>
<td>IDC</td>
</tr>
<tr>
<td>14</td>
<td>81</td>
<td>Rehab post hip arthroplasty</td>
<td>LRTI-HA</td>
<td>Rehab</td>
<td>6</td>
<td>IVL</td>
</tr>
<tr>
<td>15</td>
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<td>Wound—pressure sore</td>
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<td>31</td>
<td>IVL</td>
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<tr>
<td>16</td>
<td>79</td>
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<td>UTI</td>
<td>Rehab</td>
<td>1</td>
<td>IVL</td>
</tr>
<tr>
<td>17</td>
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<td>N/A</td>
<td>UTI</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>18</td>
<td>85</td>
<td>Collapse</td>
<td>UTI</td>
<td>Rehab</td>
<td>8</td>
<td>None</td>
</tr>
<tr>
<td>19</td>
<td>90</td>
<td>Fall</td>
<td>UTI</td>
<td>Gen med</td>
<td>6</td>
<td>IVL</td>
</tr>
<tr>
<td>20</td>
<td>88</td>
<td>Mobility issues</td>
<td>UTI</td>
<td>Rehab</td>
<td>14</td>
<td>None</td>
</tr>
<tr>
<td>21</td>
<td>86</td>
<td>Fall</td>
<td>UTI, LRTI-HA</td>
<td>Rehab</td>
<td>21</td>
<td>None</td>
</tr>
</tbody>
</table>

diagnosis. Lower respiratory tract infections were the most prevalent form of infection (Figure 1). Other common infections on admission included urinary tract infections and cellulitis. Influenza-like illness were only seen in August. Notably, of the 35 patients with primary admitting diagnosis of LRTI, only 14 had a definite indication for antibiotic use ie, chest x-ray with consolidation (11) or positive sputum culture/urinary antigen without consolidation (3).

### Hospital-acquired infections

Twenty-one patients developed 25 episodes of HAI, identified between admission and study dates (cumulative HAI prevalence of 10.7%). Ten patients had an HAI present on the study days (point prevalence 5%). Information on demographics and device use was unavailable for one patient. Table 1 shows the individual characteristics of patients and spectrum of HAIs. The mean age of patients was 85 years and total length of stay 33 days. The mean duration of stay prior to diagnosis of HAI was 14.5 days (range 1–48 days).

Urinary tract infections were the most common HAI in 13 patients (62%), and included two cases of urosepsis. Other HAIs included six hospital acquired LRTIs, three wound infections and one case of C. difficile colitis. Approximately 60% of HAI events with positive cultures yielded E. coli or Klebsiella sp. (including ESBL-producing Enterobacteriaceae).

An indwelling device was present in 89 patients (45.6%); 75 had peripheral intravenous lines and 12 had urinary catheters. Eight of 12 urinary catheters were long-term and present on admission. Twelve of 66 patients (18%) in the rehabilitation ward had indwelling devices compared to 76 of 127 medical patients (60%).

Table 2 shows selected characteristics of patients diagnosed with an HAI compared to the non-HAI group. We offer this table for descriptive purposes only, as we cannot draw conclusions on any differences between these groups without control of confounding or mediating factors. Patients with HAI were older and more likely present in rehabilitation ward at the time of diagnosis. Average length of stay was much longer in HAI group, but the study was not designed to assess whether this was a risk factor for the HAI or a consequence of the HAI. A high proportion of patients (43% and 46%) had either an indwelling peripheral vascular catheter or urinary catheter present prior to diagnosis of HAI. In contrast, only 16 (8%) had invasive procedures performed (19% in HAI and 6.8% in non-HAI group). There were no immediate post-surgical patients in the study cohort. None of the 4 HAI’s were directly related to the procedure performed. No difference was found in terms of presence of indwelling devices or invasive procedures in the HAI vs non-HAI group.

### Discussion

Infections are a common reason for admission to hospital. In addition, hospital acquired infections can complicate inpatient stay. Our study shows that in adult patients hospitalised for more than 24 hours, clinically diagnosed infections were present in 41% at the time of admission either as a primary or
secondary diagnosis. Lower respiratory tract infections were the most common type of infection present on admission. Baker et al\(^1\) showed that infections, as a principle diagnosis based on ICD diagnostic codes, accounted for 27% of hospitalisations in New Zealand between 2004 and 2008. They included admissions with durations of less than 24 hours and paediatric patients, and also noted increasing rates of admissions related to infection from 1989 to 2008. The published New Zealand data documenting the rates of infection present at hospital admission in adults is scarce.

Hospital-acquired infections are common. It is estimated that about 10% of patients admitted to a hospital in New Zealand, or any developed country, will acquire a healthcare-related infection.\(^2\) In our study, HAIs occurred with a cumulative prevalence of 10.7% and point prevalence of 5%. The HAI point-prevalence rate of 5% is comparable with other studies, including a recent Centers for Disease Control and Prevention (CDC) study of acute care hospitals in the US, which showed that on any given day, about 4% patients had at least one healthcare-related infection.\(^3\) Eurosurveillance data from acute care hospitals in Europe between 2011 and 2012, showed that on any given day 5.7% of patients (ie, one in 18 patients) had at least one HAI.\(^4\) In our study population, UTIs were the most common HAIs and were often catheter-associated. Two-thirds of those with catheter-related UTIs had long-term urinary catheters and in these patients hospital onset infections would not be easily preventable. In this study, the mean duration of hospital stay in patients with HAI was 33 days, compared to the non-HAI patients (15.1 days), and the duration of stay prior to HAI diagnosis (14.5 days). Since this study was not specifically designed to assess the contribution of HAI to length of hospital stay, we are unable to draw any conclusions from this observation.

HAIs are costly, both financially for the healthcare facility and for the patient in terms of loss of income and effects on quality of life. A study by Burns et al in 2010 looked at the cost of HAIs, and in particular the cost of blood stream infections occurring in adult patients admitted to Auckland City Hospital.\(^5\) They showed that the cost of hospital-associated blood stream infections (HA-BSIs) in a combined group of medical and surgical patients (excluding those on renal replacement therapy) was in excess of $20,000 per case. The main factor contributing to the additional cost was the longer length of stay.

Our study was performed by utilising the services of training doctors who, after an initial information session with the study investigators about data collection, completed the survey questions for their respective team patients in a real time. This approach minimised recall or interpretation bias. However, several limitations need mention. Firstly, we assessed the burden of infection in adult patients only admitted to a medium-sized Auckland hospital where no acute surgical services are present. Results may therefore not be generalised to other centres. Secondly, our exclusion of patients with less than 24-hour stay may have underestimated infections diagnosed on admission. Thirdly, we used clinician-based diagnosis criteria for respiratory tract infections to reflect ‘real-world’ practice, since the majority of these patients are prescribed antibiotics. This possibly over-estimated the true prevalence of infections. Fourthly, our assessment of cumulative HAI prevalence was based on hospital stay till the study day, which would not capture patients with HAI during the remaining period of hospitalisation. Despite these limitations, we highlight the continuing high burden of infectious diseases in adult patients admitted to hospital with consequent pressure on bed numbers, as well as antibiotic usage. In addition, our cumulative rate of hospital-acquired infections of approximately 10% has major implications in terms of costs to both healthcare institutions and patients. Risk factors for HAIs are well known and include devices such as intravenous lines, indwelling catheters, broad-spectrum antibiotics (predisposing to \(C.\)difficile\) etc. Some factors are modifiable and best practice recommends avoiding unnecessary devices, removal of ‘idle’ catheters, strict adherence of hand hygiene, and rationalisation of antibiotic use to reduce the risk of these infections.

In conclusion, this study shows that infections continue to be a significant source of morbidity in hospitalised adult patients in New Zealand, both at the time of admission and during hospitalisation.
ARTICLE

Competing interests: Nil

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