The increasing role of pharmacists in antimicrobial stewardship in English hospitals

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Objectives: To evaluate the development of pharmacist-led antimicrobial stewardship activities in English hospitals.

Methods: Distribution of an electronic questionnaire to antimicrobial pharmacists or chief pharmacists in National Health Service hospitals in England.

Results: Since a previous study, in 2005, overall numbers of specialist antimicrobial pharmacists, and their levels of experience, had increased. Over 95% of hospitals provided empirical usage guidance, antimicrobial formularies and surgical prophylaxis guidelines. Two-thirds of pharmacy departments provided antimicrobial usage reports in terms of defined daily doses at least yearly, and over 80% conducted yearly antimicrobial point prevalence studies. The vast majority of pharmacy departments indicated a willingness to supply data and audit results to a national database for benchmarking purposes.

Conclusions: The increasing role of specialist pharmacists and general pharmacists in antibiotic stewardship in acute care in England has enabled hospitals to deliver on the antibiotic stewardship agenda, although opportunity remains to expand this role further and ensure greater multidisciplinary engagement.

Keywords: antibiotic policy, prescribing, pharmacy

Introduction

Antimicrobial resistance is an increasingly important patient safety and public health issue.1,2 Emergence and spread of resistance is linked to antimicrobial exposure, both at the population and the individual level;3–8 therefore, reserving these agents to be used only where necessary and using the shortest effective courses are key. Even in the sickest patients, where it is imperative to start effective broad-spectrum therapy quickly, subsequent daily review of these prescriptions, and de-escalation to narrow-spectrum agents where possible, are now gold standard behaviours, as mentioned in the Surviving Sepsis guidelines9 and the English Department of Health Start Smart then Focus programme.10

Antimicrobial stewardship programmes aim to optimize individual patient outcomes whilst minimizing unintended consequences, such as the generation of resistant organisms and untoward effects in the individual patient.11 Such programmes typically involve evidence-based guidelines and educational programmes, and regular feedback of antibiotic usage data to prescribers to promote rational and evidence-based prescribing.10 These stewardship practices are now embedded in the English Department of Health regulatory framework.12

Clinical pharmacists have an established role within hospitals as promoters of evidence-based medicine and cost-effective prescribing.13 In England, hospital clinical pharmacy services typically include daily ward visits and medicines chart review, provision of individualized recommendations on medicine use, and pharmacist attendance on multidisciplinary ward rounds to provide specialist input on medicines management. Against a background of increasing antimicrobial resistance, it has been suggested that enhanced clinical pharmacy activities in the field of anti-infectives may help to optimize treatment, improve outcomes, promote rational prescribing, reduce inappropriate use and potentially slow the development and spread of resistance.9,11,14–17

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are driving antimicrobial stewardship worldwide, with multidisciplinary working models described in countries such as the USA,18 Australia,19 France,20 Ireland21 and, to a lesser degree, other European countries; in the UK this activity was largely primed by a one-off round of funding by the Department of Health to hospital pharmacists in the period 2003–06.22 Chief pharmacists were asked to use this money for developments to promote prudent antibiotic use and monitoring of antimicrobials within their hospitals. In 2005 we investigated the impact of this funding23 and found that there had been a demonstrable impact on the activities of hospital pharmacy departments in monitoring and controlling the use of antibiotics. The funding was also shown to have facilitated greater interaction between pharmacy and microbiology/infectious diseases departments than was previously possible. Reductions in antibiotic acquisition costs were demonstrated, although the study recommended that further work was required to fully establish the impact of pharmacy activities on clinical and microbiological outcomes.

In the light of antimicrobial stewardship now being part of formal guidance by the Department of Health12,17 this study aimed to further evaluate pharmacy-led antimicrobial stewardship activities within English hospitals by assessing: (i) the number of antibiotic specialist pharmacy staff, their qualifications and time in the speciality; (ii) pharmacist involvement in antimicrobial stewardship activities, including provision of antimicrobial prescribing surveillance and feedback; (iii) whether hospitals were linking antimicrobial usage and resistance data and/or monitoring stewardship activities with regard to clinical outcome, and the availability of data for national benchmarking; and (iv) whether hospitals were using the Department of Health Antimicrobial Self-Assessment Tool (ASAT).24 We also compared pharmacist-reported antimicrobial stewardship activities in 2005 and 2011.

Methods

An electronic audit tool (Adobe Acrobat, Adobe Software) was e-mailed to the specialist antimicrobial pharmacist for each National Health Service (NHS) acute hospital organization in England (n = 153), along with a covering letter. The majority of hospitals were expected to have a specialist antimicrobial pharmacist in post, based on previous research,23 and individuals were identified using a combination of existing databases;25 the list of acute hospitals given in the NHS service directory;26 a partial contacts list from ASG-ARHAI (the Antimicrobial Stewardship Group of the UK Department of Health Advisory Committee on Antimicrobial Resistance and Health Care Associated Infections); and personal contacts where appropriate. The tool was also circulated via the Association of Teaching Hospital Pharmacists. Where contact details for a specialist pharmacist were not available, the e-mail was sent to the chief pharmacist. The content of the audit tool was based upon our previous research to allow comparison with a baseline; additional questions were added by ASG-ARHAI.

The interactive PDF format allowed participants to directly indicate their responses by selecting from drop-down menus or clickable buttons before returning the document via e-mail. Participants were given a 2 week time frame to complete and return the electronic form; from pilot work it was estimated that the questionnaire took a maximum of 10 min to complete. Responses were analysed using an anonymized database in Excel (Microsoft Corporation).

The questionnaire, which comprised six main sections (Figure 1), was designed and piloted with reference to principles of good questionnaire design,26–29 and is available as Supplementary data at JAC Online.

Confirmation was obtained from the South West of England Research Ethics Centre that ethics approval was not required as this was an audit activity.

Results

Response rate

One-hundred-and-fifty-three acute hospitals were contacted, of which 120 responded (a response rate of 78%).

Types of hospital and bed numbers

The number of organizations listed as ‘acute hospitals’ in the NHS service directory25 decreased from 2005 to 2011, which may have been due to mergers. The average number of sites per hospital organization was 2.2 (range 1–9) and the average number of beds was 798 (range 88–2300). Of responding organizations, 58% classified themselves as district general or acute hospitals, 33% as teaching hospitals and 9% as specialist units (e.g. tertiary

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**Figure 1.** Overview of questionnaire content. The full document is available as Supplementary data at JAC Online.
paediatric referral centre, tertiary care heart and chest hospital). One organization classified itself as an academic health sciences centre. A comparison with 2005 results is shown in Table 1.

### Numbers of pharmacists and antibiotic specialist pharmacy staff

All respondents ($n = 120$) reported having at least one member of antibiotic specialist pharmacy staff, 35% had two or more and 13% had three or more: each of these staff had at least a proportion of their time devoted to antimicrobial stewardship work, though only 16% of all posts were dedicated to antimicrobial work full-time. This compares with results from the 2005 study suggesting that 88% of hospital organizations employed at least one member of antibiotic specialist staff and 21% employed two or more.

A comparison of the staffing levels reported in the 2005 survey, compared with the current results, is shown in Table 1, along with some attributes of those staff. Hospitals employed an average of

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**Table 1.** Demographics and pharmacist-reported antimicrobial stewardship activities: comparison of results from 2011 and 2005 studies (Wickens and Jacklin).

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of trusts contacted</td>
<td>153</td>
<td>183</td>
</tr>
<tr>
<td>Number of completed questionnaires and return rate</td>
<td>120 (78%)</td>
<td>125 (68%)</td>
</tr>
<tr>
<td>Type of hospital</td>
<td></td>
<td></td>
</tr>
<tr>
<td>district general/acute hospital</td>
<td>58%</td>
<td>56%</td>
</tr>
<tr>
<td>teaching hospital</td>
<td>33%</td>
<td>36%</td>
</tr>
<tr>
<td>specialist unit (e.g. tertiary paediatric referral centre, chest hospital)</td>
<td>9%</td>
<td>2%</td>
</tr>
<tr>
<td>Average number of beds per trust (range)</td>
<td>798 (88–2300)</td>
<td>855 (152–3000)</td>
</tr>
<tr>
<td>WTE pharmacists per 100 beds</td>
<td>4.6 (1.3–18.6)</td>
<td>2.98</td>
</tr>
<tr>
<td>Total number of antibiotic specialist staff in England (average WTE)</td>
<td>187 (0.76)</td>
<td>141</td>
</tr>
<tr>
<td>WTE antibiotic specialist pharmacy staff per 100 beds (range)</td>
<td>0.13 (0.02–0.43)</td>
<td>0.07 (0.01–0.286)</td>
</tr>
<tr>
<td>Proportion of specialist antibiotic staff in post for &gt;2 years</td>
<td>72%</td>
<td>14%</td>
</tr>
<tr>
<td>Antimicrobial staff designations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pharmacist</td>
<td>90%</td>
<td>89%</td>
</tr>
<tr>
<td>technician</td>
<td>7%</td>
<td>10%</td>
</tr>
<tr>
<td>other</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Qualifications of antimicrobial pharmacy staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BPharm/MPPharm/MSc Pharmacy</td>
<td>90%</td>
<td>89%</td>
</tr>
<tr>
<td>MSc</td>
<td>16%</td>
<td>19%</td>
</tr>
<tr>
<td>PhD</td>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>Antimicrobial stewardship activities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>policies and guidance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>empirical usage guidance</td>
<td>99%</td>
<td>92%</td>
</tr>
<tr>
<td>antimicrobial formulary</td>
<td>96%</td>
<td>89%</td>
</tr>
<tr>
<td>surgical prophylaxis</td>
<td>100%</td>
<td>86%</td>
</tr>
<tr>
<td>reserved antimicrobial list</td>
<td>91%</td>
<td>69%</td>
</tr>
<tr>
<td>intravenous–oral switch policy</td>
<td>87%</td>
<td>69%</td>
</tr>
<tr>
<td>automatic stop policy</td>
<td>36%</td>
<td>not asked</td>
</tr>
<tr>
<td>separate antimicrobial drug chart or section to the drug chart</td>
<td>32%</td>
<td>not asked</td>
</tr>
<tr>
<td>antibiotic usage (reports provided at least yearly)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>expenditure reports</td>
<td>74%</td>
<td>73%</td>
</tr>
<tr>
<td>reports of usage in DDDs</td>
<td>66%</td>
<td>46%</td>
</tr>
<tr>
<td>antimicrobial point prevalence survey (PPS) reports</td>
<td>82%</td>
<td>58%</td>
</tr>
<tr>
<td>outcomes monitoring (benefit shown)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>expenditure</td>
<td>68% (57%)</td>
<td>77% (33%)</td>
</tr>
<tr>
<td>usage</td>
<td>79% (54%)</td>
<td>75% (26%)</td>
</tr>
<tr>
<td>inappropriate prescribing</td>
<td>81% (68%)</td>
<td>78% (44%)</td>
</tr>
<tr>
<td>antimicrobial resistance</td>
<td>17% (14%)</td>
<td>33% (4%)</td>
</tr>
<tr>
<td>clinical outcome</td>
<td>12% (9%)</td>
<td>22% (5%)</td>
</tr>
</tbody>
</table>

*In 2001, UK schools of pharmacy reconfigured their undergraduate courses, resulting in a change from a 3 year bachelors’ degree in pharmacy to a 4 year masters’ qualification, which is now the basic qualification required for registration as a pharmacist in the UK.
4.6 whole time equivalent (WTE) pharmacists per 100 beds (range 1.3 – 18.6). The 120 responding organizations reported employing 193 antibiotic specialist staff, at an average of 0.58 WTE (range 0.05 – 1). This represents an average of 0.13 WTE antibiotic specialist pharmacy staff per 100 beds (range 0.02 – 0.43), or an average of one full-time member of antibiotic specialist staff per 776 beds. These specialist staff included 175 pharmacists, 14 pharmacy technicians, and 4 other staff (including a medicines management nurse, a data analyst and IT support staff).

**Antimicrobial stewardship activities**

Of 119 respondents who answered the question, 100% reported having surgical antimicrobial prophylaxis policies or guidance in place (Table 1). Over 95% of respondents reported having empirical usage guidance and an antimicrobial formulary in place, 91% had a reserved antimicrobial list and 87% had an intravenous–oral switch policy; these had all increased in frequency since 2005. Fewer organizations reported having an automatic stop policy (36%) or a separate antimicrobial drug chart or section to the drug chart (32%).

Of 117 respondents who answered the question, 98% reported that antibiotic specialists were involved in writing antibiotic guidance or policies and 95% were involved in antibiotic formulary decision-making (increased from 94% in both measures in 2005). Ninety-four percent of organizations had an antibiotic specialist available by telephone or pager to help with complex referrals, and 59% reported that the specialist attended ward rounds on specialties of high antibiotic use (increased from 62% and 40%, respectively, in 2005). Ninety-two percent and 84%, respectively, had specialist representation on the Infection Prevention and Control Committee and the Antibiotic Review/Steering Group in 2011 (75% and 60% in 2005), and antibiotic specialists provided horizon-scanning information on new antimicrobials in 69% of organizations (39% in 2005). Seventy percent of organizations were conducting specific antibiotic review rounds, compared with 34% in 2005.

**Provision of antimicrobial education**

The majority of hospitals reported provision of antimicrobial training to pharmacists and doctors at induction (62.7% and 68.6%, respectively); less than a quarter (24.3%) reported providing this to nurses at induction and fewer (13.5%) reported induction antibiotic training for other staff.

Post-induction, pharmacists were most likely to receive training at quarterly, 6-monthly and yearly intervals; doctors were more likely to receive training at most yearly and nurses less than yearly. Over 80% of responding organizations reported that no antibiotic education was specifically provided to patients.

**Clinical governance—ASAT**

Just under 90% of respondents were aware of the ASAT published in 2010, but only 55% of organizations had completed the self-assessment tool. Eighty-three percent of hospitals had an Antimicrobial Review or Steering Group accountable to the Drug and Therapeutics committee. Of these groups, 89% had a formal Terms of Reference, 97% had minutes or action lists, and 88% sent their minutes to the Clinical Governance, Infection Prevention and Control or other higher committee.

Eighteen percent of organizations had a written antimicrobial training and education strategy and 18% carried out competency assessment for antimicrobial prescribers, of which 60% were compulsory assessments.

**Availability of antimicrobial prescribing surveillance and usage/consumption data**

Of 117 respondents, 102 (87.1%) stated that they would be interested in submitting overall antimicrobial dispensing data to a national database hosted securely for the purposes of benchmarking between NHS hospital organizations. Figure 2 gives further details of the type of antibiotic dispensing data available; Figure 3 shows the availability of antibiotic usage data in terms of defined daily doses (DDDs) and by prescription or issue type.

**Discussion**

Between 2005 and 2011 there was an increase in the absolute number of antimicrobial specialist pharmacy staff, from 141 posts in 125 hospital organizations to 187 in 120 hospital organizations; though the majority of posts (>84%) were part-time, this...
represented a doubling in specialist staffing per inpatient bed. This is likely to be a response to the recommendations of the Health and Social Care Act and Best Practice guidance from Saving Lives, which recommend that a multidisciplinary antimicrobial management team, including a pharmacist, implement the antimicrobial stewardship agenda. Over this period, there was also an increase in general pharmacy staffing, though not at the same pace, which may reflect investment in pharmacy services to cope with increasing acuity and rapid turnover of patients.

Organizations reported increased activity in all dimensions of antimicrobial stewardship between the two studies, in tandem with the increased staff numbers: empirical usage guidance, an antimicrobial formulary and surgical prophylaxis guidelines were now available in over 95% of organizations, compared with 92%, 89% and 86% of trusts, respectively, in 2005. It also appears that these extra staff are contributing to the labour-intensive activity of providing antibiotic usage and point prevalence survey reports, and monitoring outcomes of stewardship activity in terms of expenditure, usage and degree of appropriate prescribing. However, the proportion of pharmacy departments that were monitoring outcomes of stewardship activity in terms of resistance and clinical outcome almost halved. This could relate to the increased profile of infection management during the intervening years; this activity may have been more pharmacy-led in the early days of stewardship, but later taken up more widely by trust quality management systems and/or microbiology teams, therefore being moved out of the realm of pharmacy monitoring processes. In addition, the specialist pharmacist staff were more experienced in the 2011 study; 72% of respondents had been specializing for over 2 years compared with 14% in 2005, and may have been more realistic in their interpretation of what was being effectively monitored. In a similar manner to 2005, the methodology employed in this study relied on self-reporting of achievements; however, the questions were objective and required a yes or no reply. Just over half of the trusts reported use of the ASAT, an evidence-based toolkit that offers a process-based checklist for hospitals to self-assess their level of antimicrobial stewardship and provide a means of identifying areas for improvement.

This study did not collect objective data on patient or clinical outcome, or Trust infection/resistance rates in comparison with antimicrobial stewardship activity, though the latter is multifactorial and difficult to link to specific stewardship activities alone; it has been suggested that stewardship programmes should be assessed using a mixture of process and outcome indicators. Improvements in antimicrobial stewardship have been shown to improve rational antibiotic prescribing and reduce rates of *Clostridium difficile* infection; English national *C. difficile* infection rates have been declining since 2005, which may be linked to a reduction in cephalosporin and fluoroquinolone use driven by antimicrobial stewardship practices, as well as factors such as the changing epidemiology of strain types. A recent US study showed that the presence of a pharmacist on a multidisciplinary antimicrobial stewardship team led to a significant reduction in the consumption of fluoroquinolones, clindamycin and ampicillin/sulbactam compared with when the pharmacist was not part of the team. Furthermore, feedback of indicator data on compliance with prescribing policies to prescribers has been shown to improve that compliance; this quality improvement methodology was being used by some hospitals, but not all (data not shown).

Improvements in hospital information systems and the implementation of electronic prescribing records have the potential to allow better linkage of antibiotic use and patient outcomes. We would propose that a clear set of auditable measures, as described in the Start Smart then Focus guidance, should be implemented in all trusts to facilitate benchmarking; sharing outcome data would strengthen the evidence base for interventions and behaviours to enhance stewardship. There is a willingness amongst pharmacists to share such data, with over 87% of respondents in this self-selecting population keen to share usage and audit data...
nationally, and over 80% of hospital pharmacy departments already producing data at least annually in a common DDD format. This could potentially be analysed in combination with pathogen and resistance surveillance data to provide information on the epidemiology of resistance spread. However, relatively few hospitals could break down these data into outpatient and inpatient use, thus complicating the interpretation of the contribution of inpatient antibiotic exposure to resistance rates and comparison between hospitals.

In summary, the NHS in England has invested in specialist antimicrobial pharmacists, with concomitant increases in antibiotic stewardship activity. There is some evidence that this is beneficial. However, there is untapped potential for collaborative working across the health system and sharing antibiotic usage data; this could generate robust evidence to guide future efforts in antibiotic stewardship.

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Supplementary data
The questionnaire is available as Supplementary data at JAC Online (http://jac.oxfordjournals.org).

References
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