Analysis of knowledge and attitude surveys to identify barriers and enablers of appropriate antimicrobial prescribing in three Australian tertiary hospitals

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Key words
anti-infective agent, attitude of health personnel, attitude of health personnel, clinical competence, inappropriate prescribing, questionnaire.

Abstract

Background: Antimicrobial stewardship programmes aim to optimise use of antibiotics and are now mandatory in all Australian hospitals.

Aim: We aimed to identify barriers to and enablers of appropriate antimicrobial prescribing among hospital doctors.

Methods: Two paper-based and one web-based surveys were administered at three Australian university teaching hospitals from March 2010 to May 2011. The 18-item questionnaire recorded doctors’ level of experience, their knowledge regarding the use of common antimicrobials and their attitudes regarding antimicrobial prescribing. Local survey modifications allowed inclusion of specific questions on: infections in intensive care unit patients, clinical microbiology and use of local guidelines.

Results: The respondents (n = 272) were comprised of 96 (35%) registrars, 67 (25%) residents, 57 (21%) interns and 47 (17%) consultant hospital doctors. Forty-one per cent were working in a medical specialty. Identified barriers included: gaps in antimicrobial prescribing knowledge (especially among interns), a lack of awareness about which antimicrobials were restricted and a reliance on senior colleagues to make antimicrobial prescribing decisions. Enablers of optimal prescribing included: an acknowledgement of the need for assistance in prescribing and reported readiness to consult national prescribing guidelines. These results were used to help guide and prioritise interventions to improve prescribing practices.

Conclusion: A transferable knowledge and attitudes survey tool can be used to highlight barriers and facilitators to optimal hospital antimicrobial prescribing in order to inform tailored antimicrobial stewardship interventions.

Introduction

Antimicrobial resistance is an increasing problem worldwide. A strategic global response is required to preserve current antibiotics and to reduce development of resistance.1–5 Antimicrobial stewardship programmes aim to optimise antimicrobial use and are now required as part of accreditation of many hospitals worldwide, including Australia.6 Effective antimicrobial stewardship interventions include audit and feedback, education, academic detailing, antimicrobial restriction and approval and computerised decision support.6 However, the optimal model of antimicrobial stewardship is likely to differ depending on the context, and a challenge for all institutions is to find an antimicrobial stewardship model that fits the prescribing culture of that particular institution to best facilitate sustainable change.7,8 Interventions that are tailored to address specifically identified barriers are more likely to change behaviour and to improve professional practice.9 Prompted by the experience at an initial centre,10 three hospitals adapted a survey tool to identify particular barriers to and enablers of appropriate antimicrobial prescribing. We present the results of surveys performed at these three institutions and their

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approaches to addressing the barriers and enablers identified.

We aimed to assess the knowledge and explore the attitudes of Australian hospital doctors to antibiotic use in order to identify barriers to and enablers of appropriate antimicrobial prescribing.

Methods

Setting

This study involved three Australian tertiary adult hospitals, with 350–700 beds each, in Melbourne and Brisbane. Each hospital had infectious diseases (ID) registrars who provided telephone and in-person consultations as required for complex patients. The hospitals had formularies and policies that required approval from the infectious diseases service for the use of nominated restricted, mainly broad-spectrum antimicrobials. All hospitals had some local prescribing guidelines as well as access to the Therapeutic Guidelines: Antibiotic, a nationally available antibiotic prescribing guideline available through the intranet. At the time of the survey, there were no antimicrobial stewardship teams providing post-prescription review. All three hospitals provided antimicrobial education in the form of a lecture at intern orientation. Hospital A wards, but not their intensive care unit (ICU), had a web-based decision support system at the time of the survey.

Survey design and administration

This study was approved as a quality assurance project by the ethics committees at all three hospitals as it was low risk as per National Health and Medical Research Council guidelines and, therefore, did not require full ethics approval. The survey had been developed by a multidisciplinary team of infectious diseases and microbiology doctors and a pharmacist and had been piloted at another site. The original questionnaire had 18 questions: three on participant level of experience and current role, 10 multiple choice questions regarding knowledge about appropriate antimicrobial use and five Likert-type questions assessing attitudes to antimicrobial stewardship. There were several additional free text boxes for comments. All questions testing knowledge about antimicrobial use reflected the recommendations in the Therapeutic Guidelines: Antibiotic (Appendix). Six of the 10 multiple-choice questions on antimicrobial knowledge were common across all three hospitals. Investigators at individual institutions modified some questions to identify specific barriers to and enablers of appropriate antimicrobial prescribing of particular interest at their site. At hospital A, ICU and ward doctors received different surveys.

Examples of modifications included: questions on empiric meropenem use for ICU doctors, in an effort to identify potential knowledge gaps that might explain high levels of meropenem use in that department (hospital A); questions on Gram’s stain characteristics of common bacterial pathogens in response to observed knowledge gaps among junior doctors (hospital B); and, questions on attitudes towards specific antimicrobial stewardship interventions prior to planned implementation of a web-based decision support and approvals programme (hospital C).

Survey administration varied by institution, but all surveys were anonymous and voluntary. Participants were doctors employed at the three hospitals. Doctors in Australian hospitals are defined by their level of training as follows: interns – first year post-medical school, resident – years two to three post-medical school, registrar – year four and above, and usually enrolled in a specialty training programme (medical or surgical), consultants – vocationally registered and have completed specialty training. Participants self-identified and were purposively sampled at intern, resident and medical registrar education sessions (hospital A, B and C), ICU meetings (hospital A) and grand rounds (hospital B). Hospital A and B’s paper-based surveys were distributed at the start or end of meetings, were generally completed within 10 min and were collected immediately without time to refer to other resources. Hospital C’s medical staff received the survey through email, followed by one reminder email, and had a movie ticket provided as an incentive on completion. All emailed surveys were completed within 1 month of initial distribution.

Statistical analysis

All three hospitals surveys were administered between March 2010 and 13 May 2011. All analyses were conducted in Stata version 12 (StataCorp, College Station, TX, USA). Differences in responses between groups (doctors’ levels of experience) were summarised using mean and standard deviation (SD) and were analysed using a non-parametric Kruskal–Wallis (KW). Pairwise differences between experience levels were analysed using a post-hoc Dunn test with Bonferroni correction for multiple simultaneous comparisons. Where a Bonferroni deflation of the P-value significance cut-off was not required, P < 0.05 was considered significant. Likert-type items were analysed using a 5-point scale.

A barrier was defined as process or situation that would potentially impede or obstruct optimal antimicrobial prescribing, whereas an enabler or facilitator was a process or situation which would allow optimisation of antimicrobial therapy. These definitions were established through author consensus.
Results

Surveys were submitted by 313 doctors in three hospitals, but 41 (14%) were excluded as they had submitted blank surveys. Results were therefore analysed on 272 surveys (Table 1). Exact participation rates were unavailable, but the opportunistic sampling at hospital A and B captured more than 90% of those attending the education sessions and lunchtime meetings. Hospital A’s survey captured 80% of their intensive care consultants, 30% of their medical registrars and 15% of their interns. Hospital B’s survey captured 50% of their medical registrars and 30% of their interns. Hospital C’s emailed survey estimated a 30% response rate, and also captured 30% of their registrars. Forty-five per cent of all participants were from a medical specialty.

Differences between experience levels in knowledge and attitudes to antimicrobial prescribing

Regarding common knowledge questions, registrars were found to have the highest number of correct responses, followed by consultants, then residents and interns (Fig. 1). There was a significant difference between groups (KW $P = 0.001$), with consultants, registrars and residents scoring significantly higher than interns ($P < 0.001$), and registrars scoring significantly higher than residents ($P < 0.001$). Consultants did not score significantly differently to residents ($P = 0.19$). With respect to attitudes questions, interns reported requiring a significantly higher level of assistance in choosing antibiotics (mean 4.0 (SD 0.96)) than the other levels of experience (mean 3.2 (SD 0.1)) ($P < 0.001$) (Fig. 2).

Identified barriers to and enablers of appropriate antimicrobial prescribing

Results of Likert-scored attitudes questions are displayed in Figure 3. Enablers identified included: the consultation of pharmacists and infectious diseases units, the use of Therapeutic Guidelines and the belief that prudent antimicrobial use will result in reduced resistance. Barriers included: a poor awareness of local unit and hospital guidelines, prescribers’ belief that they were aware of the management of most common conditions (despite suboptimal knowledge scores) and a lack of awareness of which antimicrobials were restricted.

Results of specific hospitals

Hospital A

Of the 74 staff surveyed at hospital A, 27 worked in the ICU, and this group was asked to complete a specifically modified questionnaire (Appendix). The question on
appropriate indications for empiric prescription of meropenem was answered correctly by 8/27 (30%) of surveyed ICU staff. Four per cent (1/27) chose the duration of antibiotic therapy for uncomplicated ventilator-associated pneumonia that was consistent with the recommendations in the National Guidelines. Twelve out of 27 ICU doctors (44%) reported that they were aware of which antimicrobials were restricted. One hundred per cent of ICU medical staff agreed or strongly agreed that prudent antimicrobial use was important to reduce resistance in their ICU.

**Hospital B**

Hospital B interns, registrars and consultants completed a table describing the Gram’s stain (Gram-positive or negative, bacilli or cocci) of common organisms (Staphylococcus aureus, Eschericia coli, Enterococcus, Pseudomonas, Listeria, Neisseria meningitidis, Enterobacter). Consultants had significantly higher Gram’s stain scores compared to other levels of experience (mean 5.4 (SD 1.5) versus non-consultants mean 4.0 (SD 1.1) (P = 0.001)). Forty-one per cent of respondents (27/66) reported that they were aware of which antimicrobials were restricted.

**Hospital C**

At hospital C, 61% (72/117) of respondents answered ‘because my consultant asked me to’ when asked about reasons for inappropriately commencing broad-spectrum antimicrobials or for not de-escalating antimicrobial therapy. The second most common answer in 48% (more than one option allowed) was ‘I am worried about missing something if I chose a narrow agent’. Seventy-three per cent of respondents reported that they were aware of current national guideline recommendations for the management of common clinical conditions. Overall 53% were equivocal or disagreed with the comment ‘I find contacting ID to be easy and effective’. One-third of respondents reported that they thought web-based approval would be a better process (than the current ID registrar approvals system). Forty-nine per cent responded ‘it would depend on how easy the system is to use’.

**Qualitative responses in survey**

Although this survey was primarily quantitative, the free text boxes in hospital C’s survey allowed participants to express views in their own words. Table 2 contains...
Three main themes emerged from hospital C’s free text box comments: fear of consequences (of inappropriate antibiotic prescribing and of a web-based decision support programme), time management issues (with obtaining approval for restricted antimicrobials) and general support for antibiotic restriction.

**Analysis of results using a theoretical framework**

An understanding of strategies to address identified barriers and enablers can be achieved in part through application of behaviour change theory. A recent consensus document formulated the theoretical domains framework (TDF) several key themes relevant to changing healthcare behaviour. These include: knowledge, skills, social/professional role and identity, beliefs about capabilities, optimism, beliefs about consequences, intentions, goals, memory, attention and decision processes, reinforcement, environmental context and resources, social influences, emotion and behavioural regulation. The TDF has been used to identify barrier and enablers and inform behaviour change strategies in several different healthcare disciplines, including medication safety and hand hygiene. Although we did not design the survey with prior knowledge of the TDF, we found that this formed a useful framework to understand our results, to inform targeted interventions and to feed back the results to medical staff, key groups and executive. A variety of interventions were proposed as a result of the feedback in each hospital (Table 3).

**Discussions**

This study reports on the results of three similar surveys that aimed to explore barriers to and enablers of appropriate hospital antimicrobial prescribing in order to inform antimicrobial stewardship interventions. Identified barriers include: gaps in antimicrobial prescribing knowledge (especially among internists), a lack of awareness about which antimicrobials were restricted and a reliance on senior colleagues to make antimicrobial prescribing decisions. Enablers of hospital prescribing include: an acknowledgement of the need for assistance in prescribing and reported readiness to consult national prescribing guidelines. Our findings support the results of other antimicrobial knowledge and attitude surveys. Other studies of hospital doctors have identified barriers of antimicrobial prescribing, such as antimicrobial prescribing knowledge gaps, the influence of senior prescribers on junior doctors’ antimicrobial choices and the utilisation of national over local guidelines. Identified enablers included a support of antimicrobial restriction and an awareness of the threat of antimicrobial resistance. All studies suggested that knowledge and attitude surveys could improve antimicrobial stewardship programme implementation but did not necessarily specify what programmes should be implemented.

This study was designed to be a simple modifiable quantitative survey, which meant it was by necessity quite short and did not explore topics in great detail. Of note, one of the TDF domains which was not identified on the survey, ‘emotion’ was clearly relevant when analysing the free text box comments. Development of the survey

**Table 2. Quotations from hospital C’s free text boxes illustrating themes**

<table>
<thead>
<tr>
<th>Theme</th>
<th>Quote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support for antibiotic restriction</td>
<td>‘Absolutely necessary so we don’t end up like the US.’</td>
</tr>
<tr>
<td>Fear of consequences (of antibiotic restriction – through web-based support or ID registrar)</td>
<td>‘I think this is good because it protects the world from resistant organisms bred by our laziness.’</td>
</tr>
<tr>
<td></td>
<td>‘Imposing any further restrictions may cause detriment to patients who require broad spectrum antibiotics.’</td>
</tr>
<tr>
<td></td>
<td>‘If there is difficulty in obtaining approval (e.g. system crash, ID reg busy) that this should not hold up the delivery of the antibiotic to the patient.’</td>
</tr>
<tr>
<td></td>
<td>‘Valuable learning opportunities are embedded in the process (ID phone referrals), hopefully this won’t be lost with the web-based system.’</td>
</tr>
<tr>
<td>Communication difficulties and time constraints (in trying to contact ID for approvals)</td>
<td>‘As a junior doctor the lack of time in the day is the restricting part of this process of obtaining approvals.’</td>
</tr>
<tr>
<td></td>
<td>‘They are often very busy and take some time getting back to you. My interns often have to spend 15 min on the phone just to get an antibiotic approval.’</td>
</tr>
<tr>
<td></td>
<td>‘Depending on the ID registrar but I generally find this to be a very difficult and time consuming task. Almost always needs multiple pages over hours.’</td>
</tr>
<tr>
<td></td>
<td>‘I feel bad for having to contact [the ID registrar] for things which are obvious.’</td>
</tr>
</tbody>
</table>
questions through a priori use of the TDF, and more
detailed exploration of themes through focus groups
and qualitative interviews would improve the validity of
results.15,26,27 Moreover, modification of the survey at each
site meant that it was difficult to compare the results
between institutions. The low–moderate response rate
may have resulted in biases, and we have no detailed
information on non-respondents. Additionally, not all
respondents answered all questions, and we suspect
that some respondents chose not to respond rather
than respond incorrectly. Nevertheless, this survey did
provide information that could be used to help guide
interventions.

Conclusion
All hospitals worldwide currently face significant prob-
lems with inappropriate antimicrobial use and the
growing problem of antimicrobial resistance among
pathogens. Identification of barriers to and facilitators of
appropriate antimicrobial use can be part of an evidence-
based strategy for developing effective antimicrobial
stewardship programmes.9,28,29 We have used a modifi-
able transferable survey tool in three Australian tertiary
hospitals to identify locally relevant barriers and enablers
with which to develop tailored antimicrobial stewardship
programmes.

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driver of multidrug resistant

Table 3 Survey results categorised into behaviour change domains, barriers or enablers and proposed interventions

<table>
<thead>
<tr>
<th>Themes</th>
<th>Survey results (hospital identifier)</th>
<th>Barrier or enabler</th>
<th>Proposed interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Knowledge-gap especially among junior staff (A, B, C)</td>
<td>Barrier</td>
<td>Increase junior staff education</td>
</tr>
<tr>
<td></td>
<td>Clinical microbiology knowledge poor (B)</td>
<td>Barrier</td>
<td>Include microbiology training at medical school</td>
</tr>
<tr>
<td></td>
<td>Appropriate indications for empiric meropenem use unclear (A–ICU)</td>
<td>Barrier</td>
<td>Clarify meropenem indications; develop guideline with ICU</td>
</tr>
<tr>
<td>Skills</td>
<td>Vancomycin dose incorrectly adjusted (C)</td>
<td>Barrier</td>
<td>Pharmacist to dose vancomycin to reduce errors</td>
</tr>
<tr>
<td>Social professional role/identity</td>
<td>Junior doctors influenced by consultants when choosing antibiotics (C)</td>
<td>Barrier</td>
<td>AS team to provide consultant to consultant advice, education and feedback</td>
</tr>
<tr>
<td>Beliefs about capability</td>
<td>Doctors need assistance choosing antimicrobials (A, B, C)</td>
<td>Enabler</td>
<td>Web-based decision support and AS teams to provide assistance to prescriber</td>
</tr>
<tr>
<td></td>
<td>Familiar antimicrobials in use more often (A)</td>
<td>Enabler</td>
<td>Develop lanyards with traffic light indications to improve familiarity</td>
</tr>
<tr>
<td>Optimism (or pessimism)</td>
<td>A web-based approval system is time consuming (A–ICU)</td>
<td>Barrier</td>
<td>Further stakeholder engagement was required before implementing</td>
</tr>
<tr>
<td>Beliefs about consequences</td>
<td>Antimicrobials often continued because doctors worried about ‘missing something’ (C)</td>
<td>Barrier</td>
<td>Point-of-care audit and feedback to doctors by AS team to support timely antimicrobial de-escalation</td>
</tr>
<tr>
<td></td>
<td>Belief that ‘prudent use of antimicrobials will reduce resistance’ (A–ICU)</td>
<td>Enabler</td>
<td>Identify and engage local ICU champions of ‘prudent antimicrobial use’</td>
</tr>
<tr>
<td>Intentions</td>
<td>‘Difficult to know which antibiotics are restricted, so I just wait for a pharmacist to tell me’ (A)</td>
<td>Barrier</td>
<td>Incentives (chocolate) provided to improve intentions</td>
</tr>
<tr>
<td>Environmental context and resources</td>
<td>Obtaining approvals through ID registrar is time consuming (C)</td>
<td>Barrier</td>
<td>Ensure web-based decision support is time efficient and easy to use</td>
</tr>
<tr>
<td></td>
<td>A web-based system needs to be easy to use (C)</td>
<td>Barrier</td>
<td>Use therapeutic guidelines for any antimicrobial stewardship programme</td>
</tr>
<tr>
<td></td>
<td>Therapeutic guidelines used regularly</td>
<td>Enabler</td>
<td>Use therapeutic guidelines for any antimicrobial stewardship programme</td>
</tr>
<tr>
<td></td>
<td>Intranet guidelines difficult to find</td>
<td>Barrier</td>
<td>Increase accessibility through home page links</td>
</tr>
<tr>
<td>Behavioural regulation</td>
<td>Most doctors did not dislike the idea of web-based approval</td>
<td>Enabler</td>
<td>Implement web-based approval</td>
</tr>
</tbody>
</table>

A, B, C, hospital names; A–ICU, hospital A intensive care unit; AS, antimicrobial stewardship; ID, infectious diseases.

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**Appendix S1** Survey questions used in the three hospitals.