Antimicrobial stewardship practice in New Zealand’s rural hospitals

Jared K Green, Sharon J Gardiner, Sarah L Clarke, Lee Thompson, Sarah CL Metcalf, Stephen T Chambers

ABSTRACT

AIMS: We aimed to describe how antimicrobial stewardship (AMS) is practised in New Zealand’s diverse rural hospital network.

METHODS: Rural hospital medical practitioners were surveyed to estimate the utilisation of prescribing resources and specialist support for AMS, and attitudes towards AMS. Questions reflected recommended strategies for AMS programmes.

RESULTS: The response rate was 80.8% (122/151) from 29 rural hospitals (3–114 beds). While 78.7% reported access to local antimicrobial prescribing guidelines, discordant answers from practitioners at the same institution were common. The practice of approval for access to broad-spectrum antimicrobial agents was uncommon. Most respondents had cared for a patient with a multi-drug resistant organism in the preceding 12 months. Only 34.8% of respondents reported receiving formal education on AMS principles, with at least 90% believing it was relevant irrespective of the clinical context considered. Respondents were more likely to believe that antimicrobial overuse and resistance were more relevant at sites distant from the context of rural hospital practice.

CONCLUSION: While AMS is perceived as relevant for rural hospital medicine, many of the building blocks of AMS systems are absent in this environment. This presents an opportunity for development as AMS strategies evolve in New Zealand.

The Infectious Diseases Society of America (IDSA) defines antimicrobial stewardship (AMS) as coordinated interventions designed to improve and measure the appropriate use of antimicrobial agents by optimising their selection and dosing regimens. Despite a growing volume of stewardship research, AMS practice in non-specialist and rural hospital settings is under-explored. Internationally, research conducted to date has focused on institutional surveys, with a handful of papers exploring the introduction and potential benefits of AMS by telemedicine in geographically remote hospitals. Although interest in AMS is increasing in New Zealand, practice is highly variable, even in larger centres. Published work consists mainly of defined daily dose (DDD) studies quantifying antimicrobial consumption in district health boards (DHBs). National and regional AMS strategies are currently under development in New Zealand, including a move towards regional rather than individual DHB antimicrobial guidelines and a national antimicrobial resistance strategy. In this context, study of what is likely to exist at the margins of any new strategy warrants discussion, including developing insight into issues faced by rural prescribers and rural AMS activities to ensure that these aspects are incorporated into mainstream AMS planning.

In the only published insight into rural hospital antimicrobial use in New Zealand, a study of antimicrobial consumption suggested relatively high use of antimicrobial agents in Hawera hospital at 117.6 DDD per 100 bed days, compared to 65.8 for Taranaki DHB as a whole. While it is unclear whether this reflects the case mix of the hospital or suboptimal antimicrobial use, it does warrant further investigation. In contrast, a DDD study looking at outpatient antimicrobial prescribing in Tairawhiti suggested comparatively low rates of prescribing to rural residents.
when compared to residents of Gisborne. Limited research has suggested that rural hospitals elsewhere are likely to have fewer infectious diseases resources available and are less likely to have established AMS programmes. To contribute to grounding research in this area, a mixed methodology study targeting New Zealand’s rural hospital doctor workforce was undertaken.

Materials and methods

A 33-item, electronic survey was created using the SurveyMonkey™ platform (SurveyMonkey Inc. Palo Alto, California, USA). This incorporated multiple-choice questions, Likert scales and free text boxes, enabling collection of quantitative and qualitative data. The survey was designed to assess perceptions of AMS and access to key and supplemental AMS strategies as outlined by the IDSA. It also incorporated questions to assess hospital and practitioner demographics and exposure to multi-drug resistant organisms (MDROs). Free text boxes asked participants to explain what they believed AMS to involve, how they believe it could be improved in the rural hospital environment, and to provide any additional comments. Using the questions as a broad frame, a thematic analysis was performed within each, employing the Framework method, as described by Ritchie and Spencer. This consists of five stages: familiarisation with the data; establishing a thematic framework; indexing/coding; charting; and mapping and interpretation. This was conducted by two authors (JG, SC) independently. While the analysis followed a largely theoretical or deductive pattern, as detailed by Braun and Clarke, attention was paid to the existence of potential latent themes, in addition to those more explicit in the text. Verbatim free-text comments are used to illustrate the themes in the results section.

A hospital was considered rural if it was classified as such by the Royal New Zealand College of General Practitioners’ Division of Rural Hospital Medicine. Hospitals were excluded if they did not provide acute care.

We attempted to survey all doctors who had practised in a rural hospital in the preceding 12 months. A senior clinician or manager was approached at each of the 29 eligible hospitals to identify potential participants. The Division of Rural Hospital Medicine was contacted to identify eligible rural hospital medicine trainees. On 10 September 2014, an electronic link to the survey was emailed to each potential participant, with three reminders sent periodically to non-responders until the survey closed. Responses were de-identified, then downloaded to Microsoft Excel™ (quantitative data) or Microsoft Word™ (qualitative data; Microsoft Corporation; Redmond, Washington, USA) for analysis.

The research team engaged in consultation with Canterbury District Health Board’s (CDHB) Te Komiti Whakarite. It subsequently received ethics approval from the CDHB/University of Otago research committee (reference #14128) and the Ngāti Porou Hauora research office (Gisborne, New Zealand; http://www.nph.org.nz).

Statistical methods

Descriptive methods were used to analyse the results, which were expressed as percentages using the number of responses to that question (variable) as the denominator.

Results

Population characteristics

Senior clinicians and managers from 29 rural hospitals (Figure 1) agreed to participate in the survey, and a total of 151 eligible practitioners were identified. Of these, 122 responded giving a response rate of 80.8% (Table 1). Most of the respondents (84.4%) identified themselves as senior medical officers and the most common scope of practice was rural hospital medicine (RHM) alone, or in combination with another specialist domain such as general practice (GP; 67.3%) (Table 1).
Hospital context

The median number of beds per hospital was 20 (range 3–114). One third of rural hospitals were administered by non-governmental organisations (NGOs, such as community or Māori health trusts [34%; (10/29)]. The model of practice varied, with 41.4% (12/29) reporting their model of care as most consistent with that of an integrated health centre (with a co-located GP clinic, visiting specialist service, diagnostic testing and hospital facility). Only 44.8% (13/29) reported following a more traditional New Zealand public hospital model while 44.8% (13/29) did not have an emergency department (Table 1). Twenty-four hospitals (82.8%) had a medicines service provided by their base hospital (7), a community pharmacy (15) or a mixture of the two (2).
Seventeen hospitals (58.6%) reported that they had access to ward pharmacy services including chart review, while only seven (24.1%) reported having on-site laboratory microbiology (Table 1).

Access to prescribing resources and advice
Most (78.7%) practitioners (96/122) reported having access to antimicrobial guidelines from their own hospital or DHB, but 9.0% (11/122) denied having a local guideline, and 12.3% (15/122) were unsure if local guidelines existed. There were discordant responses to this question from half of the hospitals from which more than one response was received (11/22). With respect to external resources, 68.0% (83 of 122) had made use of a guideline published by another DHB, 51.6% (63 of 122) had used the Best Practice Advocacy Centre’s (BPAC™) Antimicrobial recommendations for primary care, and 63.1% (77 of 122) had used UpToDate™ for antimicrobial guidance.15,16 Rural hospital doctors reported using a mean of 3.5 different prescribing resources in the past year (Figure 2A).

Respondents were most likely to solicit antimicrobial prescribing advice by telephone from specialists who are based at other hospitals or DHBs. If antimicrobial advice was required, infectious diseases physicians were contacted most frequently (80.3%; 98/122). Rural hospital doctors were likely to engage rarely or never with most advisors of antimicrobial prescribing, and to do so by telephone, suggesting that most interactions are likely to be ad hoc [Figure 2B]. Rural hospital practitioners generally agreed that their local processes for obtaining antimicrobial treatment advice were satisfactory (59.3% 70/118) and that it was easy to contact infectious diseases and microbiology services for advice (79.7%; 94/118).

Table 1: Hospital and participant demographics.

<table>
<thead>
<tr>
<th>Hospital characteristics:</th>
<th>Number</th>
<th>Percent or range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital characteristics:</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>Median bed number (range)</td>
<td>20</td>
<td>3–114</td>
</tr>
<tr>
<td>DHB* ownership</td>
<td>19</td>
<td>66%</td>
</tr>
<tr>
<td>NGO** ownership</td>
<td>10</td>
<td>34%</td>
</tr>
<tr>
<td>On-site microbiology service</td>
<td>7</td>
<td>24%</td>
</tr>
<tr>
<td>Ward pharmacy service</td>
<td>17</td>
<td>59%</td>
</tr>
<tr>
<td>Participant characteristics:</td>
<td>122</td>
<td></td>
</tr>
<tr>
<td>Senior medical officer</td>
<td>103</td>
<td>84.4%</td>
</tr>
<tr>
<td>Resident medical officer</td>
<td>12</td>
<td>9.8%</td>
</tr>
<tr>
<td>No response</td>
<td>7</td>
<td>5.7%</td>
</tr>
<tr>
<td>Scope or speciality of practice:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural hospital medicine (RHM) only</td>
<td>34</td>
<td>27.9%</td>
</tr>
<tr>
<td>General practice (GP)</td>
<td>18</td>
<td>14.8%</td>
</tr>
<tr>
<td>RHM and GP</td>
<td>30</td>
<td>24.6%</td>
</tr>
<tr>
<td>RHM and another scope</td>
<td>18</td>
<td>14.8%</td>
</tr>
<tr>
<td>Emergency medicine</td>
<td>11</td>
<td>9.0%</td>
</tr>
<tr>
<td>Internal medicine</td>
<td>4</td>
<td>3.3%</td>
</tr>
<tr>
<td>General surgery</td>
<td>3</td>
<td>2.5%</td>
</tr>
<tr>
<td>No response</td>
<td>4</td>
<td>3.3%</td>
</tr>
</tbody>
</table>

Key: *District health board; **Non-governmental organisation.
Figure 2: Access to prescribing resources, advice and practice of approval.

a) Estimated frequency of use of prescribing resources.

- Hospital/DHB Guideline
- Departmental protocols
- Guidelines from another DHB
- BPAC
- UpToDate

b) Sources of prescribing advice and estimated frequency of engagement.

- Infectious Diseases Physician
- Clinical Microbiologist
- General Physician
- Specialist Registrar/Resident
- Pharmacist
- Local Rural Generalist

c) Is pre- or post-approval sought when prescribing broad spectrum antimicrobials?
Exposure to MDROs

In the preceding year, most clinicians (90.9%; 111/122) reported caring for a patient infected with or colonised by an MDRO or *Clostridium difficile*. Most respondents reported encountering methicillin-resistant *Staphylococcus aureus* (77.0%; 94/122). Extended-spectrum beta-lactamase producing Enterobacteriaceae (ESBL; 59.0%; 72/122), *C. difficile* (47.5%; 58/122) and vancomycin resistant enterococci (VRE; 15.6%; 19/122) were encountered less frequently.

Prescribing and seeking approval for the use of restricted antimicrobials

Participants were asked if they would seek approval if they prescribed from a range of restricted antimicrobials. All the antimicrobials listed [Figure 2C] were restricted to infectious diseases/clinical microbiology specialists by the New Zealand Pharmaceutical Management Authority (PHARMAC™) except ceftriaxone (may be subject to DHB restrictions) and piperacillin/tazobactam (respiratory medicine specialists can also approve use). Approval was unlikely to be sought if practitioners prescribed ceftriaxone (1.7%; 2/115), ciprofloxacin (14.4%; 17/118) or clindamycin (30.4%; 32/105), but was more likely for piperacillin/tazobactam (50.5%; 47/93), cefepime (51.9% 27/52) and meropenem (74.6%; 50/67) (Figure 1C). If approval was sought, respondents would most frequently consult an infectious diseases physician (71%; 69/97) or clinical microbiologist (46%; 45/97).

Access to prospective audit and education

A minority of rural hospital doctors reported that they had received education on the principles of AMS (34.8%; 40/115). While most respondents reported that their pharmacy service did not provide feedback on antimicrobial prescribing (63.9%; 76/119), most of those who had received feedback found it valuable at least some of the time (94.4%; 34/36).

Perceptions of AMS, antimicrobial resistance, and antimicrobial resistance

At least 90.0% of respondents agreed that AMS was relevant irrespective of the potential setting (Figure 3B). In contrast to this, antimicrobial overuse and antimicrobial resistance were more likely to be perceived as national or international issues, rather than rural or regional ones. The Likert scales exhibited a gradient effect in which more respondents were likely to agree that these were problems the further removed the hypothetical context was from their individual practice location (Figures 3B and 3C).
Figure 3: Perceptions of antimicrobial stewardship.

a) Perceived relevance of AMS.

b) Perceived relevance of the problem of antimicrobial overuse.

c) Perceived relevance of the problem of antimicrobial resistance.
of accessibility to stewardship resources. Emphasis was placed on the need for prescribing resources and guidelines to be visible and readily accessible. Where prescribing guidelines were noted to be available, the ability to access them was thought to be difficult.

- “The biggest problem I had was finding the guidelines.”
- “The main thing to do would be to make people aware that there is an ID physician [available] to call.”

Whether urban guidelines should be applicable in rural contexts appeared to be a point of debate, with respondents both acknowledging and refuting whether the specific context of rural medicine should be acknowledged when prescribing resources are designed.

- “Some base hospital (secondary or tertiary referral centre) guidelines specify antibiotics we don’t stock.”
- “(Published antimicrobial susceptibility patterns) are not related either to our specific population nor our prescribing habits.”

Infrequency of contact with Infectious Diseases or Clinical Microbiology clinicians was noted to be an issue faced by rural hospital doctors. This was perceived to be a two-way lack of engagement. Communication between rural staff also emerged as a challenge to rural AMS. In part, this concern appeared to relate to vulnerable staffing levels, particularly upon reliance on locum staff and their perceived unfamiliarity with local pathways and protocols. In addition to issues related to orientation, uncertainty about clinical leadership was also noted.

Discussion

This is the first study to provide comprehensive insight into existing AMS practice in rural hospitals in New Zealand. Among the strengths of this study are the breadth of data collection, high penetration into the rural hospital medicine community and its mixed methodology enabling simultaneous collection of quantitative and qualitative data. One challenge we faced is that the definition of ‘rurality’ is not standardised in rural hospital research and caution must be exercised when comparing different rural health literatures. The definition we chose was pragmatic and largely follows the rural hospital medicine community's own definition, consistent with other recent research in rural New Zealand health. It is reassuring that our survey identified a similar number of rural practitioners as included in a recent New Zealand rural hospital workforce survey. One of the major limitations of this study is that it measures individuals’ perceptions of their own behaviours and exposures, rather than observational data.

While most rural hospital doctors reported having access to local antimicrobial prescribing guidelines, lack of internal consistency among responses from some hospitals and regions suggests that awareness of existing resources may be suboptimal. This issue does not appear limited to rural New Zealand as relatively low rates of awareness of existing guidelines have been noted in studies elsewhere.

The likely ad-hoc nature of most stewardship interactions in rural New Zealand is a source of potential clinical risk. Prior research in the urban hospital setting in the US has identified that 31–48% of telephone calls made to AMS professionals contain errors in the information provided by the caller. These include incorrect microbiological and physiological data, which may affect antimicrobial prescriptions.

The format of the free text sections may have steered respondents towards providing brief, ‘sound bite’ style responses. However, it did reveal that some aspects of AMS are either well understood or self-evident. This is despite the limited AMS education that the survey population reported receiving. Responses were heavily weighted towards rational and optimised prescribing practice, with fewer responses related to value and the avoidance of antimicrobial-related harm. When viewed from an inductive perspective, it appears that the need to “start well” is intuitive, but the relative paucity of responses that mention de-escalation or microbiological testing suggests that the transition from syndromic to targeted antimicrobial prescribing is not accorded the same degree of importance. This would appear concordant with survey results in diverse locations that suggest that revision of initial prescriptions is not always a practice priority, when compared to following guidelines for syndromic prescribing.
In addition to understanding at least some of the principles of AMS, most rural hospital doctors appear to believe that AMS is relevant in any clinical context. While this could suggest that the rural medicine community is a receptive environment for the introduction of AMS, it is also possible that this represents the tendency to give socially acceptable or desirable responses in qualitative research.\textsuperscript{20,23,24} Despite AMS's perceived relevance, antimicrobial overuse and prescribing were less likely to be regarded as personal or local issues. Similarly, in European studies, 91–98\% of practitioners reported that antimicrobial resistance is a problem at a national level, while fewer (63–74\%) reported it to be an issue in their daily practice.\textsuperscript{20,24,25}

Despite being perceived as relevant to the rural hospitals, AMS may have a marketing problem in this environment, including inconsistent awareness of referral pathways, the existence of guidelines and orientation to available resources. While passive devices like education and guidelines may have an immediate impact on antimicrobial prescriptions, this tends to wane, and downstream interventions like prospective audit and feedback, while labour intensive, create a more sustainable change on prescribing patterns.\textsuperscript{11} No respondents mentioned the potential for a local champion for AMS, as mentioned in some studies of rural stewardship, rather than reliance on experts at a distance.\textsuperscript{2,26}

It would be difficult to introduce a conventional AMS strategy in New Zealand's rural hospital environment. Lack of resources, personnel and AMS education have been cited as presenting barriers to the implementation of AMS programmes in rural and regional hospitals overseas.\textsuperscript{2,27} As this survey demonstrates, most rural practitioners have limited access to AMS education and prescribing feedback, and have infrequent contact with professionals who would be considered core members of an AMS team, such as infectious diseases physicians. This needs to be taken into consideration as regional and national AMS programmes are developed. Formulary restriction may be the highest yield strategy in hospitals with limited staffing, however lack of pharmacy resources will likely challenge its implementation rurally.\textsuperscript{27} Organised telemedicine AMS interventions have been trialled overseas. While data are limited, high degrees of practitioner satisfaction and reductions in prescriptions of broad spectrum antimicrobials have been reported.\textsuperscript{2,3} In fact, the implementation of an organised AMS strategy may actually increase the rate at which rural doctors solicit specialist input.\textsuperscript{3}

Srinavasan wrote that the use of the term “antimicrobial stewardship program” may have created a misperception that optimal inpatient antimicrobial use is only possible in settings with formal stewardship programs that are staffed by infectious diseases physicians and subspecialty pharmacists.\textsuperscript{28} Rather than trying to recreate tertiary AMS teams in miniature, successful development of a rural hospital AMS strategy would likely require addressing this cognitive barrier, and diversifying the skill sets of existing generalist staff and optimising the interface with larger institutions and specialists. Where they have been implemented overseas, AMS strategies in small and rural hospitals may require that AMS professionals take on multiple roles, in contrast with their urban counterparts.\textsuperscript{2,28} Sustainable AMS strategies in rural New Zealand will depend on bespoke solutions and fostering a sense of personal and local importance. Rural hospital prescribers have an appetite for more interaction with stewardship services and further education. Attention to fostering a relationship between the rural hospital and the AMS team that includes orientation to guidelines and prescribing resources may be beneficial. Potential targets for stewardship interventions in this setting could be the transition from syndromic to targeted prescribing, de-escalation of antimicrobials and optimised microbiological testing strategies.
Competing interests:
Nil.

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Author information:
Jared Green, Infectious Diseases Department, Christchurch Hospital, Department of Rural Hospital Medicine, Kaitaia Hospital, Kaitaia; Sharon J Gardiner, Infectious Diseases, Clinical Pharmacology, Pharmacy Departments, Christchurch Hospital, Christchurch; Sarah L Clarke, Department of Rural Hospital Medicine, Kaitaia Hospital, Kaitaia; Lee Thompson, Department of Population of Health, University of Otago, Christchurch; Sarah CL Metcalf, Department of Infectious Diseases, Christchurch Hospital, Christchurch; Stephen T Chambers, Infectious Diseases, Pathology Department, University of Otago, Christchurch.

Corresponding author:
Dr Jared Green, 3 Haros Avenue, Nunawading, Victoria 3131, Australia.
drnicriviera@yahoo.co.uk

URL:

REFERENCES:


