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Knowledge, attitudes, and practices related to antibiotic resistance among physicians and nurses in Italian intensive care: A multicenter cross-sectional survey

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ABSTRACT

Objectives: The aim of this study is to investigate the knowledge, attitudes and practices of Italian intensive-care physicians and nurses with respect to antibiotic resistance.
Methods: A multicenter cross-sectional survey was conducted of 20 Italian intensive care units, supported by an online validated questionnaire.
Results: A total of 143 participants took part, mainly nurses (79.7%). Most respondents were between 26 and 45 y old (62.9%), with more than 6 y of service (about 71%). Some 90% of those who took part stated that they were aware of the problem of antibiotic resistance and had easy access to guidelines and information materials on the subject. On the other hand, a high level of disagreement, mostly among nurses, emerged in relation to knowledge of the existence of national plans for the fight against AMR (62.9%) or the presence of international information campaigns (80%). A majority (76%) said they had received no specific training in the past 12 months. Most physicians (70%-90%) showed faith in their ability to prescribe, trusted guidelines, and recognized their role in antibiotic resistance by considering it while prescribing antimicrobial therapy.
Conclusions: The study highlights the need for targeted training interventions, especially for nurses, and the importance of involving all healthcare professionals in the fight against antibiotic resistance.

1. Introduction

Antimicrobial resistance (AMR) is a global threat to human health. It is estimated that a failure to address resistance to antibiotics could lead to some 11 million unnecessary deaths a year by 2050 [1]. People admitted to an intensive care unit (ICU) have a high risk of becoming colonized by or contracting an infection caused by multidrug-resistant microorganisms (MDROs), mainly due to factors such as frequent use of antibiotics, long hospital stays, use of invasive devices, and comorbidity conditions [2]. The literature states that 30% to 60% of antibiotics prescribed in ICUs are unnecessary, inappropriate, or suboptimal [3]

To try to address this alarming problem, a multimodal strategy is important, such as the “One Health” approach suggested by the World Health Organization (WHO), which involves several medical and non-medical health professions. The second of its five points provides for “training and education,” although these can be better implemented after investigating what medical knowledge, attitudes, and practices (KAPs) exist or are required to make them more effective.

The literature on the KAPs of medical professionals in intensive care in Italy with regard to antibiotic resistance is scarce. We have therefore conducted a multicenter survey among ICU physicians and nurses to assess current practice regarding the prescription and management of antibiotics, using a scaled-down version

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of the tool created by Ashiru-Oredope et al. [4], validated in its Italian version by the authors of this study.

2. Materials and methods

The main method used in this study is a voluntary, multicentric, cross-sectional fact-finding survey.

2.1. Tool description

A questionnaire was devised in Italian containing 26 items (Supplementary file 1: Italian version of the tool), representing a reduced version of the original created by Ashiru-Oredope et al. [4], which consists of 43 questions divided into various sections according to a behavior change model. A literature review was also conducted.

The questionnaire in its reduced version was subjected to a validation process: the results are outlined in a previous study, which is being evaluated for publication at the time of writing.

2.2. Setting

Public National hospitals equipped with a secondary accident and emergency department (AED) were identified from a list issued by Italy's Ministry of Health (2019). Support from the National Association of Critical Care Nurses (named ANIARTI in Italian) was also requested to reach the personnel targeted by this research; the largest reference center in each region was initially contacted. These preparations were carried out between February and mid-April 2022. Emails were sent containing a presentation by the authors, a copy of the research proposal, and a copy of the questionnaire that would be used. This material was sent to medical managers in charge of the operating units as well as the chief nurses, who if favorable were asked to disclose the survey to any personnel they coordinated.

In total, 20 Italian intensive care units agreed to participate: four of these are in the northeast of Italy, 11 in the northwest, one in central Italy, three in the south, and one in the islands, as per the Italian National Institute of Statistics (ISTAT) and Eurostat subdivisions of the country.

The questionnaire was administered online anonymously, using Google Forms, for 4 weeks from mid-April to May 2022, to physicians and nurses working in the previously identified intensive care units. Social health workers, resident doctors, and medical and nursing students were excluded.Participants expressed their informed consent on the first page of the online questionnaire.

The study and its survey received authorization from the appropriate health directors and heads of department.

2.3. Ethical approval

The Ethics Committee Lombardy 3 consulted considered that its approval was not necessary as the survey only collected anonymized and nonidentifiable data.

2.4. Statistical analysis

Data were exported from Google Forms into Microsoft Excel (Microsoft Corp, Washington DC) and then into IBM SPSS Statistics version 25 (SPSS Inc., Chicago, IL). Descriptive statistics for frequency distribution and percentages were used to analyze respondents' knowledge and understanding. Comparisons were made using the Chi-square test with a significance level of $P<0.010$. A five-point Likert scale was used for several questions, and the answers "agree" and "strongly agree" were combined and reported as "agree"; similarly, the answers "disagree" and "strongly disagree" were combined and reported as "disagree." For a better adaptation to today's study, the age groups and length of service have also been merged, bringing the groups in both categories to three instead of seven.

Where respondents described working in more than one type of ICU, the term "multipurpose" was defined to catalog the experience described.

Table 1
Demographic presentation of the sample (n=143).

Age (y)	Number of respondents	
	N	%
18–25	10	7
26–45	90	62.9
>46	42	29.4
Missing	1	0.7
Gender	**Number of respondents**	
	N	%
Female	103	72
Male	40	28
Profession	**Number of respondents**	
	N	%
Physician	26	18.2
Chief physician	3	2.1
Nurse	107	74.8
Head nurse	7	4.9
Length of service	**Number of respondents**	
	N	%
0–5	41	28.7
6–15	57	39.9
>16	45	31.5
Intensive care unit	**Number of respondents**	
	N	%
Cardiac surgery	5	3,5
General	29	20,3
Neonatal	38	26.6
Neuroscience	27	18.9
Paediatric	21	14.7
Multipurpose	20	14
Postoperative	2	1.4
Hospital region	**Number of respondents**	
	N	%
Northwest	98	68.5
Northeast	42	29.4
Central	0	0
South	2	1.4
Islands	0	0
Missing	1	0.7

3. Results

3.1. Demographic aspects

Of the approximately 700 professionals invited to participate, 148 (21.14%) responded. Five questionnaires were eliminated as incomplete, leaving 143 in total. Of those who responded, 79.7% are nurses while 21.3% are doctors, and most respondents (62.9%) belong in the 26–45 age group. Some 39.9% have a length of service ranging between 6 and 15 y, while 31.5% have worked for 16 y or more. Of those who responded, 45.5% were from one of several tertiary-level teaching hospital in the northwest of Italy (Table 1).

Table 2
Seven key knowledge questions (the percentage of physicians and nurses was calculated considering the two groups separately).

Key knowledge questions	Correct answer	Correct (%)	Incorrect (%)	Physician (%)	nurse (%)
Antibiotics are effective against viruses	False	97.2	2.8	100	96.5
Antibiotics are effective against cold and flu	False	94.4	5.6	100	94.7
Unnecessary use of antibiotics makes them become ineffective	True	92.3	7.7	89,7	93
Taking antibiotics has associated side effects or risks such as diarrhea, colitis, allergies	True	96.5	3.5	93	97.4
Every person treated with antibiotics is at an increased risk of antibiotic-resistant infection	True	74.8	25.2	82,7	72.8
Antibiotic-resistant bacteria can spread from person to person	True	90.2	9.8	96,5	88.6
Healthy people can carry antibiotic-resistant bacteria	True	83.9	16.1	86,2	83.3

A total of 88.8% respondents say they do not currently "contribute to" or "lead" antimicrobial stewardship programs or are involved in work that directly addresses the issue of microbial resistance.

3.2. Section 1—capability

Of the total sample, 95.8% agree to knowing what antibiotic resistance is; 68.5% agree regarding having sufficient knowledge about the use of antibiotics although 25.9% state their uncertainty. The vast majority, 90% to 95%, of respondents answered five out of seven key knowledge-related questions correctly (Table 2).

3.3. Section 2—opportunity

Of the total number of participants, 67.1% agree that they have easy access to infection-management guidelines (86.2% of physicians and 62.3% of nurses), while 57.3% agree that they have easy access to advice on the prudent use of antibiotics for patients as well as antibiotic resistance. However, 35% of the total sample state their uncertainty, including 38.6% of nurses.

Of all participants, 48.3% have prescribed, dispensed, or administered antibiotics more than once a day in the week prior to completing the survey, 21.7% within the same week.

Finally, 49.7% of the sample have never offered advice on the prudent use of antibiotics or on the management of infections, while 18.9% do not consider it applicable, and 12.6% consider it rarely to be appropriate: these percentages mainly reflect the view of nurses, of whom 66 respondents have never offered this advice, 21 consider it inapplicable, and 13 have rarely considered it.

3.4. Section 3—motivation

The vast majority of respondents, 93.7%, agree that there is a correlation between the prescription, distribution, and administration of antibiotics, and the appearance or dissemination of multiresistant micro-organisms. Fifty-eight percent of the sample believe they have a central role in helping to control antibiotic resistance, while 23% are uncertain: the positions of uncertainty (26.3%) and outright disagreement (17.5%) are higher among nurses.

3.5. Section 4—"one health" approach

Of all participants, 67.2% agree that wastewater can contribute to antibiotic resistance, while 88.9% agree that overuse of antibiotics in the livestock and food production sectors may be a factor.

The sample was roughly split in two in terms of participants' responses to the statement that the routine use of antibiotics to stimulate the growth of farm animals is legal in the European Union: 47.6% answered correctly with "false," while 52.4% answered "true."

3.6. Section 5—hand hygiene

A majority of 93.7% (110 out of 114 nurses; 24 of 29 physicians) of the participants said they were able to list the five stages regarding hand hygiene recommended by the WHO. In addition, 99.3% answered affirmatively that they should practice hand hygiene after the removal of gloves used when in contact with patients or with biological material.

3.7. Section 6—information available on antibiotic use and antibiotic resistance or managing infections

Approximately 80% of participants primarily use clinical practice guidelines in infection management, as well as training and continuing education (21.6%). A smaller number have direct clinical experience (35.6%) or are infection specialists (16%).

In all, 70.6% of respondents declare that they have not received any information on the opportunity to avoid the prescription, administration, or distribution of unnecessary antibiotics in the past 12 months. This figure is mainly represented by nurses (83.3%). Of those who have received such information (23.1%), most obtained it from colleagues or peers (60%).

3.8. Section 7—information and training campaigns

Some 62.9% of respondent say they are unaware whether Italy has a national action plan for tackling AMR: 32.9% disagree with the statement that there has been good national promotion of the prudent use of antibiotics, while 29.4% are uncertain, and 21.7% are unaware of any national initiatives that have been adopted. Nevertheless, 53% of the sample declare that guidelines have been disseminated in their place of work to raise awareness on the use of antibiotics and their possible contribution to resistance; 25% also mention awareness-raising works by professional organizations and/or dedicated conferences or events.

3.9. Section 8—prescription

Of the 29 physicians who participated in the survey, 55% prescribe antibiotics on a weekly basis, while 41% do so daily. Of the total respondents, 72% agree that they play an essential role in helping to control antibiotic resistance, and 96.5% consider antibiotic resistance in the treatment of patients. 79% say they are confident in making antibiotic-prescribing decisions, 96.5% trust the available antibiotic guidelines, and 86.2% believe they have easy access to them.

Of all physicians who responded, 55% state that they would have preferred not to prescribe antibiotics in the week preceding the survey but did so anyway: the main reason was fear of a deterioration in the patient's clinical condition (Fig. 1).

3.10. Descriptive analysis on inferential background

A statistical connection index was calculated, using a chi-square test, between items 1–22 and profession, length of service, hospital of origin, and type of intensive care unit. Items only relevant to physicians were evaluated using only the length of service and type of intensive care unit.

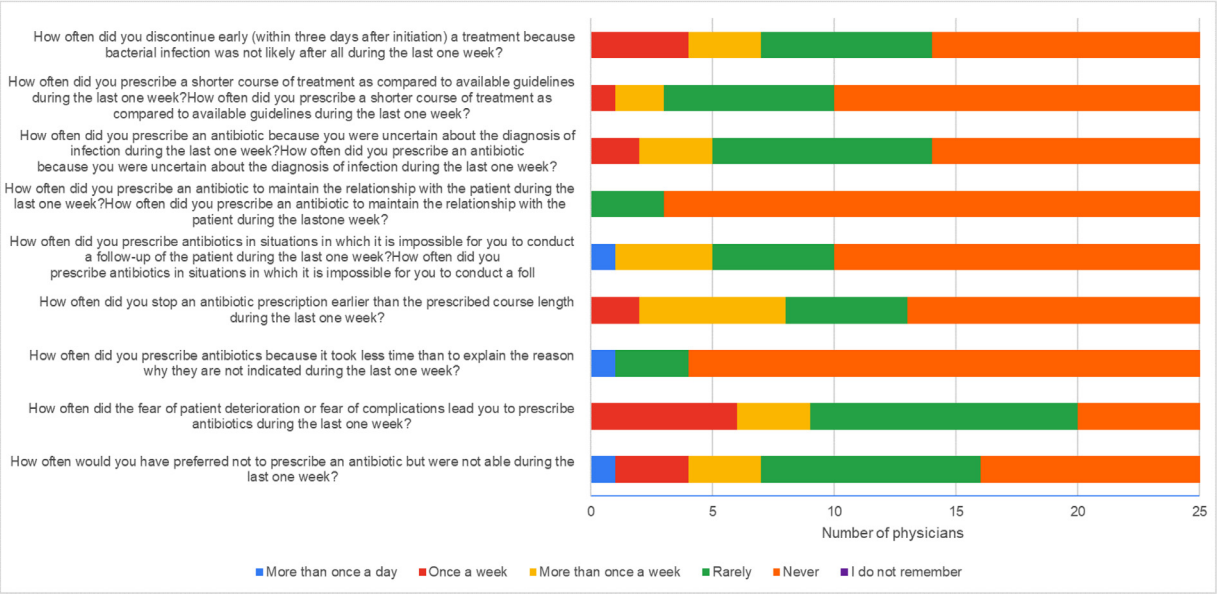

Fig. 1. Reasons for which antibiotics were prescribed in the week preceding the survey.

In terms of items 1–22 with respect to the profession, it emerges that:

- When it comes to agreeing that environmental factors such as wastewater in the environment are important contributors to bacterial antibiotic resistance in humans, nurses agree more strongly than doctors. (Chi-square 36.933, df 15, $P<0.001$.)

In terms of hospital of origin, we observe that responses from one of the several tertiary-level teaching hospital in the northwest show:

- Strong agreement with the statement: "I know what antibiotic resistance is." (Chi-square 62.721, df 44, $P<0.033$.)
- Strong disagreement with the statement: "Antibiotics are effective against viruses." (Chi-square 34.239, df 11, $P<0.000$.)
- Strong agreement with the statement: "I have good opportunities to provide advice on prudent antibiotic use to individuals." (Chi-square 116.712, df 55, $P<0.000$.)

With regard to the various types of ICU:

- When asked, "How often did you prescribe OR dispense OR administer antibiotics during the last one week?" those working in a general ICU were more likely to agree with the statement, "more than once a day" than others. (Chi-square 53.159; df 36; $P<0.033$.)
- General ICU workers were more likely to agree that, "I have easy access to the guidelines I need on managing infections" (Chi-square 38.784; df 24; $P<0.029$).

In performing the Chi-square test on the questions addressed only to physicians (23–26) and the type of intensive care, we infer that:

- Neonatal ICUs are more likely to prescribe antibiotics than polyvalent or postoperative ICUs. (Chi-square 19.873; df 6; $P<0.003$)
- When asked, "How often would you have preferred not to prescribe an antibiotic but were not able to?" neonatal ICUs were more likely to respond "never" or "rarely" than multipurpose or postoperative ICUs. (Chi-square 36.785; df 16; $P<0.002$.)
- To the question, "How often did you stop an antibiotic prescription earlier than the prescribed course length during the last one week?" neonatal ICUs were more likely to respond "never" or "rarely" than multipurpose. (Chi-square 31.450, df 16, $P<0.012$.)
- To the question, "How often did you prescribe an antibiotic to maintain the relationship with the patient during the last week?" neonatal ICUs gave an answer that indicated they had, more frequently than general pediatric ICUs. (Chi-square 37.440, df 16, $P<0.002$.)
- Asked whether they had prescribed a shorter course of treatment "as compared to available guidelines during the last week," both neonatal and neuroscience ICUs were likely to respond affirmatively and in equal propensity. (Chi-square 36.462, df 16, $P<0.002$.)

4. Discussion

The aim of this survey is to investigate, in a broad way, the aspects of antimicrobial resistance and stewardship of antibiotic medicines in Italy in various types of intensive care units. The response rate was not high (20%) and the sample comes almost exclusively from northern Italy. Furthermore, the representation of medical doctors is only 20% of the sample, the rest being represented by nurses.

Nevertheless, the data analysis has returned some significant results. The section relating to perceived and current knowledge achieved a more-than-satisfactory 90% of correct answers, demonstrating good general knowledge about antibiotic resistance, including the correct approach of only using antibiotics for bacterial infections and only when strictly necessary. These knowledge findings are in agreement with previously collected data from 2014 to 2019 [4–6]. In 2015, however, a survey conducted in Scotland among nurses and midwives highlighted how 75.8% of the sample had never heard of "antimicrobial stewardship" and did not know what definition to give the term [7].

As regards opportunity, the study participants declared that they had easy access to the guidelines and materials necessary to make good use of antibiotics, as also emerged from cluster analysis of data relating to Italian participants collected by the European Centre for Disease Control in 2019 [8].

However, the typical clinical condition of a patient admitted to an intensive care unit, who may be sedated, intubated, or in some cases newly born, does not allow for advice and/or pam-

phlets/leaflets to be delivered. Some nurses have written that "it is not the nurse's job," "in any case, you do not start 'discussing' a medical prescription with the patient in our intensive care," "I gave advice to an acquaintance, in my work role I am not the reference figure except for comparison," and "I performed a medical prescription." These and similar statements remind us that the important task of involving nurses in the campaign against AMR is still needed, as required by the multimodal strategy of the WHO and by the white paper published by the American Nurse Association [9].

The motivation for change is well understood by the respondents, who collectively display a strong awareness that there is a connection between the prescription, dispensing, and administration of antibiotics and the emergence of antibiotic resistance. On the other hand, there is still room for improvement in terms of giving medical staff a key role in AMR control, especially for the nursing profession, which does not feel this role is tailored to its profession.

Improving knowledge of the WHO's One Health strategy, as defined by the Italian National Institute of Health, is an ideal approach to achieving global health because it addresses the needs of the most vulnerable members of the population on the basis of the intimate relationship between their health, the health of their animals (where appropriate), and the environment in which they live, considering the broad spectrum of outcomes that may emerge from this relationship [1].

There is still room for improving knowledge even within the medical profession. In fact, while about 80% of the sample recognizes that the use of antibiotics in the livestock and food production sectors contributes to antibiotic resistance, the percentage decreases to less than 70% with respect to the role of wastewater in the environment. The most alarming data from our survey relates to the fact that 50% of respondents believe that it is legal in Europe to use antibiotics to stimulate the growth of farm animals: the practice has been illegal since 1 January 2006.

On a positive note, everyone seems to be well aware of the behavior to adopt with respect to hand hygiene, both the "five moments" defined by the WHO and the need to wash hands even after removing gloves. It is assumed that this type of response is influenced by the behaviors adopted and repeatedly stressed during the years of the COVID-19 pandemic, as emerges from a descriptive cross-sectional study conducted from 2018 to 2020, which shows an increase in adherence to hand hygiene practice [10].

The literature, however, reports conflicting data on this issue. In a 2014 systematic review of 42 studies on the prevalence of handwashing, it was found that this practice was still not rigidly adhered to in medical practice, even after contact with patient secretions/excretions, although it remains one of the behaviors with the greatest potential health benefits [11]. In another cross-sectional study conducted during the COVID-19 pandemic, issues related to the adherence of healthcare personnel to the WHO's "five moments" also emerged [12].

Of the total respondents, 76% declare that they have not received, in the past 12 months, any type of specific information or training on avoiding unnecessary prescriptions of antibiotics, or the dispensing or administration of antibacterial drugs. In this case, nurses are less involved in these practices anyway. Among those who have received training, this has mostly come from colleagues or peers: while this is certainly a highly useful source, it does not however reflect the principles of specific, controlled, and safe training.

The part of the study relating to information and training campaigns shows the greatest criticality. While most respondents state that Italy has highlighted awareness of antibiotic resistance in different ways (for example through conferences or events dedicated to the fight against antibiotic resistance, national or regional guidelines, etc.), on the other hand, about 70% declare that they know of no concerted national plan to combat the phenomenon in question. In fact, the "National Plan to Combat Antimicrobial Resistance 2017–2020" was approved in 2017 with an agreement between the government and the regions of Italy. This sets out the strategies for combating the phenomenon at a local, regional, and national level, consistent with the objectives of the WHO and European action plans and with the One Health vision.

The part of the investigation addressed to doctors showed more positive results. Most of the 29 participants feel confident in making prescribing decisions, have confidence in available guidelines, and know they play an essential role in helping to control antibiotic resistance by taking the issue into consideration when prescribing antimicrobial therapy. Furthermore, there seems to be a greater awareness of the fact that antibiotics should not be prescribed either to maintain the relationship with the patient, due to lack of time, or because it is impossible to carry out a re-evaluation of the assisted person.

5. Conclusion

This survey into antibiotic usage and practices, the only one in Italy concerning intensive care physicians and nurses, further highlights problems that have emerged in previous studies. Above all, the results emphasize how nurses are still left on the sidelines of the fight against antibiotic resistance as they are rarely involved in training programs and information campaigns. Not only is it necessary to implement existing programs for their benefit, but the various training bodies within the hospitals must start thinking about targeted training for each profession. Only by understanding the potential and role of each medical professional in the fight against this serious problem, which has been known about for decades, can the issue of antibiotic resistance be properly addressed. The limitations of this study include a small sample size, low response rate mainly from physicians, the use of an online questionnaire as a data collection instrument, and a participation mainly from intensive care units located in Northern Italy.

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Supplementary materials

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