Internal Medicine Journal 2001; 31: 462–469

ORIGINAL ARTICLE

What do physicians think about evidence-based antibiotic use in critical care? A survey of Australian intensivists and infectious disease practitioners

V. SINTCHENKO,[1] J. R. IREDELL,[2,3] G. L. GILBERT[3,4] and E. COIERA[1]

[1]*Centre for Health Informatics, Faculty of Medicine, University of New South Wales,* [2]*Centre for Infectious Diseases and Microbiology and Intensive Care Unit, Westmead Hospital,* [3]*Faculty of Medicine, University of Sydney and* [4]*Centre for Infectious Diseases and Microbiology Laboratory Services, Institute of Clinical Pathology and Medical Research, Westmead Hospital, Sydney, New South Wales, Australia*

Abstract

Background: The analysis of factors that influence prescribing decisions is increasingly important. Antibiotic use is often based on limited evidence and lack of information about clinical decision-making processes is an important obstacle to improving antibiotic utilization.

Aims: To compare the attitudes of intensive care unit practitioners (ICUP) and infectious disease practitioners (IDP) to antibiotic use and to the evidence-based information support.

Method: A postal survey conducted between March and July 2000 of ICUP and IDP representing all States and Territories in Australia.

Results: One hundred and fifty-three of 224 clinicians returned the questionnaire (68.3% response rate). In choosing an antibiotic, IDP placed significantly more weight than ICUP on the *in vitro* susceptibility of the pathogen ($P = 0.001$), antibiotic cost ($P = 0.05$) and possible development of antibiotic resistance ($P = 0.007$). More than 95% of both groups believed that unit-specific antibiotic susceptibility of endemic pathogens was an essential factor in rational prescribing, but only 68.5% of IDP and 38.7% of ICUP use microbiology laboratory databases. When in doubt about appropriate antibiotic use, 63.8% of ICUP seek and 76.3% usually follow the advice of IDP. Both groups agree that published antibiotic guidelines are useful, but IDP were more likely to consult them. ICUP were more likely to believe that guidelines are used to control clinicians rather than to improve quality of care ($P = 0.001$). A greater proportion of IDP (71.2%) than ICUP (52.5%) believed that antibiotic prescribing in their intensive care unit (ICU) was evidence based but most (91.8% and 86.9%, respectively) agreed that it should be.

Conclusions: Australian clinicians have positive views about evidence-based prescribing and antibiotic guidelines. However, there are clinically significant differences in prescribing behaviour between ICUP and IDP. These may be explained by different disease spectra managed by each group or different cultures, training and/or cognitive styles. Improvements in the understanding of physicians' information and decision support needs are required to strengthen evidence-based prescribing. (Intern Med J 2001; 31: 462–469)

Key words: antibiotic prescribing, clinical practice, critical care, evidence-based health care, infectious disease.

Correspondence to: Dr V. Sintchenko, Centre for Health Informatics, Level 2, Samuels Building (F25), The University of New South Wales, Sydney, NSW 2052, Australia.
Email: v.sintchenko@student.unsw.edu.au

Received 1 February 2001; accepted 5 June 2001.

INTRODUCTION

The analysis of factors that influence prescribing decisions has become increasingly important in clinical research. Numerous studies have demonstrated

significant variations in prescribing patterns between different countries, between individual prescribers, and within and between specialties.[1–3] These differences are probably related not only to different patient populations but also to variations in doctors' attitudes and decision-making.[1] A clear understanding of the nature of prescribing decisions and physician information needs at the point of care is often lacking, but is essential for rational antibiotic management.

Despite a strict regulatory process for evaluating new drugs and a strong tradition of promoting appropriate prescribing, Australia has one of the highest rates of antibiotic use in the developed world.[4] Antibiotic use in the community has been extensively researched during the last 2 decades and appears to be significantly influenced by patients' demands and other social factors.[1–3] In contrast, critical care medicine offers a decision-making environment almost free from this type of influence. However, current attitudes of hospital-based practitioners to antibiotic prescribing remain largely unknown.

The prescribing of antibiotics in the intensive care unit (ICU) is usually empirical and is often based on limited evidence.[5,6] (Evidence is graded and defined by its ability to establish and support conclusions and, in this context, includes patient-specific data and published treatment guidance.[7,8]) ICU represent the most common source of nosocomial infections within the hospital, with infection and antimicrobial resistance rates several-fold higher than in the general hospital setting or community.[5] A high prevalence of hospital-acquired infections in ICU patients is associated with high utilization of antibiotics. There is no doubt that antibiotic policies and other control measures can be efficacious in reducing levels of antibiotic use and costs, without detriment to patient care or antimicrobial resistance levels.[5,9,10] Nevertheless, the optimal antibiotic control measures remain to be described.[10]

The aim of the present study was to explore and compare attitudes of specialist medical practitioners in Australia to antibiotic use and evidence-based information support in the intensive care setting. We chose infectious disease practitioners (IDP) and intensive care unit practitioners (ICUP) as the study groups. The former group possesses knowledge and expertise regarding antibiotic use and provides the authority for hospital antibiotic protocols. The latter have direct responsibility for patient care and control prescribing in the ICU.

METHODS

To generate a national sample of physicians who provide intensive care or infectious disease (ID) consultation, we used the 1999 lists of accredited practitioners provided by The Royal Australasian College of Physicians and the Royal College of Pathologists of Australasia. The total sample numbered 108 infectious disease physicians or clinical microbiologists (grouped together in this report as IDP) and 128 ICUP.

An initial mailing, including a letter explaining the purpose of the study, a survey questionnaire, consent form and a business reply envelope, was sent out to all physicians in these groups between March and April 2000. Those who had not responded within 4 weeks were sent a reminder with a second copy of the survey materials. The 55-item structured questionnaire, which had been pilot-tested, covered some demographic features (e.g. training university, year of graduation, training specialty), practice settings (e.g. location of the ICU, number of beds and level of the unit according to the Australian Council of Healthcare Standards criteria), a case scenario, questions concerning the use of antibiotics in the critical care setting and opinions about antibiotic guidelines and other information sources. Responses were measured on a 5-point Likert-type scale with anchors specific to the question (e.g. 1 = strongly agree; 2 = agree; 3 = unsure; 4 = disagree; 5 = strongly disagree). Copies of the questionnaire are available on request or at <http://www.chi.unsw.edu.au/mailabsurvey.pdf>.

The Human Ethics Committee of the University of New South Wales approved the study protocol.

Descriptive statistics were generated using Microsoft EXCEL™ 1997. One-way analysis of variance (ANOVA) was used to test significant differences between groups. Statistical significance was set at $P < 0.05$. In addition, groups were compared by using χ^2- and *t*-tests when applicable.

RESULTS

Of the original 242 clinicians, we excluded three of the authors (V. Sintchenko, G. L. Gilbert and J. Iredell) from the sample. A further 15 were ineligible (not involved in ICU prescribing, on sabbatical leave, retired or not contactable). From the 224 eligible respondents, we received 153 completed questionnaires (68.3% response rate). We could not determine response bias because no data were collected from non-responders. Demographic data,

practice characteristics and responses to the questionnaire are shown in Table 1. Of the 80 ICUP eligible for the study, 41 (51.2%) had anaesthetic training and three (3.7%) were non-accredited practitioners. The majority of intensivists surveyed (87.5%) worked full-time in their ICU. The IDP and ICUP were similar with respect to experience and practise patterns. All respondents were salaried specialists representing all States and Territories of Australia.

Antibiotic choice decision

The majority of respondents believed that virulence of the pathogen and its antibiotic susceptibility *in vitro* were important factors in their decision to choose antibiotics (90.2%, $n = 138$ and 97.4%, $n = 149$, respectively). Antibiotic propensity to promote resistance in nosocomial pathogens was considered important by 97.3% of respondents. Most (79.7%, $n = 122$) felt that the cost of the antibiotic is also an important consideration. Table 2 summarizes respondents' views about some attributes of antibiotic choice.

When asked to indicate the importance of various attributes for antibiotic choice decision, respondents from both the IDP and intensivists groups rated most of those listed as at least moderately important (Table 2). The highest rated were antibiotic susceptibility *in vitro*, antibiotic potential for adverse effects and its propensity to promote bacterial resistance. Interestingly, IDP appear to place significantly more importance on the pathogen's *in vitro* susceptibilities and antibiotic cost than ICUP. Lowest rated were the risk of serious superinfection by IDP and the antibiotic cost by intensivists.

When asked to estimate a percentage of appropriate antibiotic cover for initial empirical therapy of suspected infection, the majority of IDP and ICUP (76.4% and 63.4%, respectively) felt that antibiotic selection for community-acquired sepsis should cover 90–95% of possible pathogens. Only a small fraction of respondents in both groups (9.7% and 11.2%, respectively) demanded more extensive coverage (99–100%). The spread of opinion on antibiotic management is shown in Fig. 1. The majority of IDP but only one-third of ICUP ($P = 0.01$) cited 95% guarantee of antibiotic cover as acceptable for initial antibiotic therapy of community-acquired sepsis. Otherwise, there was no significant difference in preferences between groups. Neither the type of training, level of ICU, training university, time since graduation nor site of practice was significantly associated with antibiotic cover expectancy.

Clinicians' preferences in treatment decisions

The majority of respondents (77.1%, $n = 118$) preferred high-specificity clinical definitions for infection to reduce the rate of potential overdiagnosis and antibiotic misuse. It was agreed by 90.4% of IDP but only 73.8% of ICUP that development of future resistance is a valid argument against empirical

Table 1 Sample characteristics of respondents

	IDP	ICUP
Clinicians selected for the study	108	134
Eligible responders	96	128
Response rate	73 (76.0%)	80 (62.5%)*
Practice type		
Metropolitan hospital	65 (89.0%)	74 (92.5%)
Level III intensive care unit	N/A	70 (87.5%)
Professional college fellowship	71 (97.3%)	77 (96.2%)
Training university		
Australia	60 (82.2%)	53 (66.3 %)
Overseas	13 (17.8%)	27 (33.7%)
Years since medical school graduation		
<10	4	3
11–20	35	42
21–30	27	22
31+	7	9
One or more publications in refereed journals in past 3 years	63 (86.3%)	61 (76.2%)

*Overall response rate: 153/224 (68.3%). IDP, infectious disease practitioners; ICUP, intensive care unit practitioners; N/A, not applicable.

broad-spectrum antibiotic use ($P = 0.007$). More than two-thirds (69.9%, $n = 107$) of all respondents agreed that quantitative reporting of minimal inhibitory concentrations is more valuable than qualitative sensitivity or resistance results. ICUP expressed significantly greater belief in the value of surveillance cultures as tools for monitoring hospital antibiotic resistance than their ID colleagues (Table 3). The majority of IDP and ICUP (98.6% and 90.0%, respectively) indicated that they consider medico-legal implications when making antibiotic prescribing decisions.

When presented with a case scenario about a patient with ventilator-associated pneumonia (see Appendix I) whose blood culture revealed a methicillin-resistant coagulase-negative staphylococcus, opinions of respondents varied greatly (data not shown). For example, 27.4% of IDP and 48.7% of ICUP felt that it was appropriate to start vancomycin ($P = 0.007$). However, 57.5% and 46.2% of them, respectively, disagreed with this suggestion ($P = 0.17$). Furthermore, more than half (59.4%) of the respondents believed that this culture result could be ignored as a probable contamination, but 31.4% felt that this could be wrong. Only 25% of intensivists who chose to start antibiotics stated that they would consult the ID/clinical microbiology team. Although individual respondents produced a wide range of scores for each of the attitude scales, there was minimal variation in means between the two groups.

Table 2 Value of some attributes for antibiotic choice decision (no. and % of positive answers)

Attribute	IDP ($n = 73$)			ICUP ($n = 80$)			*P*
	Very important	Somewhat important	Unsure or not important	Very important	Somewhat important	Unsure or not important	
Antibiotic propensity to promote resistance in the unit	36 (49.3)	36 (49.3)	1 (1.4)	38 (47.5)	39 (48.8)	3 (3.7)	NS
Antibiotic cost	12 (16.4)	51 (69.9)	10 (13.7)	6 (7.5)	53 (66.2)	21 (26.3)	0.05
Antibiotic potential for adverse effects	36 (49.3)	36 (49.3)	1 (1.4)	34 (42.5)	44 (55.0)	2 (2.5)	NS
Virulence of the pathogen	46 (63.0)	22 (30.1)	5 (6.8)	35 (43.7)	35 (43.7)	10 (12.5)	NS
Pathogen antibiotic susceptibility *in vitro*	65 (89.1)	8 (10.9)	0 (0)	31 (38.7)	45 (56.3)	4 (5.0)	0.001
Risk of serious superinfection	23 (31.5)	39 (53.4)	11 (15.1)	33 (41.2)	37 (46.3)	10 (12.5)	NS

To simplify the presentation of results, self-reported 5-point scale attitudes were grouped into three groups (very important and important; somewhat important; unsure and not important). Statistics were calculated by ANOVA. IDP, infectious disease practitioners; ICUP, intensive care unit practitioners; NS, not significant.

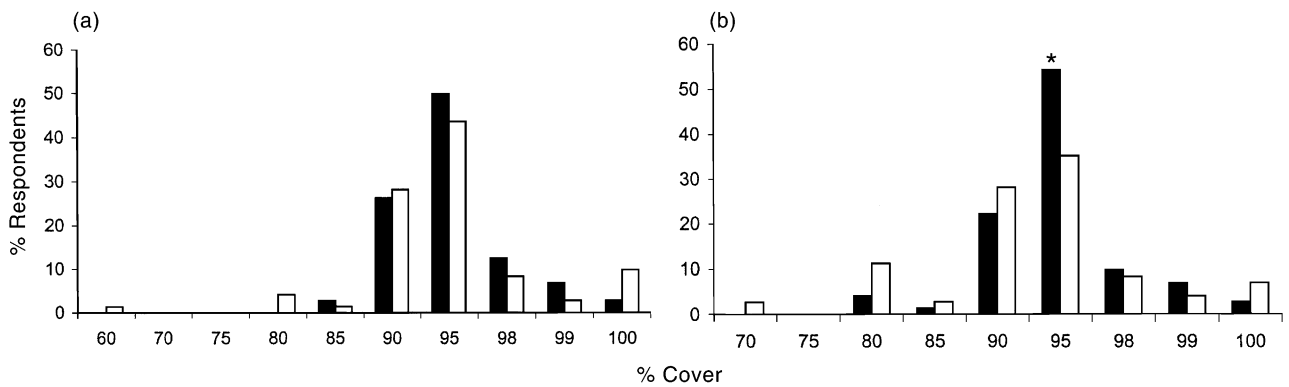

Figure 1 Percentage of antibiotic cover considered acceptable by (■) infectious disease practitioners and (□) intensivists for initial antibiotic therapy for (a) hospital-acquired and (b) community-acquired sepsis. *P value between the two groups is 0.01.

Reactions to antibiotic guidelines

Overall, the participants were positive about the value of antibiotic guidelines. Both groups of respondents expressed some reservations that they did not address difficult dilemmas in clinical practice, and ICUP were more likely than IDP to believe that the guidelines were used to control clinicians rather than improve quality of care ($P = 0.001$). Both groups rated them as a convenient source of advice (Table 3). Many respondents were not convinced that the possible development of resistance is a valid argument against broad-spectrum antibiotic cover. The majority (71.2%) of IDP felt that antibiotic prescribing in their hospitals' ICU was evidence based, compared with only 52.5% of intensivists. Nevertheless, the vast majority in both groups (91.8% and 86.2%, respectively) indicated that prescribing should be evidence based.

Information sources used for prescribing

The responses to the unscaled items about information sources used in practice for antibiotic prescribing are listed in Table 4. Although these responses demonstrate an awareness of different sources providing guidelines for antibiotic use, they also document a significant usage of laboratory-based information resources. IDP seek information from external sources for advice on management of individual patients more often that intensivists (26.1% and 10.0%, respectively; $P = 0.01$). The majority of respondents agreed that unit-specific prevalence of pathogens and their resistance patterns are essential for rational antibiotic prescribing. However, this information is unlikely to be accessible for many of them. Only 68.5% of IDP and 38.7% of ICUP stated that they use the microbiology laboratory databases to guide prescribing decisions ($P < 0.001$). This may be

Table 3 Physicians' attitudes to antibiotic use in intensive care unit (mean scores)

Statement	IDP	ICUP	*P*
1. Unit-specific prevalence of pathogens and their resistance patterns are essential for rational antibiotic use.	1.52	1.61	NS
2. Surveillance cultures are useful tools for monitoring hospital antibiotic resistance.	2.71	2.27	0.007
3. Development of future resistance is a valid argument against broad-spectrum antibiotic cover.	1.81	2.10	0.024
4. Antibiotic guidelines are a convenient source of advice.	1.63	1.75	NS
5. Antibiotic guidelines do not address difficult dilemmas in my practice.	2.73	2.39	NS
6. Guidelines are used to control clinicians rather than improve quality of care.	4.18	3.80	0.001
7. Antibiotic use in my ICU is evidence based.	2.57	2.77	NS
8. Microbiology laboratory support is reliable.	1.50	2.17	0.05

Items were rated on a scale of 1 (strongly agree) to 5 (strongly disagree). Statistics were calculated by ANOVA. IDP, infectious disease practitioners; ICUP, intensive care unit practitioners; NS, not significant; ICU, intensive care unit.

Table 4 Information sources used in clinical practice (%)

	IDP ($n = 73$)	ICUP ($n = 80$)	*P**
Hospital antibiotic formulary	69.9	50.0	0.01
Therapeutic guidelines	98.6	86.2	0.005
Australian medicines handbook	12.3	6.2	NS
Local microbiology laboratory database	68.5	38.7	<0.001
Local intranet resources	15.1	8.7	NS
Web-based resources (e.g. Medline, PubMed)	80.8	51.2	<0.001

*χ^2 test. IDP, infectious disease practitioners; ICUP, intensive care unit practitioners; NS, not significant.

in part because databases are not readily available or convenient to use. When specifically asked, the majority of respondents (71.2% and 62.5% of IDP and ICUP, respectively) believed that computer-based antibiotic prescribing aids would help to reduce misuse of antibiotics.

Finally, when in doubt about antibiotic use most intensivists indicated that they would seek advice from the ID/clinical microbiology team ($n = 51$, 63.8%) and/or from the laboratory ($n = 67$, 58.7%) and, of these, the majority (76.3% and 63.8%, respectively) would always or frequently follow the advice. Only four (5%) stated that they 'never' followed laboratory advice.

DISCUSSION

To our knowledge, there have been no previously published studies of the attitudes to antibiotic use of specialist practitioners. Our findings provide, for the first time, much needed evidence to support existing beliefs about attitudes pertinent to antibiotic prescribing in intensive care.[11] Similar important variations in prescribing have been found between different types of community doctors (e.g. family physicians and paediatricians).[12] While this practice variation does not necessarily influence patient outcomes, it implies that professionals may be exposed to different information sources or have different beliefs about the hazards and benefits of antibiotics. It is noteworthy that this variation exists among prescribers in tertiary referral hospitals; it is possible that even wider variations exist among those in general hospitals or private practices.

Differences in physicians' preferences and cognitive biases may explain at least part of the practice variation.[13] For example, the value bias, in which judgements of the probability of an outcome are biased according to its importance, may lead to overestimation of the probability of infection for very sick patients. We used antibiotic cover estimates for empirical antibiotic treatment of sepsis as a surrogate marker of prescribers' risk tolerance. Our results demonstrate that some clinicians aim at unrealistic targets for antimicrobial cover perhaps because they place a greater weight on potential losses than the gains. For some prescribers, the broadest possible antibiotic coverage compensates for uncertainty of clinical diagnosis in critical care and achieves the desired outcome, albeit at a greater cost and increased risk of adverse effects and bacterial resistance.[14] Alternatively, this non-linear component in decision-making might reflect attention mechanisms that allow the clinician to remain maximally sensitive to unpredictable events in the critical care environment.

Although microbiological studies form the basis for appropriate treatment, Australian clinicians exhibited varying opinions on the contribution of laboratory results to decisions regarding appropriate antibiotic treatment, which is consistent with previous overseas findings.[15] The different specialty background of the two groups and the empirical nature of antibiotic prescribing in the intensive care environment could contribute to observed variations. In a recent survey, 25% of Canadian internists cited lack of relevant evidence as a barrier to the use of evidence-based practice (EBP) and only a minority (20%) of respondents reported frequently using EBP guidelines.[16] Our observations confirm that, while it would be desirable, there is no consensus on antibiotic use in intensive care practice. Although data indicate that 75% of the decisions in a general internal medicine inpatient service are supported by evidence, similar information is not available for the ICU setting.[17,18] It is apparent that much of current critical care practice is based on our understanding of physiology rather than on evidence of effectiveness. Antibiotics are often chosen in a setting of incomplete knowledge of causative pathogens and uncertain prognosis. However, there is an increasing realization that prescribing is less affected by outcome estimates than by the hospital culture.[10] Practice environment is an important behavioural barrier to implementation of EBP and its impact on physician decision-making needs more study.[19] Despite reports of short-term effects, there is little evidence that excessive use of antibiotics will be controlled by guidelines, restrictive formularies or other administrative measures. Our results support a view that this may be because antibiotic misuse more often results from inadequate information than from inappropriate behaviour.[20] The complexity of prescribing decisions in the critical care environment because of time pressure, severity of illness of the patients, the empirical nature of antibiotic use and the timeliness and limited availability of laboratory results should be acknowledged. Relevant information available at the bedside when decisions are being made may facilitate integration of evidence with individual patient data, improve physicians' confidence in prescribing and address the variation in decision-making.[21,22]

These conclusions should be interpreted in light of the limitations in the study design. First, the survey relied on self-reported behaviour without verification

that physicians actually practised in the manner described. Physicians often overestimate the effectiveness of their use of tests or procedures.[23] Second, we studied only the two most important decision points: the decision to use antibiotics and the choice of antibiotic(s), ignoring the selection of the dosage, route, interval and duration of the therapy. We have addressed the quality of the prescribing decision only partially, not covering all issues related to appropriate, effective, safe and economic antibiotic use. Finally, we have surveyed specialist practitioners, many of whom practise in tertiary referral hospitals and hold academic appointments. Community clinicians are likely to differ from academics in prescribing practices and in information needs. However, this has the advantage of representing the point of view of professionals who are usually 'early adopters' of new concepts and the opinion leaders in their field.

Previously undocumented facts have emerged from the study: (i) lack of unit-based prevalence of resistance data to support antibiotic prescribing, (ii) interest of Australian clinicians in antibiotic prescribing aids and (iii) clinically significant differences in beliefs about laboratory support reliability between IDP and ICUP. Our results provide information about relative value of different types of information needed for therapeutic decision-making and help to identify key issues for design and implementation of strategies to improve antibiotic prescribing in Australian hospitals. Further study on prescribing patterns is required to delineate the relationship between information supply and actual practice.

ACKNOWLEDGEMENTS

V. Sintchenko was supported by a National Health and Medical Research Council of Australia research scholarship at the time of the study. Conflict of interest: none.

The participation of intensive care consultants and infectious disease practitioners in our research, without financial incentive, is acknowledged gratefully. The authors are indebted to Associate Professor Jeanette Ward, who contributed to questionnaire design. We also thank Dr Ken Harvey for critical review of an earlier draft of the manuscript.

REFERENCES

1 Bradley CP. Decision making and prescribing patterns – a literature review. Fam Pract 1991; 8: 276–87.
2 Jones DA, Sweetnam PM, Elwood PC. Drug prescribing in Wales and in England. J Epidemiol Community Health 1980; 34: 119–23.
3 Olesen F, Oestergaard I. Patients with urinary tract infections: proposed management strategies of general practitioners, microbiologists and urologists. Br J Gen Pract 1995; 45: 611–13.
4 Turnidge J. Antibiotic use or misuse? Med J Aust 1997; 167: 116–17.
5 Singh N, Yu VL. Rational empiric antibiotic prescription in the ICU. Clinical research is mandatory. Chest 2000; 117: 1496–9.
6 Bellomo R, Bersten AD, Boots RJ *et al.* The use of antimicrobials in ten Australian and New Zealand intensive care units. Anaesth Intensive Care 1998; 26: 648–53.
7 Sackett DL. Rules of evidence and clinical recommendations on the use of antithrombotic agents. Chest 1989; 95: 2S–4S.
8 Buetow S, Kenealy T. Evidence-based medicine: the need for a new definition. J Eval Clin Pract 2000; 6: 85–92.
9 Gould IM. A review of the role of antibiotic policies in the control of antibiotic resistance. J Antimicrob Chemother 1999; 43: 459–65.
10 Polk R. Optimal use of modern antibiotics: emerging trends. Clin Infect Dis 1999; 29: 264–74.
11 Elstein AS, Christensen C, Cottrell JJ, Polson A, Ng M. Effects of prognosis, perceived benefit, and decision style upon decision making in critical care. Crit Care Med 1999; 27: 58–65.
12 Watson RL, Dowell SF, Jayaraman M, Keyserling H, Kolczak M, Schwartz B. Antimicrobial use for pediatric upper respiratory tract infections. Reported practice, actual practice, and parent beliefs. Pediatrics 1999; 104: 1251–7.
13 Nightingale SD, Grant M. Risk preference and decision making in critical care situations. Chest 1988; 93: 684–7.
14 Yu VL, Stoehr GP, Starling RC, Shogan JE. Empiric antibiotic selection by physicians: evaluation of reasoning strategies. Am J Med Sci 1991; 301: 165–72.
15 Gomez J, Conde Cavero SJ, Cardona JLH *et al.* The influence of the opinion of an infectious disease consultant on the appropriateness of antibiotic treatment in a general hospital. J Antimicrob Chemother 1996; 38: 309–14.
16 McAlister FA, Graham I, Karr GW, Laupacis A. Evidence-based medicine and the practising clinician. J Gen Intern Med 1999; 14: 236–42.
17 Ellis J, Mulligan I, Rowe J, Sackett DL. Inpatient general medicine is evidence-based. Lancet 1995; 346: 407–9.
18 Ionnidis JPA, Lau J. State of the evidence: current status and prospects of meta-analysis in infectious diseases. Clin Infect Dis 1999; 29: 1178–85.
19 Greenhalgh T. Is my practice evidence-based? BMJ 1996; 313: 957–8.
20 Burke JP. Antibiotic resistance – squeezing the balloon? JAMA 1998; 280: 1270–71.
21 Hunt DL, Haynes RB, Hanna SE, Smith K. Effects of computer-based clinical decision-support systems on physician performance and patient outcomes: a systematic review. JAMA 1998; 280: 1339–46.
22 Craig JC, Irwig LM, Stockler MR. Evidence-based medicine: useful tools for decision making. Med J Aust 2001; 174: 248–53.
23 Lurie N, Manning WG, Peterson C *et al.* Preventive care: do we practise what we preach? Am J Public Health 1987; 77: 801–4.

APPENDIX I: SAMPLE CASE SCENARIO AND QUESTIONS

A 48-year-old man with a history of alcohol abuse and liver disease was admitted to the ICU with profound hypotension and gastrointestinal bleeding. After resuscitation he remained ventilator-dependent for 3 weeks and eventually developed fever with a presumptive diagnosis of pneumonia. His lines were changed 3 days previously. His chest radiograph demonstrated no real improvement after 5 days of first-line broad-spectrum antibiotics because diagnosis of pneumonia and his tracheal aspirate the next day yielded a heavy predominant growth of *Klebsiella pneumoniae*. Because of the patient's deterioration a blood culture was collected. Coagulase-negative *Staphylococcus* is isolated from blood culture. It is resistant to methicillin, erythromycin, ciprofloxacin; sensitive to vancomycin and rifampicin.

Please rate how strongly you agree or disagree with the following statements for the different scenarios. Please circle one number in each row:

	Strongly agree	Agree	Unsure	Disagree	Strongly disagree
Start vancomycin and change *in vitro* lines	1	2	3	4	5
Take another blood culture and start vancomycin	1	2	3	4	5
Ask for infectious disease opinion	1	2	3	4	5
Ignore as probable contaminant if patient remains stable	1	2	3	4	5