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# Psychosocial determinants of physicians' acceptance of recommendations by antibiotic computerised decision support systems: A mixed methods study

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ABSTRACT

Antibiotic computerised decision support systems (CDSSs) were developed to facilitate optimal prescribing, but acceptance of their recommendations has remained low. We aimed to evaluate physicians' perceptions and attitudes toward antibiotic CDSSs and determine psychosocial factors associated with acceptance of CDSS recommendations for empirical therapy. A mixed methods study was conducted in an adult tertiary-care hospital in Singapore, with its in-house antibiotic CDSS that integrates antimicrobial stewardship with electronic prescribing. Focus group discussions were conducted among purposively sampled physicians and data were analysed using the framework approach. Emerging themes were included in the questionnaire with newly developed scales for the subsequent cross-sectional survey involving all physicians. Principal components analysis was performed to derive the latent factor structure that was later applied in multivariate analyses. Physicians expressed confidence in the credibility of CDSS recommendations. Junior physicians accepted CDSS recommendations most of the time, whilst senior physicians acknowledged overriding recommendations in complex patients with multiple infections or allergies. Willingness to consult the CDSS for common and complex infections (OR = 1.68, 95% CI 1.16–2.44) and preference for personal or team decision (OR = 0.61, 95% CI 0.43–0.85) were associated with acceptance of CDSS recommendations. Cronbach's $\alpha$ for scales measuring physicians' attitudes and perceptions towards acceptance of CDSS recommendations ranged from 0.64 to 0.88. Physicians' willingness to consult an antibiotic CDSS determined acceptance of its recommendations. Physicians would choose to exercise their own or clinical team's decision over CDSS recommendations in complex patient situations when the antibiotic prescribing needs were not met.



## 1. Introduction

The rapid emergence and unimpeded increase in antibiotic resistance has raised serious concerns about the public health threat of a post-antibiotic era [1]. Antibiotic prescribing is regarded as the key driver of antimicrobial resistance [2–4], and prescriber involvement in antibiotic stewardship efforts is paramount [5].

Attempts have been made to understand physician and patient factors influencing antibiotic prescribing. Physicians' attitudes, such as fear of future complications and of losing the patient, and patient-related factors including the patient's clinical status and antibiotic allergies were identified as major factors associated with inappropriate antibiotic prescribing [6,7]. In the limited studies on physicians working in adult acute-care hospitals, specific barriers to optimal antibiotic prescribing included lack of confidence in antibiotic guidelines, inertia of current practice, and lack of independence in decision-making [8,9].

Clinical decision support systems have been developed to improve clinical practice, but one-third have not managed to

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succeed [10,11]. Features of such systems deemed critical for improving clinical practice included decision support provided automatically within the clinical workflow, given at the time and location of decision-making, and that is computer-generated [11]. Antibiotic computerised decision support systems (CDSSs) incorporating these critical features have been developed to facilitate optimal antibiotic prescribing [12–16]. Antibiotic CDSSs are particularly useful for antibiotic selection for empirical therapy, as optimal selection is complex when the causative pathogen is as yet unknown and it is when the greatest discordance with recommended antibiotic guidelines occurs [17,18].

Although such systems were developed with active feedback from physicians [19], less than one-half of antibiotic CDSS recommendations were accepted [16]. Physicians' negative perceptions of clinical decision support systems can affect their use [20]. To date, there is no validated scale available for measuring physicians' perceptions of CDSSs [21,22]. Some studies have attempted to understand the relationship between physicians' perceptions and the adoption of antibiotic CDSSs [22]. However, the psychosocial determinants for physicians' acceptance of antibiotic recommendations by antibiotic CDSSs have remained poorly understood. Qualitative methods have been increasingly recognised as an important complement to quantitative methods for gaining better insights into clinical practices and behaviours and are becoming more widely accepted in medical research [7,23,24].

We therefore sought to evaluate physicians' perceptions and attitudes toward a tertiary hospital's antibiotic CDSS, 'Antimicrobial Resistance Utilisation and Surveillance Control' (ARUSC) [25], and to determine the psychosocial factors associated with physicians' acceptance of antibiotic recommendations for empirical therapy by the system, using a mixed methods study design.

## 2. Materials and methods

A mixed methods design was employed, with a qualitative phase followed by a dominant quantitative phase. Themes derived from the qualitative study were used to inform the quantitative survey.

### 2.1. Study setting

Both studies were conducted in Tan Tock Seng Hospital, a 1500-bed adult tertiary care centre in Singapore. In 2009, the hospital launched its in-house ARUSC, which integrates antimicrobial stewardship with the computerised prescribing order entry system and provides patient-specific evidence-based antibiotic recommendations at the point of prescribing [25]. Inputs from all clinical departments were considered in ARUSC's development. However, acceptance of ARUSC's antibiotic recommendations has remained at 67% [unpublished data].

### 2.2. Qualitative study

#### 2.2.1. Focus groups

Two focus group discussions (FGDs) were conducted, separately with junior and senior physicians purposively sampled from all clinical specialties, in February 2013. FGDs were facilitated by a junior attending physician who was respected by junior physicians and well regarded by senior physicians, but not directly involved with the hospital's antimicrobial stewardship programme.

The discussions used the same set of semi-structured questions and were audio-recorded and transcribed verbatim. Participants are referred to by study numbers (S1–6 and J1–5), and strict confidentiality of their identities was maintained.

### 2.3. Quantitative study

#### 2.3.1. Study population

A cross-sectional questionnaire survey was then conducted from 1 April 2013 to 26 April 2013. All physicians involved with inpatient care were included in the study.

#### 2.3.2. Survey questionnaire

A survey instrument was developed that comprised 20 questions on the situations for use, the perceived credibility and usefulness, and the desired useful features of ARUSC for empirical antibiotic therapy. A five-point Likert scale ranging from 1 ('strongly disagree') to 5 ('strongly agree') was used for each response. In addition, the survey instrument included a 'yes/no' question on the physician's preference for obtaining ARUSC's recommendations via a mobile application as well as an item requesting the physician to rank from 1 ('most preferred') to 6 ('least preferred') the likelihood of acceptance of recommendations from six information sources including ARUSC and consultation with an infectious diseases (ID) physician. Information on the physician's designation, clinical specialty, and length of practice in the clinical department and hospital were collected.

The initial survey instrument was enhanced to incorporate two questions on the use of ARUSC for renal dose adjustment and when on-call, as these were subthemes that emerged strongly from the FGDs. The improved questionnaire was piloted on ten junior and five senior physicians who provided useful feedback on the construct of three questions. These were revised for the final questionnaire.

#### 2.3.3. Conduct of survey

Physicians were informed of the study via email, 1 week prior to the study. Survey questionnaires were distributed to all physicians via their departments. In addition, physicians were individually approached in the inpatient wards and were invited to participate. The questionnaire did not contain any identifiers and could not be traced to the participating physician.

Ethical approval for both studies was obtained from the Domain Specific Research Board, National Healthcare Group (Singapore) and the University of California, Los Angeles (UCLA) (Los Angeles, CA) Institutional Review Board.

### 2.4. Data analysis

#### 2.4.1. Qualitative analysis

Data were analysed from the FGDs using the framework approach [26]. Emerging themes were categorised according to the perceived facilitators and barriers associated with acceptance of ARUSC antibiotic recommendations.

#### 2.4.2. Quantitative analysis

The mean (± standard deviation) and median (interquartile range) were computed for each question and were compared between junior and senior physicians and between medical and surgical specialties. Student's *t*-test was used to compare the differences in means between groups. Acceptance of recommendations from ARUSC and consultation with an ID physician was defined as having a ranking of 1 to 3, respectively, for the most preferred information source. Odds ratios (ORs) and 95% confidence intervals (CIs) were derived from the univariate analysis of the association between the 20 question items and acceptance of ARUSC's recommendations and preference for obtaining ARUSC recommendations via a mobile application, respectively. Principal components analysis (PCA) was performed with varimax rotation to derive the latent factor structure that was later applied in the multivariate analyses. Reliability of the survey scales was measured using Cronbach's