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Antibiotic pharmacists in the ascendancy

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Specialist pharmacists have become an established feature of the antibiotic stewardship landscape in hospitals throughout the UK over the last decade. This review examines the origins of the specialist antibiotic pharmacist and how the role has developed in recent years. Antibiotic pharmacists fulfil a vital function in modern National Health Service hospitals as key members of the infection control team with overall responsibility for initiatives to promote rational antibiotic prescribing. Evidence of the impact of antibiotic pharmacists on clinical, microbiological and financial outcomes is presented along with examples of innovative practice. Finally, a vision for the future of the antibiotic pharmacist role is outlined.

Keywords: antimicrobial prescribing, pharmacy, microbiology, hospital

Introduction

The model of pharmacy services adopted by British hospitals has evolved considerably over the last 30 years. While retaining the core functions of efficient procurement, distribution and safe and secure handling of medicines, clinical services provided by pharmacists have become an established part of hospital healthcare.[1] Evidence is accumulating to show that clinical pharmacy activities lead to improved patient care, with better use of medicines that in many cases is more cost-effective.[2] Analysis of US hospital data examining four health outcome measures—mortality, length of stay, drug costs and total cost of care—revealed the ratio of clinical pharmacists to occupied beds as the only pharmacy variable associated with positive outcomes for all four measures and similar data are becoming available for the UK.[3,4]

Modern-day clinical pharmacists in UK hospitals spend a substantial proportion of their time on wards, reviewing drug therapy and tailoring optimal treatment regimens for individual patients, often as members of collaborative multi-disciplinary healthcare teams. Pharmacists are increasingly available on ward rounds to provide advice at the point of prescribing or alternatively, they will be in a position to intervene and influence prescribing before therapy commences by triaging requests for new medications. Clinical pharmacists with the appropriate training and support are therefore ideally placed to promote responsible and effective antibiotic prescribing.

The majority of UK clinical pharmacists undertake formal postgraduate training in clinical pharmacology and therapeutics, often with an element of specialist instruction in the field of antimicrobial therapeutics. Traditionally viewed as generalists, with knowledge of a broad range of therapy areas, UK hospital pharmacists have broken the mould in recent years as the concept of specialization has emerged in hospital pharmacy practice. Pharmacists with an interest in a particular area of therapeutics such as cardiology, critical care or mental health, have sought and undertaken specialty training and now pursue successful careers as specialist clinical pharmacists and consultant pharmacists.[5]

Antibiotic pharmacists

Specialist antibiotic pharmacist posts were established in a small number of UK hospitals in the early 1990s, however, it was not until 2003 that the potential of the antibiotic pharmacist became embedded in the collective conscience of Chief Pharmacists in national health service (NHS) hospitals across England and Wales.

Several national and international reports on the subject of antimicrobial resistance since 1998 had acknowledged the important role hospital pharmacists have to play in influencing antibiotic prescribing and identified the potential to build on this promising foundation to promote responsible use of antibiotics.[6–9] The value of pharmacists was highlighted by the Standing Medical Advisory Committee who contended that pharmacists, particularly in hospitals, have an important role in controlling, prescribing and identifying inappropriate prescribing.[8] A role for hospital pharmacists was also advocated in the 'Winning Ways' report from the UK Chief Medical Officer on healthcare associated infection in England, which stipulates that support for prudent antibiotic prescribing in hospitals will be provided by clinical pharmacists, along with medical microbiologists and infectious diseases physicians.[7] This requirement has been incorporated into performance indicators for NHS acute trusts and is currently subject to audit by the Healthcare Commission.

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Responding to a recommendation from its Specialist Advisory Committee on Antimicrobial Resistance, the Department of Health (DH) announced an investment of £12M over 3 years to support clinical pharmacy activities around the promotion of prudent antimicrobial prescribing.[10,11] A survey of 183 NHS Trusts in England was undertaken in 2005 to investigate the involvement of pharmacy staff in anti-infective medicines management and the impact of the DH funding. Of the 130 Trusts who responded, 125 employed at least one specialist member of pharmacy staff with responsibility for anti-infectives, 89% of whom were pharmacists.[12]

The role of the antibiotic pharmacist

A number of reviews of the role of the antibiotic pharmacist have been published in recent years.[13–19] A tradition of collaboration between pharmacists and microbiologists is well established.[20,21] Typical responsibilities of the hospital antibiotic pharmacist are discussed below.

Expert advice

The antibiotic pharmacist is expected to provide expert advice on the management of antibiotic therapy in individual cases referred by ward pharmacist colleagues and to act as a triage for cases requiring input from staff in microbiology or infectious diseases. Advice may be provided over the telephone in response to radio page or in person on ward rounds, often in conjunction with microbiology or infectious diseases clinicians.

Education and training

Antibiotic pharmacists are frequently called upon to provide education and training for pharmacists, doctors, nurses and other healthcare professionals on prudent antibiotic prescribing and to raise awareness of hospital guidelines and policies. This may include presentations at induction sessions for new hospital staff.

Liaison role

The antibiotic pharmacist acts as a liaison between microbiology and pharmacy departments with regard to such issues as the antibiotic formulary, managed entry of new antibiotics, laboratory susceptibility testing and monitoring of antibiotic levels.

Formulary enforcement

Many hospitals operate an antibiotic formulary restricting choice of available agents and requiring microbiologist or infectious diseases physician authorization for prescribing of certain broad-spectrum agents. The antibiotic pharmacist typically plays an important role in supporting ward pharmacists in enforcement of antibiotic formularies and monitoring compliance of prescribers.

Antibiotic guidelines

Developing and maintaining antibiotic guidelines is one of the fundamental roles of the antibiotic pharmacist and he/she will often act as catalyst between a number of stakeholders, working to achieve consensus and endorsement by key opinion leaders in the hospital. It is recognized, however, that clinical practice guidelines have had a limited effect on changing physician behaviour and numerous studies have explored the underlying reasons.[22,23] The critical task of implementing prescribing policies and encouraging compliance with antibiotic guidelines has fallen largely to ward pharmacists, without whom many of these initiatives would be largely ineffectual. The successful implementation of clinical guidelines is beholden to efficient communication and antibiotic pharmacists are ideally placed to conduct educational campaigns and to engage pharmacist and doctor colleagues.

Antibiotic policy

A wide variety of policies designed to control antibiotic prescribing have been described in the published literature and introduced to varying degrees in UK hospitals, often initiated and implemented by antibiotic pharmacists. Examples of issues addressed include:

- Intravenous-to-oral switch or sequential therapy
- Mandatory antibiotic order forms
- Therapeutic substitution of antibiotics
- Automatic stop orders

Antibiotic serum level monitoring and dosing

A recent review of aminoglycoside and glycopeptide serum level monitoring in the US demonstrated that there were significantly fewer numbers of related deaths when pharmacists provided this service in comparison with other healthcare professionals.[24] Antibiotic pharmacists are responsible for developing policy for serum level monitoring of these agents and for training pharmacists in safe and effective dosing practices.

Monitoring and feedback

Antibiotic pharmacists invariably undertake or facilitate monitoring of antibiotic use and prescribing by means of electronic stock control systems or through dedicated prescribing audits.[25,26] The value of regular feedback to prescribers including trend analysis and benchmarking with peers is increasingly recognized as a tool for effectively influencing prescribing and antibiotic pharmacists are working towards providing this feedback routinely in UK hospitals.[27]

Research and development

Antibiotic pharmacists are also active in practice research and a Cochrane Review of interventions to improve antibiotic prescribing practices for hospital inpatients identified 22 robust studies where the interventions were delivered by pharmacists, predominately educational and exclusively aimed at decreasing antibiotic treatment.[28] Antibiotic pharmacists are expected to coordinate research and practice development in this area and to share best practice with colleagues in peer-reviewed publications.

Evidence and outcomes

The quality of published research into the effectiveness of interventions to improve the quality of antibiotic prescribing in

hospitals is relatively weak.[29] However, there are a number of robust studies in the literature describing positive clinical, microbiological and economic outcomes of clinical pharmacy activity in the area of antibiotic prescribing. Although specialist antibiotic pharmacists are not mentioned specifically in the following reports, they are likely to be instrumental in the successful local implementation of similar initiatives.

A study carried out to examine the impact of an antimicrobial prescribing protocol for management of community-acquired lower respiratory tract infection reported both clinical and economic outcomes.[30] Clinical pharmacists were involved with the development and encouraged day-to-day implementation of the protocol on hospital wards. Patients treated using the protocol had significant reductions in length of stay, intravenous drug administration, duration of intravenous therapy and number of treatment failures. A multicentre study of guideline implementation for pneumonia was carried out at 23 hospitals and 60 outpatient clinics in the US.[31] Pharmacists were part of the multidisciplinary group that developed and implemented the guidelines and the study reported a significant reduction in 30 day mortality (odds ratio 0.69, 95% CI 0.49–0.97) for hospitalized patients treated by physicians who participated in the guideline programme.

A study reporting microbiological outcomes following implementation of a multidisciplinary antimicrobial management team, including pharmacists, reported significant and sustained reductions in *Clostridium difficile*-associated diarrhoea and resistant Enterobacteriaceae.[32]

Researchers at a tertiary university hospital in Scotland evaluated the impact of a restricted antimicrobial policy implemented by ward pharmacists and reported a significant and sustained reduction on the use and cost of the restricted agents in the 2 years following introduction of the policy.[33] The cost of development, dissemination and implementation of the policy was fully evaluated and found to be $<20\%$ of the cost savings generated.

Information about the cost-effectiveness of employing specialist pharmacy staff in this role is lacking but savings of £10 per patient reviewed on multi-disciplinary ward rounds per day have been attributed to the antibiotic pharmacist.[34] Some hospitals have reported annual cost savings associated with antibiotic management activities of between £23 000 and £500 000.[12]

Innovative practice

Antibiotic pharmacists have been exploring innovative solutions to common problems in antimicrobial medicines management and sharing the fruits of their labours with colleagues in the NHS.

Wickens *et al.*[35] in St Mary's hospital, London, have successfully deployed a web-based referral system used by ward pharmacists to alert the microbiology pharmacist to patients with antimicrobial-related problems for triaging and subsequent discussion with microbiology or infectious diseases clinicians as well as recording outcomes.

Hills, a microbiology pharmacist at Nottingham has collaborated with microbiology colleagues to design and implement a hospital web site for infection management.[36] The web site leads users through an interactive process to local recommendations for investigation and treatment of common infections as well as information about monitoring antibiotic serum levels and local susceptibility patterns.

Weeks *et al.*[37] at Southampton University Hospitals NHS Trust have reported on the cost-effective implementation of antimicrobial management teams with regular review of patients referred by ward pharmacists on ward rounds with microbiologists and clinical pharmacists.

The future for antibiotic pharmacists

Continuing concerns over inappropriate antibiotic prescribing and the menace of hospital-acquired infection with multiresistant microorganisms, combined with the incorporation of antibiotic prescribing data into key performance indicators for hospitals, will mean that the skills of the antibiotic pharmacist remain in demand for the foreseeable future. The Infectious Diseases Society of America has recently endorsed the role of the pharmacist with specialist infectious diseases training as a core member of the hospital antimicrobial stewardship team and many UK hospitals have opted to continue to fund antibiotic pharmacist posts following the expiration of DH dedicated funding in 2006.[38]

Antibiotic pharmacists have a vital role to play in the forthcoming implementation of electronic prescribing and will be instrumental in harnessing the potential of computerized decision support for improving the quality of antibiotic prescribing and for monitoring prescribing trends and associated healthcare outcomes.[39]

The challenges that lie ahead will include the development of an accredited training programme and competency assessment for specialist antibiotic pharmacists in order to ensure that they are fit-for-purpose. Computer-assisted learning packages and web-based accreditation and competency assessment are already in the advanced stages of development.

Weller and Jamieson[17] outlined the implications of supplementary prescribing by antibiotic pharmacists and the importance of clear role delineation between microbiologists, infectious diseases physicians and antibiotic pharmacists. The need for clarification of responsibilities will become even more acute with the advent of independent pharmacist prescribing and the appointment of consultant antibiotic pharmacists over the coming years. Successful antibiotic pharmacists are likely to be those who can play to their strengths and differentiate the service they provide from their colleagues in microbiology and infectious diseases, adding demonstrable value to their local healthcare economy in the process.

Antibiotic pharmacists are here to stay but further investment in practice research is of paramount importance to identify the most efficient and effective means of deploying this valuable pharmacy resource.

Transparency declarations

None to declare.

References

1. Department of Health 2000. *Pharmacy in the Future—Implementing the NHS Plan*. London: UK Department of Health. www.dh.gov.uk/assetRoot/04/06/82/04/04068204.pdf (13 March 2007, date last accessed).

2. Schumock GT, Butler MG, Meek PD *et al*. Evidence of the economic benefit of clinical pharmacy services: 1996–2000. *Pharmacotherapy* 2003; **23**: 113–32.

3. Bond CA, Raehl CL, Franke T. Interrelationships among mortality rates, drug costs, total cost of care, and length of stay in United States hospitals: summary and recommendations for clinical pharmacy services and staffing. *Pharmacotherapy* 2001; **21**: 129–41.

4. Borja-Lopetegi A, Webb DG, Bates I *et al*. Association between clinical medicines management services, pharmacy workforce and patient outcomes. In: *Abstracts of the UKCPA Progress in Practice Symposium, Leicestershire, UK*, *2006*. Short Paper Contributions, pp.16–17.

5. Department of Health (UK) 2005. *Adult Critical Care: Specialist Pharmacy Practice*. www.dh.gov.uk/assetRoot/04/11/40/93/04114093.pdf (13 March 2007, date last accessed).

6. Chief Medical Officer 2002. *Getting Ahead of the Curve: A Strategy for Combating Infectious Diseases*. www.dh.gov.uk/assetRoot/04/06/08/75/04060875.pdf (13 March 2007, date last accessed).

7. Chief Medical Officer 2003. *Winning ways: Working Together to Reduce Healthcare Associated Infection in England*. www.dh.gov.uk/assetRoot/04/06/46/89/04064689.pdfdh.gov.uk/assetRoot/04/06/46/89/04064689.pdf (13 March 2007, date last accessed).

8. Standing Medical Advisory Committee Sub-group on Antimicrobial Resistance 1998. *The Path of Least Resistance*. www.advisorybodies.doh.gov.uk/smac1.htm (13 March 2007, date last accessed).

9. World Health Organization 2001. *Global Strategy for Containment of Antimicrobial Resistance*. www.who.int/drugresistance/WHO%20Global%20Strategy%20-%20Executive%20Summary%20-%20English%20version.pdf (13 March 2007, date last accessed).

10. Chief Medical Officer 2003. *Hospital Pharmacy Initiative for Promoting Prudent Use of Antibiotics in Hospital*. www.dh.gov.uk/assetRoot/04/01/35/63/04013563.pdf (13 March 2007, date last accessed).

11. Interdepartmental Steering Group on Resistance to Antibiotics and Other Antimicrobial Agents. Clinical Prescribing Subgroup 2001. *Optimising the Clinical Use of Antimicrobials*. wwww.dh.gov.uk/assetRoot/04/08/43/95/04084395.pdf (13 March 2007, date last accessed).

12. Wickens HJ, Jacklin A. Impact of the hospital pharmacy initiative for promoting prudent use of antibiotics in hospitals in England. *J Antimicrob Chemother* 2006; **58**: 1230–7.

13. Hand K, Lawson W. A career as a specialist microbiology pharmacist. *Hosp Pharm* 2004; **11**: 459–64.

14. Hand K. Education—the fundamental role of the antibiotic pharmacist. *Pharm Prac* 2004; **14**: S3–S7.

15. Jepson A, Wickens HJ. What does a microbiology pharmacist do? *Pharm J* 2003; **271**: 774–5.

16. Knox K, Lawson W, Dean B *et al*. Multidisciplinary antimicrobial management and the role of the infectious diseases pharmacist–a UK perspective. *J Hosp Infect* 2003; **53**: 85–90.

17. Weller TM, Jamieson CE. The expanding role of the antibiotic pharmacist. *J Antimicrob Chemother* 2004; **54**: 295–8.

18. Wickens HJ, Wade P. How pharmacists can promote the sensible use of antimicrobials. *Pharm J* 2004; **274**: 427–30.

19. Lawson W, Ridge K, Jacklin A *et al*. Infectious diseases pharmacists in the UK: promoting their role establishing a national network. *J Inf* 2000; **40**: A31.

20. British Society for Antimicrobial Chemotherapy. Hospital antibiotic control measures in the UK. *J Antimicrob Chemother* 1994; **34**: 21–42.

21. Woodford EM, Wilson KA, Marriott JF. Documentation of antibiotic prescribing controls in UK NHS hospitals. *J Antimicrob Chemother* 2004; **53**: 650–2.

22. Cabana MD, Rand CS, Powe NR *et al*. Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA* 1999; **282**: 1458–65.

23. Hayward RS, Guyatt GH, Moore KA *et al*. Canadian physicians' attitudes about and preferences regarding clinical practice guidelines. *CMAJ* 1997; **156**: 1715–23.

24. Bond CA, Raehl CL. Clinical and economic outcomes of pharmacist-managed aminoglycoside or vancomycin therapy. *Am J Health Syst Pharm* 2005; **62**: 1596–605.

25. Dean B, Jacklin A, Rogers T *et al*. The use of serial point prevalence studies to investigate antiinfective prescribing. *Int J Pharm Pract* 2002; **10**: 121–5.

26. Pelle B, Gilchrist M, Lawson W *et al*. Using defined daily doses to study the use of antibacterials in UK hospitals. *Hosp Pharm* 2006; **13**: 133–6.

27. Arnold FW, McDonald LC, Smith RS *et al*. Improving antimicrobial use in the hospital setting by providing usage feedback to prescribing physicians. *Infect Control Hosp Epidemiol* 2006; **27**: 378–82.

28. Davey P, Brown E, Fenelon L *et al*. Interventions to improve antibiotic prescribing practices for hospital inpatients. *Cochrane Database Syst Rev* 2005; CD003543.

29. Ramsay C, Brown E, Hartman G *et al*. Room for improvement: a systematic review of the quality of evaluations of interventions to improve hospital antibiotic prescribing. *J Antimicrob Chemother* 2003; **52**: 764–71.

30. Al-Eidan FA, McElnay JC, Scott MG *et al*. Use of a treatment protocol in the management of community-acquired lower respiratory tract infection. *J Antimicrob Chemother* 2000; **45**: 387–94.

31. Dean NC, Silver MP, Bateman KA *et al*. Decreased mortality after implementation of a treatment guideline for community-acquired pneumonia. *Am J Med* 2001; **110**: 451–7.

32. Carling P, Fung T, Killion A *et al*. Favorable impact of a multidisciplinary antibiotic management program conducted during 7 years. *Infect Control Hosp Epidemiol* 2003; **24**: 699–706.

33. Ansari F, Gray K, Nathwani D *et al*. Outcomes of an intervention to improve hospital antibiotic prescribing: interrupted time series with segmented regression analysis. *J Antimicrob Chemother* 2003; **52**: 842–8.

34. Jones D, Cheesbrough J. Antibiotic pharmacist saves £10 per patient per day. *HSJ* 2005; **115**: 30.

35. Wickens HJ, Robson R, Griffiths T. A web-based pharmacy to microbiology referral system. *Hosp Pharm* 2006; **13**: 131–2.

36. Hills TJ, Boswell TC, Weston VC. The introduction and impact of an hypertext markup language-based antibiotic guidelines website. In: *Abstracts of the UKCPA Progress in Practice Symposium, Leicestershire, UK, November 2006. Short Paper Contributions*, pp.26–27.

37. Weeks C, Jones G, Wyllie S. Costs and health care benefits of an antimicrobial management programme. *Hosp Pharm* 2006; **13**: 179–82.

38. Dellit TH, Owens RC, McGowan JE, Jr *et al*. Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines for developing an institutional program to enhance antimicrobial stewardship. *Clin Infect Dis* 2007; **44**: 159–77.

39. Evans RS, Pestotnik SL, Classen DC *et al*. A computer-assisted management program for antibiotics and other antiinfective agents. *N Engl J Med* 1998; **338**: 232–8.