JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Original Article

Assessment of Brazilian pharmacists' knowledge about antimicrobial resistance

Fernando de Sá Del Fiol, Silvio Barberato-Filho, Luciane Cruz Lopes, Cristiane de Cássia Bergamaschi, Rodrigo Boscariol

Pharmacology Department, University of Sorocaba, Sorocaba, SP, Brazil

Abstract

Introduction: Antimicrobial resistance (AR) is a multifaceted problem of global significance. In addition to developing new drugs and using antimicrobial guidelines, it is essential that health professionals understand all aspects of the problem and the most effective ways to handle it. This study evaluated pharmacists' level of knowledge about bacterial resistance and antibiotic use in Brazil.

Methodology: The study was conducted using a survey provided electronically to pharmacists in São Paulo State, Brazil.

Results: In total, 754 pharmacists completed the survey. The majority of the pharmacists were young (under 30 years of age), female, and worked in community pharmacies. Pharmacists who worked in hospital or community pharmacies reported a greater AR interference in their work than did pharmacists working in other locations ($p < 0.05$). With respect to factors that contribute to AR, pharmacists placed little weight on the role of inadequate hand washing or lack of immunization campaigns. The pharmacists also believed that vaccination was of limited value in combating AR and instead placed the highest value on educational campaigns. The study showed that pharmacists who used package inserts and advertising material as their source for updated information had a poorer understanding of the appropriate use of antibiotics than did those who obtained their information from scientific journals, textbooks, or scientific meetings.

Conclusions: The results highlight the need for adequate information regarding AR to reach health professionals such as pharmacists. Governments should promote campaigns for integrated actions to combat the serious global problem presented by AR.

Key words: Pharmaceutical education; infectious diseases; antimicrobial resistance.

J Infect Dev Ctries 2015; 9(3):239-243. doi:10.3855/jidc.4853

(Received 13 February 2014 – Accepted 22 November 2014)

Introduction

Antibiotic use in healthcare has become widespread over the past 70 years. Although antibiotics have been hugely successful in treating infectious diseases, indiscriminate and irrational antibiotic use has been implicated in the emergence of multi-resistant microorganisms [1-7]. The misuse of antibiotics stems from the lack of established prescribing criteria for physicians, the absence of control in drug dispensation, and from incorrect patient usage [8-12].

In addition to the rapid spread of resistant microorganisms, the pharmaceutical industry has shown diminishing interest in the research and production of new antimicrobial drugs, leading to dwindling therapeutic options [2]. Thus, antimicrobial resistance (AR) has become one of the current greatest public health challenges [4,5,10,13].

In 2011, the World Health Organization (WHO), concerned about problems associated with the increase in AR, chose AR as the theme for World Health Day. In an attempt to address this issue, WHO published guidelines to combat AR, including, among others, appropriate information for healthcare professionals regarding the rational use of antibiotics [3,4,14].

In addition to WHO, other organizations involved in combating AR have pursued similar strategies, such as providing health care professionals with information on the appropriate use of antibiotics [5,6,15,16].

Methodology

To assess health professionals' knowledge regarding the use of antibiotics and AR, a structured questionnaire was constructed, similar to those previously reported [17-19]. The questionnaire was electronically released to all pharmaceutical professionals associated with the São Paulo Regional Council of Pharmacy (SRF-SP) and was available to complete between 1 and 31 July, 2012.

After receiving the invitation to participate in the study, pharmacists were directed to a specific website

to read the Free and Informed Consent Form (FICF). After informed consent was obtained, the subjects were directed to the survey questions. The inclusion criterion for participation was association with SRF-SP.

The questionnaire was divided into three sections. The first section gathered demographic, academic, and professional information from the pharmacists. The second section contained questions regarding AR, and the final section included technical information about the use of antibiotics.

In the second section of the questionnaire, the participants were presented with ten factors that could contribute to the emergence of AR. The subjects were asked to rate these ten factors using a scale of 1.0 (not important) to 5.0 (very important). The pharmacists were then asked to rate the top six strategies for combating AR using the same scale.

The third section included eight questions that were designed to assess the technical knowledge of pharmacists about the use of antibiotics. Each correct answer was awarded one point such that the scores could vary from 0 to 8. The survey participants were divided into four groups based on the source of information that they reported using to update their knowledge of antibiotic use, and the mean score was calculated for each group.

The data analyses included descriptive statistics, the Friedman test, and analysis of variance followed by Tukey-Kramer multiple comparison tests (5% significance level). The study was approved by the University of Sorocaba Ethical Research Committee (protocol number: 13.271/2012).

Results

The questionnaire was completed by 754 pharmacists. The data in Table 1 show that most of the study participants were young (58.5% were 30 years of age or younger), and the majority were women. This is consistent with the recent changes in Brazilian higher education aimed at increasing the number of female students, especially in pharmacy schools [20].

With respect the participants' level of education, 42% of had attended postgraduate courses (*Lato sensu*), 4% had a master's and/or doctoral degree (*Stricto sensu*), and 54% indicated that they had no postgraduate training beyond pharmacy school.

With respect to AR, 87.1% of the survey participants considered it a global problem, 12.3% believed that this problem is limited to Brazil, and 0.6% did not consider it a problem. These results are very similar to those reported in studies of physicians, nurses, and medical students; about 90% of healthcare professionals today recognize AR as a global problem [17-19,21-23].

Table 3 shows factors related to the emergence of AR and the mean importance given to each one by the survey respondents. The pharmacists considered the use of antibiotics without medical prescription (factor 2, mean score of 4.7), errors in prescriptions (factor 3, mean score of 4.6), and lack of compliance with the treatment (factor 4, mean score of 4.6) to be the most significant contributors to the emergence of AR. These results are similar to those observed in other studies [24].

Table 4 shows the pharmacists' ratings of strategies to combat AR. The pharmacists believed that educational campaigns represent the most

Table 1. Demographic data of pharmacists (n = 754)

Age group (years)	Male, n (%)	Female, n (%)	Total, n (%)
Under 30	112 (25.4)	329 (74.6)	441 (58.5)
31 to 40	98 (41.0)	141 (59.0)	239 (31.7)
41 to 50	23 (43.4)	30 (56.6)	53 (7.0)
Over 50	8 (38.1)	13 (61.9)	21 (2.8)
Total	241 (31.9)	513 (68.1)	754 (100.00)

Table 2. Pharmaceutical field and interference (%) of antimicrobial resistance in pharmacists' professional activities

Pharmaceutical field	N (%)	Antimicrobial resistance interferes with work (%)
Community pharmacy	459 (60.9)	86.9
Hospital pharmacy	82 (10.9)	97.6
Pharmaceutical industry	34 (4.5)	76.5
Teaching	21 (2.8)	61.9
Clinical laboratory	14 (1.8)	64.3
Other	144 (19.1)	68.0
Total	**754 (100.0)**	**82.9**

Table 3. Factors contributing to antimicrobial resistance (n = 754)

Factors contributing to antimicrobial resistance	Mean Score	SD	Friedman*
1. Overuse of antibiotics in medical prescriptions	4.2	0.84	a
2. Overuse of antibiotics without prescriptions	4.7	0.69	b
3. Errors in medical prescriptions (dose, length of use)	4.6	0.65	b
4. Lack of patient compliance with prescribed treatment	4.6	0.67	b
5. Lack of orientation in antibiotic dispensation	4.4	0.76	c
6. Inadequate hands washing	3.8	1.13	d
7. Lack of immunization campaigns	3.3	1.29	e
8. Lack of new antimicrobial drugs	3.3	1.18	e
9. Use of antimicrobials as growth promoters in animals	3.9	1.05	d
10. Patient pressure for antibiotic prescription	3.8	1.12	d

SD: standard deviation; *Different letters indicate statistical significance (Friedman test, $p < 0.05$)

Table 4. Importance of strategies to combat antimicrobial resistance (n = 754)

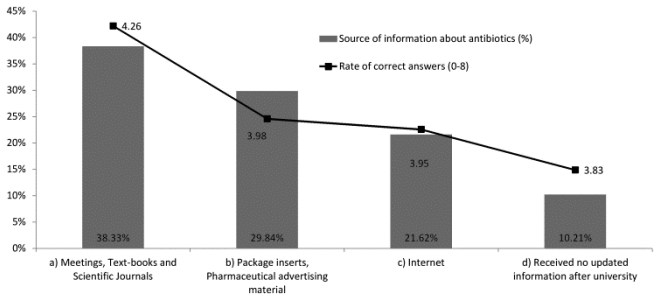
Strategies to combat antimicrobial resistance	Mean score	SD	Friedman*
1. Educational campaigns	4.5	0.7	a
2. Use of therapeutic guidelines	4.3	0.8	b
3. Better control on antibiotics sales	4.3	0.9	b
4. Vaccination campaigns	3.5	1.2	c
5. Reduction of antibiotic use in agriculture and veterinary fields	3.6	1	c
6. Development of new antibiotics	3.8	1	d

SD: standard deviation; *Different letters indicate statistical significance (Friedman test, $p < 0.05$)

important strategy that can be adopted ($p < 0.05$). The use of therapeutic guidelines and better control of antibiotics sales ranked as the next two most important strategies. This result is very similar to the WHO's recommendation of providing information to health professionals and the general public to combat AR [3].

Figure 1 shows that a large percentage of pharmacists (38.3%) received updated information about the use of antibiotics from scientific meetings, textbooks, and scientific journals (group a). These pharmacists scored the highest in the third section of the survey designed to test their knowledge of antibiotic usage, with a mean score of 4.26. The pharmacists in group b, who used package inserts and pharmaceutical advertising material as their source for updated information, scored significantly lower on the technical questions (mean score, 3.98; $p = 0.040$). This result shows that the quality of the information source can interfere with its accuracy. It is important to emphasize the low level of accuracy (3.83) demonstrated by the professionals who did not update their knowledge regarding the use of antibiotics after university.

Figure 1. Source of information about antibiotics (%) and rate of correct answers.



Discussion

The pharmacists were asked about where they work and whether the problem of AR has interfered with their daily work. As seen in Table 2, most of the participants worked in community pharmacies (public or private), which make up the fastest-growing area of pharmaceutical employment in Brazil [25]. Of the survey participants, 82.9% reported that AR has interfered in their daily work. Hospital pharmacies were found to have the greatest percent of pharmacists reporting such interference (97.6%, $p < 0.05$). This result shows that pharmacists working in hospital settings have an increased awareness of the problem of AR; this may be due to the fact that they are involved in the care of critically ill patients and encounter resistant microorganisms.

In Table 3, it is important to note that inadequate hand washing (factor 6), the lack of immunization campaigns (factor 7), and the lack of new antimicrobial drugs (factor 8) were considered the least important contributors to AR by the pharmacists,

with mean values of 3.8, 3.3, and 3.3, respectively, and had the biggest standard deviations. It is surprising that the pharmacists considered inadequate hand washing to have little contribution to AR despite the fact that information on the value of hand washing is widely available. The large standard deviations found for factors 6 and 7 indicate a wide range of responses among pharmacists and show a lack of consistent knowledge among pharmacists.

It is also interesting to note that the study participants did not think that a lack of immunization campaigns (factor 7) contributed much to AR. This finding suggests that pharmacists are not informed about the benefits of the vaccines used to prevent pneumococcal infections. Countries that have included this vaccination in their official immunization schedule have significantly decreased the number of bacterial infections, use of antibiotics and, consequently, AR [26,27].

Vaccination campaigns (strategy 4 – Table 4) received the lowest mean score (3.5), indicating that the study participants believed that vaccination strategies are of little value in combatting AR. The results of this study showed that pharmacists are not aware of alternative vaccine campaigns. In addition, they may benefit from additional information related to AR, as shown in other studies [17,21,22,28].

The results of this study highlight a gap in the knowledge of pharmacists regarding AR. This problem includes a lack of knowledge of the importance of simple measures such as hand washing and immunization in preventing prevent bacterial infections. It is essential that the scope of the problem of AR and information on effective measures of control are communicated to all healthcare professionals.

In the information era, we still have problems ensuring that appropriate information reaches target groups. The results of this study demonstrated that just as important as the information itself is the source from which it comes. In this study, when pharmacists used information sources lacking technical and scientific rigor, their resulting knowledge level was low. Thus, with the dissemination of scientifically rigorous information, we may successfully combat AR.

Acknowledgements

The authors wish to thank São Paulo Regional Council of Pharmacy.

References

1. van Hoek AH, Mevius D, Guerra B, Mullany P, Roberts AP, Aarts HJ (2011) Acquired antibiotic resistance genes: an overview. Front Microbiol 2: 203.
2. Appelbaum PC (2012) 2012 and beyond: potential for the start of a second pre-antibiotic era? J Antimicrob Chemother 67: 2062-2068.
3. Leung E, Weil DE, Raviglione M, Nakatani H (2011) The WHO policy package to combat antimicrobial resistance. Bull World Health Organ 89: 390-392.
4. Holloway KA (2011) Combating inappropriate use of medicines. Expert Rev Clin Pharmacol 4: 335-348.
5. Spellberg B, Bartlett JG, Gilbert DN (2013) The future of antibiotics and resistance. N Engl J Med 368: 299-302.
6. Belongia EA, Knobloch MJ, Kieke BA, Davis JP, Janette C, Besser RE (2005) Impact of statewide program to promote appropriate antimicrobial drug use. Emerg Infect Dis 11: 912-920.
7. Pulcini C, Gyssens IC (2013) How to educate prescribers in antimicrobial stewardship practices. Virulence 4: 192-202.
8. Del Fiol Fde S, Lopes LC, Barberato-Filho S, Motta Cde C (2013) Evaluation of the prescription and use of antibiotics in Brazilian children. Braz J Infect Dis 17: 332-337.
9. Teixeira Rodrigues A, Roque F, Falcao A, Figueiras A, Herdeiro MT (2013) Understanding physician antibiotic prescribing behaviour: a systematic review of qualitative studies. Int J Antimicrob Agents 41: 203-212.
10. Chandy SJ, Mathai E, Thomas K, Faruqui AR, Holloway K, Lundborg CS (2013) Antibiotic use and resistance: perceptions and ethical challenges among doctors, pharmacists and the public in Vellore, South India. Indian J Med Ethics 10: 20-27.
11. Mainous AG, 3rd, Diaz VA, Carnemolla M (2009) A community intervention to decrease antibiotics used for self-medication among Latino adults. Ann Fam Med 7: 520-526.
12. Fleming A, Browne J, Byrne S (2013) The effect of interventions to reduce potentially inappropriate antibiotic prescribing in long-term care facilities: a systematic review of randomised controlled trials. Drugs Aging 30: 401-408.
13. Paphitou NI (2013) Antimicrobial resistance: action to combat the rising microbial challenges. Int J Antimicrob Agents 42 Suppl: S25-S28.
14. McNulty CA (2012) European Antibiotic Awareness Day 2012: general practitioners encouraged to TARGET antibiotics through guidance, education and tools. J Antimicrob Chemother 67: 2543-2546.
15. Kotwani A, Wattal C, Joshi PC, Holloway K (2012) Irrational use of antibiotics and role of the pharmacist: an insight from a qualitative study in New Delhi, India. J Clin Pharm Ther 37: 308-312.
16. Tonna AP, Stewart DC, West B, McCaig DJ (2010) Exploring pharmacists' perceptions of the feasibility and value of pharmacist prescribing of antimicrobials in secondary care in Scotland. Int J Pharm Pract 18: 312-319.
17. Guerra CM, Pereira CA, Neves Neto AR, Cardo DM, Correa L (2007) Physicians' perceptions, beliefs, attitudes, and knowledge concerning antimicrobial resistance in a Brazilian teaching hospital. Infect Control Hosp Epidemiol 28: 1411-1414.
18. Minen MT, Duquaine D, Marx MA, Weiss D (2010) A survey of knowledge, attitudes, and beliefs of medical students concerning antimicrobial use and resistance. Microb Drug Resist 16: 285-289.

19. Srinivasan A, Song X, Richards A, Sinkowitz-Cochran R, Cardo D, Rand C (2004) A survey of knowledge, attitudes, and beliefs of house staff physicians from various specialties concerning antimicrobial use and resistance. Arch Intern Med 164: 1451-1456.
20. INEP (2013) Higher Education Research: 2011 Brazil: Ministry of Eduction. Available at: http://censosuperior.inep.gov.br/resumos-tecnicos Accessed July, 2013.
21. Abbo LM, Cosgrove SE, Pottinger PS, Pereyra M, Sinkowitz-Cochran R, Srinivasan A, Webb DJ, Hooton TM (2013) Medical Students' Perceptions and Knowledge about Antimicrobial Stewardship. How are we Educating our Future Prescribers? Clin Infect Dis 57: 631-638.
22. Garcia C, Llamocca LP, Garcia K, Jimenez A, Samalvides F, Gotuzzo E, Jacobs J (2011) Knowledge, attitudes and practice survey about antimicrobial resistance and prescribing among physicians in a hospital setting in Lima, Peru. BMC Clin Pharmacol 11: 18.
23. Itokazu GS, Schwartz DN, Garey KW, Rodvold KA, Danziger LH, Weinstein RA (2006) Pharmacists' perceptions of the effectiveness of antimicrobial control programs. Am J Health Syst Pharm 63: 2504-2508.
24. Pulcini C, Williams F, Molinari N, Davey P, Nathwani D (2011) Junior doctors' knowledge and perceptions of antibiotic resistance and prescribing: a survey in France and Scotland. Clin Microbiol Infect 17: 80-87.
25. Bastos CRG, Caetano R (2010) The pharmacist's perceptions about their job at communitarian pharmacies of the state of Rio de Janeiro. Ciênc Saúde Colet 15 Suppl 3: 3541-3550.
26. Scott JR, Millar EV, Lipsitch M, Moulton LH, Weatherholtz R, Perilla MJ, Jackson DM, Beall B, Craig MJ, Reid R, Santosham M, O'Brien KL (2012) Impact of more than a decade of pneumococcal conjugate vaccine use on carriage and invasive potential in Native American communities. J Infect Dis 205: 280-288.
27. Paradiso PR (2012) Pneumococcal conjugate vaccine for adults: a new paradigm. Clin Infect Dis 55: 259-264.
28. Lucet JC, Nicolas-Chanoine MH, Roy C, Riveros-Palacios O, Diamantis S, Le Grand J, Papy E, Rioux C, Fantin B, Lefort A, Ravaud P (2011) Antibiotic use: knowledge and perceptions in two university hospitals. J Antimicrob Chemother 66: 936-940.

Corresponding author

Prof. Dr. Fernando de Sá Del Fiol
Universidade de Sorocaba
Rodovia Raposo Tavares, Km 92,5
CEP: 18023-000, Sorocaba SP, Brazil
Phone: 55 15 99617058
Fax: 55 15 21017074
Email: fernando.fiol@prof.uniso.br

Conflict of interests: No conflict of interests is declared.