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TITLE PAGE

Perceptions, current practices and interventions of community pharmacists regarding antimicrobial stewardship: a qualitative study

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1 ABSTRACT

2 **Background:** Community health care accounts for the vast majority of antibiotic use in
3 Europe. Given the threat of antimicrobial resistance (AMR), there is an urgent need to
4 develop new antimicrobial stewardship (AMS) interventions in primary care that could involve
5 different health care providers including community pharmacists. This study aimed to explore
6 the perceptions, current practices and interventions of community pharmacists regarding
7 antimicrobial stewardship.

8 **Methods:** Semi-structured qualitative interviews were conducted with community
9 pharmacists in France. Participants were recruited through a professional organization of
10 community pharmacists combined with a snowballing technique. Interviews were audio
11 recorded, transcribed and analyzed using thematic analysis. The *Consolidated Framework*
12 *for Implementation Research* was used while developing the interview guide and carrying out
13 thematic analysis.

14 **Results:** Sixteen community pharmacists participated. All the respondents had good
15 awareness about antimicrobial resistance and believed community pharmacists had an
16 important role in tackling AMR. Some barriers to community pharmacists' participation in
17 AMS were identified such as difficult interactions with prescribers, lack of time and lack of
18 access to patient medical records and diagnosis. Increased patient education, audits and
19 feedback of antibiotic prescribing, increased point-of-care testing and delayed prescribing
20 were interventions suggested by the pharmacists to improve antibiotic use in primary care.
21 Strategies cited by participants to facilitate the implementation of such interventions are
22 increased pharmacist-general practitioner collaboration, specialized training, clinical decision
23 support tools as well as financial incentives.

24 **Conclusions:** This study suggests that community pharmacists could play a greater role in
25 infection management and AMS interventions. Further interprofessional collaboration is
26 needed to optimize antibiotic prescribing and utilization in community health care.

27
28 **Keywords:** Antibiotic stewardship, community pharmacists, primary care, implementation
29 research, *Consolidated Framework for Implementation Research*

30 31 32 KEY POINTS

- 33 • Community pharmacists are well-positioned and well-regarded health care providers
34 who could play a greater role in the management of common infections and antimicrobial
35 stewardship in primary care.
- 36 • This article identifies several opportunities for antimicrobial stewardship interventions
37 in community pharmacies despite some barriers, both internal and external to the pharmacy
38 environment.
- 39 • Our findings highlight multiple facilitators that could support the successful
40 implementation of antimicrobial stewardship activities into community pharmacy practice.

41 42 43 44 INTRODUCTION

45 Background

46
47 Antimicrobial resistance (AMR) is a major public health concern, listed by the World Health
48 Organization (WHO) in 2019 as one of the ten threats to global health [1]. AMR is indeed
49 responsible each year for more than 700,000 deaths worldwide and 25,000 deaths in Europe
50 [2]. More than 10 million deaths per year worldwide and beyond 100,000 billion dollars
51 economic loss are predicted by 2050 if antibiotic resistance continues to grow [3]. The
52 emergence of AMR and the scarce development of new antibiotics could lead in the near
53 future to a lack of effective antibiotics. Excessive and inappropriate antibiotic use are major
54 drivers of the development of antibiotic resistance worldwide [4–6].

For the last 20 years, antimicrobial stewardship (AMS) has been one of the pillars of the fight against antibiotic resistance, along with infection control. Antimicrobial stewardship programs (ASPs) have been introduced in response to the threat of AMR with the aim to optimize antibiotic use and to improve the quality of infection care [7,8]. ASPs' effectiveness has been demonstrated in both hospital and community settings [9,10], with evidence of decreased antibiotic treatment duration, reduced length of hospital stay and reduced incidence rates of colonization and infection with resistant bacteria [9,11,12]. ASPs often consist of various components, such as improved microbiological diagnosis with enhanced collaboration between clinical and microbiological teams, prospective audit and feedback on antibiotic prescribing, prescriber education and training as well as clinical decision support at the point-of-care [8–10]. Despite being widely implemented in hospital settings, ASPs remain rare in primary care settings. However, in Europe, primary care accounts for more than 90% of total antibiotic consumption [4]. Community-based physicians and especially general practitioners (GPs) are therefore the main prescribers of antibiotics. Given the major volume of antibiotic misuse in primary care and the threat of AMR, there is an urgent need to identify and develop new interventions to improve antibiotic use in the community.

The use of antibiotics in primary care involves several health professionals, including community pharmacists. In addition to being medication experts, community pharmacists are often the most accessible and available health care providers to patients. Community pharmacists are often patients' first point of contact and thus play a key role in patients' self-management of infections and GP referral. In addition, they are often the last health professional seen by patients before treatment initiation, making them the ideal provider to educate patients about appropriate medication use. Most community pharmacies also benefit from being located close to patients. In France, the French Directorate for Research, Studies, Evaluation and Statistics (DREES) reported that community pharmacies are among the most evenly distributed health services [13]. In addition, the scope of community pharmacy practice in several countries has been expanding in recent years, incorporating vaccine administration [14,15], point-of-care testing [16] and the provision of antibiotics without medical consultation under specific conditions [17]. For instance, in the United Kingdom, community pharmacists have the ability to supply antibiotics without individual medical prescription for uncomplicated urinary tract infections (UTIs) under patient group directions (PGDs) [18]. The recent expansion of community pharmacists' services could lead to an enhancement of their role in AMS, as is the case in some countries. Several studies, including nationwide surveys [19,20], qualitative studies [21,22] and one scoping review [23] have explored the knowledge, attitudes and practices of community pharmacists towards AMS. These studies demonstrated overall good knowledge and awareness of antibiotic misuse and AMR among community pharmacists as well as the practice of AMS by some pharmacists. Examples of AMS practices adopted by pharmacists included educating patients about infections and antibiotic use, providing self-care advice and reviewing prescriptions for compliance with guidelines.

However, the implementation of AMS practices is often complex due to contextual barriers resulting in limited adoption of best practices by health care professionals [24]. These barriers may be structural, organisational or cultural, such as lack of financial and human resources or lack of acceptability by providers. These obstacles are even more significant in primary care [24]. Indeed, the implementation of AMS interventions in primary care faces specific challenges, such as infrequent training [25,26], lack of time [27], uncertain diagnosis [27], lack of systematic follow-up [27,28] or pressure to prescribe from patients or patients' family members [27–29]. These challenges are barriers to the successful implementation of interventions and the adoption of improved practices by practitioners. In addition, many interventions found to be effective in public health research fail to achieve significant patient benefit outcomes in real-life practice. Public health interventions researchers recognize the need to assess not only the outcomes of interventions but also their implementation process

to determine the extent to which interventions are effective in some specific contexts and can be transposed in other contexts. Theoretical frameworks have therefore been developed to help researchers understand common implementation constructs that can determine the successful implementation of interventions and how they apply in a specific context. The Consolidated Framework for Implementation Research (CFIR) is a comprehensive framework that identifies and specifies constructs from published implementation theories that are recognized to influence implementation positively or negatively [30]. The CFIR is composed of five major domains, including intervention characteristics, outer setting, inner setting, characteristics of individuals and implementation process [31]. The CFIR provides a pragmatic framework for approaching complex, multi-level and multi-stakeholder settings such as primary care settings.

Objectives

The main purpose of this study was to use a theoretical framework to assess the feasibility and acceptability of implementing AMS interventions in the pharmacy setting. The use of a theoretical framework to target future antibiotic stewardship interventions is an innovative approach to understand this complex care setting at the individual, interpersonal and organizational levels. Additionally, we sought to determine specific barriers and facilitators to community pharmacists' role in AMS, in order to identify strategies which could facilitate the implementation of future AMS interventions in pharmacies.

MATERIAL AND METHODS

Study design

We conducted a qualitative study using in-depth semi-structured individual interviews. The study is reported in accordance with the Consolidated Criteria for Reporting Qualitative studies (COREQ) checklist [32] (see Additional file 1).

Interview guide

An interview guide was developed after reviewing previous published studies and CFIR theoretical constructs [31]. The interview guide consisted of twenty-three questions regarding participants' current practices in infection management and in antibiotic dispensing, their general knowledge and perceptions on antibiotic resistance and antibiotic stewardship as well as their views on potential interventions to promote better antibiotic use in primary care. Interview questions included the following: "What information do you give to patients when dispensing antibiotics?" and "How do you think community pharmacists can improve antibiotic use?". The interview guide was reviewed and validated by several AMS specialists and community pharmacists. The interview guide was additionally checked for face validity during two preliminary individual interviews with community pharmacists, resulting in minor adjustments regarding the order of the guide's questions. The detailed interview guide is presented in the Additional file 2.

Participant selection

The participant selection was informed by theoretical sampling with inclusion of individuals working as a pharmacist in a community-based pharmacy in France. Individuals not practicing as community pharmacist in France or unable to speak French were excluded as study participants. For the purpose of obtaining a maximum variation sample in terms of sociodemographic status, we combined two recruitment methods. We recruited the majority of the respondents through a professional organization of community pharmacists, the "Union Régionale des Professionnels de Santé pharmaciens Île-de-France". A snowballing technique and convenience sampling were used to recruit additional participants based on geographical proximity and availability.

Data collection

An invitation letter describing the overall subject of the study was first sent to the “Union Régionale des Professionnels de Santé pharmaciens Île-de-France” organization who then disseminated it to their members through email. A detailed information sheet and a consent form were subsequently sent by mail to pharmacists who expressed interest in participating in the study following the first email. A face-to-face or videoconference interview was then arranged with pharmacists who consented to participate in the study. Given the ongoing COVID-19 pandemic, all interviews except one were conducted by videoconference using the Zoom application. All interviews were conducted in French by the first author over a four-month period between February and May 2021 in the Parisian area, France. After informed oral and written consent was obtained from the participants, the interviews were audio recorded using a dictaphone. The socio-demographic data of each participant were collected at the end of each interview. Participant recruitment was continued until data saturation was obtained. No honorarium was provided to study participants.

Data analysis

Upon completion of the interviews, audio recordings were anonymized and transcribed verbatim using the automatic transcription software NVivo Transcription. Thematic analysis was carried out in the following steps: familiarization with the data, generating codes, searching for themes using an inductive approach, reviewing and organizing themes, and analyzing the results through the framework analysis method [33]. Two researchers (CD and NPS) each independently inductively coded all transcripts. The two researchers then collectively reviewed and reached a consensus about the application of themes through independent coding and group discussion. Data analysis was then conducted by one researcher (CD) using a deductive approach with comparison to previous literature and CFIR constructs [31]. Thematic analysis results were then reviewed and agreed upon by the whole research team. Upon completion of analysis, a workshop was held between two researchers and three other community pharmacists to present and discuss results from analysis. During this workshop, an open discussion was held following the presentation of the results to examine direct implications and opportunities for community pharmacy practice. A report was subsequently produced for which quotes from the interviews were selected and translated into English by two researchers. The open-source software R for Statistical Computing was used to analyze the participants' sociodemographic data.

RESULTS

Sample characteristics

A total of 16 interviews were conducted. The mean length of the interviews was 43 minutes. The characteristics of the participants are detailed in Table 1. Half of the participants were women and mean age was 49 years old. The majority of the respondents held the position of pharmacy managers and had more than 20 years of community pharmacy experience. However, the characteristics of the community pharmacies where the participants practiced varied. Indeed, of all pharmacy participants, 3 practiced in rural areas while 7 practiced in neighbourhood pharmacies and 6 in city centre pharmacies. Among the study participants, 3 practiced in low-income neighbourhoods.

Thematic analysis

Thematic analysis yielded 6 main themes, which are detailed as follows.

1) Perceptions on AMR and inappropriate antibiotic use

The majority of the respondents reported good knowledge and awareness about AMR, for which they credited the initial training curriculum for pharmacists.

All respondents reported being frequently confronted with inappropriate antibiotic prescribing by GPs and dentists as well as patient antibiotic misuse. Participants' perceptions towards inappropriate antibiotic use in the community are summarized in Table 2. The majority of participants cited a lack of knowledge and false beliefs among patients, contributing to prescribing pressure on prescribers and dispensing pressure on pharmacists as well as self-medication with antibiotics and a lack of compliance with antibiotic prescriptions from patients.

"I think it's a really big pressure on GPs. I think there are times when they wouldn't prescribe antibiotics or they would delay prescribing and they can't." (P8)

"We also have patients demanding antibiotics when it's not appropriate like when people tell us: 'I would like an antibiotic because I have a sore throat'." (P12)

"Patient compliance is the real issue. If you look at it closely, a lot of patients don't take antibiotics for the prescribed duration." (P12)

All study participants believed community pharmacists had an important role to play in tackling AMR. Some pharmacists described having been involved in AMS activities, including per-unit antibiotic dispensing, rapid strep testing, delayed antibiotic prescribing or relying on clinical decision support systems (CDSSs) for checking antibiotic prescriptions compliance with guidelines.

"Absolutely, pharmacists have to be involved." (P11)

2) Current practices in the management of infections

Many study participants reported patients often first seek advice and treatment from community pharmacists when showing early signs of infection before medical consultation. According to the respondents, the most frequent infectious situations for which patients consult community pharmacists are urinary tract infections, dental infections and upper respiratory tract infections. When asked about how they manage infections, participants reported different courses of action and patient care trajectories depending on the cause of infection (e.g. viral, bacterial), the patient profile (e.g. comorbidities, patient history), the clinical presentation (e.g. severe or atypical presentation) and the time from onset of symptoms. Subsequent management is summarized in Figure 1. For instance, when faced with patients presenting symptoms suggestive of viral infection such as nasopharyngitis, the vast majority of participants described providing self-care advice, combined with over-the-counter (OTC) medication, without systematic referral to a GP.

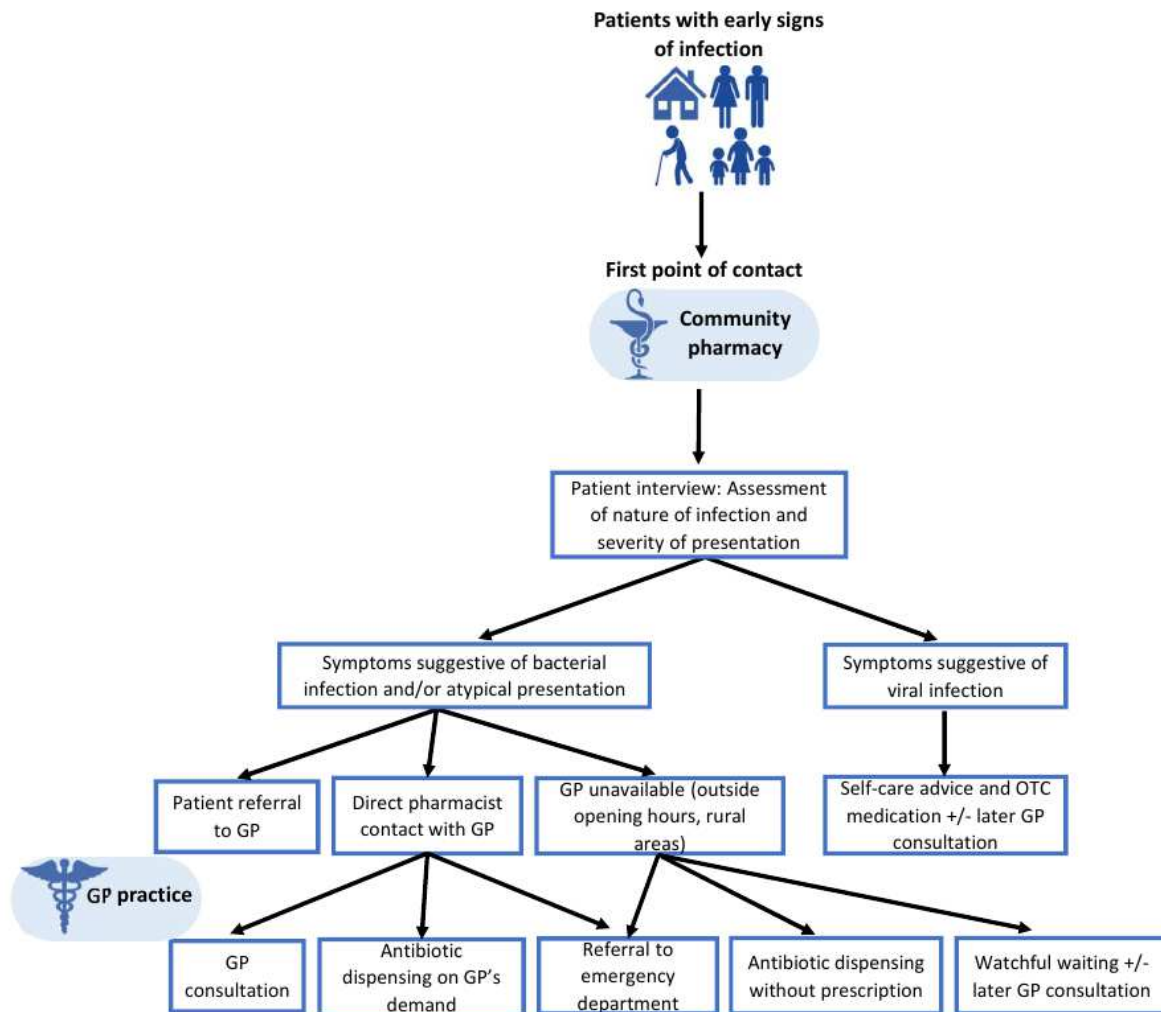


Figure 1: Community pharmacists' initial approach of common infections
GP: General practitioner; OTC: Over-the-counter

3) Current antibiotic dispensing practices

Regarding the dispensing process, the majority of participants described usually questioning patients about the physician's diagnosis as well as their medical history and usual treatment. Most participants also reported systematically assessing clinical safety parameters like allergies or drug interactions with the help of pharmacy management systems. Many participants also stated that they screened prescriptions for prescribing errors and compliance with guidelines. In addition, the majority of respondents viewed dispensation as the appropriate time to raise patient awareness about the importance of medication adherence, especially the duration and dosage of treatment.

"We make sure to write down the dosage and we tell them: "Even if symptoms get better after three days, you have to go through with the treatment (...)"» (P13)

They also reported that they usually provide information on the expected adverse effects of treatment. Participants described occasional interactions with prescribers regarding prescribing errors, especially allergies, drug interactions as well as inappropriate antibiotic selection, dosage or duration.

4) Barriers to community pharmacists' participation in AMS

Several barriers to community pharmacists' role in current and future AMS activities were cited by the participants, as presented in Table 3. More than half of the participants recognized the lack of access to medical diagnosis and patients' medical records as a major barrier to pharmacists' screening of prescriptions for guideline compliance.

"(...) sometimes we lack information about the situation because some patients are not able to tell us the reason why their physician prescribed an antibiotic (...)" (P15)

Complicated interactions with GPs and prescribers' lack of acceptability to accept questioning or potential changes to prescriptions were another important barrier to the implementation of audits and feedback on the quality and safety of antibiotic prescriptions by pharmacists (n=8/16, 50%).

"I tell you, sometimes when pharmacists call doctors about inappropriate dosage, some doctors will agree to change the prescription but others will tell us to go through with their prescription and supply the inappropriate dosage anyway." (P6)

Pharmacists' lack of time (n=6/16, 38%) and lack of expertise on infections (n=5/16, 31%) were also mentioned by some participants as well as pharmacy staff' lack of qualifications to perform AMS activities (n=5/16, 31%).

5) Facilitators to community pharmacists' participation in AMS

Multiple enablers intrinsic to the pharmacy profession as well as potential levers for future interventions that may facilitate their role in patient management and the appropriate use of antibiotics were also described by the participants. They are listed in Table 3. Most participants recognized as intrinsic assets the fact that community pharmacists are well-positioned (n=11/16, 60%), knowledgeable (n=7/16, 44%) providers as well as well-regarded health professionals by service users (n=5/16, 31%).

According to respondents, community pharmacists' trust relationship with patients (n=11/16, 69%) and their direct involvement in antibiotic supply for the community give them leverage to raise patient awareness about AMR and antibiotic use.

"Our interactions with patients are a bit more informal, which makes it easier to build rapport and raise awareness." (P15)

"People talk to pharmacists easily. I think they trust us and they listen to us. Besides, we usually take the time for people who come in." (P4)

Among levers that could be implemented to facilitate pharmacists' role in AMS interventions, over half the participants named the development of collaborative relationships with GPs. Nearly 70% of respondents also stressed the importance of implementing clear policies and protocols to support pharmacists' involvement in AMS activities. In addition, half the respondents emphasized the value of continuing education for community pharmacists to update their knowledge of prescribing guidelines and infection management.

"But it would need for pharmacists to be well trained on these topics. For many of my colleagues, I think trainings go back a long way so it would be necessary for them to do training. But I think a lot of pharmacists would agree to participate in trainings." (P7)

Another facilitator mentioned by nearly a third of the participants was the change in mentality among younger generations of GPs. According to several study participants, younger GPs are more favorable toward pharmacists' uptake of non-traditional roles and generally more inclined to interprofessional cooperation.

Furthermore, as part of integrating a methodological framework in this study, barriers and facilitators identified through analysis were systematically compared and linked to the corresponding CFIR constructs as well as to the levels to which these implementation factors refer. These findings are presented in Table 4. Among the factors that may influence the implementation of interventions, main facilitators include pharmacists' personal characteristics and their relationship with service users as well as their general position within the community and care pathway. External characteristics, namely pharmacy organization, policies and communication networks, are other key factors that may impact the feasibility of pharmacists' participation in AMS interventions.

6) Potential AMS interventions in community pharmacies

Several opportunities for AMS interventions in community pharmacies were mentioned by the study participants, one of which is increasing patient education about the rational use of antibiotics (n=15/16, 96%) during infection consultation and antibiotic dispensing at the pharmacy. For example, educational and training materials, such as leaflets, could support and further enhance current education practices. Such improved patient education may reduce patients' expectations to receive antibiotics for common viral infections and therefore decrease the pressure on GPs to prescribe antibiotics. It may as well improve patients' adherence to antibiotic therapies.

"(...) that's where pharmacists' role comes into play. Because we know which patients are always demanding for antibiotics, we can try to educate them." (P3)

Another intervention discussed during the interviews was for pharmacists to conduct audits of antibiotic prescribing with feedback to prescribers, although some participants expressed concerns about the acceptability of GPs and the feasibility of this kind of interventions without pharmacists' access to medical diagnosis. Nevertheless, the majority of respondents believed the implementation of CDSSs in pharmacies to display clinical practice guidelines could support pharmacists' prescription screening and assist potential audits of antibiotic prescribing in pharmacies. Some participants stressed the importance of integrating such tools with pharmacy management software.

"If pharmacists check every prescription and they have to go and find the official guidelines themselves, it's too difficult. But if we had a tool that could help us check compliance with guidelines after supplying information then there would be a double check, which is always better." (P2)

"But then, I think that with electronic tools, there are simple things that can be set up. With management software for example, there are ways of setting up pop-ups with decision trees or queries." (P4)

All participants were confident in the ability of pharmacists to prescribe and dispense antibiotics without medical consultation for the treatment of uncomplicated infections such as uncomplicated cystitis or streptococcal pharyngitis. Moreover, many participants pointed out the patient benefits that such interventions could have.

"I think given the current difficult access to care for some patients, it could be beneficial in some situations. But it should not be fully open. We need decision trees. We need a clear framework. I think in many cases it would allow for quick treatment of infection." (P4)

In addition, some participants (n=4/16, 25%) highlighted the need for increased point-of-care testing in community pharmacies, namely urine dipstick and rapid strep testing, to optimize patient triage and prioritize patient referral to GPs for infections requiring antibiotic therapy. Some participants (n=4/16, 25%) also stressed the benefits of having patients returning leftover antibiotic tablets to reduce self-medication.

DISCUSSION

Main findings

This qualitative study, guided by the CFIR, explores French community pharmacists' perceptions about the implementation of AMS interventions in community pharmacy practice. The findings suggest that French community pharmacists are well-aware of AMR and antibiotic misuse in the community. Moreover, participants expressed strong interest in playing a bigger role in the management of common infections and in participating in AMS by incorporating AMS practices targeting prescribers and users into their practice. However, several barriers to implementing such activities into community pharmacy practice were cited during the interviews, such as lack of access to medical diagnosis, difficult interactions with GPs, lack of time and lack of specialized knowledge regarding the management of infections. These barriers go beyond the individual characteristics of pharmacists and relate to the overall organization of community pharmacies and primary care. It is worth mentioning that the interactions between community pharmacists and GPs were described as a barrier as well as a facilitator when an informal collaborative framework existed between the health care professionals. Similarly, some of the facilitators mentioned, such as continuing education and specialized training and the implementation of clinical decision support tools in community pharmacies, could be promising strategies to remove the above-mentioned barriers. In addition, the implementation of Shared Medical Records in primary care may help to address community pharmacists' lack of information regarding medical diagnosis by allowing easy information sharing between community pharmacists and physicians.

The barriers and facilitators identified during the interviews were systematically linked the theoretical constructs listed in the CFIR. Participants suggested potential facilitators for interventions that confirmed validated recommendations such as the Expert Recommendations for Implementing Change (ERIC) [34,35]. For instance, as far as interpersonal relations are concerned, ERIC strategies recommend creating an alliance and organizing local discussions [35]. As for overcoming organizational barriers, ERIC strategies suggest involving administrative structures and creating incentives [35].

Among the opportunities for AMS suggested by the participants, one can note the expansion of community pharmacists' prescribing rights. The positive effects of expanding prescribing for community pharmacists were especially expressed by the participants that worked in rural pharmacies. Furthermore, these pharmacists also expressed that they often felt compelled to refer patients with signs of bacterial infections to hospital emergency departments or to dispense antibiotics without prescription, given the lack of GPs in rural areas. A legislated right for pharmacists to supply certain antibiotics without medical consultation in specific conditions like non-complicated UTIs or bacterial pharyngitis could benefit to populations lacking access to primary care services. Given the evenly distribution and the extended hours of community pharmacies, a prescribing role for pharmacists could allow for overall better access to infection care outside opening hours of general practices. Moreover, it could also help to reduce delays in infection care by simplifying the care pathway and reduce GPs' workload.

The impact of the COVID-19 health crisis on the community pharmacist profession can also be discussed. Indeed, community pharmacists have played a major role in the frontline primary care response to the pandemic by educating the general public about SARS-CoV2 infection and COVID-19 vaccines, performing rapid antigen testing [36] and administering COVID-19 vaccines in pharmacies [37]. The COVID-19 pandemic has highlighted the capacity of community pharmacists to uptake non-traditional roles and to provide key public health care services. One could therefore hypothesize that the recent health crisis has enhanced the position of pharmacists in the primary health care system and the public opinion, paving the way for increased role in AMS.

Comparison with existing literature

The barriers and facilitators that we identified in this study are similar to those found in two qualitative studies conducted in the United Kingdom [21,22]. Those two studies also considered community pharmacists' inability to conduct clinical examinations at the pharmacy, the lack of human resources and language barriers between pharmacists and patients as potential barriers to community pharmacists' participation in AMS. Another obstacle to the implementation of AMS in pharmacies, identified by Jones et al. [21], is the lack of understanding of the concept of antimicrobial resistance by patients. In one systematic review of pharmacists' knowledge, perceptions and practices regarding antimicrobial stewardship, Saha *et al.* found that pharmacists' opinion towards AMS interventions were positive in most studies [23]. However, two studies in that review pinpointed that this opinion varied according to pharmacists' qualifications and professional experience. More educated and experienced pharmacists were more likely to be favorable to AMS interventions in the pharmacy. In addition, that review found that only 30% of pharmacists routinely checked antibiotic prescriptions for guideline compliance. In addition, the authors of that review and those of one of the qualitative studies [22] considered financial incentives and remuneration for AMS activities as important levers for the successful implementation of AMS interventions in community pharmacies.

Strengths and limitations

This study has several strengths, one of which is the variety of the participants' sociodemographic profile. This variety was likely obtained thanks to our combination of two participant recruitment methods. We are confident that this profile diversity helped capture the diversity of French community pharmacists' perspectives and practices. In addition, our collaboration with a professional organization of pharmacists allowed for triangulation of the results during a workshop between the researchers and community pharmacists from the organization. Another strength of this study is the use of a validated methodological framework for the development of the interview guide and thematic analysis. Indeed, the integration of an implementation framework into this research allowed us to consider specific cultural characteristics of the primary health care setting and enabled us to identify interventions that are specifically tailored for the pharmacy setting. Additionally, it helped determine implementation strategies to support the implementation of such interventions thanks to existing expert recommendations [34]."

Several limitations can be discussed, such as the existence of a recruitment bias regarding the participant selection. Indeed, one can assume that pharmacists that were willing to participate in this study viewed AMR as an important matter and were prompt on being involved in improvement opportunities. Moreover, this study focused on the perceptions and attitudes of community pharmacists. These perceptions may not be representative of all primary health care providers and stakeholders. We believe the perspectives of other stakeholders like service users and other primary health care professionals should also be explored to properly assess the feasibility and acceptability of AMS interventions in primary care. Further research should especially focus on exploring the views of GPs on pharmacists' involvement in AMS interventions as their collaboration is a key factor in the successful implementation of future AMS interventions. In addition, this study exclusively focused on the French primary care setting and these results therefore may not be directly generalizable to different health care systems or settings.

CONCLUSIONS

This study suggests that community pharmacists' skills and position in the community are underutilized while the current scope of community pharmacy practice has room for more

interventions to improve infection management and the rational use of antibiotics. Community pharmacists' pharmaceutical expertise as well as their accessibility and close relationship with patients could promote a better utilization of antibiotics by patients and prescribers. Potential facilitators for the effective and sustainable implementation of AMS interventions in community pharmacies are increased GP-pharmacist collaboration, specialized training and Shared Medical Records. Multiple AMS components could be routinely practiced by community pharmacists such as increased patient education through educational materials, increased point-of-care testing and delayed prescribing. Multi-faceted AMS interventions, tailored to the community pharmacy setting and based on interprofessional cooperation, must be implemented and evaluated.

Additional materials

Additional file 1: COREQ checklist (pdf)

Additional file 2: Interview guide (docx)

LIST OF ABBREVIATIONS

AMR: Antimicrobial resistance

AMS: Antimicrobial stewardship

ASP: Antimicrobial stewardship program

CDSS: Clinical Decision Support System

CFIR: Consolidated Framework for Implementation Research

ERIC: Expert Recommendations for Implementing Change

GP: General practitioner

ID: Infectious diseases

PGD: Patient group direction

OTC: Over-the-counter

UTI: Urinary tract infection

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DECLARATIONS

Ethics approval and consent to participate

This study was approved by the Institutional Review Board (IRB00011642) of the French Infectious Diseases Society (CER-MIT n°2021-0301). Informed consent was obtained from all participants.

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

C.D. (Conceptualization, Methodology, Investigation, Data Curation, Formal Analysis, Writing—Original Draft Preparation); A.C. (Methodology, Resources, Writing—Review & Editing); E.D. (Methodology, Resources, Writing—Review & Editing); F.P. (Methodology, Resources, Writing—Review & Editing); R.A. (Conceptualization, Methodology, Writing—Review & Editing); F.-X.L. (Conceptualization, Methodology, Writing—Review & Editing, Project Administration, Supervision); N.P.-S. (Conceptualization, Methodology, Data Curation, Formal Analysis, Validation, Writing—Original Draft Preparation, Writing—Review & Editing, Project Administration, Supervision).

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Table 1: Sociodemographic characteristics of participants

Sociodemographic characteristics	n = 16 (%)
Community pharmacists	
Gender	
Male	8 (50)
Female	8 (50)
Age (years)	
< 30	3 (19)
30–39	1 (6)
40–49	3 (19)
50–59	8 (50)
≥ 60	1 (6)
Job title	
Pharmacist manager	12 (75)
Assistant pharmacist	4 (25)
Community pharmacy practice experience (years)	
< 10	4 (25)
10–19	3 (19)
20–29	5 (31)
≥ 30	4 (25)
Community pharmacy practice	
Number of pharmacists at the pharmacy (full-time equivalent)	
≤ 2	8 (50)
> 2	8 (50)
Number of pharmacy staff at the pharmacy (full-time equivalent)	
≤ 2	7 (44)
> 2	9 (56)
Pharmacy structure	
Group	11 (69)
Independant	5 (31)
Current practice location	
Neighbourhood pharmacy	7 (44)
City centre pharmacy	6 (37)
Rural pharmacy	3 (19)

Table 2: Community pharmacists' perceptions regarding patients' and prescribers' inappropriate antibiotic use

Community pharmacists' perceptions	n = 16 (%)
Inappropriate patient behavior regarding antibiotics	
Pressure on pharmacists to dispense antibiotics without prescription	10 (63)
Lack of knowledge regarding AMR and antibiotic use	7 (44)
Pressure on GPs to prescribe antibiotics	7 (44)
Non-adherence to dosage or duration of prescribed antibiotics	6 (38)
Self-medication with antibiotics	6 (38)
Inappropriate antibiotic prescribing practices	
Inappropriate prescribing regarding choice of antibiotic	6 (38)
Inappropriate prescribing regarding antibiotic dosage	5 (31)
Over-prescription of antibiotics in situations when not required	5 (31)
Improvement of prescribing practices in recent years	3 (19)

AMR: antimicrobial resistance; GPs: general practitioners

Table 3: Barriers, facilitators and potential levers to community pharmacists' participation in AMS

Barriers		n = 16 (%)
Lack of access to medical diagnosis and records		11 (69)
GPs' lack of acceptability of pharmacists' prescription review		8 (50)
Lack of time		6 (38)
Pharmacists's lack of specialized knowledge on ID and AMS		5 (31)
Pharmacy staff's lack of skills and qualifications		5 (31)
Difficulties in reaching GPs		3 (19)
Facilitators	Levers for future AMS interventions	n = 16 (%)
Accessibility and availability of pharmacists/First point of contact		11 (69)
Trust relationship with patients		11 (69)
Implementation of CDSSs in pharmacies	✓	11 (69)
Policies and legal framework for pharmacists' AMS activities	✓	11 (69)
Enhanced interprofessionnal collaboration with GPs	✓	9 (56)
Specialized training in ID and AMS/Continuing training	✓	8 (50)
Experience and expert knowledge about medication		7 (44)
General public's positive opinion towards pharmacists		5 (31)
Younger GPs' positive opinion towards GP-pharmacist collaboration		5 (31)
No appointment required for consultation in pharmacies		5 (31)
Use of pharmacy management systems for decision support	✓	5 (31)
Public information and awareness campaigns on AMS	✓	4 (25)
Long opening hours in pharmacies		4 (25)
Patient knowledge and cross-disciplinary approach		4 (25)
Financial incentives/Reimbursement models	✓	3 (19)
Last health professional contact before treatment initiation		3 (19)
Availability of Shared Medical Records in pharmacies	✓	2 (13)

AMS: antimicrobial stewardship; CDSSs: Clinical Decision Support Systems; GPs: general practitioners;
ID: infectious diseases

Table 4: Synthesis of barriers and facilitators to community pharmacists' participation in AMR and corresponding CFIR constructs

Levels	Barriers	Facilitators	Constructs CFIR
Community pharmacists	Pharmacy staff's lack of skills and qualifications Pharmacists's lack of specialized knowledge on ID and AMS	Continuing training/Specialized training in ID and AMS Experience and expert knowledge about medication Patient knowledge and cross-disciplinary approach	Learning Climate Self-efficacy Other Personal Attributes
Relationship with users		Accessibility and availability of pharmacists/First point of contact Last health professional contact before treatment initiation Trust relationship with patients No appointment required for consultation in pharmacies Long opening hours in pharmacies General public's positive opinion towards pharmacists Public information and awareness campaigns on AMS	Patient Needs and Resources Patient Needs and resources Patient Needs and resources Patient Needs and Resources Patient Needs and Resources Implementation Climate External policies and incentives
Relationship with GPs	GPs' lack of acceptability of pharmacists' prescription review Difficulties in reaching GPs	Younger GPs' positive opinion towards GP-pharmacist collaboration Enhanced interprofessional collaboration with GPs	Implementation Climate Networks and Communications
Pharmacy policy and health system organization	Lack of access to medical diagnosis and records Lack of time	Availability of Shared Medical Records in pharmacies Financial incentives/Reimbursement models Policies and legal framework for pharmacists' AMS activities Implementation of CDSSs in pharmacies Use of pharmacy management systems for decision support	Available Resources Available Resources Organizational Incentives and Rewards External Policies and Incentives Access to Knowledge and Information Access to Knowledge and Information

AMS: antimicrobial stewardship; CFIR: *Consolidated Framework for Implementation Research*; CDSSs: Clinical Decision Support Systems; GPs: general practitioners; ID: infectious diseases