Antibiotic use: knowledge and perceptions in two university hospitals

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Objectives: To investigate knowledge and perceptions about antibiotic prescription in two university hospitals.

Methods: Physicians completed four case vignettes describing infections and a questionnaire. For each vignette, the physicians were asked to determine whether hospital admission and antibiotic treatment were needed; whether a treatment change was needed; and the duration of antibiotic treatment. The questionnaire collected data on beliefs and perceptions regarding antibiotic prescription.

Results: Of 412 eligible physicians, 206 agreed to participate. Factors associated with a vignette score above the median were anaesthesiologist/intensivist (adjusted odds ratio, 3.09; P = 0.02), perception of inappropriate antibiotic use as risky for the patient (adjusted odds ratio, 2.84; P = 0.03) and self-efficacy (adjusted odds ratio, 2.18; P = 0.02), whereas being a surgeon was associated with a vignette score lower than the median (adjusted odds ratio, 0.14; P < 0.0001).

Conclusions: The high participation rate suggested awareness of antibiotic use. Educational programmes specifically targeted at surgeons are needed. We identified cognitive factors that affect knowledge of antibiotic prescription, and may help in the design of education programmes and interventions aimed at improving antibiotic use.

Keywords: antimicrobial management, case vignettes, guideline adherence, prospective studies, continuing medical education

Introduction

Antibiotic use remains high in hospitals, with wide variations across countries. For instance, the amount of antibiotics used in southern European countries is about three times higher than in Scandinavian countries or the Netherlands. Among the many reasons for these differences, socio-cultural factors play a prominent role.

Several studies from the 1970s and 1980s found that about half the orders for antibiotics were unnecessary or involved dosage errors or an inappropriately long duration of use. This proportion did not change over the years. Many studies, performed using different methodological approaches, established that higher antibiotic use resulted in higher resistance rates, whereas frugal antibiotic use decreased resistance rates. Although most infectious diseases consultants agree that inappropriate antibiotic use increases resistance rates, most also believe that concern about resistance is not a key factor when selecting antibiotics for the individual patient. Furthermore, few data are available on the determinants of prescribing practices of individual physicians.

The objective of this study was to evaluate knowledge and perceptions about antibiotic prescription among physicians at two university hospitals.
Antibiotic use in hospitals

Methods

Hospitals
The study was conducted in two public teaching hospitals for adults, located in the same neighbourhood of Paris, France, and affiliated with the same university. The Bichat-Claude Bernard Teaching Hospital is a 35000 patients per year. The Beaujon Teaching Hospital is a 460 bed hospital that has 17 units, most of which are surgical units covering all types of surgery except urology. It employs 340 physicians (including medical students and residents) and admits ~20000 patients per year.

Study design
The study took place in 2008 and consisted of a cross-sectional survey of practices, beliefs and attitudes regarding antibiotic prescription among physicians working at the two study centres. The heads of all 41 inpatient units were invited to participate. In each of the participating units, the physicians were informed that a meeting on antibiotic prescription would be held. At the meeting, the physicians were asked to answer four case vignettes and to complete a questionnaire.

The study was approved by the ethics committee of the Bichat-Claude Bernard Hospital, which waived the need for written informed consent from the participants. The case vignettes and questionnaires were completed anonymously.

Case vignettes
Case vignettes were used as a surrogate of actual practice to measure knowledge regarding antibiotic prescription. Vignettes are well suited to assessing the quality of clinical practice. We used a standardized protocol to develop 16 vignettes. We first selected common infections seen in hospital patients. For each selected condition, evidence-based criteria were available for deciding whether antibiotic treatment was in order, selecting the initial antibiotic regimen, adapting the antibiotics and determining the duration of antibiotic therapy. The diagnosis was stated clearly in each vignette; thus, we did not investigate knowledge about diagnosing infectious diseases, nor questions regarding antibiotic resistance, though half of the vignettes included situations where antibiotic resistance should be a consideration in decision-making, at either the individual or population level.

Among the 16 case vignettes, 8 were about community-acquired infections and 8 about healthcare-associated infections. The infectious condition was pneumonia or bronchitis in five vignettes, urinary tract infection in three, skin and soft tissue infection in two, gastrointestinal infection in two, catheter-related infection in two, meningitis in one and fever during neutropenia in one. Difficulty was considered minor in four vignettes, intermediate for eight and marked for four. Most vignettes included four questions: whether hospital admission was in order; whether antibiotic treatment was required and, if so, which one; whether the antibiotic regimen required modification after 3 or 4 days based on microbiological study results and clinical course; and the optimal duration of antibiotic treatment. An example of three vignettes is available as Supplementary data at JAC Online.

The 16 vignettes were organized in 4 sets of 4 vignettes each, according to the following rules: each set included one easy, one difficult and two intermediate vignettes; the four vignettes in a set dealt with infections of different organs; and each set included two community-acquired and two healthcare-associated infections. Each physician completed one of the four sets of vignettes. The sets were assigned to the physicians at random. The answer to each vignette was rated on a five-point scale and the four ratings were summed to obtain the total score (range, 0–20).

Questionnaire
The physicians completed a questionnaire immediately after answering the case vignettes. The questionnaire was based on social theory principles applied to healthcare behaviour. It included nine questions related to cognitive factors, i.e. perceived susceptibility and knowledge, intention to adhere, attitude towards antibiotic prescription, perceived behavioural and subjective norms, self-efficacy, perceived difficulty of adherence and motivation (Table 1). Perceived susceptibility explored the perception of patient risk associated with inappropriate antibiotic use. Self-efficacy explored the perceived ability of the physician to improve his/her practice. The items covered both aspects of antibiotic prescription, i.e. recovery of the individual patient and effects on bacterial ecology with the possible emergence of resistant strains. We used a seven-point Likert scale for the answers. In accordance with previous studies, the two points of the scale closest to the most positive perception possible were considered positive answers and the other five points negative answers. We also collected unit, age, sex, duration of medical practice and professional status (resident, fellow, attending physician or professor). Completing the four case vignettes and the questionnaire took <3 h.

Statistical analysis
Results were described as median [interquartile range (IQR)] for continuous variables or frequency (%) for categorical variables. We performed univariate and multivariate analyses using logistic regression to assess cognitive factors associated with vignette scores above the median. The non-parametric Wilcoxon rank-sum test or Kruskal–Wallis test was used for continuous variables and the chi-square or Fisher’s exact test, as appropriate, was used for categorical variables.

Factors included in the stepwise multivariate model were those associated with a vignette score above the median in the univariate analysis.

Table 1. Assessment of physicians’ individual cognitive factors related to antibiotic prescription

<table>
<thead>
<tr>
<th>Cognitive factor</th>
<th>Question about antibiotic prescription</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived susceptibility</td>
<td>Do you think that inappropriate antibiotic use puts your patients at risk?</td>
</tr>
<tr>
<td>Perceived knowledge</td>
<td>Do you know the recommendations for antibiotic prescription?</td>
</tr>
<tr>
<td>Intention to adhere/ perceived practice</td>
<td>Do you follow recommendations for antibiotic prescription during patient care?</td>
</tr>
<tr>
<td>Attitude towards antibiotic prescription</td>
<td>Do you perceive appropriate antibiotic prescription as a useful/useless measure?</td>
</tr>
<tr>
<td>Perceived behavioural norm</td>
<td>Do your colleagues follow recommendations for antibiotic prescription?</td>
</tr>
<tr>
<td>Perceived subjective norm</td>
<td>Do you think that your behaviour towards antibiotic prescription serves as a model for your colleagues?</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>Do you feel able to comply with recommendations for antibiotic prescription?</td>
</tr>
<tr>
<td>Perceived difficulty of adherence</td>
<td>Do you feel it is difficult to comply with recommendations for antibiotic prescription?</td>
</tr>
<tr>
<td>Motivation</td>
<td>Do you want to improve your compliance with recommendations for antibiotic prescription?</td>
</tr>
</tbody>
</table>
analysis with \( P<0.20 \). Because the median scores differed across the four sets of vignettes, all analyses were adjusted for set. All tests were two-sided and \( P \) values of \(<0.05\) were considered statistically significant.

Statistical analyses were done using SAS release 9.1 (SAS Institute, Cary, NC, USA).

Results

Of the heads of the 41 eligible hospital units, 33 consented to participate, 16/24 at the Bichat-Claude Bernard Hospital and 17/17 at the Beaujon Hospital. Of the 412 physicians who prescribed antibiotics for inpatients, 206 (50\%) agreed to participate and completed the questionnaire.

Table 2 reports the main data on the 206 participating physicians. The median global vignette score was 11.4 (IQR, 8.9–14.3) (Table 2). Median scores varied significantly across the four vignette sets \( (P=0.003\) , being highest in Set 3 and lowest in Set 4.

In the univariate analysis, variables associated with a score above the median value: being an anaesthesiologist or intensive care unit (ICU) physician \( \text{adjusted odds ratio (aOR)}, 3.09 \) \((95\% \text{ CI}, 1.20–8.00); P = 0.02\); perceived susceptibility \( \text{aOR}, 2.84 \) \((1.08–7.50); P = 0.03\); and self-efficacy \( \text{aOR}, 2.18 \) \((1.12–4.25); P = 0.02\). Being a surgeon was independently and negatively associated with a score above the median value \( \text{aOR}, 0.14 \) \((0.05–0.35); P < 0.0001\).

Discussion

In two university hospitals with a reasonably high participation rate among physicians, case vignettes identified a subgroup of physicians with a high level of knowledge regarding antibiotic prescription. This high level of knowledge was associated with several physician characteristics and cognitive factors.

Participation was quite high in both hospitals, with 80\% of unit heads agreeing to the study and 50\% of physicians in those units agreeing to complete four case vignettes and a questionnaire. However, 20\% of the unit heads did not answer our invitation to participate in the study. Because of the initially high response rate, we did not follow up the non-respondents for participation.

Case vignettes have been used for years to measure variations in the approach of physicians to the diagnosis and treatment of various conditions, including infectious diseases. However, case vignettes have rarely been used to evaluate antibiotic treatment in the hospital setting. Several studies have been performed about knowledge and cognitive factors related to antibiotic prescription among hospital physicians, but most were qualitative. To our knowledge, our study is the first to quantitatively investigate these factors. This is surprising, as using antibiotics appropriately is difficult. Failure to adhere to recommendations is a complex issue that is not easily explained or modified. When prescribing antibiotics, the physician should consider both the best interests of the individual patient and the inevitable ecological impact of the antibiotics on the patient’s commensal flora and on environmental microorganisms. It is well established, however, that physicians first consider individual outcome rather than ecological impact when prescribing.

Physician knowledge, as assessed by the vignette scores, varied considerably across specialties, independently of other variables. Knowledge was best among anaesthesiologists and ICU physicians and worst among surgeons. We are not aware of other studies evaluating this factor. Our data indicate that efforts to educate physicians about antibiotic use should preferentially target surgeons, at least in French university hospitals. The lower level of knowledge in surgeons may be partly

Table 2. Characteristics of participants and scores on case vignettes exploring knowledge about antibiotic prescription; there were four sets of case vignettes and each physician completed a single set

<table>
<thead>
<tr>
<th>Hospital, n (%)</th>
<th>Set 1 (n = 54)</th>
<th>Set 2 (n = 45)</th>
<th>Set 3 (n = 56)</th>
<th>Set 4 (n = 51)</th>
<th>Total (n = 206)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bichat-Claude Bernard</td>
<td>28 (52)</td>
<td>22 (49)</td>
<td>34 (61)</td>
<td>29 (57)</td>
<td>113 (55)</td>
</tr>
<tr>
<td>Beaujon</td>
<td>26 (48)</td>
<td>23 (51)</td>
<td>22 (39)</td>
<td>22 (43)</td>
<td>93 (45)</td>
</tr>
<tr>
<td>Professional status, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>attending or professor</td>
<td>32 (59)</td>
<td>27 (60)</td>
<td>31 (55)</td>
<td>24 (47)</td>
<td>92 (45)</td>
</tr>
<tr>
<td>resident or fellow</td>
<td>22 (41)</td>
<td>18 (40)</td>
<td>25 (45)</td>
<td>27 (53)</td>
<td>114 (55)</td>
</tr>
<tr>
<td>Type of unit, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>medical unit</td>
<td>23 (43)</td>
<td>23 (51)</td>
<td>31 (55)</td>
<td>23 (45)</td>
<td>100 (49)</td>
</tr>
<tr>
<td>anaesthesiology, ICU</td>
<td>12 (22)</td>
<td>11 (24)</td>
<td>7 (13)</td>
<td>7 (14)</td>
<td>37 (18)</td>
</tr>
<tr>
<td>surgical unit</td>
<td>15 (28)</td>
<td>8 (18)</td>
<td>11 (20)</td>
<td>15 (29)</td>
<td>49 (24)</td>
</tr>
<tr>
<td>emergency room and its downstream unit(^*)</td>
<td>4 (7)</td>
<td>3 (7)</td>
<td>7 (13)</td>
<td>6 (12)</td>
<td>20 (10)</td>
</tr>
<tr>
<td>Global score (/20)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean (SD)</td>
<td>11.7 (3.6)</td>
<td>11.0 (3.5)</td>
<td>12.4 (3.8)</td>
<td>10.0 (3.5)</td>
<td>11.3 (3.6)</td>
</tr>
<tr>
<td>median (IQR)</td>
<td>11.8 (9.3–14.3)</td>
<td>11.3 (8.9–15.3)</td>
<td>12.5 (10.7–14.7)</td>
<td>10.3 (7.1–12.5)</td>
<td>11.4 (8.9–14.3)</td>
</tr>
</tbody>
</table>

\(^*\)The downstream unit is a ward that houses medical or surgical patients staying for up to 48 h in the hospital, with simple conditions not requiring admission to a specialty ward.
related to the practice in French hospitals of having the anaesthesiologist, instead of the surgeon, prescribe antibiotics during the postoperative period. In addition, surgeons usually treat specific infectious conditions from their specialty, whereas physicians from medical wards or ICU may treat a broader range of infectious diseases. Interestingly, knowledge did not differ significantly between junior and senior physicians, indicating that education should target both groups, in keeping with data from an earlier study. Most educational sessions are designed for residents, but senior physicians often decide whether patients on the wards require antibiotics and which antibiotic should be used.

After adjustment for professional status and type of unit, two cognitive factors, perceived susceptibility and self-efficacy, were significantly associated with knowledge (vignette scores). The risks associated with inappropriate antibiotic use should be emphasized in the medical curriculum and continuous medical education should be provided to help physicians improve their antibiotic prescription practice. Most physicians consider the impact of antibiotic treatment on the individual patient but not the ecological impact, which is not immediately visible.

A higher perceived ability to comply with recommendations (self-efficacy) was independently associated with better knowledge. Improving knowledge could be crucial for better antibiotic prescription. Among our 206 respondents, several factors were favourable: 82% perceived their practice as suboptimal; and 86% felt they had insufficient knowledge; but 70% deemed that adhering to recommendations was difficult. In addition, 88% of respondents were highly motivated to improve their antibiotic prescription practice (Table 3).

Our study has strengths and limitations. It was conducted in a sample of individuals representing all sectors and specialties of two hospitals. Our results likely reflect the situation in our institution. However, participation bias may have occurred, since 20% of units did not participate. Furthermore, the 50% of non-participating physicians may have been less interested in antibiotic use than the participants. Knowledge may not accurately predict actual practice. For example, despite a high level of knowledge, an ICU physician may prescribe an antibiotic with a wider spectrum than required in a well-defined situation, because of high illness severity with a high risk of death should the patient have another diagnosis or the infection be due to a resistant bacterial strain. Furthermore, we investigated knowledge using case vignettes and not a survey of actual practice. Although case vignettes are well-established surrogates for clinical practice, a survey of actual antibiotic prescription might have produced different results. Our results were obtained in two university hospitals and, therefore, may not apply to other settings. In these two university hospitals, educational efforts such as academic detailing and regular meetings, together with antibiotic stewardship, may increase awareness about antibiotic prescription and affect beliefs and perceptions. These factors may explain the high participation rate among physicians in our study, even among the senior physician group. Finally, antibiotic prescription practices are affected by socio-cultural factors that vary across countries.

In conclusion, we identified factors that significantly affect knowledge of antibiotic prescription. Our results may help in designing specific education programmes and interventions aimed at improving antibiotic use.

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**Transparency declarations**
None to declare. J.-C. L. had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Supplementary data**
An example of three vignettes is available as Supplementary data at JAC Online (http://jac.oxfordjournals.org/).

**References**