Original Article

Antibiotic prescribing knowledge, attitudes, and practice among physicians in teaching hospitals in South India

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Abstract

Background: Antibiotic overuse is a major public health challenge worldwide. Data from India related to physician antibiotic prescribing patterns are limited. **Aims:** We assessed antibiotic prescribing knowledge, attitudes, and practices among physicians in Mangalore, South India. **Materials and Methods:** Using a cross-sectional descriptive study design, physicians at academic tertiary hospitals completed an anonymous on-site survey. The survey items incorporated Likert scales, and data were analyzed using SPSS version 15.0. **Results:** Of the 350 physicians approached using a convenient sampling method, 230 (66%) consented and interviewed. The physician's knowledge of resistance patterns of common bacteria was related to receiving periodic updates on resistance patterns of bacteria ($P = 0.019$) and participation in courses on antibiotics ($P = 0.026$). Individuals with more number of years of experience (mean of 11 years) were less likely to justify antibiotic use for uncomplicated bronchitis ($P = 0.015$) and acute gastroenteritis ($P = 0.001$). Most respondents ($n = 204$, 89%) believed that physicians overprescribed antibiotics in routine clinical practice. Forty-five percent ($n = 104$) stated that their hospitals did not have an infection control policy in place. **Conclusions:** This study provides some understanding of physician's antibiotic prescribing patterns from teaching hospitals in India. Judicious antimicrobial use through educational and antimicrobial stewardship programs remains critical to control the spread of antibiotic resistance.

Keywords: Antimicrobial resistance, attitudes, India, knowledge, physicians, practices

Introduction

Antibiotic overuse is a major public health challenge worldwide and results in emergence and spread of antibiotic-resistant bacterial pathogens in hospital, clinic, and community settings.[1-6] A myriad of contextual factors may influence antibiotic prescribing including social, institutional, economic, political, and cultural factors warranting development of innovative strategies and interventions.[3] Studies in high-income and low- and middle-income (LMIC) countries have shown that it is often doctor perception of patient demand rather than actual patient demand that is associated with antibiotic overprescription.[7] Behavioral characteristics of both physicians and patients contribute to unnecessary antibiotic prescribing patterns.[8] Studies have shown that physicians often feel pressured to prescribe antibiotics due to patient treatment preferences or expectations.[9-11]

Physicians at teaching hospitals have an unfortunate reputation of overuse of antibiotics.[12-14] In an analysis of 10 studies undertaken

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at teaching hospitals worldwide, 40%–91% of antibiotics prescribed by physicians were inappropriate.[1] Physicians who practice in a medical school or university setting are significantly less likely to be adherent to practice guidelines than those in other practice specialties.[15] Antibiotic overuse is common in India, a country with a population of 1028 million people, where 70% of individuals reside in rural areas but 60% of hospitals, 75% of clinics, and 80% of physicians are located in urban areas.[16,17] Provision of health care to the population is through private sector; over 90% of hospitals are private.[17,18] The recent reports of emergence and importation of novel multidrug-resistant mechanism in bacterial pathogens from India and other countries in South Asia is a serious concern.[19,20]

There is a paucity of literature from India related to antimicrobial surveillance and antibiotic prescribing patterns.[2] A recent community-based surveillance report indicated a much higher use of antimicrobials in three Indian cities compared with two cities in South Africa but also indicated the operational and logistical challenges of long-term surveillance of antimicrobial use in LMIC.[2] Studies on antibiotic use are few and primarily conducted in public hospitals supported by the state governments.[21] In this setting, physicians have to follow national prescribing guidelines for patients who access medical care free of cost or at affordable prices.[14] In contrast, data from private teaching hospitals related to antimicrobial use are very scarce where patients usually pay for medical care. One report from two private hospitals in Ujjain, India, demonstrates widespread antibiotic prescribing.[14] The World Health Organization has developed a global strategy for combating antimicrobial resistance.[22] Assessment of physicians' knowledge, attitudes, and behavior is a necessary first step toward understanding why gaps appear between evidence and practice.[23]

Objectives

We evaluated the knowledge, attitudes, and practices in regard to antibiotic prescribing by physicians in Teaching Hospitals in South India with the goal of identifying knowledge gaps and inform interventions that could lead to judicious use of antimicrobials and development of antimicrobial stewardship program.

Materials and Methods

Study design, participants, and sites

This cross-sectional descriptive study was conducted through anonymous on-site survey in Mangalore, India. Eligible respondents were attending physicians and subspecialty residents in adult or pediatric inpatient units or ambulatory clinics practicing at any of the five academic tertiary hospitals located in Mangalore, a coastal city in the State of Karnataka, South India. A total of 350 physicians were approached using a convenient sampling method.

Survey development and content

A survey was developed building on a questionnaire used by the alliance for prudent use of antibiotics.[24] The survey included four sections and elicited information on basic demographics characteristics, knowledge of appropriate antibiotic use, and physician's attitudes toward antibiotic prescribing in regular practice.

The demographics section elicited information on gender, current level of training, years practicing, and field of medicine of the practicing physician. The knowledge section of the survey assessed awareness of antibiotic resistance patterns for a few common bacteria by administering a six-item knowledge test which included four clinical scenarios to assess judicious antibiotic use.[15,25]

The attitudes section helped identify factors that influence a physician to prescribe antibiotics. This was done by asking physicians to select which factors either increase/decrease/or have no effect on antibiotic prescribing.[26] Only by understanding these factors can effective interventions be developed to improve the use of antibiotics.[11] The survey items used a Likert scale to assess what interventions the physicians believe would promote more prudent use of antibiotics.

In the practice section, antibiotic use and patterns in regular practice was assessed by identifying the most common clinical situations where antibiotics are used and the most common antibiotics used. This section also inquired about the usage of laboratory facilities and whether the physicians receive regular information regarding antibiotic resistance patterns. It also inquired if the physician has taken any course or formal training on infection control or antibiotic usage.

Statistical analysis

Statistical analysis was performed using SPSS version 15.0 software (SPSS Institute, Chicago, IL, USA). Comparison between groups was performed using Fisher's exact/Chi-square analysis for proportions and *t* test / ANOVA procedures for continuous variables. $P \leq 0.05$ was considered statistically significant.

Ethical considerations

The study was reviewed and approved by the Ethics Committee at Nitte University, Mangalore, and participating institutions. Informed consent was obtained from all participants.

Results

Sociodemographic characteristics of respondents

Of 350 eligible physicians, 230 physicians (66%) completed the survey. The demographic characteristics of the respondents are shown in Table 1. Of the total, the majority were males (n = 168, 73%). The overall average practicing period of the physicians were 10.7 years. The male physicians had a mean age of 35 years, with a mean of 11.5 years of practice whereas the female physicians had a mean age of 32 years, with a mean of 8.7 years of practice. Most physicians were practicing

consultants or attending physicians (n = 141, 61.3%), followed by physicians in the 1st year of residency (n = 52, 22.6%). Physicians surveyed were practicing in various specialties including internal medicine (n = 54, 23.5%), followed by surgery (n = 45, 19.6%), orthopedics (n = 27, 11.7%), dermatology (n = 26, 11.3%), and pediatrics (n = 23, 10%).

Knowledge

Of the 230 physicians, a majority (n = 170, 74%) reported awareness of antibiotic resistance patterns for *Staphylococcus aureus*, followed by Gram-negative bacteria (*Klebsiella*, *Acinetobacter*, *Pseudomonas aeruginosa*, *Salmonella* sp.) (n = 136, 59%), Group A *Streptococcus* (GAS) (n = 117, 51%), and *Streptococcus pneumoniae* (n = 105, 46%). A majority of the respondents (n = 142, 62%) stated that the antimicrobial resistance patterns are applicable to their routine clinical practice in their respective hospital settings.

The physicians were asked if antibiotic use was justified in three clinical scenarios encountered frequently in routine ambulatory settings [Table 2]. From a total of 229 physicians, most respondents (n = 119, 52%) justified use of antibiotics for uncomplicated bronchitis, followed by the common cold (n = 101, 44%) and acute gastroenteritis (n = 25, 11%). Physicians with more number of years of experience (mean of 11 years) were less likely to justify antibiotic use for uncomplicated bronchitis (P = 0.015) and for acute gastroenteritis (P = 0.001).

Provider knowledge in regard to antibiotic use was assessed [Table 3], and the majority correctly agreed (n = 188, 82%) that there would be a reduced risk of emergence of antibiotic-resistant infections if fewer antibiotics were prescribed. Of the respondents, a majority incorrectly agreed (n = 143, 62%) that azithromycin is the drug of choice for a case of GAS pharyngitis in an adult patient. Fifty-one percent (n = 117) correctly agreed that the commensal flora of the gut are considered the most important reservoir for antimicrobial resistance genes in both community and hospital environments. It was found that physicians with more years of experience (mean of 12.5 years) were more likely to know that the commensal flora of the gut are considered the most important reservoir for antimicrobial resistance genes (P = 0.004).

Attitudes

Table 4 describes factors that drive antibiotic prescribing among physicians. Of the total 230 physicians, most (n = 204, 89%) believe that health-care providers overprescribe antibiotics. Respondents reported that the following factors increased the likelihood of antibiotic prescribing for upper respiratory tract infections: Purulent nasal discharge (n = 203, 89%), to prevent serious complications (n = 181, 79%), and fever (n = 166, 73%). The factors that would decrease antibiotic prescribing reported by physicians were antibiotic resistance concerns (n = 165, 72%), medication costs (n = 140, 61%), and by following standard treatment guidelines (n = 93, 41%).

Table 1: Characteristics of respondents (n=230)

Provider characteristic	Male (%) (n=168)	Female (%) (n=62)	Total (%) (n=230)
Mean (SD) age in years	35.27 (8.7)	32.24 (7.4)	34.46 (8.5)
Mean (SD) years of practice	11.4 (8)	8.7 (7)	10.7(8)
Current level of training			
Consultant	107 (63.7)	34 (54.8)	141 (61.3)
1st year residency	37 (22)	15 (24.2)	52 (22.6)
2nd year residency	12 (7.1)	7 (11.3)	19 (8.3)
3rd year residency	12 (7.1)	6 (9.7)	18 (7.8)
Specialization			
Internal medicine	49 (29.2)	5 (8.1)	54 (23.5)
Surgery	36 (21.4)	9 (14.5)	45 (19.6)
Orthopedics	26 (15.5)	1 (1.6)	27 (11.7)
Dermatology	11 (6.5)	15 (24.2)	26 (11.3)
Pediatrics	17 (10.1)	6 (9.7)	23 (10.0)
Obstetrics/gynecology	6 (3.6)	16 (25.8)	22 (9.6)
Ophthalmology	13 (7.7)	7 (11.3)	20 (8.7)
Ear nose throat	10 (6.0)	3 (4.8)	13 (5.7)

Table 2: Physician's response to: Are antibiotics justified in given clinical scenarios?

Clinical scenario	Agree (%)	Disagree (%)	Unsure (%)
Case A			
Acute bronchitis/cough illness for 5 days with purulent sputum; no fever; normal lung examination	119 (52)	92 (40)	18 (7.9)
Case B			
Watery diarrhea for 3 days; not foul smelling; no fever; otherwise normal examination	25 (10.9)	193 (84.3)	11 (4.8)
Case C			
Upper respiratory tract infection, purulent nasal discharge for 5 days; no fever; no cough; otherwise normal examination	101 (44.1)	116 (50.7)	12 (5.2)

The physicians rated the following interventions as most important to promote judicious use of antibiotics: access to appropriate diagnostic testing, improve antibiotic knowledge and awareness, standard treatment guidelines, and receiving periodic updates on resistance patterns for their area.

Practice

Of the 230 physicians surveyed, all the respondents (n = 230, 100%) have access to a reference microbiology laboratory for culture and antimicrobial susceptibility testing. In assessing how often physicians use culture and antimicrobial susceptibility testing before prescribing antibiotics, majority responded frequently (n = 116, 51%), followed by always (n = 39, 17%) and occasionally (n = 38, 17%).

The clinical situations or the signs and symptoms for which antibiotics are most often prescribed were reported

Table 3: Distribution of responses to knowledge questions regarding antibiotics

Statement	Agree (%)	Disagree (%)	Unsure (%)
Patients will have reduced risk of antibiotic-resistant infections if prescribed fewer antibiotics	188 (82)	30 (13)	11 (4.8)
Azithromycin 500 mg administered as a 3 days course is justified as the first line therapy for a case of Group A *Streptococcus* pharyngitis in an adult patient	143 (62.4)	63 (27.5)	23 (10)
The commensal flora of the gut is considered the most important reservoir for antimicrobial resistance genes in both the community and hospital environments	117 (51)	54 (24)	58 (25)

Table 4: The influence of various factors on the likelihood of provider antibiotic prescribing

Factor affecting antibiotic prescribing (*n*)	Would increase prescribing (%)	Would decrease prescribing (%)	No change (%)
Purulent discharge (224)	203 (88.6)	3 (1.3)	18 (7.9)
Diagnostic uncertainty (222)	135 (59)	34 (14.8)	53 (23.1)
Patient request/expectation (223)	75 (32.8)	17 (7.4)	131 (57.2)
Patient satisfaction (222)	61 (26.6)	14 (6.1)	147 (64.2)
Fever (220)	166 (72.5)	10 (4.4)	44 (19.2)
Treatment uncertainty (218)	122 (53.3)	37 (16.2)	59 (25.8)
Standard treatment guidelines (215)	75 (32.8)	93 (40.6)	47 (20.5)
Time pressure (218)	110 (48)	14 (6.1)	94 (41)
Potential return visit cost (216)	79 (34.5)	29 (12.7)	108 (47.2)
Drug promotion (217)	58 (25.3)	20 (8.7)	139 (60.7)
Antibiotic resistance concerns (221)	30 (13.1)	165 (72.1)	26 (11.4)
Medication cost (220)	12 (5.2)	140 (61.1)	68 (29.7)
To prevent serious complications (220)	181 (79)	28 (12.2)	11 (4.8)

as fever (n = 84, 12.2%), preoperative use (n = 45, 6.6%), and infected wounds (n = 44, 6.4%). Of the respondents, a majority (n = 182, 80%) reported that they evaluated patient adherence to antibiotic therapy at follow-up.

The three most common antibiotics for upper respiratory tract infections that are used most in daily ambulatory practice were cephalosporins (56%), followed by fluoroquinolones (29%) and penicillins (45%). Antibiotics are commonly used for prophylaxis; 66% (n = 151) of the respondents agreed they use antibiotic prophylaxis; the most common reason is preoperative use (n = 78, 34%). Of the physicians surveyed, 75% (n = 171) reported having written material for the patients who talk about dosage, adherence, and compliance with the antibiotic regimen.

A majority of respondents (n = 184, 80%) stated that they do not periodically receive information on trends in bacterial resistance specific to their geographical setting. Of those who receive information on antibiotic resistance patterns in their setting, 8% (n = 18) reported they receive such information from microbiology/clinical laboratories, 2% (n = 4) from medical journals, and 1% (n = 2) from the pharmaceutical industry. Physicians who were unaware of the resistance pattern of *S. pneumoniae* were more likely not to receive periodic updates on antimicrobial resistance patterns of bacteria, 86% versus 14% (P = 0.019).

The physicians were asked to rank from 1 to 5 their main sources of information on antibiotics. The most commonly cited source was medical textbooks (51%), followed by pharmaceutical industry (31%), scientific meetings (20%), scientific journals (18%), and professional associations (19%). Of the physicians surveyed, 45% (n = 104) stated that their hospitals lacked a formal infection control program in place whereas none of the hospitals had an antibiotic restriction policy.

When physicians were asked if they have participated in short-term courses or continued medical education (CME) or formal training on judicious use of antibiotics/infection control, 18% reported participation in CME courses, yet 100% did not undergo formal training on antibiotic stewardship. It was also found that those physicians who were unaware of the resistance pattern of *S. pneumoniae* were more likely not to have participated in courses on judicious use of antibiotics, 87% versus 13% (P = 0.026).

Discussion

The study found a variable rate of awareness of antibiotic resistance patterns to a few common bacteria. Less than half of the physicians reported awareness of antimicrobial resistance to *S. pneumoniae*; knowledge of this resistance pattern was shown to be more likely to be reduced in physicians who did not receive periodic updates on resistant bacteria and have not participated in short courses such as CMEs, on antibiotics. In other studies, the regular receipt of area-specific resistance information has been independently associated with knowledge of *S. pneumoniae* resistance patterns.[24]

A high percentage of physicians agreed to use antibiotics for two common illnesses such as uncomplicated bronchitis and

common cold. This finding is consistent with other published reports.[5,8,25] The US Centers for Disease Control and Prevention and Infectious Disease Society of America Guidelines do not recommend routine antibiotic treatment of cold or upper respiratory tract infection or uncomplicated acute bronchitis since the vast majority of these illnesses have a nonbacterial etiology.[27] Studies have shown increased antibiotic use associated with presence of purulence, yet purulent discharge from the respiratory tract, is not an accurate indicator of a bacterial infection that requires antibiotic therapy.[8,25] The study did, however, find that majority of physicians do not agree to use of antibiotics for a case of acute gastroenteritis of likely viral origin. The study found that physicians with more years of experience were less likely to justify antibiotic use for the conditions. In contrast, other studies have found that physicians with fewer years of experience to report less antibiotic prescribing.[25]

It is concerning that only half of the physicians surveyed in our study were aware that the commensal flora of the gut is considered the most important reservoir for antimicrobial resistance genes. Physicians with more years of experience (mean of 12.5 years) were more likely to know this fact. It was found that of those who had said they are aware of resistance pattern for GAS, more than half incorrectly justified the use of azithromycin as the first-line treatment of a GAS pharyngitis. Penicillin or amoxicillin is the treatment of choice for GAS pharyngitis.[28]

We found that the majority believe physicians overprescribe antibiotics, similar to other reported health-care provider surveys.[26] A host of factors ranging from physician and patient attitudes to medical, social, and cultural practices can play a role in physician antibiotic prescribing decision-making process.[3] In the study, respondents reported the most common factors which increase antibiotic prescribing as purulent discharge, fever, and to prevent serious complications. In our study, more than half the physicians report that patient or parent expectations or pressure would have no change on their antibiotic prescribing pattern; in contrast, others studies have found that patient pressure most commonly influenced antimicrobial prescribing decision even though the doctor believed antibiotics were not indicated.[9,25,26]

Interventions described by the surveyed physicians that would allow judicious use of antibiotics included access to diagnostic testing, improved awareness of antimicrobial resistance patterns and antibiotic knowledge, implementation of standard treatment guidelines, and receipt of periodic updates related to local bacterial resistance patterns.[29] Interventions such as academic detailing for doctors and guidelines supported by microbiological data have been found to decrease inappropriate antibiotic practices.[11] In spite of this, less than a fourth of physicians receive periodic information on resistance bacteria specific to their geographical working area. Surveillance of resistant strains in both hospitals and community settings provides key information for effective management of patient care and prescription practices.[30]

In our study, about half of the respondents reported that their hospitals do not have an infection control policy in place. This finding is of major concern since there is evidence-based data indicating that a comprehensive infection control program can limit the emergence and transmission of antimicrobial-resistant bacteria.[31] Despite the challenge of placing such committees in hospitals where a culture of complete physician autonomy exists, the benefits far outweigh the challenges.[32] All the respondents reported that antibiotic restriction policies are not present in their hospitals. Antimicrobial restriction either through formulary limitation or by requirement of preauthorization and justification has been shown to be the most effective method of controlling antimicrobial use.[31]

Education is imperative to enhance judicious use of antimicrobials.[3,4,29] In our study, less than a fifth of physicians had attended educational courses on antibiotics and appropriate prescribing. Antimicrobial stewardship strategies within hospitals use health-care provider education as the most frequently employed intervention. Appropriate use of antibiotics must be included in such continuing medical education. Educational efforts include conference presentations, student and house staff teaching sessions, and provision of written national guidelines to improve antibiotic use in LMIC.[31,33]

The study has several limitations. The survey relied on physician's recall and self-reported practices. We did not assess the relationship of attitudes to actual antimicrobial prescribing; thus, there may have been information bias toward providing answers that the respondents thought the investigators wanted to hear, leading to underestimates of the prevalence of inappropriate attitudes, and prescribing behaviors.[25] We did not probe other factors that can influence physician attitudes toward antibiotic prescribing including pharmaceutical promotion, very limited consultation and dispensing times, and economic incentives. The study was conducted at four teaching private hospitals in one city in Southern India limiting generalizability. The three clinical scenarios used to assess judicious use of antibiotics were limited to a few features and not actual patients and the vignettes do not allow ordering further point-of-care diagnostic tests as might have been appropriate, before prescribing antibiotics.[8] We did not measure antibiotic consumption and prescription audit to determine the appropriate use of antibiotics and whether interventions are effective. Despite these limitations, our study provides a good insight into physician's knowledge, attitudes, and practice patterns related to antibiotic use in South India. Data from this survey can be utilized to enhance education, antimicrobial surveillance, and antibiotic prescribing patterns among physicians in our setting.

Conclusions

Our study has identified the following crucial areas that need to be addressed more effectively to control the menace of antibiotic resistance in our setting: (1) improve antimicrobial prescribing

by educational and administrative means; (2) monitoring and providing feedback regarding antibiotic resistance nosocomial infection, reviews at epidemic control meetings, and the discussions at the microbiology unit. It is encouraging to note that the Government of India has recently formulated a national policy for containment of antimicrobial resistance.[34] In addition, the Global Antibiotic Resistance Partnerships has published several short-term and long-term recommendations for control of antimicrobial resistance in LMIC.[35] Rapid implementation of the above recommendations is vital to limit the spread of growing antimicrobial resistance in India.

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Conflicts of interest

There are no conflicts of interest.

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