Knowledge, attitude and practice of antibiotic use and antimicrobial resistance: a study post the 'Red Line' initiative

Deepanwita Banerjee and Anu Raghunathan*

Chemical Engineering Division, CSIR-National Chemical Laboratory, Pune 411 008, India

Antimicrobial resistance (AMR) is propagated by irrational use of antibiotics by healthcare practitioners and the uninformed public. This study assessed a select cohort of 504 urban Indians for their knowledge, awareness and practice of antibiotic use and AMR. Forty seven per cent were unaware of the differences between over-the-counter drugs and antibiotics. One in four believes that dose-skipping does not contribute to AMR. One in ten tends to self-medicate. One in five bought medicines without prescription or started an antibiotic course by calling a doctor. Our results mandate educational campaigns, stewardship and surveillance at the national level for prudent antimicrobial use in the Indian community.

Keywords: Antibiotic resistance, attitude, community, knowledge, practice.

THE antibiotic era has been remarkably short and the miracle of these drugs is slipping away. Life without antibiotics is unimaginable in a world that has had cheap and plentiful supply since World War II. Antibiotics are societal drugs[1] used not only to treat primary infections but are also a staple in modern medicine. Antimicrobial resistance (AMR) is a threat that ranks along with climate change and terrorism[2]. Antibiotic resistance occurs when an antibiotic has lost its ability to control bacterial growth effectively even in therapeutic concentrations. This phenomenon can turn back the clock on decades of progress in modern medicine and return us to a pre-antibiotic era. The World Health Organisation (WHO) currently projects 700 deaths per day and predicts that by 2050, ten million deaths will be attributed to AMR alone, a number far greater than that for cancer[3]. The portfolio management decisions of major pharmaceutical companies have also led to drying up of antibiotic discovery pipeline[4], a catastrophe of huge proportions.

The World Health Assembly adopted a global action plan in 2015 on AMR that outlines five main objectives[5]. The scope of the threat necessitates action and solutions to be implemented at several levels of society.

*For correspondence. (e-mail: anu.raghunathan@ncl.res.in)

Antimicrobial resistance is thus a multifactorial problem and the social context in India plays a major role (Figure 1). Ranking high is the lack of regulation and policy with respect to prescription, over-the-counter (OTC) sales[6,7] and environmental disposal[8–10] of antibiotics. The situation is exacerbated by uncontrolled use in livestock and animal products[11], poor health systems and lack of containment of infections[12,13]. Basic hygiene is also compromised by open defecation and unsustainable sanitation[14]. There appears to be an irrational antibiotic use in the country[15], without any AMR surveillance[6,16] at the local or national level. This can lead to prolonged sickness, extended treatment and unaffordable health care, among other problems.

Since 2011, major interventions have been put into action by government at community level to tackle the problem of antibiotic resistance. The Jaipur Declaration[17], signed in September 2011 followed by the Chennai Declaration[18] in August 2012, implement policies regulating antibiotic use in India (Table 1). Before 2012, there was also no functioning national antibiotic policy to restrict OTC dispensing of antibiotics. In March 2014 Schedule H1 in the Drugs and Cosmetics Act was adopted at the federal level, which restricted the sale of 46 OTC drugs, including antibiotics and anti-TB drugs[19]. Among other actions taken by the government, 'Medicines with the Red Line' media campaign was launched during the three-day international conference on antimicrobial resistance in February 2016 (ref. 20). A first version of guidelines for standardized national treatment was recently issued by the National Centre for Disease Control, Government of India for practitioners for rational use of currently available antibiotics and effective management of patients for common infectious diseases[21,22]. On the contrary, regulation of antibiotic residues in animal food produce remains in a grey area with standards existing for seafood and honey but not for poultry[15].

There are many hurdles to overcome AMR. First, India remains the world's largest consumer of antibiotics amongst BRICS countries[23] (Brazil, Russia, India, China and South Africa) with per capita usage increasing by 37% in the last decade[15,24] (Figure 2). A need exists to impose a delicate balance between increasing access for appropriate indications and decreasing the excessive

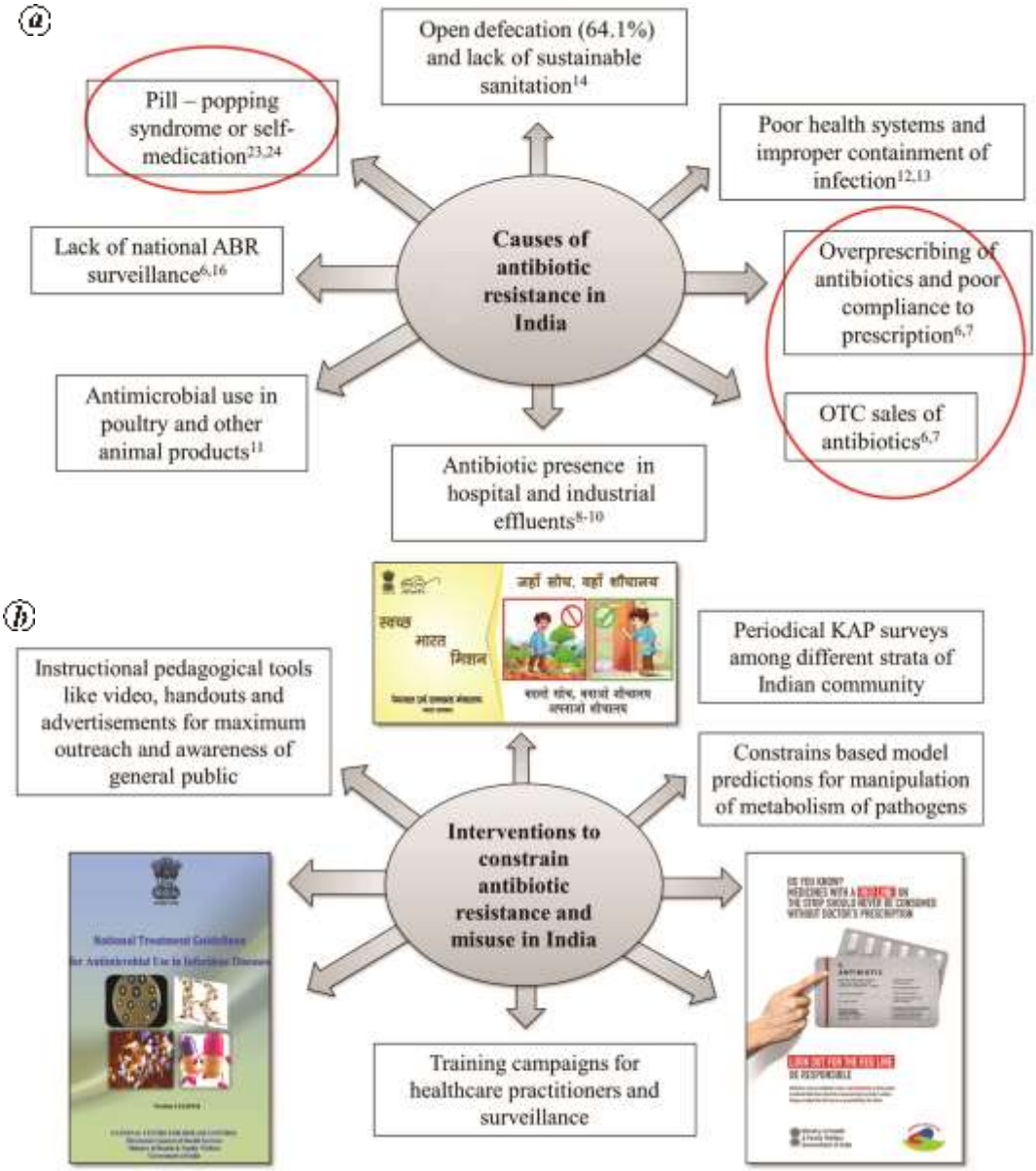

Figure 1. Antibiotic resistance, a multifactorial problem that needs multipronged intervention to constrain antibiotic resistance and misuse. This figure has been adapted to the Indian context from various important research and newspaper articles referred in this study to address (***a***) the causes and (***b***) interventions associated with antibiotic resistance and misuse in Indian community. This study focusses primarily on the ones encircled in red (***a***). The interventions (***b***) needed not only include government enactment (pictures) but there is also a need for active participation of healthcare practitioners as well as general public.

inappropriate use of antibiotics for cough, cold and diarrhoea[25]. Thus, amongst the many hurdles to overcome AMR, poor national surveillance[16] and an apathy towards rational use of antibiotics rank highest in the Indian subcontinent.

The knowledge, attitude and practice (KAP) survey tools were developed in 1950s for family planning and population studies in third world countries[26]. Over the last five years, three studies that focused on the general population showed varied levels (13% to 100%)[27,28] of self-medication of which 32% were antimicrobials[29]. Antibiotic re-use and shared prescriptions were also high (~30%) and more than half the cohorts stopped taking the medicine once the symptoms subsided[30]. The urban population was more aware[28] of the proper use of medicines, expiry dates and disposal mechanisms as opposed to rural populations[31]. Such ignorance in the latter was due to lack of information and knowledge and non-availability of health care facilities[32] rather than financial costs. Antibiotics (amoxicillin and co-amoxiclav, roxithromycin, azithromycin, ciprofloxacin, cefixime and levofloxacin)[29,33–36] and paracetamol[29,37] were commonly bought over-the-counter for fever, cold and cough. Only 20% of the rural pregnant women used prescriptions to buy

Table 1. National policies and campaigns against antibiotic misuse and resistance

	Date	Features
Jaipur Declaration[17] on antimicrobial resistance	6 September 2011	11 countries health ministers of the WHO's South-East Asia Region signed the Declaration which urges governments to develop national antibiotic policies and enforce regulations on the use of antimicrobial agents and ensure rational use.
Chennai declaration[18]	August 2012	Indian Medical Societies including government policymakers, Medical Council of India, the Indian Council of Medical Research, the Drug Controller General of India and WHO discussed a five year roadmap of actions critical to containing resistance domestically and to forge consensus around the necessary steps – 'a roadmap to tackle the challenge of antimicrobial resistance'[18].
		March 2014 saw adoption at the federal level of the Schedule H1 to the Drugs and Cosmetics Act, which restricts the sale of 46 over-the-counter drugs, including antibiotics and anti-TB drugs.
'Medicines with the Red Line' public awareness campaign[20]	February 2016	Indian Health Minister launched the campaign in an international conference on antimicrobial resistance in New Delhi which emphasizes to learn how to identify prescription drugs; curb self-medication; and become more aware of the dangers of misusing antibiotics. The packaging of all prescription only drugs is now being marked with a red line.
National treatment guidelines for common infectious diseases, 1.0 version[21]	19 February 2016	National Centre for Disease Control under Ministry of Health and Family Affair, Government of India has published the 1st version of national treatment guidelines to enhance appropriate usage of antimicrobials for common infectious diseases.

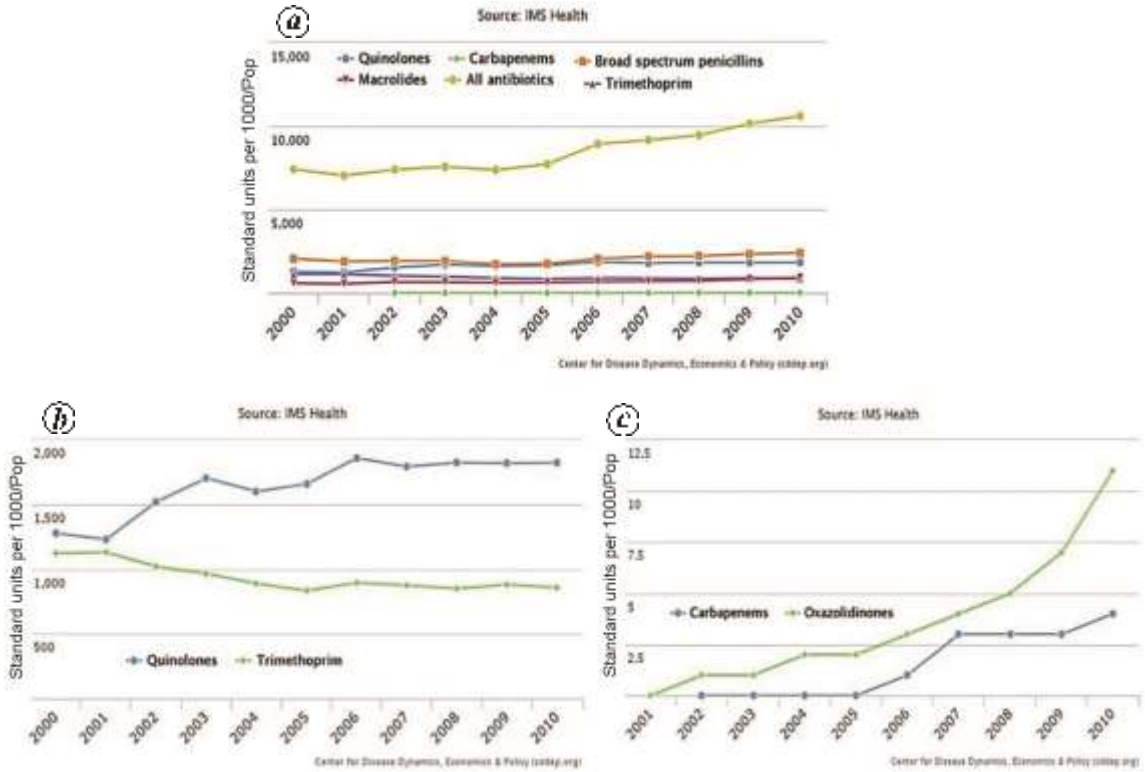

Figure 2. Trends in antibiotic consumption in India, 2000–2010. Source: CDDEP, Resistance Map, Washington DC: Center for Disease Dynamics, Economics and Policy, 2015; http://www.resistancemap.org (20 August 2015).

antibiotics[38]. Only 20–30% of the population cohorts[34] on an average were aware of the use of antibiotics in bacterial versus viral infections. A higher level of education was correlated with high KAP score as 90% of postgraduates, 84.1% of graduates and only 67% of high school matriculates had the highest KAP score[39].

India, with a population of more than 1.34 billion (as of July 2017) marked by cultural diversity and varied socio-economic backgrounds, requires assessments across different strata of the community. In this study we use KAP survey as a tool for the educational diagnosis of antibiotic use and misuse within a select cohort of the

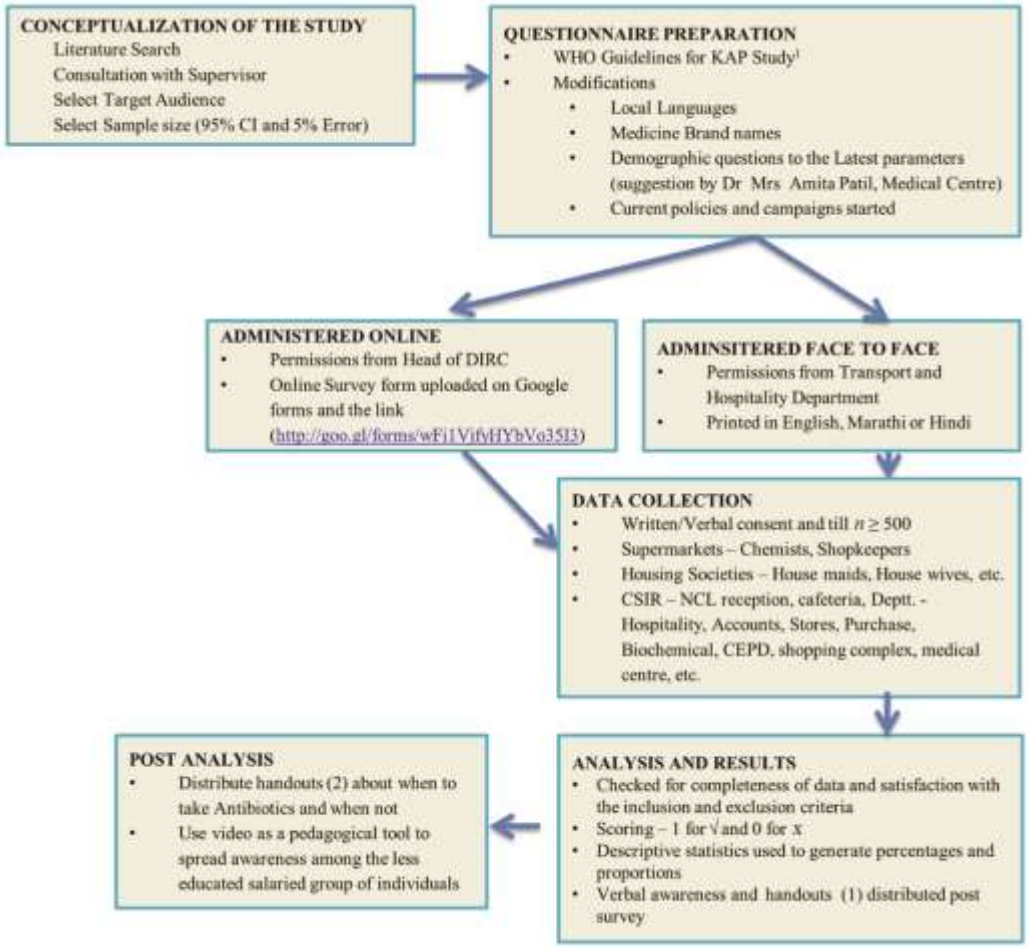

Figure 3. Methodology followed in the present study.

Indian population to evaluate the public health issue of AMR.

Material and methods

Study design and population

This study was a 7-week cross-sectional questionnaire-based survey conducted between June and July 2016 as part of a CSIR 800 project. Around 504 respondents belonging to different demographic strata of Indian society were targeted which also included CSIR–NCL students, scientists and other staff, chemists and businessmen. Individuals less than 18 years and above 75 years of age were excluded along with those who did not give verbal consent. Individuals who were unable to answer the questions due to some barriers were excluded along with pregnant women.

Study questionnaire

A semi-structured questionnaire was developed following WHO guidelines[40] on KAP survey focusing on antibiotic use and misuse. The questionnaire was modified to accommodate the current policies and campaigns started by Indian government[18–20] and to suit the target population. The annual income stratification was done with the updated Kuppuswamy's socio-economic status scale[41]. Stratification based on literacy included illiterates (no education at all), lower primary education (below 8th class education), primary to secondary education (8th to 12th class education), undergraduates, graduates and postgraduates. The questionnaire included a total of 35 questions out of which there were 26 close-ended questions pertaining to the responders' knowledge, attitude and practices regarding antibiotic use and self-medication. The knowledge section consisted of 14 questions followed by 5 questions pertaining to attitude and 7 questions in the practice section. Nine open-ended questions regarding the demographic details of participants were also included. The questionnaire covered the following aspects: (a) standard demographic data to assess any correlation between respondent demographic characteristics and antibiotic use practices; (b) respondent's attitude and behaviour towards regulated use of antibiotics and antibiotic resistance; (c) self-medication; (d) information about medicines given to them by pharmacists, and (e) obtaining

Table 2. Demographic details of all 504 respondents

Gender		Occupation	
Male	252 (50.0)	Student	200 (39.7)
Female	252 (50.0)	Salaried	196 (38.9)
Age		Business	24 (4.8)
18–20	21 (4.2)	Professional	43 (8.5)
21–30	286 (56.7)	House wife	12 (2.4)
31–40	114 (22.6)	Retired	9 (1.8)
41–50	34 (6.7)	Doctor	6 (1.2)
51–60	39 (7.7)	Others	14 (2.8)
61–75	10 (2.0)		
		Annual income (Rs)	
Educational qualification		Less than 20,000	36 (8.2)
Illiterate	13 (2.6)	20,000–100,000	128 (29.0)
Lower primary	28 (3.6)	100,000–500,000	172 (39.0)
Primary to secondary	28 (3.6)	500,000–1,000,000	72 (16.3)
Undergraduate	34 (6.7)	More than 1,000,000	33 (7.5)
Graduate	94 (18.7)		
Postgraduate	288 (57.1)	Family member in health related field	
Others	19 (3.8)	Yes	129 (26.0)
		No	368 (74.0)

prescriptions and having them filled. Response options included True/False, Yes/No and 5 point *Likert* scale (strongly disagree – disagree – undecided – agree – strongly agree) wherever appropriate and the first question had multiple choices.

The above mentioned pre-tested questionnaire was administered by two different approaches (Figure 3). The questionnaire was uploaded on Google forms and the link (http://goo.gl/forms/wFi1VjfyHYbVo35I3) was provided to the respondents through official e-mails or social media. The questionnaire was made available in English and Marathi to target the local population. The study was explained to the respondents and then informed consent obtained. Participants either filled the questionnaire independently or read the questions and answers were recorded for them. To achieve generalizability of the sample, a survey was conducted with the help of some general public at different study sites (e.g. shopping malls, supermarkets, housing societies, CSIR–NCL reception, cafeteria, different departments, medical centre, etc.). See Supplementary Material 1 – Questionnaire in English and Marathi for reference. The questionnaires received were checked for completeness of data and satisfaction with inclusion and exclusion criteria. Simple pedagogical tools and descriptive statistics were used to generate percentages and proportions.

Statistical analysis

The data was analysed by using simple descriptive statistics to generate frequencies, percentages and proportions. Data was further summarized by appropriate statistical tests using GraphPad Prism 6, version 6.01 for Windows (GraphPad Software Inc., San Diego, 2007).

Results and discussion

This is the first of a kind study done with a moderate size dataset (>500) involving general population of India and is comparable to two studies of similar sample sizes (around 500), one was conducted in the rural areas of Maharashtra[32] and another in Sonipat city, Haryana[27], which focussed on reporting utilization practices in the households rather than antibiotic use. Although bigger datasets have been reported they are for a certain subtype of population, e.g. 1121 dental and paramedical students[42], 872 parents[39] and 656 pregnant women visiting village clinics[38]. However, there is no study on general population or a cross-section of society and hence a holistic sample set has been addressed in this study.

Demographics

The demographics of the 504 respondents are presented in Table 2, where 66.5% belonged to Maharashtra. The age, education and professional/employment status were analysed. Ninety eight per cent of the study group was below the age of retirement (60 years). The dataset consisted of students and salaried individuals in similar ratio (~40%). Within the set there were 196 employed people of which 40 were graduates, 75 postgraduates and among the professionals there were 7 chemists and 6 clinicians.

The overall results (Figure 4 *a*) conveyed that out of 504 respondents, 8% had the right knowledge, 12% had the right attitude and 23% followed right practice for rational antibiotic use. Only 4 (<1%) respondents had the right knowledge, attitude and practice towards rational antibiotic use and AMR; they were all postgraduates.

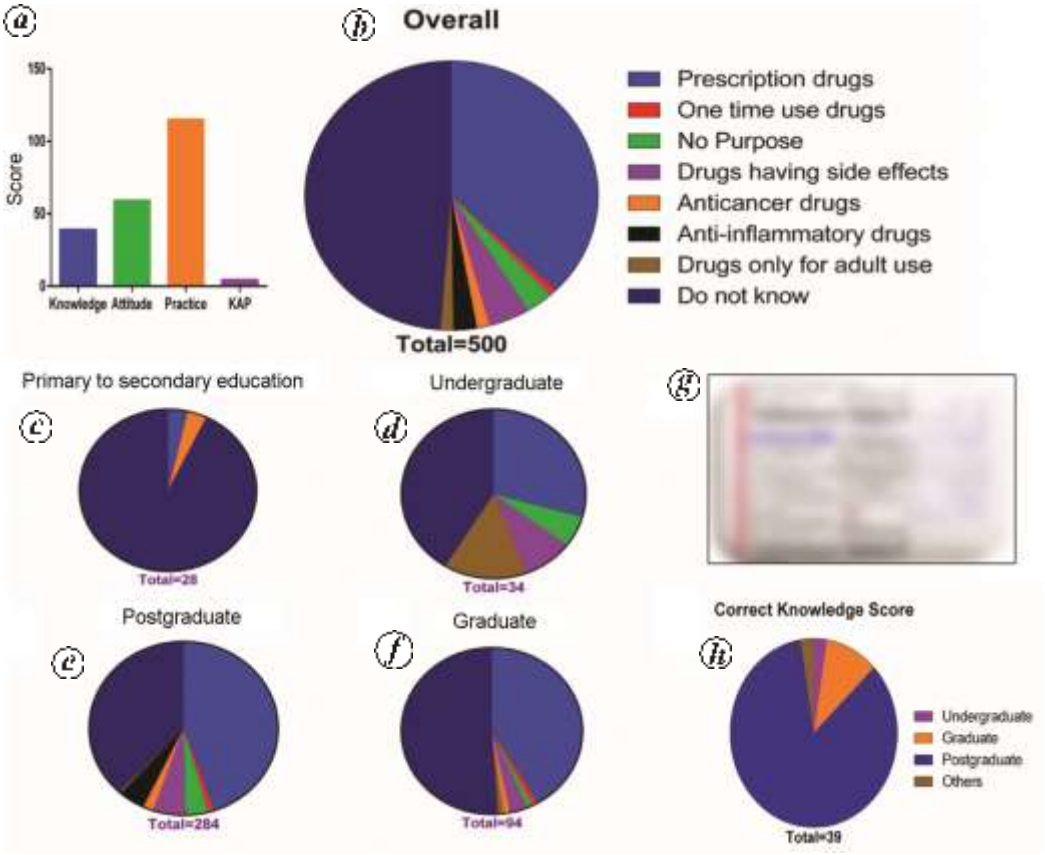

Figure 4. Overall KAP score and response to the first question of the knowledge section of the KAP survey.

Knowledge

The respondents were tested for their knowledge on the use of antimicrobials in viral and bacterial infections, purchase of OTC and prescription drugs including the recently introduced red line drugs and AMR (Figure 4 *b–g*). On the whole, right knowledge about antibiotic use and resistance was observed only in 39 out of 504 individuals that included 33 postgraduates (Figure 4 *h*). With respect to profession, 19 students, 11 salaried and 4 professionals belonged to this group.

The postgraduates had the highest score (13.6 ± 2.8 out of 17) and illiterates had the lowest score (5.8 ± 3.1). Students (13.4 ± 3) outperformed other professionals. Out of the 504 respondents, 15 individuals thought the red line on the medicine strip or package had no purpose and among them 11 were postgraduates. Overall, 63% respondents were unaware and this the red line indicated prescription drugs and this included 71% undergraduates, 58.5% graduates and 55% postgraduates. Also 31% were unaware that bacterial infection was not the cause for common cold and cough which included 28% of postgraduates and 38% graduates. Almost half the respondents (47%) were unaware that antibiotics could not cure viral infections but only bacterial infection. More graduates (55%) than postgraduates (27%) belonged to this group. Nearly 86% of respondents who received only school education were unaware of the same. Similarly 90% of the respondents who had received only school education did not know the differences between commonly used antibiotics and OTC medicines along with 17% of postgraduates and 32% of graduates. Illiterates had no idea about the red line or the specificity of antibiotics towards bacterial infection. They neither could differentiate between OTC and antibiotics, nor were aware of the consequences of indiscriminate use of antibiotics. Thus 69.2% of illiterates believed that common cold and flu was caused by climate change and more than 60%, believed that paracetamol was an antibiotic. None of the respondents with education till primary level were aware of the red line. Around half the undergraduate respondents believed that antibiotics were prescribed to reduce pain and inflammation compared to 83.2% postgraduates who disagreed. On an average, 61% of illiterates and school pass-outs believed that antibiotics were prescribed for pain or inflammation. In addition, 22% of respondents either did not comment on or disagreed that AMR was a serious problem posed by our society locally or globally. Six out of seven illiterates, three out of four school pass outs, one in ten postgraduates, one in five graduates and all undergraduates belonged to this group.

The knowledge of ineffectiveness of antibiotics on irrational use was least in undergraduates (51.5%) and highest in postgraduates (90.6%). Awareness about the medical

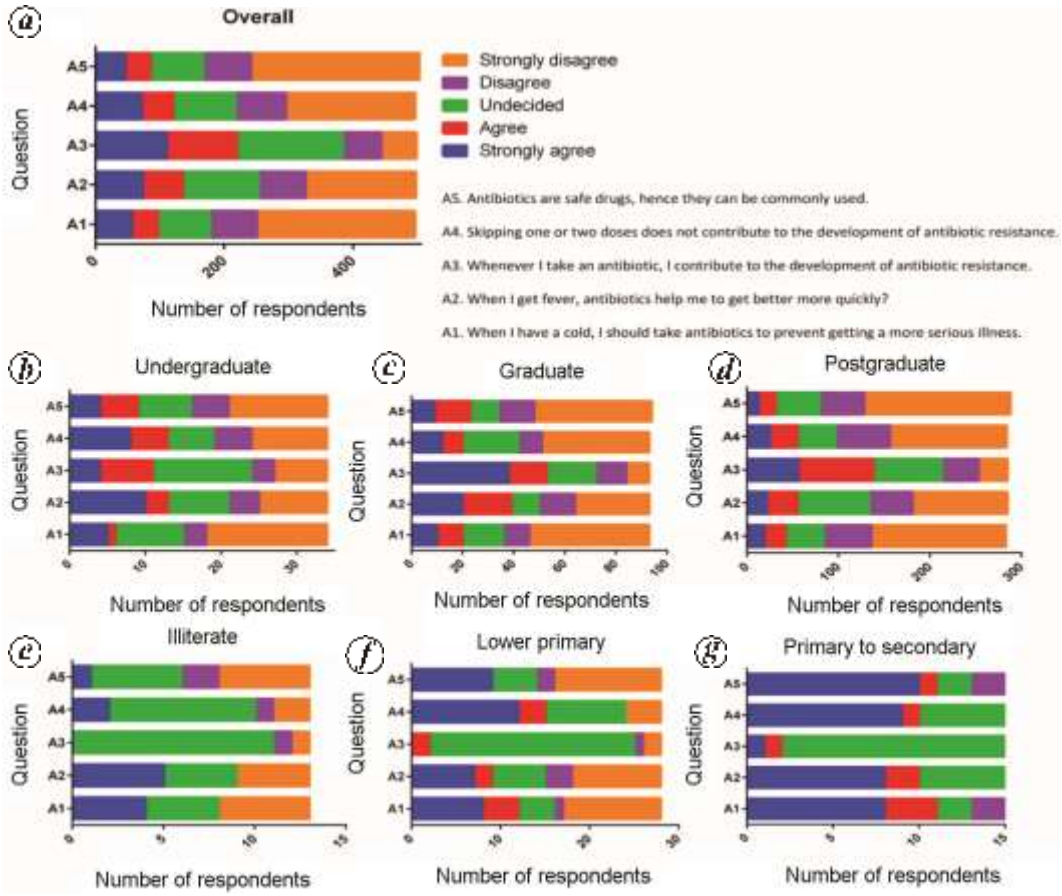

Figure 5. Responses to the attitude section of the KAP survey.

cost burden was significantly higher (91%) compared to that of other repercussions associated with injudicious and indiscriminate use of antibiotics (55%) in the study group.

Attitude

The attitude towards falling sick and the consumption/prescription of antibiotics defined the tendency of the population to contribute towards AMR (Figure 5). A total of 59 respondents (11%) showed the right attitude; this included 41 postgraduates, 12 graduates and 2 undergraduates. Based on profession 28 students, 14 salaried respondents, 8 professionals and 4 businessmen belonged to this group. None of the illiterates was aware of his contribution towards antibiotic resistance by consuming antibiotics. Postgraduates including businessmen once again had the highest average score (3.1 ± 1.3 out of 5) whereas lowest was (1.5 ± 1.3) for illiterates. More than 23% in each group disagreed that they contribute to AMR by taking antibiotics while more than 79% of illiterates and school pass-outs remained undecided. One in five postgraduates to one in four graduates of the higher educated group believed that skipping a dose does not contribute to AMR. This was within the range documented in the studies, i.e. 21.3%–31% (ref. 43) but was less than that documented in the study performed in the rural areas of Maharashtra[32]. Here 36% of school pass outs believed the same whereas 62% illiterates remained undecided. One fourth of the study group believed that skipping a dose does not contribute to AMR which included 53.6% of those studied till primary level, 36% respondents of primary to secondary education, 19.4% of postgraduates and 22% of graduates. Again the indecision in less educated respondents was highlighted through responses of 61.5% of illiterates and 36% of school pass outs being unaware of the consequences of skipping a dose.

Practice

Practices here measure the concrete action of popping pills in response to sickness with or without consultation of a doctor (Figures 6 and 7). Highest number of consumers of antibiotics (Figure 2) was the educated population like 58.8% undergraduates, 75.5% graduates and 69.1% postgraduates compared to 30.8% uneducated respondents. The average frequency of antibiotic use was 23% similar to the statistics available for India[7]. Postgraduates had the highest average score (7.1 ± 2.0 out of 9) and illiterates had the lowest (4.3 ± 1.4). Retired respondents

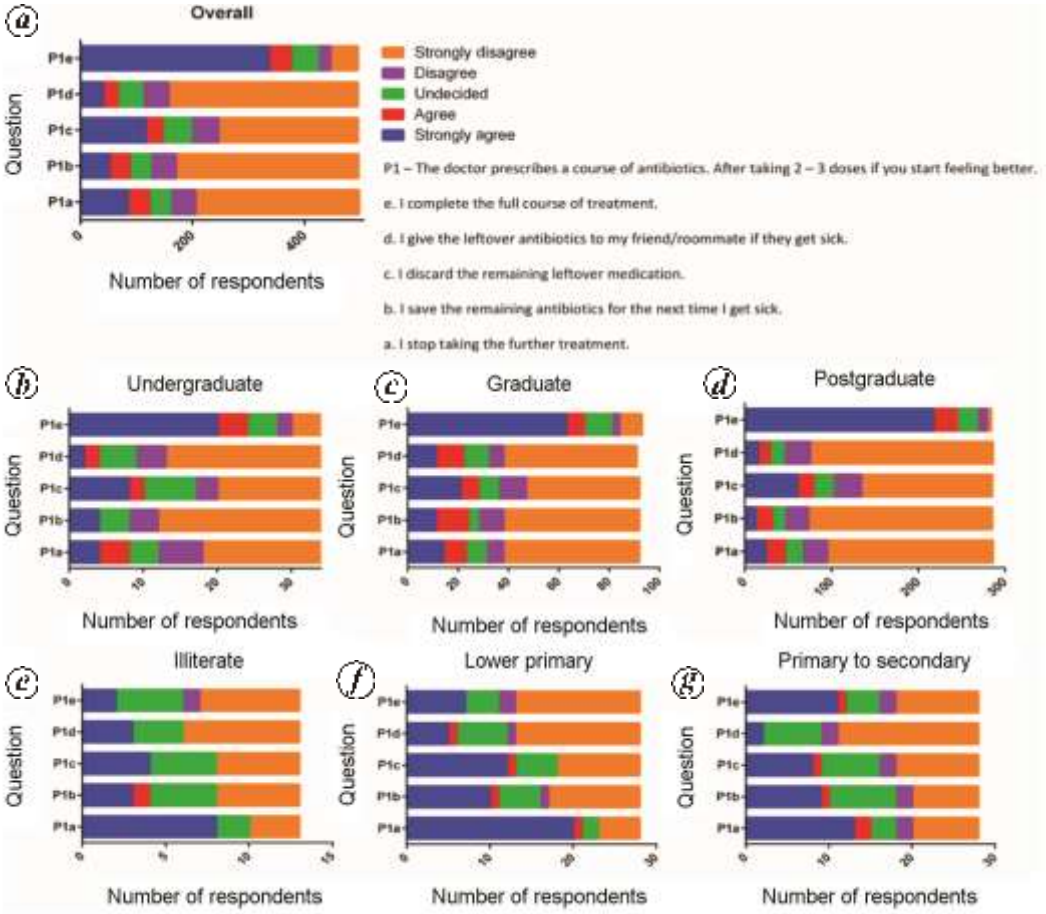

Figure 6. Responses to the practice section question 1 of the KAP survey.

also reflected good practice with an average score of 7.2 ± 2.1 compared to an average score of 5.9 ± 2.2 by the salaried group of individuals. The 115 individuals following the right practice consisted of 89 postgraduates, 10 graduates, 7 undergraduates and one from each group that had received primary and secondary education respectively. The group of 115 individuals followed right practice included 66 students, 25 salaried, 7 professionals, 4 each of retired persons and doctors and 2 businessmen. One in four people in this study would stop taking antibiotics once they felt better and did not complete the full course (Figure 6). This proportion was higher for illiterates (62%) and individuals with lower primary education primary education (75%) along with 53.6% from the primary to secondary education group which concurred with the scores reported by Aishwaryalakshmi *et al.*[30]. Additionally, 16% of postgraduates and 24% each of undergraduates and graduates had the same practice and did not complete the full course. Eleven per cent of undergraduates and postgraduates saved antibiotics for future use.

There was no clear understanding of how unused antibiotics were disposed among the under-educated population, which was a major societal concern as reported earlier[31]. This calls for spreading awareness regarding appropriate disposal of unwanted medicines. Medicating friends or relatives voluntarily was prevalent irrespective of the level of literacy as 23% of illiterates and graduates practised sharing their medicines with friends or family along with 10% of postgraduates and 12% of undergraduates. In this study, 14.5% did not practice completion of the full course of prescribed medicines which was in accordance with Agarwal *et al.*[39]. This cluster of individuals included 54% of illiterates, 61% of lower primary educated individuals, 6% of postgraduates and 15% of undergraduates and graduates. In addition, 9.7% of individuals were found to self-medicate similar to the proportions obtained by Kasabe *et al.*[37] for the patients category in the Pune region. More than 7% of illiterates, postgraduates and individuals with primary to secondary education belonged to this group along with 17.7% of undergraduates, 14% of graduates and 21% pre-primary educated individuals. More illiterates and individuals with lower primary education (31.5%) along with 2% of postgraduates, 3% of undergraduates, 6.4% of graduates and 14.3% of individuals with primary to secondary education did not check the expiry date before consumption of antibiotics. One in five bought medicines without a medical receipt and tended to start an antibiotic course by

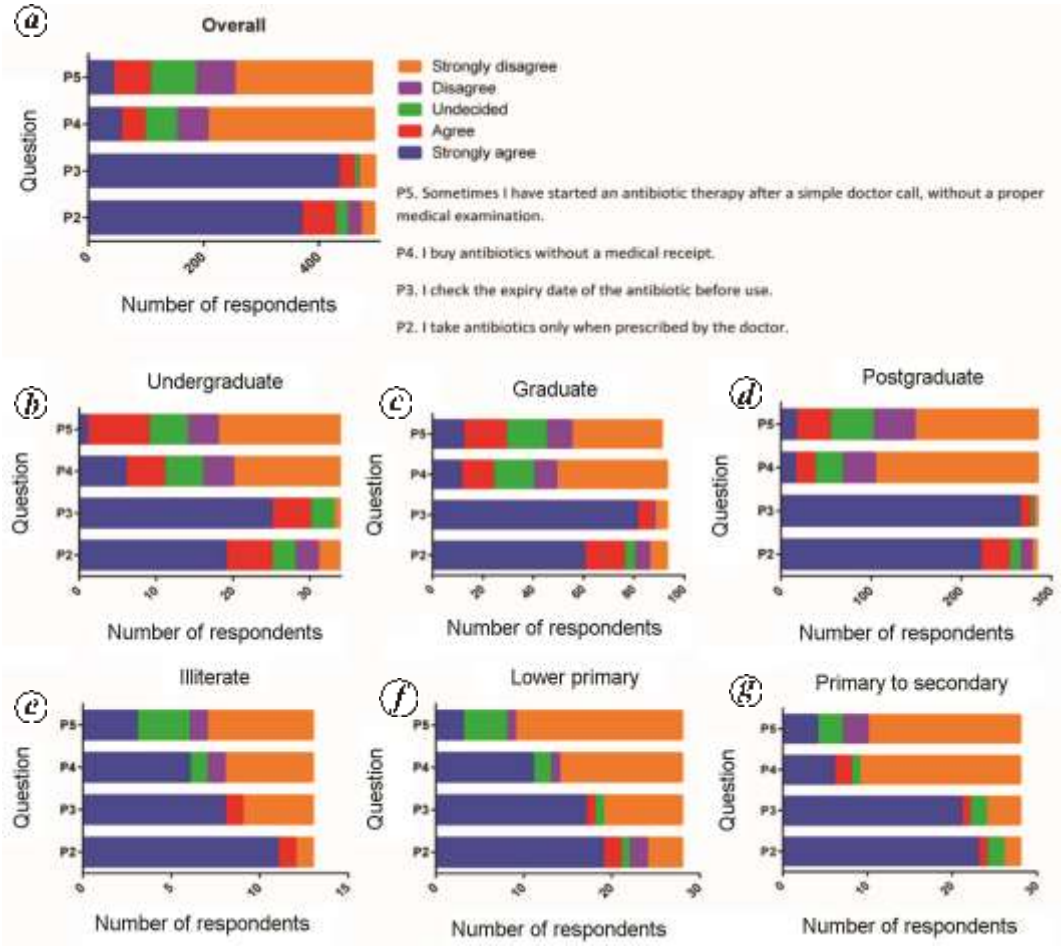

Figure 7. Responses to the practice section questions 2 to 5 of the KAP survey.

calling a doctor without a proper medical examination (Figure 7). The 20% of respondents who bought antibiotics without a prescription consisted of 13% of postgraduates, 29% of undergraduates and graduates and 40% of lower primary educated individuals. Forty six per cent of illiterates agreed and the same proportion disagreed on buying antibiotics without prescriptions/medical receipts.

The percentage of population buying OTC antibiotics is alarming and shows severe laxity resulting in the need for stringent policies to restrict even the supply system of antibiotics from chemists to consumers as suggested in earlier reports[44]. The 22% of respondents who started an antibiotic course with just a phone call to the doctor without any proper medical examination included 31.9% of graduates, 19% of postgraduates, 25% of illiterates and undergraduates and 12.5% of school pass outs. Thus in this manner 65.5% of respondents had consumed antibiotics in the last year similar to that reported by Chinnasami *et al.*[34].

In the KAP survey questionnaire, five questions, i.e. KQ1, KQ4, KQ11, AQ4 and PQ1e (see Supplementary Material) critically decided the respondent's status towards antibiotic stewardship. None of the adults who had received only school education knew the correct answer. Our study highlights the definitive influence of education on the prudent use of antibiotics, as the proportion of correct responses increased from 9% in undergraduates to 11% in graduates to 21% in postgraduates respectively.

The correlational statistics (Table 3) suggests that if we categorize based on literacy, postgraduates had a moderate positive correlation ($P \leq 0.0001$) whereas school pass-outs had a weak to moderate negative correlation between knowledge and attitude (K–A). If categorization was based on profession, better correlation was observed between K–A, knowledge and practice (K–P) and attitude and practice (A–P) for salaried individuals (strong for K–P) in comparison to students. House wives showed moderate (if not statistically significant) negative correlation between K–A. Based on gender, males had a moderate positive correlation, better for A–P in contrast to females, who had a moderate positive correlation (better than males) for K–A and a strong positive correlation for K–P.

Interpretation of findings from this survey should be done cautiously as there are limitations to the study including the size and location of the population. The study revealed a higher knowledge, awareness and

Figure 8. Handouts customized to local scenario distributed post survey to all the 504 individuals.

practice in individuals who were educated at least till higher secondary level. The study also revealed unawareness amongst 30–40% of this cross-section of society to the difference between bacterial and viral infections and the futility of using antibiotics for the latter. The majority did not realize the problem with skipping a dose or incomplete courses of prescribed antibiotics. The red line was not identified by a majority of the population and neither could they identify the global threat posed by AMR. One in five believed antibiotic resistance was not a serious issue. One in four individuals stopped taking the antibiotics once they felt better. One in ten people self-medicated on a regular basis; including one in five undergraduate and one in seven graduates.

We recommend the implementation of educational programmes about antibiotic usage at primary/secondary schools in the country. There is an utmost need for proper statutory antibiotic control policies restricting the availability of drugs to the public. Educational programmes should make healthcare practitioners aware including pharmacists/chemists and consumers alike. Safe practices need to be reiterated. Students and salaried employees must be educated about dangers of self-medication and indiscriminate use of drugs. Minor ailments can be relieved with OTC medications such as paracetamol or with some other traditional or herbal medicines, without physician consultation. Instructional and educational campaigns among different classes of society using short videos, printed handouts and other pedagogical tools are critical (Figure 8 shows handouts distributed after this study was conducted). Private firms and pharmacists should be involved as partners for creating awareness

Table 3. Correlational statistics for all 504 respondents

	Variable (*n*)	K–A	K–P	A–P
Based on literacy	Illiterate (13)	0.030	0.077	0.199
	Lower primary (28)	–0.183	0.150	0.295
	Primary to secondary (28)	–0.270	0.128	0.041
	Undergraduate (34)	0.398[a]	0.369[a]	0.367[a]
	Graduate (94)	0.277[b]	0.203	0.316[b]
	Postgraduate (288)	0.329[d]	0.257[d]	0.398[d]
	Others (19)	0.477[a]	0.576[b]	0.223
Based on profession	Student (200)	0.383[d]	0.250[c]	0.370[d]
	Salaried (196)	0.488[d]	0.505[d]	0.441[d]
	Business (24)	0.390	0.425[a]	0.503[a]
	Professional (43)	0.288	0.264	0.439[b]
	Housewife (12)	–0.331	0.214	0.546
	Retired (9)	0.385	0.127	0.476
	Doctor (6)	0.000	–0.114	–0.218
	Others (14)	–0.222	0.621[a]	0.150
Gender	Male (252)	0.411[d]	0.391[d]	0.446[d]
	Female (252)	0.444[d]	0.510[d]	0.395[d]

[a]$P \leq 0.05$, [b]$P \leq 0.01$, [c]$P \leq 0.001$ and [d]$P \leq 0.0001$.

among communities for rational use and resistance to antibiotics. Currently, there is a huge market and policy failure that allows the sale of drugs without a prescription. To address the threat of AMR, our study underscored the importance of education and prudent use of antibiotics in human medicine. It is critical to develop strategies comprising measures related to information, education and surveillance across the varied populations in India. Antibiotic stewardship activities in hospitals, clinics and nursing homes are critical along with imposition of good sanitation and hygiene. Coordination between the health sector and the animal husbandry/poultry sector is also essential. In any ecological system, including antibiotics, pressure causes evolution. In the light of resultant development of resistance and therapeutic failures, research programmes to develop quick diagnostics and extending the shelf life of existent antibiotics need to be funded. Government needs to formulate a comprehensive plan to deal with AMR and invest or provide aid for state-of-the-art diagnostics and new drugs. Non-adherence to such practices is a major public health issue.

In conclusion, our study of 504 individuals is the first of a kind for the general population that sheds light on the knowledge, attitude and practices regarding antibiotic use and resistance among Indians belonging to varied income strata, different professions and educational background. The results bring to light the fact that interventions and awareness campaigns should not be only educational but multipronged to tackle the serious societal issue of antibiotic resistance within the society with special reference to its 800 million citizens. One needs to sound the alarm and educate each citizen about the scope and threat of AMR. Battling resistant bugs mandates the prudent use of antibiotics.

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