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A point prevalence survey of antibiotic prescriptions: benchmarking and patterns of use

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WHAT IS ALREADY KNOWN ABOUT THIS SUBJECT

- Inappropriate antimicrobial use has been associated with increased morbidity and hospital costs.
- Antibiotic policies aim to improve patient outcomes whilst reducing adverse effects associated with antimicrobial use.
- More insight into the actual implementation of antibiotic policies is needed in order to explore patterns of antibiotic prescribing.

WHAT THIS STUDY ADDS

- This study assessed the current patterns of antibiotic prescribing and the impact of a hospital antibiotic policy on these practices.
- It demonstrated the value of point prevalence surveys in informing antibiotic stewardship and identifying targets for quality improvements.
- The study emphasized the importance of participating in international networks, such as the European Surveillance of Antimicrobial Consumption (ESAC), in supporting optimal antibiotic use.

AIM

The aim of the study was to assess current patterns of antibiotic prescribing and the impact of a hospital antibiotic policy on these practices.

METHODS

The study involved collecting information regarding hospitalized patients utilizing the ESAC audit tool.

RESULTS

In the study site hospital, the use of the restricted agents was low whilst the use of the non-restricted agents was high. Compliance with the hospital antibiotic guidelines was 70%.

DISCUSSION

The findings identified monitoring non-restricted antibiotics and compliance with guidelines as targets for quality improvements in our hospital. Point prevalence surveys may offer a simple method of monitoring antibiotic policies, thus, informing antibiotic stewardship.

Introduction

Inappropriate antimicrobial use has been associated with increased morbidity, mortality and hospital costs [1]. As antimicrobial use is considered a major determinant in the evolution of resistance [2], hospital antibiotic stewardship has been widely implemented in an attempt to improve patient outcome whilst reducing adverse effects associated with antimicrobial use [3]. The control of antibiotics within the Northern Health and Social Care Trust in Northern Ireland has been scrutinized over a long period of time [4]. Robust guidance on the use of antibiotics has been in place since 1995 and was revised in 1999 specifically to restrict the use of second and third generation cephalosporins in response to an outbreak of *Clostridium difficile* infection (CDI). The use of cefotaxime was restricted to specific infections such as meningitis and facial cellulitis whilst intravenous cefuroxime was restricted to surgical prophylaxis. Following this, the use of second and third generation cephalosporins was very low within the hospital. In January 2008, the use of fluoroquinolones (mostly ciprofloxacin) was restricted (by its removal from the empirical antibiotic guidelines and from all wards) in response to controlling a major CDI outbreak, and subsequently the use of fluoroquinolones was remarkably decreased. The objective of this research was to assess current patterns of antibiotic prescribing and the impact of the current hospital antibiotic policy on these practices, using the European Surveillance of Antimicrobial Consumption (ESAC) audit tool [5]. ESAC is an international data collection network which aims to improve antimicrobial prescribing through collecting data on patterns of antibiotic prescribing utilizing a standard method [5].

Methods

The study was carried out in the Antrim Area Hospital in Northern Ireland, United Kingdom, a 426 bed general teaching hospital serving a population of approximately 420 000. The hospital provides all acute, general medical and surgical services, supports a range of outpatient facilities and acts as a centre for the co-ordination of health service provision throughout a defined geographical area in Northern Ireland. In May 2008 and May 2009, Antrim Area Hospital participated in two point prevalence surveys as part of the ESAC project. This involved collecting specific information, utilizing the ESAC audit tool, regarding patients who were in the hospital at 08.00 h on the survey day. Clinical pharmacists were asked to carry out this survey on a specific day on their respective wards. The required data were determined through reviewing patients' case notes. The survey was completed over 2 days during May 2008 and over 2 days during May 2009. The following data were collected: number of admitted patients in each department, patients' age and gender, antimicrobial agents used, dose per administration, number of doses per day, route of administration, anatomical site of infection, indication for therapy (community acquired infection, hospital acquired infection or prophylaxis), and compliance with the local hospital antibiotic policy. Prophylactic antibiotics for surgical patients were not assessed during this study. In addition the individual prescribed antibiotics were grouped into classes belonging to group J01 (antibacterials for systemic use) of the Anatomical Therapeutic Chemical (ATC) classification system from the WHO Collaborating Centre for Drug Statistics Methodology [6]. The latter is similar to, but contains subtle differences when compared with some national classification systems, e.g. the British National Formulary (BNF) [7].

In 2008, 50 European hospitals (from 28 countries) took part in the study, of which 53% and 26% were tertiary and secondary hospitals, respectively; the remaining participating hospitals were primary, paediatric and infectious disease hospitals. Out of the 50 hospitals, 66% were teaching hospitals. In 2009, 172 European hospitals (from 22 countries) took part in the study, of which 34% and 51% were tertiary and secondary hospitals, respectively; the remaining participating hospitals were primary, paediatric and infectious disease hospitals. Out of the 172 hospitals, 46% were teaching hospitals.

Results pertaining to Antrim Area Hospital were compared with all hospitals (at the European level) and were expressed as percentages and median of the hospitals' percentages, respectively.

Results

Characteristics of patients included in the two point prevalence surveys in Antrim Area Hospital, compared with all European hospitals, are shown in Table 1. The results of the two consecutive surveys showed that the most frequently prescribed antibiotics, in the study site hospital *vs*. all hospitals, respectively, were combinations of penicillins including beta-lactamase inhibitors (52% and 43%, 2008 and 2009 *vs*. 21% and 34%, 2008 and 2009) and macrolides (15% and 12%, 2008 and 2009 *vs*. 3% and 6%, 2008 and 2009, Table 2). The findings demonstrated that the use of the restricted antibiotics was very low in Antrim Area Hospital. The use of the restricted antibiotics, in the study site hospital compared with all hospitals, respectively, was as follows: second generation cephalosporins (0% and 0%, 2008 and 2009 *vs*. 6% and 3%, 2008 and 2009), third-generation cephalosporins (2% and 3%, 2008 and 2009 *vs*. 7% and 3%, 2008 and 2009), and fluoroquinolones (1% and 2%, 2008 and 2009 *vs*. 13% and 12%, 2008 and 2009, Table 2). The results of the May 2009 survey showed that 70% of the antibiotics prescribed for patients in Antrim Area Hospital were found to be in compliance with the hospital antibiotic policy (Table 2).

Table 1

Patients' characteristics and patterns of antibiotic prescribing for patients who received antibiotic treatment during the point prevalence surveys May 2008 and May 2009 (Antrim Area Hospital compared with all European hospitals)

Characteristics	Point prevalence survey-May 2008 Antrim Area Hospital Number of patients (%)*	Point prevalence survey-May 2008 All hospitals (n = 50) (%) of patients†	Point prevalence survey-May 2009 Antrim Area Hospital Number of patients (%)*	Point prevalence survey-May 2009 All hospitals (n = 172) (%) of patients†
Number of patients	342	444 (272–744)	353	348 (214–559)
Median age (years) (interquartile)	66 (43–79)	62 (42–76)	73 (52–82)	67 (48–79)
Treated patients	123 (36)	33 (26–38)	108 (31)	29 (24–35)
Speciality				
Medicine	104 (38)	31 (24–38)	77 (37)	28 (21–33)
Surgery	13 (27)	32 (26–42)	15 (26)	31 (26–39)
Intensive care unit	6 (29)	50 (41–65)	6 (27)	55 (44–71)
Other	0 (0)	4 (1–13)	10 (16)	7 (3–26)
Indication				
Infection	119 (97)	76 (60–84)	99 (92)	82 (72–89)
Prophylaxis	4 (3)	24 (15–39)	9 (8)	18 (11–28)
Indication for prophylaxis				
Medical	4 (67)	28 (19–48)	9 (100)	29 (12–50)
Indication for infection				
Community acquired	87 (73)	66 (52–76)	67 (68)	64 (54–74)
Hospital acquired	32 (27)	34 (23–47)	32 (32)	36 (25–46)
Route of administration				
Oral	66 (44)	26 (20–40)	47 (35)	33 (15–48)
Parenteral	83 (56)	74 (59–79)	87 (65)	67 (52–85)

*Data are expressed as number of patients and percentages. †Data are expressed as median of hospitals' percentages and interquartiles.

Table 2

Antibiotics prescribed, indication for treatment mentioned in notes and compliance rates with local antibiotic policy for patients who received antibiotic treatment during the point prevalence surveys May 2008 and May 2009 (Antrim Area Hospital compared with all European hospitals)

Characteristics	Point prevalence survey-May 2008 Antrim Area Hospital Number of patients (%)*	Point prevalence survey-May 2008 All hospitals (n = 50) (%) of patients†	Point prevalence survey-May 2009 Antrim Area Hospital Number of patients (%)*	Point prevalence survey-May 2009 All hospitals (n = 172) (%) of patients†
Antibiotic prescriptions				
Tetracyclines (J01AA)	1 (1)	1 (0–1)	0 (0)	1 (0–3)
Penicillins with extended spectrum (J01CA)	3 (2)	4 (1–6)	5 (4)	5 (3–10)
Beta-lactamase sensitive penicillins (J01CE)	5 (3)	4 (1–7)	6 (5)	3 (1–8)
Beta-lactamase resistant penicillins (J01CF)	10 (7)	3 (1–8)	7 (5)	8 (3–12)
Combinations of penicillins including beta-lactamase inhibitors (J01CR)	75 (52)	21 (9–30)	56 (43)	34 (21–42)
First generation cephalosporins (J01DB)	2 (1)	3 (1–11)	0 (0)	1 (0–6)
Second generation cephalosporins (J01DC)	0 (0)	6 (2–12)	0 (0)	3 (0–10)
Third generation cephalosporins (J01DD)	3 (2)	7 (3–13)	4 (3)	3 (2–9)
Monobactams (J01DF)	4 (3)	1 (0–2)	6 (5)	0
Carbapenems (J01DH)	5 (3)	4 (1–7)	4 (3)	4 (1–7)
Trimethoprim and derivatives (J01EA)	3 (2)	4 (1–5)	5 (4)	1 (0–7)
Macrolides (J01FA)	21 (15)	3 (1–5)	15 (12)	6 (3–12)
Other aminoglycosides (J01GB)	1 (1)	6 (3–7)	4 (3)	5 (2–9)
Fluoroquinolones (J01MA)	1 (1)	13 (7–17)	2 (2)	12 (6–20)
Glycopeptide antibacterials (J01XA)	3 (2)	5 (1–6)	10 (8)	5 (1–9)
Imidazole derivatives (J01XD)	3 (2)	5 (3–7)	5 (4)	6 (3–11)
Other antibacterials (J01XX)	2 (1)	1 (0–1)	0 (0)	0 (0–1)
Indication for treatment mentioned in notes	136 (90)	80 (55–90)	110 (81)	80 (70–88)
Compliance with the hospital antibiotic policy	NA‡	NA‡	54 (70)	75 (55–84)

*Data are expressed as number of patients and percentages. †Data are expressed as median of hospitals' percentages and interquartiles. ‡NA, data not available; measuring compliance with hospital antibiotic policies was considered only in the second point prevalence survey.

Discussion

The findings of this study illustrated patterns of antibiotic use in the study site hospital and demonstrated the value of antibiotic policies in restricting the use of high risk agents. However, the reduction in the use of the restricted agents was associated with a parallel increase in prescribing of combinations of penicillins including beta-lactamase inhibitors and macrolides, where their use was higher in the study site hospital than in other European hospitals included in this survey. In two recent investigations conducted in Antrim Area Hospital [8, 9], the use of amoxicillin-clavulanic acid and macrolides was shown to be a risk factor for the development of hospital-acquired methicillin resistant *Staphylococcus aureus* (HA-MRSA) and CDI. Thus, the implemented changes in the study site hospital formulary were similar to squeezing a balloon [10] where a reduction in the incidence of resistance of specific resistant bacteria is often associated with an increase in the incidence of other types of resistant micro-organisms. The results showed that the use of non-restricted antibiotics increased the use of restricted agents, highlighting the importance of monitoring antibiotic policies and promoting the informed use of non-restricted agents. Review of the results of the May 2008 survey (May 2008, Table 2) led to recommendations to optimize the use of amoxicillin-clavulanic acid and macrolides with a consequent reduction in 2009 (Table 2). Prophylactic antibiotics were used in surgical procedures and in medical patients for the prevention of recurrent urinary tract infections and *Pneumocystic carinii* pneumonia. Of note, a high rate of reporting on indications for treatments from patient notes, which represents good clinical practice, was observed during both surveys. The value of antibiotic guidelines in decreasing antibiotic use and associated cost has been documented. As the compliance rate in the study site hospital was only 70%, full compliance with the guidelines should be targeted.

In conclusion, despite the proven value of antibiotic stewardship in controlling antibiotic resistance in hospitals, more insight into its implementation is needed in order to explore patterns of antibiotic prescribing. Point prevalence surveys may be considered a simple method of monitoring the effectiveness of antibiotic policies and of providing useful data on patterns of antibiotic use, thus informing and guiding local and national antibiotic stewardship. The findings of the present study highlight the importance of considering the monitoring of non-restricted antibiotic agents and compliance with the hospital antibiotic guidelines as targets for quality improvements in Antrim Area Hospital. Finally, volumes of antibiotic use vary between countries according to their local antibiotic guidelines. Thus, systematic comparison with other institutions may result in improving performance via identifying and adopting best practices. Participation in ESAC is therefore beneficial in supporting optimal antibiotic use and benchmarking.

Competing Interests

There are no competing interests to declare.

REFERENCES

1 Paterson DL. The role of antimicrobial management programs in optimizing antibiotic prescribing within hospitals. Clin Infect Dis 2006; 42: (Suppl. 2): S90–5.

2 Gyssens IC. Quality measures of antimicrobial drug use. Int J Antimicrob Agents 2001; 17: 9–19.

3 MacDougall C, Polk RE. Antimicrobial stewardship programs in health care systems. Clin Microbiol Rev 2005; 18: 638–56.

4 McElnay JC, Scott MG, Sidara JY, Kearney P. Audit of antibiotic usage in a medium-sized general hospital over an 11-year period. The impact of antibiotic policies. Pharm World Sci 1995; 17: 207–13.

5 Ansari F, Erntell M, Goossens H, Davey P. The European Surveillance of Antimicrobial Consumption (ESAC) point-prevalence survey of antibacterial use in 20 European hospitals in 2006. Clin Infect Dis 2009; 49: 1496–504.

6 WHO Collaborating Center for Drug Statistics Methodology. Guidelines for ATC Classifications and Ddds Assignment. Oslo: WHO Collaborating Center, 2002.

7 Pelle B, Gilchrist M, Lawson W, Jacklin A, Franklin BD. Using defined daily doses to study the use of antibacterials in UK hospitals. Hosp Pharmacist 2006; 13: 133–6.

8 Aldeyab MA, Monnet DL, López-Lozano JM, Hughes CM, Scott MG, Kearney MP, Magee FA, McElnay JC. Modelling the impact of antibiotic use and infection control practices on the incidence of hospital-acquired methicillin-resistant Staphylococcus aureus: a time-series analysis. J Antimicrob Chemother 2008; 62: 593–600.

9 Aldeyab MA, Harbarth S, Vernaz N, Kearney MP, Scott MG, Funston C, Savage K, Kelly D, Aldiab MA, McElnay JC. Quasiexperimental study of the effects of antibiotic use, gastric acid-suppressive agents, and infection control practices on the incidence of Clostridium difficile-associated diarrhea in hospitalized patients. Antimicrob Agents Chemother 2009; 53: 2082–8.

10 Polk RE. Antimicrobial formularies: can they minimize antimicrobial resistance? Am J Health Syst Pharm 2003; 60: (Suppl. 1): S16–9.