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Fighting antibiotic resistance in Portuguese Hospitals: understanding antibiotic prescription behaviors to better design antibiotic stewardship programs.

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HIGHLIGHTS

- Physicians know antibiotic resistance problem but they do not recognize it on their own hospital
- Antibiotic prescription barriers are mainly associated with microbiological data availability
- Efforts should be made to improve access to local epidemiological data
- Continuous education on the antibiotic resistance problem should be a priority

ABSTRACT

Objective: Since physicians play an important role on antibiotic usage, it is vital to understand their antibiotic-prescribing behaviour and knowledge on antimicrobial resistance, in order to develop and implement effective antibiotic stewardship interventions. The aim of this study was to evaluate Portuguese physicians' knowledge, and understand prescription behaviours, difficulties and barriers in their antibiotic prescription process to promote better and well adapted antibiotic stewardship policies.

Methods: The study was conducted in 2016, using a self-administered questionnaire to physicians in two tertiary public hospitals from two different regions in Portugal.

Results: Participating physicians (30 of 63 – response rate of 47.6%) identified antibiotic resistance as a global problem; however, one third did not recognize antibiotic resistance as a major problem on their own hospital. Factors that influence most antibiotic prescription were "microbiology laboratory results", "patient clinical situation" and patient "co-morbidities". On the other hand, "colleagues' opinion" and "costs control" were considered less determining factors. Regarding difficulties and bottlenecks on the antibiotic prescription process, participant physicians reported the "lack of (or delayed) microbiological results" and "no access to antibiotic susceptibility patterns" as major barriers. "Education and training" was considered the most effective intervention to improve antibiotic prescription.

Conclusion: Our results suggest that the design and implementation of antibiotic stewardship interventions should provide better data management and sharing tools between physicians and the microbiology laboratory, especially through the creation of antimicrobial prescribing guidelines according to hospital epidemiology, and an easy access to hospital antibiotic susceptibility patterns and epidemiological data.

KEYWORDS: Antibiotic Prescription; Antimicrobial Resistance; Antibiotic Stewardship Interventions; Microbiology Laboratory; Hospital; Portugal

1. INTRODUCTION

Antimicrobial resistance is a growing worldwide health threat that has been associated with incorrect prescription and overuse of antibiotics [1]. Considering that physicians play a central role on antibiotic usage, a better understanding on their prescribing behaviours and knowledge of antimicrobial resistance is critical to design interventions, that will enable to implement effective antibiotic stewardship programs (ASP) [2,3].

In spite of some publications on antibiotic prescribing behaviour [4,5], scarce data is available on prescribing practices in Portugal [6], where antibiotic consumption is still higher than the European average [7]. Additionally, other countries' results may not be applicable since it has been proven that socio-cultural factors impact on antibiotic prescription [8].

The present study was developed under the scope of HAITooL project (http://haitool.ihmt.unl.pt/). The main goals of the present study were to evaluate and understand physician's knowledge and prescription behaviours on antibiotics in two Portuguese hospitals, and to identify difficulties and barriers on the antibiotic prescription process, in order to allow the proper design and implementation of ASP adapted to the Portuguese context.

2. METHODS

2.1 Setting and study population. The study was conducted in 2016 in two Portuguese hospitals: Hospital A, a general and tertiary public university hospital, located in Lisbon (Portugal's capital); and Hospital B, a general and tertiary public hospital, located in the central/south region of Portugal. The study population was a convenience sample since questionnaires were delivered to the physicians that participate in the HAITooL project. In total, 63 questionnaires were delivered: nine in Hospital A, and 54 in Hospital B.

2.2 Questionnaire. A self-administered questionnaire (developed based on comparable studies [3,5,9] and pre-tested by the authors) was distributed in paper format, by hand. The questionnaire included 35 items distributed by four pages and encompassed questions on socio-demographic (age and gender) and

professional aspects (years after graduation and medical specialization), and questions about the antibiotic resistance problem (using a five point Likert-style scale, from “totally agree” to “totally disagree”) and antibiotic prescription confidence (using a five point Likert-style scale, from “totally confident“ to “not confident“).

The questionnaire also included three questions regarding factors that influence/impact on antibiotic prescription (Figure 1) and two open-ended questions were the physician was invited to describe difficulties and barriers on antibiotic prescription process, and to enumerate which strategies should be implemented to improve antibiotic prescription. The responses obtained were grouped in thematic categories to facilitate the analysis.

Questionnaire response took approximately 10 minutes, was voluntary and an informed consent form was presented to each participant describing the study context and requesting participation in the study.

2.3 Statistical analysis. Statistical analysis was performed using SPSS Version 23. Since data came from a convenience sample, only descriptive analysis was used. The qualitative variables were presented in frequencies. Age was presented by median and interquartile range (IQR), given its asymmetric distribution.

3. RESULTS

3.1 Participants’ characteristics. Among the 63 distributed questionnaires, 30 were returned completed (response rate = 47.6%): eight from Hospital A (response rate = 88.9%) and 22 from Hospital B (response rate = 40.7%). Participants’ median age were 30.0 years (IQR: 27.0-51.5) and 56.7% were female. More than half of the participants (53.3%) were specialists and 35.7% were senior doctors (more than 20 years after graduation).

Even though it was a convenience sample, data was analyzed in three contexts: (i) as a whole, (ii) by hospital (A and B), and (iii) by years after graduation (classified into tertiles: one to four years, five to twenty years, and more than twenty years). Statistical analysis showed no differences in participants‘ characteristics, neither between the two hospitals, nor between years after graduation. Therefore, the results presented below report the analysis on the entire, non-stratified, sample.

3.2 Participants' knowledge about antibiotic resistance. All participants inquired agreed that inappropriate antibiotic use puts patient at risk (83.3% totally agree and 16.7% agree). However, one third did not recognize antibiotic resistance as a serious problem on their own hospital (30.0% undecided and 3.3% disagreed, Table 1, Section A).

3.3 Antibiotic prescription behaviors. National/institutional guidelines for antibiotic prescription were reported as totally known by only 13.3% of the respondent physicians, however, most physicians (86.7%) responded that they follow it. More than half (56.4%) considered themselves as a role model for antibiotic prescription, and only 53.3% considered that colleagues follow antibiotic prescription guidelines (Table 1, Section B).

Overall, participating physicians have a good knowledge about when antibiotic prescription is necessary: all disagreed (55.2% disagree and 44.8% totally disagree) with the sentence "Is always better to prescribe antibiotics in excess than to not prescribe" (Table 1, Section C). However, some discrepancies on prescription behaviors were identified: when asked if "Fever and high inflammatory parameters are indicative of infection and empiric antibiotic therapy should be immediately started", 56.7% agreed but 30.0% totally disagreed. The results were even more divergent when questioned if "Combined antibiotic therapy is preferred to monotherapy in severe infections": 40% agreed (or totally agree), 33.3% disagreed (or totally disagree) and 26.7% were undecided (Table 1, Section C).

3.4 Confidence level on antibiotic prescription process. Most (64.3%) physicians were confident on prescribing antibiotics empirically, deciding for antibiotic prescription, or prescribing antibiotics according to local epidemiological data on antibiotic susceptibility patterns. All (71.4% totally confident, 28.6% confident) were confident on changing antibiotic therapy after knowing the microbiological results (Table 2).

3.5 Factors that influence antibiotic prescription. Factors that influence most the antibiotic prescription process (Figure 1 - Question A) were "microbiology laboratory results" (chosen by 58.6% physicians), "patient

clinical situation" (31.0%) and "antibiotic prescription guidelines" (10.3%). "Colleagues' opinion" was not chosen by any physician.

Regarding factors that could impact on antibiotic prescription decision (Figure 1 - Question B), 37.0% physicians considered the "access to clinical information and antibiotic susceptibility patterns" as the most important one, followed by "concern with possible future complications in the patient" (33.3%), "contribution to antibiotic resistance problem" (25.9%), and "meeting patients' (and their relatives) expectation" (3.7%). Contrariwise, factors such as "patient socio-economic and cultural condition", "conviction that the problem of antibiotic prescription is overvalued", and "costs control" do not seem to influence physician's antibiotic prescription decision.

Additionally, participant physicians were asked to describe factors taken into account on the antibiotic prescription decision process (Figure 1 - Question C). The most common factors described were: co-morbidities and patient clinical situation (36.7% each), easy to administer and convenience of dosage, route and time of treatment (30.0%), antimicrobial susceptibility pattern (26.7%), microbiological laboratory results and focus of infection (20.0% each).

3.6 Difficulties and barriers on the antibiotic prescription process. Close to one-third (30.0%) of participating physicians reported the "lack of (or delayed) microbiological results" as the major barrier on antibiotic prescription process, followed by "no access to antibiotic susceptibility patterns" (16.7%). "Lack of antimicrobial prescribing guidelines adapted to hospital epidemiology" (13.3%) and "quality of clinical data" (13.3%) were also mentioned. Other difficulties/barriers described were: "colleagues' opinion", "patient clinical situation", "prior authorization request for some antibiotics", "patients not aware of antibiotic resistance problem", "lack of experience" and "availability of antibiotics in hospital pharmacy".

3.7 Strategies to effectively improve antibiotic prescription. "Education and training on antibiotic prescription" was the strategy identified by most physicians (43.3%), followed by "availability of local epidemiological data", "antimicrobial prescribing guidelines adapted to hospital epidemiology" (16.7% each),

and “prescription control” (13.3%). Only one physician considered “informatics tools” as an efficient strategy to improve antibiotic prescription**.**

4. DISCUSSION

This study evaluated knowledge, self-understood prescription behaviour, and perceived difficulties and barriers in antibiotic prescription process, among 30 physicians in two Portuguese hospitals, in order to assist the co-design and implementation of locally adapted ASP.

We noticed that one-third of respondents did not recognize antibiotic resistance as a serious problem in their own hospital. This lack of awareness has been also described by several other authors [3,5] and should be consider when ASP are designed.

In this study, the level of confidence of participating physicians was high (64.3%) when prescribing antibiotics, however, less than reported in other studies [4]. Nevertheless, the confidence level on the microbiology laboratory should be highlighted: in spite of almost half of respondents identified, the (no) reporting of microbiological results/data (antibiotic susceptibility patterns and local epidemiological data) as a barrier to antibiotic prescription process, the level of confidence on antibiotic prescription reached 100% when microbiology results were known. A positive association between antibiotic susceptibility reporting from microbiology laboratories and antibiotic prescribing has been described by other authors [10]. Based on that, a good communication between physicians and the microbiology laboratory should be considered as a priority in any ASP [11].

Two major factors that influence antibiotic prescription were identified: “co-morbidities” and “patient clinical situation”, as described in other studies [12]. However, it is important to notice, that in contrast with other studies [13], participant physicians do not considered the influence of peers and senior colleagues as an important determinant on antibiotic prescription, it’s even appointed as a barrier. These results can be explained by the fact that 35.7% of participating physicians were senior doctors (more than 20 years after graduation), or by national cultural dimensions [14].

In spite of some studies reporting no improvements after educational interventions (reviewed in [15]), education has been widely recognized as a successful strategy for rational antibiotic prescription [15,16]. In our study, education and training were pointed out as the most effective strategy to improve antibiotic prescription, as also described in England, France and Scotland [4,5]. Thus, and according to the European guidelines [17], the inclusion of lessons on appropriate antimicrobial use and antimicrobial resistance in medical school's programs, in parallel with regular training for practicing physicians, should be reinforced.

Computerized decision-support systems have been described as an advantage in antibiotic prescription processes [18]. However, in our study only one physician suggested it as an efficient strategy to improve antibiotic prescription, probably because physicians often describe information systems as obsolete (A. S. Simões et al, unpublished observations). To avoid it, information system should be supported by end-users inputs [19], as happens in HAITooL surveillance and decision-support system, that have been co-designed and implemented with physicians in order to fulfill their needs and requirements for antibiotic prescription process [20].

This study has major limitations, namely, the small size of the convenience sample (and the low response rate), limiting the generalizations to the whole country and even to the participant hospitals. The low response rate can be interpreted by a lack of interest on the antibiotic resistance problem or even a weak commitment by hospitals administrators, since unfortunately these kind of studies are not immediately perceived as a helping tool. On the other hand, physicians' busy/overloaded schedule can explain the low response rate. Another major limitation is that the study was based in a questionnaire that lead to answers based on physicians' own experiences. Moreover, the effect of socially desirable responses should be taken into account when interpreting results. For instance, the big percentage of "undecided" answers regarding perception on the problem of antibiotic resistance and prescription behavior may reveal a willingness not to give socially inconvenient answers. Additionally, the fact that the questionnaire was only pre-tested by the authors may also influence, not only the obtained answers but also the low response rate, since some questions could was been misunderstood. However, we consider that our study portrays a starting point on the knowledge on antibiotic resistance problem and prescription behaviors among Portuguese physicians and should be considered as a baseline to design ASP adapted to Portuguese context.

5. CONCLUSIONS

Several barriers and difficulties on the antibiotic prescription process were described, mainly associated with the availability of microbiology laboratory data. However, confidence when prescribing antibiotics reached the highest level when supported by microbiology laboratory results. Our results suggest that efforts should be made to improve data sharing between physicians and the microbiology laboratory, for instance, the availability of antimicrobial prescribing guidelines adapted to local hospital epidemiology, and easy access to hospital antibiotic susceptibility patterns and epidemiological databases. Further studies are needed to continuously understand prescription behaviors of Portuguese physicians, in order to better design ASP and help to decrease antibiotic resistance in Portuguese Hospitals.

DECLARATIONS

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Competing Interests: The authors declare that they have no conflicts of interests

Ethical Approval: Ethic Committees of participating hospitals approved HAITooL project. An informed consent form was presented to each participant in the initial part of the questionnaire with instructions for completing and requesting participation in the study. As it was a self-completed questionnaire, the return of the questionnaire inferred the informed consent given by the participants. Data was codified in order to be analyzed anonymously.

Availability of data and materials

The datasets during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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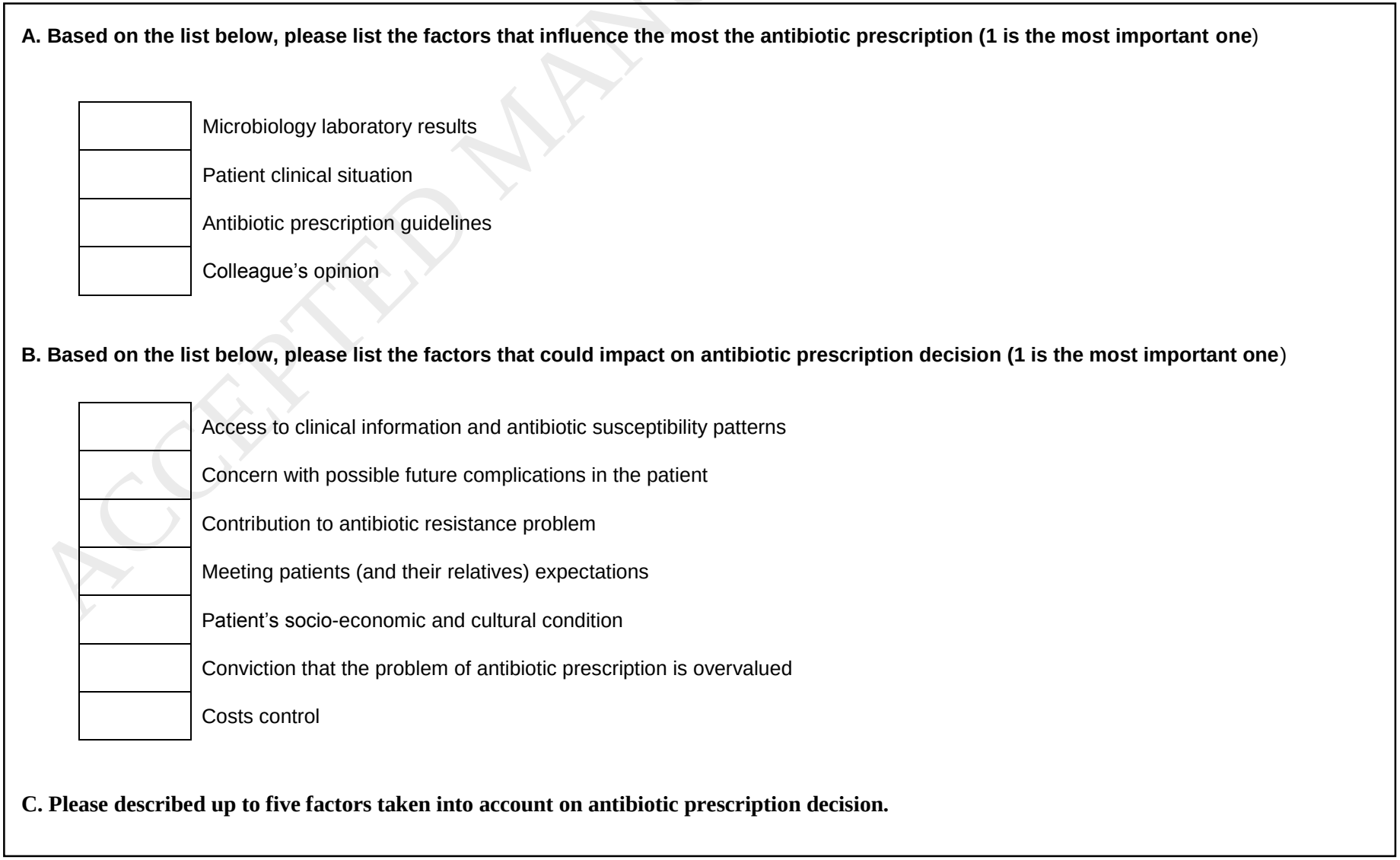
FIGURES

Figure 1. Questions included in the questionnaire that are about factors that influence antibiotic prescription.



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TABLES

Table 1. Perception on the problem of antibiotic resistance and prescription behaviors by participating physicians (n=30).

Questions		Totally agree % (n)	Agree % (n)	Undecided % (n)	Disagree % (n)	Totally disagree % (n)
Section A	The inappropriate use of antibiotics puts your patients on risk.	83.3 (25)	16.7 (5)	0.0 (0)	0.0 (0)	0.0 (0)
	Antibiotic resistance is a serious problem in my hospital.	23.3 (7)	43.3 (13)	30.0 (9)	3.3 (1)	0.0 (0)
	The effort to prescribe the most adequate antibiotic is useful.	86.7 (26)	13.3 (4)	0.0 (0)	0.0 (0)	0.0 (0)
Section B	I follow the guidelines for antibiotic prescription	16.7 (5)	70.0 (21)	13.3 (4)	0.0 (0)	0.0 (0)
	I am able to follow the guidelines for antibiotic prescription	13.3 (4)	56.7 (17)	16.7 (5)	13.3 (4)	0.0 (0)
	Physicians, in general, follow guidelines for antibiotic prescription.	3.3 (1)	50.0 (15)	26.7 (8)	20.0 (6)	0.0 (0)
	Your behavior on antibiotic prescription is considered as a role model.	3.3 (1)	53.3 (16)	36.7 (11)	6.7 (2)	0.0 (0)
Section C	Is always better to prescribe antibiotics in excess than to not prescribe.	0.0 (0)	0.0 (0)	0.0 (0)	55.2 (16)	44.8 (13)
	Fever and high inflammatory parameters are	0.0 (0)	56.7 (17)	13.3 (4)	0.0 (0)	30.0 (9)

indicative of infection and empiric antibiotic therapy should be immediately started.					
Combined antibiotic therapy is preferred to monotherapy in severe infections.	10.0 (3)	30.0 (9)	26.7 (8)	23.3 (7)	10.0 (3)
Extending antibiotic treatment up to 14 days is useful to consolidate clinical cure.	0.0 (0)	6.7 (2)	6.7 (2)	53.3 (16)	33.3 (10)
Extending antibiotic treatment up to 14 days is useful to decrease risk of recurrences.	0.0 (0)	3.3 (1)	6.7 (2)	56.7 (17)	33.3 (10)
In a patient with suspected infection and sterile microbiological samples, antibiotic should be administered until day 10-14.	0.0 (0)	10.0 (3)	16.7 (5)	43.3 (13)	30.0 (9)
The same antibiotic can be used as prophylactics and as therapeutic.	0.0 (0)	33.3 (10)	16.7 (5)	23.3 (7)	26.7 (8)

Table 2. Confidence level on antibiotic prescription process by participating physicians (n=30).

Question	Totally confident % (n)	Confident % (n)	More or less confident % (n)	Low confident % (n)	Not confident % (n)
What is your level of confidence when prescribing antibiotics empirically?	0.0 (0)	64.3 (18)	32.1 (9)	3.6 (1)	0.0 (0)
What is your level of confidence when deciding antibiotic therapy prescription?	0.0 (0)	64.3 (18)	35.7 (10)	0.0 (0)	0.0 (0)
What is your level of confidence to change antibiotic therapy after knowing the microbiology results?	71.4 (20)	28.6 (8)	0.0 (0)	0.0 (0)	0.0 (0)
What is your level of confidence to prescribe antibiotics according to local and national guidelines?	3.6 (1)	64.3 (18)	32.1 (9)	0.0 (0)	0.0 (0)
What is your level of confidence when prescribe antibiotics according to local epidemiological data on antibiotic susceptibility patterns?	3.6 (1)	60.7 (17)	32.1 (9)	3.6 (1)	0.0 (0)