Original Article

Knowledge, attitude, and practice survey on antimicrobial use and resistance among Indian clinicians: A multicentric, cross-sectional study

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Abstract

Purpose: This multicentric questionnaire-based study was undertaken to address the lack of systematic background data on the knowledge, attitudes, and practices among Indian physicians related to antimicrobial use and resistance.

Materials and Methods: A validated structured study questionnaire was used for capturing respondent particulars, antimicrobial prescribing habits, knowledge of antimicrobial resistance (AMR), ways of choosing and learning about antibiotics, agreement or disagreement with certain perceptions regarding antibiotics, selection of antibiotics in specific settings, and suggestions regarding rationalizing antimicrobial use in the practice setting. Summary statistical analysis of the pooled data was done.

Results: Five hundred and six respondents with a mean (standard deviation) age of 31.4 (8.71) years participated in the study. Three hundred and twenty-seven were medical and 179 surgical discipline clinicians. Overall, the theoretical knowledge about antimicrobials was satisfactory, but areas of concern were noted in the attitude and practice domains. A substantial proportion of participants failed to identify the correct choice of antibiotics in the case-based scenarios. 38.33% reported not attending a single continuing medical education on antimicrobials during the past year. Statistically significant differences were not observed in the KAP quotient scores between medical and surgical discipline respondents.

Conclusions: Despite satisfactory background knowledge regarding the rational use of antimicrobials and AMR patterns, there are discrepancies in the physicians' prescribing attitude and thus strengthen the case for instituting specific interventions to improve antimicrobial prescribing.

Keywords: Antibiotics, antimicrobial resistance, attitude, India, knowledge, practice, survey

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INTRODUCTION

Antimicrobial resistance (AMR) from irrational and inappropriate use of antibiotics has emerged over the years as a major global public health threat and has worldwide economic, social, and political implications.[1,2] Multiple microbes, originally susceptible to commonly used antimicrobials, are now showing resistance patterns that render them unresponsive to standard treatment modalities. Such resistance then results in prolonged duration of illness, higher expenditure, increased risk of complications, or even death.[1] Several factors contribute significantly to the progression of AMR in developed and developing countries. These include overuse of antimicrobials in prescriptions, inappropriate selection of antibiotics, inappropriate dosing or treatment duration, lack of access to timely diagnostic tests, pressure of pharmaceutical promotion, lack of public awareness of the issue, access to antibiotics without prescription, self-medication, and inappropriate use of leftover antibiotics and poor doctor–patient relationships.[2-5] Inadequate infection control measures disseminate resistant organisms through the hospital and community, thereby adding to the problem.[6]

It is apparent that many of the drivers of irrational or inappropriate antimicrobial use and consequent AMR relate to deficiencies in prescribers' knowledge, attitude and practice (KAP) in relation to antibiotics. Studies have been conducted around the world looking into physicians' knowledge, attitude, and practices on antibiotic use and resistance, commonly used information sources for prescribing and recommendations to improve antibiotic prescribing.[6,7] They enable the researchers and policy-makers to assess the ground situation and institute, wherever feasible, remedial measures.

Unfortunately, credible Indian data in this regard are lacking. We were able to identify only a few Indian KAP studies on antibiotic prescribing[3,8,9] of relatively recent origin, but the scope of these studies is limited in geographic extent and therefore may not be a true representation of the situation across health-care settings in the country. In view of this unmet need, our study objective was to assess the knowledge, attitude, and practice of practicing physicians toward antibiotic prescribing and AMR. The study shall provide us with background data before the implementation of an antimicrobial stewardship program (ASP) and identify areas where interventions can be made to improve knowledge and rationalize AM prescribing habits. This survey is broad-based because we recruited participants across multiple centers and at various stages in their professional careers. The centers are all tertiary care teaching hospitals that witness high volumes of prescription of antimicrobials at both inpatient and outpatient settings.

MATERIALS AND METHODS

The study was designed as a cross-sectional observational study across five tertiary care teaching medical colleges (Kolkata, Chandigarh, Bhopal, Ujjain, and Baroda) in India. Institutional ethics committee approval was obtained from each of the participating centers and data collection extended over 8 weeks between January and March 2019.

The primary study tool was a KAP survey questionnaire in English which was designed at one of the centers (Kolkata) and, after face and content validation, was field-tested at all five centers before finalization. Intraclass correlation coefficient value for absolute agreement of at least 0.7 was taken as the cutoff for retaining an item in unchanged form. The questionnaire was not designed *de novo* but adapted, with permission from that used by the team of García *et al*. in Peru for a KAP study among clinicians.[10] The survey form was administered by an interviewer during the survey, but no personal identifiers were recorded. It comprised 32 closed- or open-ended questions structured into five sections (A to E), in which 11 were knowledge based, 8 attitude/perception based, and 7 practice based. The questionnaire included information about the respondents, his/her antimicrobial prescribing habits, knowledge of AMR, ways of choosing and learning about antibiotics, agreement or disagreement with certain perceptions regarding antibiotics, selection of antibiotics in specific settings, and suggestions regarding rationalizing antimicrobial use in the practice setting.

Any practicing physician associated with the hospital for at least 1 year was eligible. Separate written informed consent was not obtained as consent was implied if the participant responded to the questionnaire after having been apprised of the nature and purpose of the survey by the study coordinator at the site. This was also made clear in the opening statements in the survey form. Sample size for the study was based on the proportion of the respondents perceiving AMR to be a problem in their own setting. Assuming this proportion to be 50% (a conservative choice since there is no nation-wide data in this regard), we estimated that 517 subjects would be needed with 3% margin of error at 95% confidence level. This calculation assumed the size of the population of respondents at each study site to be 1000. Rounding off our sample size was 500, split into 100 respondents at each center. Although sampling for the study was purposive, each participating center ensured that both medical and surgical specialties were represented in their sample. We computed a total score of each respondent's answers based on 11, 7, and 4 assessable items in the knowledge, attitude, and practice components, respectively. For every correct response, a

score of 1 and for every incorrect response, a score of 0 was accorded. For items in the questionnaire with more than one correct answer, fractional value scores were imparted.

Descriptive statistical analysis was reported as frequency, mean (standard deviation), and median (interquartile range). Mann–Whitney U-test was used to examine statistical differences between median scores of medical (n = 327) versus surgical (n = 179) discipline respondents. Chi-square test was used to analyze any statistically significant differences across responses ($P < 0.001$) for categorical variables, with $P < 0.05$ as the cutoff for statistical significance. Spearman's rho correlation coefficient was computed for assessing the correlation between nonparametric data. Data analysis was done using Statistica version 6.0 (StatSoft Inc., 2001, Tulsa, Oklahoma, USA) software.

RESULTS

Characteristics of respondents

A total of 506 respondents from 5 centers were interviewed for the study: Kolkata 114, Chandigarh 92, Bhopal 100, Ujjain 100, and Baroda 100. Their characteristics are summarized in Table 1. Majority were males (70.75%) and aged below 50 years (94.07%). The respondents comprised various categories of prescribers, with the bulk being junior or senior residents serving in the hospital concerned. The distribution profile of the survey respondents based on their designation indicated that study respondents in four out of five centers predominantly comprised junior residents while one center had mainly senior faculty level respondents (50.88%).

Findings from the knowledge-based components of the questionnaire

Majority of the participants (438, 86.56%) opined that the extent of AMR was a major problem in their setting and 458 (93.08%) believed that knowledge about AMR to be helpful in their practice. An overwhelmingly high proportion felt AMR to be a problem in India, with 477 (94.26%) clinicians believing that antibiotics are inappropriately prescribed in India. Table 2 summarizes the pooled analysis of the knowledge component items.

Table 1: Respondent profile

Respondents' characteristics	Values
Age (years), mean±SD	31.4±8.71
Gender, male, *n* (%)	358 (70.75)
Number of years in practice	
Median (IQR)	3 (2-6)
Range	1-50
Discipline	
Primarily medical	327 (64.62)
Primarily surgical	179 (35.57)
Designation, *n* (%)	
House staff	10 (1.98)
Junior resident	283 (56.04)
Senior resident	86 (17.03)
Junior faculty	35 (6.93)
Senior faculty	91 (18.02)

*There was statistically significant difference ($P<0.001$) in the distribution of responder designation between the participating centers. SD=Standard deviation, IQR=Interquartile range

Findings from the attitude/perception-based section of the questionnaire

In the section assessing the perception among clinicians about the extent of AMR in their work setting, most described AMR as a major problem; 64.3% of the participants agreed to the statement that patient's demand for antibiotics contributes to resistance while a sizeable cohort (17.69%) agreed with the statement that prescribing antibiotics does not cause damage even if patients do not need them. Significantly, 38.33% of the participants reported not attending any continuing medical education (CME) program on antimicrobials during the last year. Among those who attended such programs, the number of such educational programs attended ranged from 1 to 3.

The respondents' attitudes toward antibiotic prescribing are summarized in Table 3. The perception of respondents about the causes of AMR in India is summarized in Figure 1. About 70% of the respondents felt that incorrect duration and dosing and overuse of antimicrobials in the community and in hospitals are the key contributors of AMR in India.

Findings from the practice section of the questionnaire

The respondents' practices regarding antibiotic prescribing are summarized in Table 4. The item on sources of information for clinicians who seek help on antimicrobial prescribing revealed that national/international guidelines were the single most important source (58.69%) of information, followed by Internet-based sources (40.51%), information from peers (37.74%), drug formulary, and textbooks (36.75%). Figure 2 shows the results of appropriate antimicrobial selection for common case-based scenarios and knowledge about some characteristic properties of antimicrobials.

Respondents' perception regarding implementable steps in their hospital to rationalize antimicrobial use and minimize AMR is shown in Figure 3.

Comparison between medical and surgical discipline respondents on knowledge, attitude, and practice domain scores

Table 5 summarizes the knowledge, attitude, and practice domain score between respondents belonging primarily to medical (n = 327) disciplines and their

Table 2: Pooled analysis of the knowledge component of the questionnaire (*n*=506)

Question related to respondents' knowledge	Response, *n* (%)
Extent of antimicrobial resistance in the setting of respondent's practice	
Minor problem	68 (13.43)
Major problem	438 (86.56)
Knowledge about AMR in your setting will be helpful in your practice	
Not sure	25 (4.94)
No	10 (1.97)
Yes	471 (93.08)
Opinion whether antibiotics are inappropriately prescribed in India?	
Not sure	16 (3.16)
No	13 (2.56)
Yes	477 (94.26)
Respondent's opinion regarding AMR in India	
Minor problem	25 (4.94)
Major problem	481 (95.05)
Respondent's opinion regarding whether AMR is a global problem	
Not sure	20 (3.95)
Seldom	30 (5.92).
Occasionally	80 (15.81)
Frequently	376 (74.3)
Perceived causes of antibiotic resistance in India	
Overuse in hospitals	364 (71.93)
Overuse in community	362 (71.54)
Overuse in animals	134 (26.48)
Incorrect dosing/duration	344 (67.98)
Improper regulations	224 (44.26)
Improper hospital infection control	201 (39.72)
Inadequate diagnostic support	75 (14.84)
Inadequate immunization	168 (33.20)
Poor quality of antimicrobials	138 (27.27)
Others	16 (3.16)
Which antibiotic can be considered safe during pregnancy? (correct response: Amoxicillin)	
Amoxicillin	423 (84.76)
Ciprofloxacin	30 (5.92)
Doxycycline	32 (6.14)
Gentamicin	14 (2.76)
Which antibiotic has the best activity against anaerobes? (correct response: Metronidazole)	
Not responded	1 (0.2)
Ciprofloxacin	10 (1.99)
Co-trimoxazole	27 (5.37)
Metronidazole	456 (90.83)
None of these	6 (1.19)
Choice of drug for methicillin-resistant *Staphylococcus aureus* (correct response vancomycin)	
Cefuroxime	24 (4.74)
Ceftriaxone	35 (6.91)
Vancomycin	433 (85.57)
None of these	9 (1.77)
Antibiotic capable of crossing blood-brain barrier (correct response: Ceftriaxone)	
No response	1 (0.20)
Clindamycin	23 (4.61)
Ceftriaxone	299 (60.04)
Vancomycin	163 (32.73)
None of these	12 (2.41)
Incidence of resistance of *Pseudomonas aeruginosa* to ciprofloxacin in their hospital is	
Not responded	3 (0.6)
Not sure	209 (41.8)
<20%	92 (18.4)
20%-50%	98 (19.6)
>50%	99 (19.8)

AMR: Antimicrobial resistance

surgical ($n = 179$) counterparts. No significant differences were observed between the knowledge, attitude, and practice scores across the categories (medical versus surgical discipline) of prescribers ($P = 0.078$; $P = 0.572$; $P = 0.548$), respectively. However, those in the medical disciplines perceived AMR to be a more intense problem in their local setting as well as in the global context. They also perceived that the development of local/national antibiotic use guidelines would be more useful than using international ones.

Table 3: Attitudes of participants related to antimicrobial prescribing (*n*=506)

Response to the item	Strongly disagree	Disagree	Agree	Strongly agree
Respondent's opinion whether patient demand for antibiotics contribute to overuse	49 (9.72)	130 (25.79)	258 (51.19)	67 (13.29)
Respondent's selection of antibiotics is more affected by availability rather than the appropriateness	60 (11.88)	205 (40.59)	192 (38.01)	48 (9.5)
The development of local/national antibiotic use guidelines is perceived to be more useful than using international ones	16 (3.16)	48 (9.48)	186 (36.75)	253 (50)
Antibiotic guidelines and antibiotic stewardship are of help in clinical care	15 (2.98)	51 (10.13)	202 (40.16)	235 (46.71)
Antibiotics do not cause damage even if patients do not need them	271 (55.76)	129 (26.54)	56 (11.52)	30 (6.17)

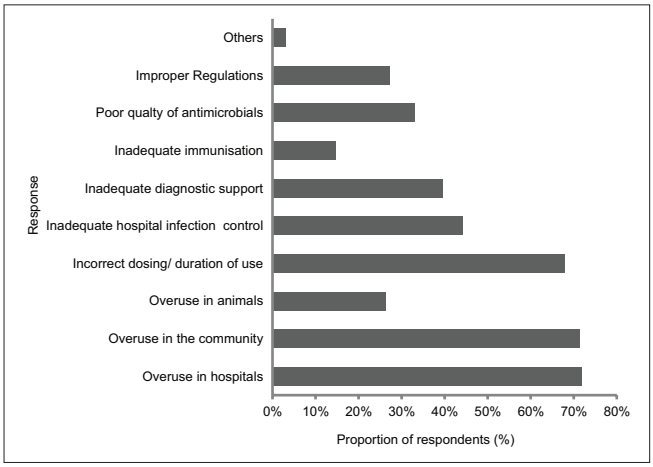

Figure 1: Perception of respondents in the survey about the cause of antimicrobial resistance in India (*n* = 506)

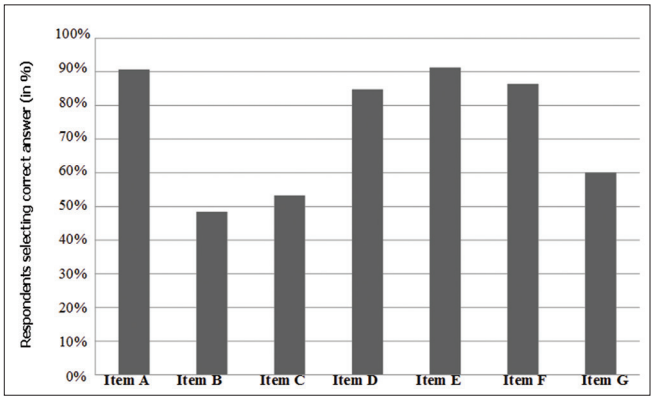

Figure 2: Proportion of respondents who answered correctly in the section on antibiotic selection and common characteristics of some antimicrobials in the survey (*n* = 506). Item A: A 1-year-old child develops acute-onset watery diarrhea with no or some dehydration. What would you recommend? Item B: A 32-year-old man is complaining of fever (39C), nasal discharge, and throat pain for 3 days. What would you recommend? Item C: In the ward, there are two patients with impaired kidney function. Patient A is a 68-year-old man with cellulitis in the lower limb. He received clindamycin. Patient B is a 64-year-old woman with diabetes who received empiric treatment for sepsis with ceftriaxone and gentamicin. In which case you will need to adjust the antibiotic dose? Item D: Which one of the given antibiotics can be considered safe during pregnancy? Item E: Which one of the given antibiotics has the best activity against anaerobes? Item F: Methicillin-resistant *Staphylococcus aureus* is susceptible to Item G: Which one of the given antibiotics can effectively cross the blood–brain barrier?

We also quantified the strength of association between knowledge, attitude, and practice scores with the number of years in practice, but no correlation was observed (Spearman's rank correlation coefficients, $\rho = 0.190$, 0.013, and 0.040, respectively). However, strong positive correlations were noted between attitude and practice scores ($\rho = 0.923$; $P < 0.001$) and moderate positive correlation between knowledge and attitude scores ($\rho = 0.441$; $P < 0.001$) and knowledge and practice scores ($\rho = 0.477$; $P < 0.001$). Therefore, practice gets reflected in the attitude toward rational prescribing. However, knowledge *per se* may not influence attitude or practice very strongly.

DISCUSSION

The survey was conducted across 5 centers in India on 506 clinicians. Pooled analysis revealed that the department of medicine emerged as the discipline with most numbers of participants across the centers. Overall, the theoretical knowledge about antimicrobials was satisfactory. However, despite good scores in this area, 51.6% of participants believed that antibiotics can be given for common cold and fever and 9.34% of respondents believed in prescribing antimicrobials in a case of acute-onset watery diarrhea. Furthermore, 47.52% of clinicians agreed with the statement that their selection of antibiotics was more affected by availability rather than its appropriateness. Compared to senior physicians, residents in training were less confident about antimicrobial prescribing. This correlates with the findings of some previous studies,[8,11] but in contrast to these studies, a large number sought the opinion of seniors/peers in antimicrobial prescribing.

Sources of information on antimicrobials that are used by clinicians were probed in this study. National/international antimicrobial use guidelines emerged as the major source of information for clinicians (58.69%) who seek information about antimicrobials, followed by Internet-based sources (40.51%) and senior colleagues/peers (37.74%). This pattern agrees with the earlier KAP study[10] which has been the source of our questionnaire.

Some areas of concern were identified in the attitude and practice domains. Significantly, 17.69% of the respondents

Table 4: Participants' response to practice component items of the study questionnaire

Question related to practice domain	Response, *n* (%)
How frequently do you require help in selecting antibiotics?	
Never	9 (1.77)
Sometimes	70.35
Most of the time	116 (22.92)
Almost always	24 (4.94)
Which sources of information do you turn to while selecting antibiotics?	
Internet-based sources	205 (40.51)
National/international antimicrobial guidelines	297 (58.69)
Drug formulary/journal/textbook	186 (36.75)
Local hospital guidelines	163 (32.21)
Peers/senior colleagues	191 (37.74)
ID specialists/microbiologists/clinical pharmacologists	154 (30.43)
Others	8 (1.58)
How frequently does a senior colleague recommend an antibiotic different from your choice?	
Not sure	38 (7.63)
Never	22 (4.42)
Sometimes	414 (83.13)
Almost always	24 (4.81)
A 1-year-old child develops acute onset watery diarrhea with no or some dehydration. What should be recommended?	
Ciprofloxacin	24 (4.77)
Cefixime	10 (1.98)
Both	7 (1.39)
Others	6 (1.19)
No antibiotic; only ORS and zinc	456 (90.65)
A 32-year-old man is complaining of fever (39°C), nasal discharge, and throat pain for 3 days. What should be recommended?	
Ciprofloxacin	38 (7.63)
Doxycycline	11 (2.2)
Azithromycin	209 (41.8)
No antibiotic needed	242 (48.4)
In the ward, there are two patients with impaired kidney function. Patient A is a 68-year-old man with cellulitis in the lower limb. He received clindamycin. Patient B is a 64-year-old woman with diabetes who received empiric treatment for sepsis with ceftriaxone and gentamicin. In which case you will need to adjust the antibiotic dose?	
Patient A	44 (8.78)
Patient B	171 (34.13)
Both patients A and B	242 (48.4)
Neither	19 (3.79)

ORS=Oral rehydration solution

Table 5: Knowledge and attitude/perception-related components and scores between respondents belonging primarily to medical and surgical disciplines (*n*=506)

Item	Medical discipline (*n*=327)	Surgical discipline (*n*=179)	*P*
Knowledge score median (IQR)	8.5 (7.6-9.5)	8.4 (7.3-9.4)	0.078
Attitude score median (IQR)	5.06 (4.28-6.28)	4.7 (4.28-6.28)	0.572
Practice score median (IQR)	3 (3-4)	3 (3-4)	0.548

IQR=Interquartile range

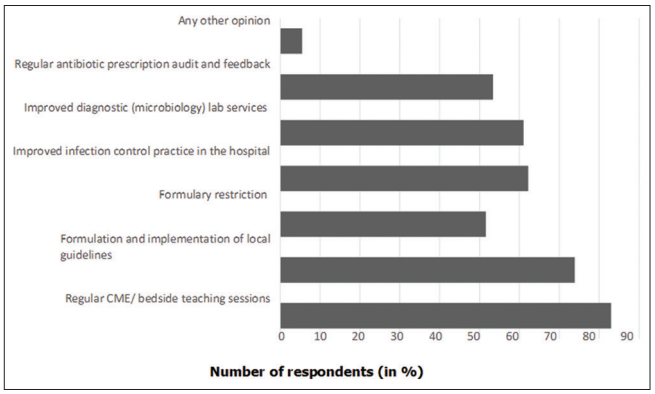

Figure 3: Respondents' perception regarding implementable steps in their hospital to rationalize antimicrobial use and minimize antimicrobial resistance (*n* = 506)

surveyed believed that prescribing antibiotics do not cause damage to the patient even if they do not need the same. Furthermore, 39.7% of the clinicians failed to identify the antibiotic capable of crossing the blood–brain barrier and as many as 41.8% of the respondents pooled across the centers incorrectly estimated the incidence of resistance of *Pseudomonas aeruginosa* to ciprofloxacin in their hospital. Similar results have been reported in a Peruvian study.[12]

Clinicians were aware of AMR as a local and worldwide health-care problem. As reported in similar studies among practitioners in the USA,[13,14] our study revealed that majority of the participants believed that excess use of antimicrobials, both in the hospital and in community settings, contributed to AMR. Over half of the respondents agreed that the demand for antimicrobials contributes to its overuse in the hospital setting.

Regarding the appropriateness of potential remedial interventions, the vast majority of the participants perceived CME to be of utility suggesting a possible knowledge gap about antimicrobials and infectious disease management.[14] Specific recommendations for sensitization of the clinicians and restriction of the use of antimicrobials, especially for diarrhea and fever, may be stressed upon.

The strengths of our study include that it is possibly the first multicentric study conducted to generate background data before the implementation of an AMS program across five medical colleges in India. One of the limitations of KAP surveys like the present one is that participants may give desirable answers rather than expressing their true opinion. Case-based questions were adopted to restrict this form of bias. Furthermore, by ensuring that the study coordinator was present when the questionnaire was being answered, the possibility of respondents expressing shared opinions after discussion with colleagues or peers was minimized. The study participation was also limited to tertiary care doctors, and private clinicians were not included. Thus, the opinion of clinicians in private set-ups was not obtained which may limit the generalizability of our study. In addition, as this was a cross-sectional study, it provided only a snapshot of the views of the respondent which may change over time. Therefore, a longitudinal follow-up study on the same cohort can provide useful insights and capture the changes in their attitudes and behavior.

CONCLUSIONS

We can say that, given the limited information in this aspect in India, our study adds value in understanding the scope of the problem. Despite satisfactory background knowledge regarding the rational use of antimicrobials and AMR patterns, there are discrepancies in the physicians' prescribing attitudes. This strengthens the case for instituting regular CME programs, development of institutional antibiotic policies, induction of infectious disease consultants, hospital infection control nurses, and pharmacists in implementing ASPs. Emphasis must be placed on the implementation of antibiotic prescribing guidelines at institutional level and allied measures like formulary restriction to reduce the knowledge-attitude dissonance detected in this survey.

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Conflicts of interest

There are no conflicts of interest.

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