Research Square

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Knowledge, attitudes and behaviour of Swiss healthcare workers on antibiotic use and resistance: A cross-sectional study

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Abstract

Background

Healthcare workers (HCW) play a key role in prescribing antibiotics and preventing the spread of resistant pathogens in healthcare settings. This survey aimed to assess HCW knowledge and behaviour regarding antibiotic use and antimicrobial resistance (AMR).

Methods

In November 2022, participants of the SURPRISE+ cohort - including HCW from 14 institutions in eastern Switzerland - were invited to complete a 141-item questionnaire on knowledge and attitudes regarding AMR, antibiotic prescribing habits and personal antibiotic use. Survey results were summarized and stratified by professional groups: physicians, nurses, paramedics and other professionals.

Results

Of the 3’514 HCW invited, 1’505 (43%) completed the survey. Of these, 10% were physicians, 45% nurses, 15% paramedics and 29% other professionals. The median age was 45 years (range 16–69) and 81% were women.

Concern about AMR in Switzerland was expressed by 73.8% (1’111/1’505) of participants. However, only 37.9% (570/1’505) were concerned about AMR in their own healthcare institution. 64.4% (969/1’505) of respondents believed that too many antibiotics are prescribed in Switzerland, whereas only 24.6% (371/1’505) thought this was the case in their own institution. 13% (16/123) of the physicians believed that they prescribe antibiotics too often, while 43.1% (53/123) felt that their colleagues overprescribe. Only 43.2% (67/155) of the physicians and 9.4% (64/682) of the nurses believed that they play a key role in controlling AMR. A total of 56.1% (845/1’505) of participants, particularly physicians and nurses, expressed a desire for more information or training on AMR and antibiotic use. Regarding personal use of antibiotics, 18.2% (274/1’505) reported taking at least one antibiotic in the previous 12 months. Most participants (93.9%, 1’413/1’505) reported taking antibiotics strictly as prescribed. However, 11.6% (175/1’505) reported taking antibiotics without a prescription.

Conclusion

HCWs in our cohort demonstrated a marked discrepancy between their self-assessment and their perceptions of others regarding antibiotic resistance and antibiotic overuse. The perception among HCWs that they play only a limited role in combating antimicrobial resistance is concerning. Our findings highlight the need for targeted educational interventions to enhance awareness and engagement in antimicrobial stewardship.

Background

Increasing antimicrobial resistance (AMR) constitutes a global challenge, posing a significant threat to public health [1]. Healthcare workers (HCW) play a crucial role in managing antibiotic use and preventing the spread of resistant pathogens within healthcare facilities [2]. Thus, their knowledge, attitudes, and practices are essential for implementing correct prescribing and prevention measures effectively.

Previous studies on AMR and knowledge among HCW in various countries around the world have shown that the threat of increasing AMR is widely recognized [3–5]. However, studies have also revealed significant gaps in knowledge regarding the mechanisms underlying the development of AMR, as well as considerable variation depending on professional role and workplace setting. [6, 7]. A recently published systematic review reported that only 56.5% of HCW worldwide demonstrated good knowledge of AMR, 60.4% had a positive attitude, and just 48.5% reported appropriate practices - underscoring the persistent global gap between awareness and effective action [8].

This survey assesses HCW knowledge of antibiotic resistance, their behaviour in prescribing antibiotics for patients, and their perceived personal responsibility in combating AMR. In this context, we also examined the practice of self-medication with antibiotics. This practice poses an ongoing concern for public health systems in European and Anglo-Saxon countries [9].

A better understanding of these factors may help develop targeted strategies to increase awareness for AMR and to support HCW in making evidence-based prescribing decisions.

Methods

This cross-sectional study was conducted within the prospective multicenter cohort “SURveillance of infectious diseases among health PRofessionals In SwitzErland” (SURPRISE+), which was initiated in August 2020 and has been described previously [10]. In April 2022, the cohort was expanded to 14 institutions in eastern Switzerland. Assessment of AMR was subsequently added as a study focus [11–13]. During the WHO Antibiotic Awareness Week in November 2022, participants were invited to complete a web-based questionnaire consisting of 141 items [14].

The questionnaire assessed the following five main topics: (I) general opinions on AMR and antibiotic use; (II) knowledge about AMR and antibiotic use; (III) perceptions of hygiene and infection prevention; (IV) prescribing behaviour (for physicians only); and (V) personal antibiotic use among study participants. It included multiple-choice questions, true/false statements to assess knowledge, and 5-point Likert-scale questions with responses ranging from "strongly disagree" to "strongly agree." Respondents could select “don’t know/no answer” for each question regardless of question type. Participants were categorized into four professional groups: physicians, nurses, paramedics and other professionals (see Supplementary Table 1 for the questionnaire).

All participants were assessed on their general knowledge of AMR, its mechanisms, and appropriate indications for antibiotic use through 14 knowledge-based questions. Physicians answered six additional, profession-specific questions on antibiotic indications for various diseases and the use of antibiotics for resistant bacteria. A knowledge score was calculated based on the number of correct answers. The maximum possible score was 20 points for physicians and 14 points for the other professional groups. Only fully completed questionnaires were included in the analysis.

Continuous variables are presented as median and range, and categorical variables as numbers and percentages. All analyses were conducted using RStudio (version 2023.12.0) for statistical analysis and

visualization. The study was approved by the ethics committee of Eastern Switzerland (BASEC-No.: 2020 – 01322).

Results

Of the 3514 invited HCW, 1505 (43%) completed the survey: 155 (10%) physicians, 682 (45%) nurses, 230 (15%) paramedics and 438 (29%) other professionals. Participants had a median age of 45 years (range 16–69 years). Women accounted for 81% of the respondents (1217/1505), and 90% (1362/1505) were employed in acute care hospitals. Table 1 provides further details on the study participants.

Table 1
Characteristics of the Study Population across the four study groups

Variables	**All** **n = 1505**	**Physicians** **n = 155**	**Nurses** **n = 682**	**Paramedics** **n = 230**	**Other professions** **n = 438**
Age in years, median (range) *	45 (16–69)	45 (26–69)	44 (16–64)	47 (23–69)	49- (22–67)
Male gender, n (%)	288 (19.1)	79 (51.0)	70 (10.3)	25 (10.9)	114 (26.0)
Healthcare setting: acute clinic, n(%)	1362 (90.5)	143 (92.3)	636 (93.3)	197 (85.7)	386 (88.1)
Long-term care facility	143 (9.5)	12 (7.7)	46 (6.7)	33 (14.3)	52 (11.9)

I: General opinions on antimicrobial resistance and antibiotic use

Most study participants (73.8%, 1’111/1’505) expressed concern about AMR in Switzerland. 37.9% (570/1’505) were concerned about AMR in their own healthcare institution and 64.4% (969/1’505) of respondents believed that too many antibiotics are prescribed in Switzerland, whereas 24.6% (371/1505) thought this was the case in their own institution.

More than three-quarters of respondents (82.7%, 1’245/1’505) agreed that they had sufficient knowledge about the use of antibiotics for their current practice; 50.7% (763/1’505) confirmed that it is important in their profession to have a good knowledge of antibiotics, particularly physicians (88.4%, 137/155) and nurses (77.7%, 530/682). 43.2% (67/155) of the physicians and 9.4% (64/682) of the nurses believed that they play a key role in controlling AMR. Furthermore, 19.3% (290/1505) were familiar with the term “antibiotic stewardship” (Supplementary Table 2).

II: Knowledge about antimicrobial resistance and antimicrobial use

Responses to questions assessing knowledge of AMR, its mechanisms, and appropriate indications for antibiotic use are summarized in Table 2 for all participants and in Table 3 for physicians only. The knowledge

score was 16 (IQR: 15–18) out of 20 among physicians, 11 (IQR: 10–12), 10 (IQR: 9–11), and 9 (IOR: 7–11) out of 14 among nurses, paramedics and other professionals. The proportion of study participants answering more than 75% of the questions correctly differed between professional groups: 77.4% (120/155) of physicians, 60.3% (411/682) of nurses, 43.0% (99/230) of paramedics and 37.7% (165/438) of other professionals (Fig. 1). A large majority of participants (91.7%, 1’380/1’505) identified the extensive use of antibiotics in livestock farming and food production as significant factors contributing to AMR in humans. 69.4% (1’045/1’505) recognized that unnecessary antibiotic use can lead to reduced antibiotic effectiveness. 32.3% (486/1’505) believed that AMR is adequately addressed in their workspace. More than half of the participants, 56.1% (845/1’505), expressed a desire for more information or training on this topic. This demand was highest among nurses (69.1%, 471/682), followed by physicians (56.1%, 87/155) (Supplementary Table 6).

Table 2 Survey of knowledge among all study participants regarding antibiotic resistance and antibiotic use

Questions	Group	All		Physicians		Nurses		Paramedics		Other professions	
	n	1505		155		682		230		438	
	Correct answer	Respondents with correct answer		Respondents with correct answer		Respondents with correct answer		Respondents with correct answer		Respondents with correct answer	
		n	%	n	%	n	%	n	%	n	%
The excessive use of antibiotics in livestock farming and food production are important factors contributing to antibiotic resistance in humans.	true	1380	91.7	153	98.7	633	92.8	207	90	387	88.4
Antibiotic resistance means that bacteria are able to withstand the effects of various antibiotics.	true	1392	92.4	151	97.4	637	93.4	213	92.6	391	89.3
Unnecessary use of antibiotics renders antibiotics useless.	true	1045	69.4	128	82.6	477	69.9	153	66.5	287	65.5
Healthy people can carry antibiotic-resistant bacteria.	true	1215	80.7	151	97.4	591	86.7	182	79.1	291	66.4
Antibiotics interfere with the metabolism of bacteria so that their growth is	true	1193	79.3	154	99.4	590	86.5	169	73.5	280	63.9

inhibited or they are killed.											
Antibiotics can also kill common bacteria that normally live in or on our bodies.	true	1235	82.1	154	99.4	597	87.5	184	80	300	68.5
Antibiotic use is associated with side effects and risks such as diarrhea, colitis and allergies.	true	1313	87.2	152	98.1	650	95.3	186	80.9	325	74.2
Antibiotic-resistant bacteria can be transmitted from person to person.	true	975	64.8	150	96.8	473	69.4	140	60.9	212	48.4
Anyone who has been treated with antibiotics is at increased risk of infection with antibiotic-resistant bacteria.	false	532	35.3	47	30.3	273	40	82	35.7	130	29.7
Newly developed antibiotics alleviate the problem of antibiotic resistance.	false	668	44.4	117	75.5	332	48.7	72	31.3	147	33.6
Antibiotics are effective against viruses.	false	1378	91.5	149	96.1	665	97.5	215	93.5	349	79.7
Antibiotics are effective against colds and flu.	false	1379	91.6	152	98.1	655	96	206	89.6	366	83.6
A cystitis can only be	false	1282	85.2	153	98.7	625	91.6	198	86.1	306	69.9

cured with antibiotics.											
Antibiotic resistance means that the patient becomes resistant to an antibiotic and that this antibiotic is therefore no longer effective for this person.	false	333	22.1	91	58.7	109	16	43	18.7	90	20.5

Table 3
Survey of knowledge among physicians (Group A) regarding antibiotic use and resistance

Physician- specific questions	**Correct answer**	**All (n = 155)**		**Acute hospital (n = 143)**		**Other clinics (n = 12)**	
		n	**%**	**n**	**%**	**n**	**%**
Cephalosporins are not effective against enterococci.	true	104	67.1	98	68.5	6	50
Co-amoxicillin can be used to cover anaerobic bacteria (e.g. in diverticulitis)	true	97	62.6	94	65.7	3	25
Amoxicillin is useful for the treatment of most bacterial respiratory infections in primary care.	true	123	79.4	118	82.5	5	41.7
Severe infections with ESBL-producing (extended spectrum beta-lactamase) bacteria should initially be treated with carbapenems if possible.	true	78	50.3	74	51.7	4	33.3
The risk of becoming infected with MRSA (methicillin-resistant Staphylococcus aureus) in hospital is steadily increasing in Switzerland.	false	39	25.2	38	26.6	1	8.3
Asymptomatic bacteriuria in a diabetic patient should be treated with antibiotics.	false	117	75.5	111	77.6	6	50

III: Perception of Hygiene and Infection prevention

Overall, 75.3% (1’133/1’505) of participants reported trusting the infection prevention measures implemented in their facility. Proper hand hygiene was rated as an important or very important prevention measure by 96.6% (1’454/1’505) of participants, followed by wearing gloves in risk situations (92.7%, 1’395/1’505), isolating patients (79.0%, 1’189/1’505) and screening patients (76.3%, 1’148/1’505). Further details are provided in Supplementary Table 3.

IV: Prescribing behaviour in physicians

Among the 155 physicians, 79.4% (123/155) reported prescribing antibiotics and 54.8% (85/155) indicated previous experience with treatment failure due to resistant pathogens. While 62.6% (97/155) of all physicians stated that AMR is systematically recorded and evaluated in their healthcare organization, 38.1% (59/155) confirmed that information on local resistance patterns is available. Among physicians prescribing antibiotics, 82.9% (102/123) reported feeling confident in doing so. 13% (16/123) believed that they personally prescribe antibiotics too often, while 43.1% (53/123) felt that their colleagues overprescribe. Furthermore, 57.7% (71/123) expressed a desire for more feedback on their own antibiotic prescribing behaviour (Fig. 2). Physicians reported that prescribing decisions were primarily influenced by clinical guidelines (99.2%, 122/123), the patient's clinical condition (97.6%, 120/123), and advice from infectious diseases consultation services (95.9%, 118/123). Additional factors included fear of complications (68.3%, 84/123) and level of inflammatory markers (61.8%, 76/123) (Fig. 3B).

V: Personal antibiotic use among study participants

Overall, 18.2% (274/1505) of participants reported taking at least one antibiotic and 3.4% (51/1505) two antibiotics in the 12 months preceding the survey (Supplementary Table 4); these figures were similar across professional groups.

The most common indications were urinary tract infections, skin and soft tissue infections, and respiratory tract infections (Fig. 4). The most frequently used antibiotics were amoxicillin/clavulanic acid, fosfomycin and trimethoprim/sulfamethoxazole (Supplementary Table 5).

Most participants (93.9%, 1'413/1'505) reported taking antibiotics strictly as prescribed. 11.6% (175/1'505) reported taking antibiotics without a prescription, with a particularly high proportion among physicians (38.7%, 60/155) (Supplementary Table 6).

Discussion

This study provides insights into HCW's knowledge, attitudes, and behaviours regarding AMR and antibiotic use in Switzerland. While most participants demonstrated good knowledge of antibiotic use and resistance, our findings reveal a notable gap between knowledge and perceived personal responsibility in addressing AMR, as well as between self-assessment and perception of others regarding antibiotic overuse.

Overall knowledge levels were relatively high, particularly among physicians and nurses, who are most directly involved in antibiotic prescribing and management. Nevertheless, knowledge gaps persisted across all professional groups. Although most respondents reported familiarity with AMR and felt sufficiently informed for their professional roles, only a minority perceived themselves as key contributors in combating AMR. This discrepancy suggests that awareness of the problem does not necessarily translate into a sense of individual responsibility. Similar patterns have been observed in other settings. Although in a European survey across 30 EU/EEA countries, a higher proportion of HCW reported knowledge of antibiotic action and personal responsibility in addressing AMR [15].

A further important finding was the discrepancy between physicians' self-assessment of prescribing practices and their evaluation of colleagues. While a considerable proportion believed that colleagues overprescribe antibiotics, only a small minority acknowledged overprescribing themselves. In addition, although most respondents expressed concern about AMR at the national level, far fewer perceived it as a relevant problem within their own healthcare institutions. Comparable observations have been reported in studies from other regions, including Latin America, suggesting that HCW may recognize AMR as a global challenge while underestimating its local relevance [16]. This distorted perception, which is a form of cognitive bias [17, 18], may limit engagement with antimicrobial stewardship initiatives at the institutional level.

Antibiotic consumption among HCW was also notable, with 18% reporting antibiotic use within the previous year. This proportion was lower than the reported European average of 23% in the general population [19]. Greater knowledge of appropriate indications for antibiotic treatment may partly explain this difference. Nevertheless, easier access to antibiotics and the possibility of self-medication may influence antibiotic use among HCWs. Indeed, the proportion of participants who reported taking antibiotics without a prescription was higher in our study than in the European survey (11.6% vs 8%). This finding suggests that, despite lower overall antibiotic consumption, self-medication may be more common among HCWs and highlights the importance of addressing HCWs' own antibiotic use as part of antimicrobial stewardship efforts.

Several implications for antimicrobial stewardship emerge from our findings. Educational interventions should not only aim to improve knowledge but also strengthen HCW awareness of their personal responsibility in preventing AMR. Structured feedback on prescribing practices has been shown to support adherence to evidence-based guidelines and may help address discrepancies between perceived and actual prescribing behaviour [20]. In addition, ensuring accessible local resistance data may further support informed prescribing decisions [21].

This study has several strengths, including its large sample size, the inclusion of multiple healthcare professions, and the comprehensive assessment of knowledge, attitudes, and behaviours related to AMR. However, some limitations should be acknowledged. The use of self-reported data introduces the possibility of reporting bias, particularly with respect to socially desirable responses. Among the various healthcare professions included in the study, physicians, who are responsible for prescribing antibiotics, represented a relatively small proportion of respondents. Finally, selection bias cannot be excluded, as HCW with a greater interest in or awareness of antibiotic use and AMR may have been more likely to participate in the survey. This may have led to an overestimation of knowledge and awareness and may limit the generalizability of our findings to the broader HCW population.

Conclusions

HCW demonstrated generally good knowledge of antibiotics and AMR, but important gaps remain regarding perceived responsibility and engagement in antimicrobial stewardship. Targeted educational initiatives, improved access to local resistance data, and structured feedback on prescribing behaviour may strengthen stewardship efforts. Addressing these gaps is essential to support HCW in their role as key actors in combating antimicrobial resistance.

Abbreviations

AMR
Antimicrobial resistance
HCW
Health care workers
IQR
Interquartile ranges
WHO
World Health Organisation
ESBL
Extended-spectrum beta-lactamase
MRSA
Methicillin-Resistant Staphylococcus aureus
COVID-19
Coronavirus disease 2019

Declarations

Ethics approval and consent to participate:

The SURPRISE study was approved by the ethics committee of Eastern Switzerland (BASEC-No.: 2020 – 01322). Written informed consent was obtained from all participants before enrolment.

Consent for publication:

not applicable

Competing interests:

The authors declare that they have no competing interests"

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Author Contribution

T.B., C.K., M.S., S.P.K., P.K. and A.C. conceived the study. D.V., R.S., M.R., and A.C. were involved in data collection. F.G., T.D. and T.B. first analysed and interpreted the data, M.W. and A.C. drafted the first version of the manuscript; all authors edited and approved the final version of the manuscript

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Availability of data and materials:

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

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Figures

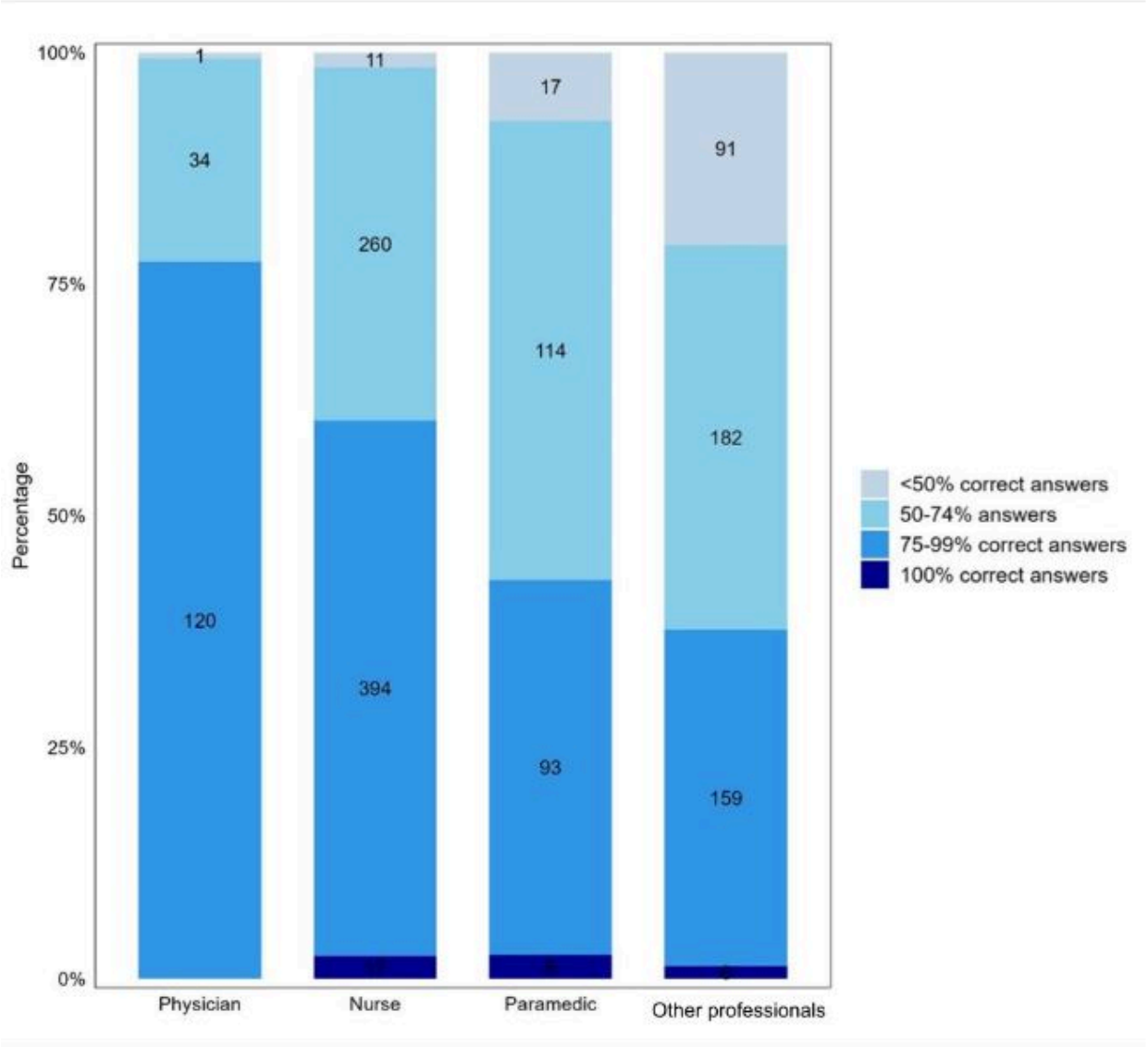


Figure 1

Evaluation of knowledge about antibiotic use and antimicrobial resistance in the four study groups

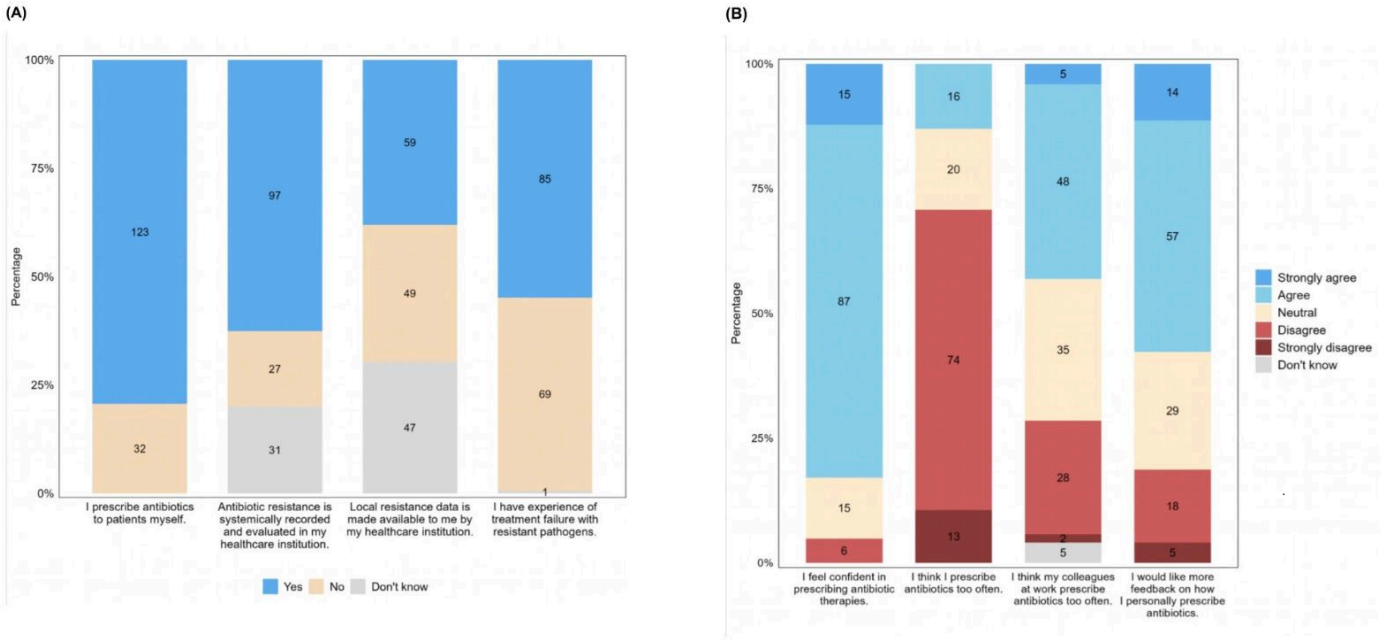


Figure 2

Perspectives of Physicians on Antibiotic Prescriptions

(A) Questions 1–4 were formulated as yes–no questions.
(B) Questions 5–8 were answered on a 5-point Likert scale ranging from 'strongly agree' to 'strongly disagree

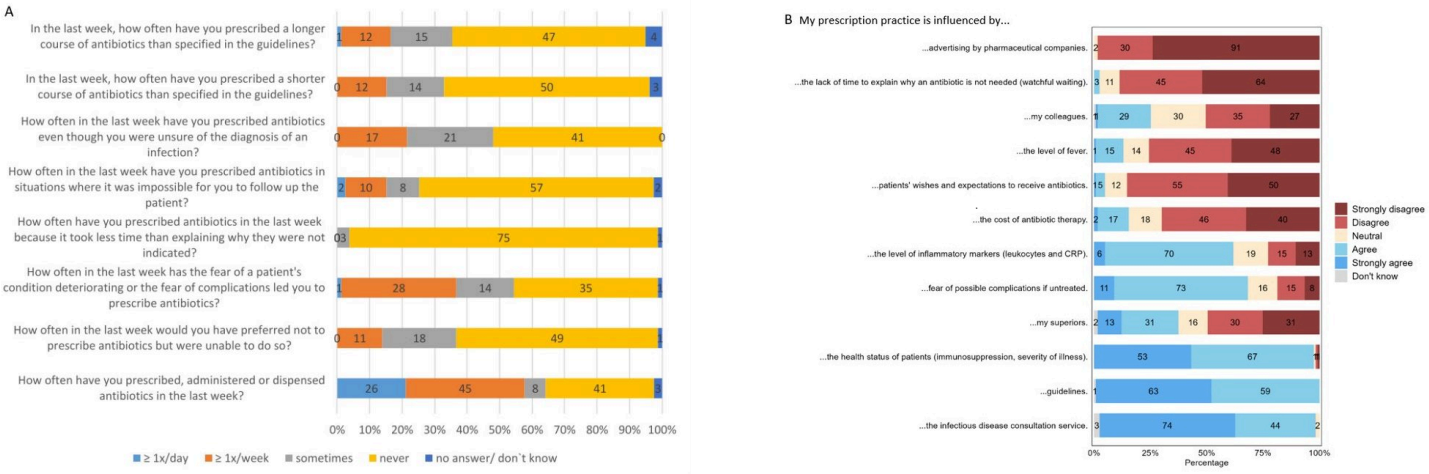


Figure 3

Factors Influencing Physicians' Prescription Practices and Prescription Frequency

A: Questions 13- 20 were answered on a scale ranging from "≥ 1x/day" to "never"

B: Questions 1–12 were answered on a 5-point Likert scale ranging from 'strongly agree' to 'strongly disagree

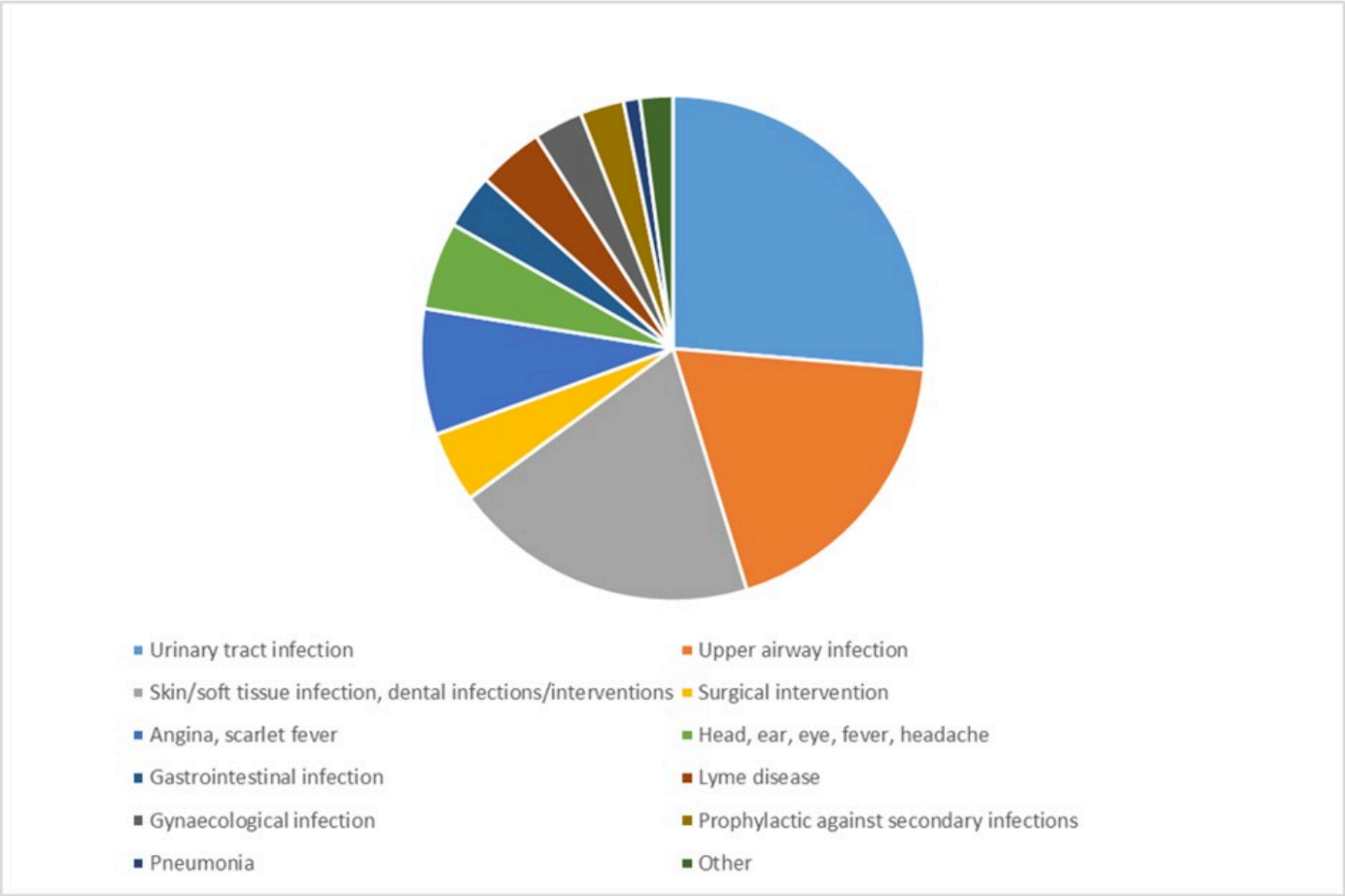


Figure 4

Indications for personal antibiotic use across the four study groups

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplemetaryTable1Questionnaire.docx
- Supplementarytables2to6.docx