

# Self-perceived Preparedness to Prescribe Antibiotics Among Swiss Medical Students: Results from a Cross-sectional Survey in four Swiss Universities in 2015.

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## Research article

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# Abstract

## Background

Previous studies have highlighted that medical students do not feel well prepared to prescribe antimicrobials. The ESCMID Study Group for Antimicrobial stewardship (ESGAP) conducted a survey among European medical students to assess self-reported preparedness about prudent antibiotic use and the perceived lack of education. The aim of the present study was to specifically focus on the perceptions of Swiss medical students.

## Methods

A cross-sectional web-based survey was conducted in 2015 by ESGAP involving sixth-year medical students from Switzerland. The survey investigated self-reported preparedness on diagnosis and treatment of infections, availability and perceived usefulness of different teaching methods and the perceived need for further education on antibiotic use. "Preparedness scores" were created by calculating the percentage of students who felt sufficiently prepared on each topic.

## Results

We received responses from 137 medical students from 4 medical schools (Bern, Geneva, Lausanne and Zurich). The overall estimated response rate was 19%. Overall, 62% of Swiss students reported needing more education on antibiotics or at least on their prudent use. Teaching methods perceived as more useful were discussion of clinical cases (80.2%), clinical rotation in infectious diseases (77.0%) and small group teaching (75.0%), but the latter 2 were reported as unavailable for nearly half of the students (36.5% and 47.5%, respectively). Almost all of the students felt sufficiently prepared to recognize clinical signs of infection (99.3%), to interpret inflammation markers (94.9%) and to have sufficient knowledge of consequences of antibiotic misuse (95.5%). Less than half of them felt prepared to select the right empirical treatment without using guidelines (33.8%), to identify the need for combination therapy (39.7%) or to select the shortest adequate treatment duration (39.3%).

## Conclusions

Most Swiss final year medical students feel they need more education on antibiotics. Some of the teaching methods perceived as more useful by students seem still insufficiently available in Swiss medical schools. Active and interprofessional teaching activities can be a first step towards more effective education on prudent antibiotic use.

## Background

Antibiotic misuse is frequent and a key driver of antimicrobial resistance (AMR) [1, 2]. Educating future prescribers in the appropriate use of antimicrobials early during medical studies seems a key intervention for improving antibiotic use in the medium and long term [3–5]. Undergraduate curricula usually include

learning objectives regarding the diagnosis and treatment of infections and increasingly highlight also the risk of misuse of antimicrobials and the global concern of increasing AMR [3, 6]. Despite these efforts, previous studies have shown that medical students do not feel well prepared to appropriately prescribe antimicrobials at the end of their studies [7–10].

The ESCMID (European Society of Clinical Microbiology and Infectious Diseases) Study Group on Antimicrobial stewardshiP (ESGAP) conducted a cross-sectional web survey among final year medical students from 29 European countries, including Switzerland, in 2015, which has recently been published [11]. This Student-PREPARE survey investigated self-reported preparedness on different topics about prudent antibiotic use and the perceived lack of education, and compared the results among the participating countries. Although some differences emerged across countries, most European students expressed a need for more education on antibiotic use [6, 11, 12]. In this manuscript we present an in-depth subgroup-analysis of the Swiss results of the survey.

## Swiss medical school system

The program of Swiss medical schools is regulated by Federal law [13]. It is composed of three years of Bachelor studies and three years of Master studies. In 2015 the full course could be conducted in 5 different universities (Basel, Bern, Lausanne, Geneva and Zurich), while Fribourg University offered only Bachelor studies. Nowadays, more universities offer Bachelor (Neuchâtel and University of Italian Switzerland) or Master studies (Fribourg, Lucerne, St. Gallen and University of Italian Switzerland).

During the Master studies, the majority of learning activities take place in hospitals. In the final year, students complete 10 months of clinical internships in different settings. At the end of the sixth year, students take the Swiss Federal Examination in Medicine, in order to continue their training as junior doctors at hospitals.

## Methods

### *Study design and participants*

This study was part of the ESGAP Student-PREPARE project, a cross-sectional multicentre web-based survey conducted in 2015 which aimed to assess final year medical students' self-reported preparedness on prudent antibiotic use, the results of which were published in 2018 [11]. Twenty-nine European countries [EU Member States together with the four European Free Trade Association countries (Iceland, Liechtenstein, Norway and Switzerland)] were involved in the study. In each country a local coordinator invited all medical students in their final year to participate, as previously described [11]. The survey was self-administered and was accessible on Survey-Monkey© from January to December 2015. Here, we report the subset of data collected among Swiss medical students.

### *Questionnaire development*

The questionnaire was designed by international experts on antimicrobial stewardship and was informed by previous studies conducted among medical students [7, 10, 14]. The survey was composed of 47 items divided in 3 sections and was administered in English. The first section included questions on demographics. The second section assessed self-reported preparedness on 27 topics related to diagnosis and treatment of infections and prudent use of antibiotics; these questions were formulated using a 7-point Likert-type scale. The last section focused on availability and perceived usefulness of different teaching methods and the perceived need for further education.

### *Statistical analyses*

The survey results were analysed using Microsoft Excel 2013 (Microsoft Corporation, Redmond, WA, USA). Categorical variables are presented as percentages.

Responses to questions on preparedness topics were merged in 2 categories (1–3, not sufficiently prepared; 4–7, at least sufficiently prepared). For each curriculum topic, a “preparedness score” was created by calculating the percentage of students who felt at least sufficiently prepared on each topic at medical school level. A national preparedness score for each topic was then calculated as the mean of the different medical school preparedness. A global preparedness score was calculated for each student as the percentage of topics on which the student felt at least sufficiently prepared. A medical school global preparedness score was then calculated as the mean of the student’s preparedness score and finally a national preparedness score as the mean of the schools’ preparedness scores.

Table 1  
Unavailability of teaching methods for antibiotic use among Swiss medical students.

Teaching methods	Unavailability, % (n)				
	CH N = 137	Berne N = 34	Geneva N = 22	Lausanne N = 41	Zurich N = 40
Lectures (with > 15 people)	1.5% (2/137)	0.0% (0/34)	0.0% (0/22)	4.7% (2/41)	0.0% (0/40)
Small group teaching (with < 15 people)	47.5% (65/137)	28.6% (10/34)	0.0% (0/22)	73.1% (31/41)	60.0% (24/40)
Discussions of clinical cases and vignettes	11.9% (16/137)	2.9% (1/34)	4.4% (1/22)	23.8% (10/41)	10.0% (4/40)
Active learning assignments (e.g. article reading, group work, preparing an oral presentation)	54.0% (74/137)	45.7% (16/34)	34.8% (8/22)	45.2% (19/41)	77.5% (31/40)
E-learning	55.5% (76/137)	37.1% (13/34)	43.5% (10/22)	54.8% (23/41)	75.0% (30/40)
Role play or communication skills sessions dealing with patients demanding antibiotic therapy	69.3% (95/137)	57.1% (20/34)	43.5% (10/22)	71.4% (30/41)	87.5% (35/40)
Infectious diseases clinical placement (i.e. clinical rotation or training in infectious diseases, involving patients)	36.5% (50/137)	25.7% (9/34)	39.1% (9/22)	42.9% (18/41)	35.0% (14/40)
Microbiology clinical placement	49.6% (68/137)	37.1% (13/34)	56.5% (13/22)	71.4% (30/41)	30.0% (12/40)
Peer or near-peer teaching (i.e. teaching led by other students, or recently qualified doctors)	52.6% (72/137)	42.9% (15/34)	34.9% (8/22)	47.6% (20/41)	72.5% (29/40)

Table 2  
Self-reported preparedness on different curriculum topics

Curriculum topic	Percentage of students who feel at least sufficiently prepared					
	Switzerland (n = 137)	European average (n = 7328)	University of Berne (n = 34)	University of Geneva (n = 22)	University of Lausanne (n = 41)	University of Zurich (n = 40)
To recognise the clinical signs of infection	99.3	95.7	100.0	100.0	100.0	97.4
To assess the clinical severity of infection (e.g using criteria, such as the septic shock criteria)	86.0	85.2	94.1	90.9	80.5	82.1
To use point-of-care tests (e.g. urine dipstick, rapid diagnostic tests for streptococcal pharyngitis)	86.0	70.2	91.2	90.9	92.7	71.8
To interpret biochemical markers of inflammation (e.g. CRP)	94.9	94.7	100.0	90.9	92.7	94.9
To decide when it is important to take microbiological samples before starting antibiotic therapy	91.2	84.4	94.1	90.9	90.2	89.7
To interpret basic microbiological investigations (e.g. blood cultures, antibiotic susceptibility reporting)	86.8	86.4	85.3	95.5	90.2	79.5
To identify clinical situations when not to prescribe an antibiotic	79.4	79.8	88.2	81.8	80.5	69.2
To differentiate between bacterial colonisation and infection (e.g. asymptomatic bacteriuria)	80.9	73.6	76.5	72.7	85.4	84.6

Curriculum topic	Percentage of students who feel at least sufficiently prepared					
	Switzerland (n = 137)	European average (n = 7328)	University of Berne (n = 34)	University of Geneva (n = 22)	University of Lausanne (n = 41)	University of Zurich (n = 40)
To differentiate between bacterial and viral upper respiratory tract infections	85.3	84.1	88.2	81.8	90.2	79.5
To select initial empirical therapy based on the most likely pathogen(s) and antibiotic resistance patterns, without using guidelines	33.8	56.0	20.6	36.4	51.2	25.6
To decide the urgency of antibiotic administration in different situations (e.g < 1 hr for severe sepsis, non-urgent for chronic bone infections)	58.1	62.2	58.8	59.1	65.9	48.7
To prescribe antibiotic therapy according to national/local guidelines	66.9	68.5	70.6	68.2	73.2	56.4
To assess antibiotic allergies (e.g. differentiating between anaphylaxis and hypersensitivity)	71.3	64.9	70.6	63.6	75.6	71.8
To identify indications for combination antibiotic therapy	39.7	49.6	41.2	31.8	51.2	30.8
To decide the shortest possible adequate duration of antibiotic therapy for a specific infection	39.3	44.5	32.4	36.4	56.1	28.9
To prescribe using principles of surgical antibiotic prophylaxis	33.3	51.4	32.4	27.3	41.5	28.9

Curriculum topic	Percentage of students who feel at least sufficiently prepared					
	Switzerland (n = 137)	European average (n = 7328)	University of Berne (n = 34)	University of Geneva (n = 22)	University of Lausanne (n = 41)	University of Zurich (n = 40)
To review the need to continue or change antibiotic therapy after 48–72 hours, based on clinical evolution and laboratory results	64.0	67.7	61.8	63.6	75.6	53.8
To assess clinical outcomes and possible reasons for failure of antibiotic treatment	62.5	68.3	64.7	54.5	68.3	59.0
To decide when to switch from intravenous (IV) to oral antibiotic therapy	42.6	52.3	44.1	40.9	56.1	28.2
To measure/audit antibiotic use in a clinical setting, and to interpret the results of such studies	37.9	45.9	41.9	10.5	45.9	40.5
To work within the multi-disciplinary team in managing antibiotic use in hospitals	53.0	52.0	63.6	28.6	58.5	51.3
To discuss antibiotic use with patients who are asking for antibiotics, when I feel they are not necessary	80.1	82.6	79.4	90.9	80.5	74.4
To communicate with senior doctors in situations where I feel antibiotics are not necessary, but I feel I am being inappropriately pressured into prescribing antibiotics by senior doctors	40.7	43.9	47.1	31.8	37.5	43.6

Curriculum topic	Percentage of students who feel at least sufficiently prepared					
	Switzerland (n = 137)	European average (n = 7328)	University of Berne (n = 34)	University of Geneva (n = 22)	University of Lausanne (n = 41)	University of Zurich (n = 40)
To use knowledge of the common mechanisms of antibiotic resistance in pathogens	80.9	72.6	76.5	77.3	80.5	87.2
To use knowledge of the epidemiology of bacterial resistance, including local/regional variations	62.5	57.4	64.7	45.5	65.9	66.7
To practise effective Infection control and hygiene (to prevent spread of bacteria)	92.6	89.1	88.2	90.9	92.7	97.4
To use knowledge of the negative consequences of antibiotic use (bacterial resistance, toxic/adverse effects, cost, Clostridium difficile infections)	95.5	88.5	97.0	95.5	90.0	100.0

### *Ethical approval*

The study was approved by the Ethics Committee of Nancy University Hospital, France. Participation was voluntary, anonymous and without compensation.

## **Results**

### *Participation*

We received responses from 137 medical students from 4 Swiss medical schools: Bern (Be) (n: 34; 24.8%), Geneva (Ge) (n: 22; 16.1%), Lausanne (La) (n: 41; 29.9%) and Zurich (Zu) (n: 40; 29.2%). The University of Basel did not participate in the survey because we were not able to identify a correspondent for administration of the survey. Among the contacted medical schools, the response rate for Switzerland was 19%, similar to the median response rate across countries (20%). The median age of the students was 25 years old (IQR 24.8-26.0) and 54.7% (75/137) of them were female.

### *Need for more education and teaching methods*

Overall, 62% (80/130 participants who answered this section of the questionnaire) of Swiss medical students reported that they felt they needed more education on antibiotic use in order to be prepared for their future work as junior doctors. Of them, 31.8% (41/130) felt they had enough training on general use of antibiotic treatments, but that they needed more training on their prudent use, while 30.2% (39/130) expressed the need for more education on both general and prudent use of antibiotics.

Similar to the other European countries, teaching methods perceived as more useful when available were discussion of clinical cases (97/121, 80.2%), clinical rotation in infectious diseases (67/87, 77%) and small group teaching sessions (54/72, 75.0 %); however, the latter 2 were reported unavailable for 36.5% (50/137) and 47.5% (65/137) of the Swiss students (figure 1).

Compared to the European average [11] many teaching methods were more frequently reported as unavailable in Switzerland, such as small group teaching (47.5% in Europe vs 18.7% in Switzerland), active learning assignments (54.0% vs 33.8%), peer-to-peer teaching (52.6% vs 38.3%), clinical rotations in infectious diseases (36.5% vs 23.8%) and microbiology (49.6% vs 37.3%) and role play sessions (69.3% vs 57.5%). Unavailability of teaching methods among the four Swiss Universities involved in the study are shown in more detail in table 1.

### *Global preparedness score*

The global preparedness score for Switzerland was 67.9%. This result was concordant with the median global preparedness score across Europe (71.2%) [11].

### *Preparedness in different curriculum topics*

Self-reported preparedness of Swiss students in the different curriculum topics is described in table 2. Almost all of the students felt sufficiently prepared to recognize clinical signs of infection (99.3%), to interpret marker of inflammation (94.9%), to recognize the right moment to perform microbiological tests (91.2%), to practice infection control (92.6%) and to have a good knowledge of negative consequences of antibiotic misuse (95.5%). Similar score of preparedness were observed among the four different Universities who participated in the study for the topics referred to “diagnostic” skills, with the exception of preparedness for the use of point-of-care tests, which was lower in Zurich (71.8%) when compared to the other schools (La 92.7%, Be 91.2% and Ge 90.9%).

Conversely, lower preparedness rates emerged in the sections where “prescription” skills were investigated. More than half of the students (66.9%) felt sufficiently prepared to prescribe an antimicrobial treatment according to guidelines (La: 73.2%, Be: 70.6%, Ge: 68.2% and Zu: 56.4%), but this rate was lower when students were asked to prescribe without using guidelines (33.8%); Lausanne was the only school where at least half of the students (51.2%) reported that they felt sufficiently prepared for this task (Ge: 36.4%, Zu: 25.6% and Be: 20.6%).

Less than half (42.6%) of the students felt prepared to decide if the switch to an oral treatment was feasible, with the lowest score reported in Zurich (La: 56.1%, Be: 44.1%, Ge 40.9% and Zu: 28.2%), and only

39.3% felt ready to decide the shortest adequate duration of a treatment (La: 56.1%, Ge: 36.4%, Be: 32.4% and Zu: 28.9%). Moreover, students felt largely not enough prepared (39.7%) to identify the need for combination therapy (La: 51.2%, Be: 41.2%, Ge: 31.8% and Zu: 30.8%) and to prescribe prophylaxis (Switzerland: 33.3%, La: 41.5%, Be: 32.4%, Zu: 28.9% and Ge: 27.3%).

Capacity to measure antibiotic use was reported lower in Geneva (10.5%) than in the other schools (La: 45.9%, Be: 41.9% and Zu: 40.5%) and as well as managing antibiotic use in a multidisciplinary team (Be: 63.6%, La: 58.5%, Zu: 51.3% and Ge: 28.6%).

## Discussion

This study shows that, as their European colleagues, Swiss students do not feel sufficiently prepared on antibiotic prescribing and they feel they need more education. Although the preparedness scores of Swiss students largely overlap with the European results, some differences can be highlighted.

The proportion of Swiss students who felt prepared to prescribe a treatment without using guidelines was much lower than that reported across Europe and, looking in detail, this was reported by all the universities but Lausanne. On the other hand, the rate of students feeling prepared to select a treatment according to guidelines was similar to European average. A similar pattern had emerged for UK students, suggesting the hypothesis that large availability of local guidelines may be helpful, especially for young physicians, but could lead to the feeling of not being capable to prescribe a treatment independently [11]. As guidelines will never be able to cover all possible clinical situations that prescribers face in real life practice, educators should pay particular attention to help students developing the skill to judge the applicability of guidelines.

Preparedness on use of point-of-care test was higher for Swiss students, but, as well as prescribing according to guidelines, this was one of the topics with the greatest variation in preparedness among countries, related to different availability of resources and variability in national recommendations [11].

Swiss students reported high scores of preparedness in diagnostic issues, as had their European colleagues involved in the Student-PREPARE survey and in previous studies [9–11,15]. However, misdiagnosis is one of the main reasons for unnecessary antimicrobial prescriptions, as well as misinterpretation of clinical or microbiological data [2]. Therefore, this self-confidence might be at least partially biased by some lack of “real life” clinical practice experience and failure to appreciate the “swampy lowlands” of medical decision making with real patients that do not fit textbook descriptions [16].

In the Student-PREPARE survey, higher levels of preparedness were consistently reported in some countries. Possible explanations for these findings include a difference in the quality of education provided in different countries, but also cultural factors related to self-confidence and preparedness feeling [6,11,17]. Cultural differences between French speaking and German speaking regions in Switzerland have been pointed out as one of the factors influencing the disparities regarding use of antibiotics and rates of antimicrobial resistance among Swiss cantons [18–20]. Although we observed some differences in the preparedness for some topics and in the availability of teaching methods among universities, we did not

observe a correlation in strengths and weaknesses when comparing French (Geneva and Lausanne) and German speaking faculties (Berne and Zurich).

Swiss students, as well as their colleagues from other countries and disciplines [11,21], stressed the importance of active methods of learning, as well as their inadequate availability. Infectious disease internships, whose effectiveness in improving knowledge and confidence in AMS principles has been shown in different studies, should be encouraged and made possible for every student [21–23].

As suggested by King *et al.*, some of the skills where students report the lower preparedness, which involve more complex antimicrobial stewardship (AMS) strategies, could be more difficult to address with traditional teaching methods, leading to the need of frequent re-evaluation of both teaching contents and their delivery methods [21,24]. Only half of the Swiss students (as well as the Europeans) reported feeling prepared to work in a multidisciplinary team, suggesting the need to move towards interprofessional educational strategies [21,25]. Workshops where pharmacy and medical students collaborate dealing with clinical case simulations have been shown to help both in conveying AMS concepts and in highlighting the importance of interprofessional collaboration [25]. Promoting interaction among different health care professions, by inviting pharmacists, dentists, nurses and midwives to participate in lectures where AMS concepts are taught to medical students, could set up the basis for cooperation.

The validity of our results may be partially limited by the low response rate, but this was similar to response rates obtained across Europe and to those reported by previous similar studies [8,10,11]. Nevertheless, as previously published, the low response rate does not necessarily undermine the study's representativeness [26,27]. Due to the small number of respondents, differences in responses between the different universities should be interpreted with caution. A larger participation could help to better understand possible gaps in the education program, as well as differences among Swiss universities, in order to define targets that need to be improved. Furthermore, the responses are self-reported and therefore do not necessarily reflect the objective “real degree” of preparedness or real practices with patients.

Since 2015 Switzerland has adopted a national strategy on antibiotic resistance [28]. Improved education of medical students is currently not a core component of the strategy. In 2019 ESCMID published a set of generic competencies in antimicrobial prescribing and stewardship relevant to every independent prescriber. Educators could benefit from this list to guide the revision of curricula and teaching materials [29]. More active and interprofessional teaching activities seem like an essential step to guarantee that future physicians will use antibiotics more responsibly than the preceding generations.

## Conclusions

Most Swiss final year medical students feel they need more education on antibiotics or at least on their prudent use. Some of the teaching methods perceived as more useful by students, such as discussion of clinical cases or infectious diseases clinical placement, seem still insufficiently available in most Swiss medical schools. Active and interprofessional teaching activities, involving pharmacists, nurses and other health professions, can be a first step towards more effective education on prudent antibiotic use.

## Abbreviations

ESCMID (European Society of Clinical Microbiology and Infectious Diseases); ESCMID Study Group for Antimicrobial stewardship (ESGAP); antimicrobial resistance (AMR); Bern (Be); Geneva (Ge); Lausanne (La); Zurich (Zu); antimicrobial stewardship (AMS).

## Declarations

### Ethics approval and consent to participate

The study has received ethical approval from Comité de Réflexion Ethique Nancéien Hospitalo-Universitaire, the ethical committee of Nancy University Hospital, France. Written informed consent was obtained from all the participants. Participation was voluntary, anonymous and without compensation.

### Consent for publication

Not applicable.

### Availability of data and materials

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

### Competing interests

The authors declare that they have no competing interests.

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### Authors' contributions

AR, GC and BDH analysed and interpreted the data. CP and OJD designed the original study. AR, GC and BDH drafted the manuscript. All authors read and approved the final manuscript.

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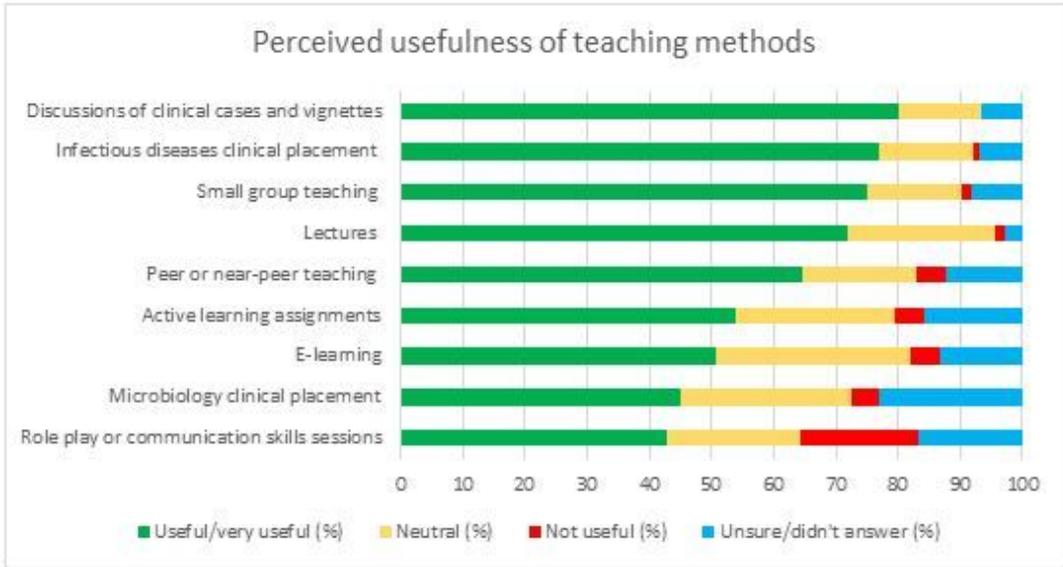
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## Figures



**Figure 1**

Perceived usefulness of teaching methods in Swiss Universities.