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A qualitative analysis of the unwritten rules influencing antibiotic prescribing practices among French poultry veterinarians

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Background: It is now recognized that a better understanding of prescriber behaviour is needed to improve antimicrobial stewardship programmes. Most studies conducted in the livestock sector have focused on farmers' perspectives, while the prescribing habits of veterinarians have remained overlooked.

Objective: Our study explored the psychosocial determinants associated with antibiotic prescribing practices in the French poultry sector by analysing the informal norms and unwritten rules that influence veterinarians' prescribing decisions.

Methods: A qualitative study was conducted in four French regions in February 2021. Using the biographical narrative interpretive method, semi-structured interviews were conducted with 16 poultry veterinarians with varying professional experience. Three main themes were retained for data analysis: (i) compliance with and deviations from prescribing recommendations, (ii) the influence of fellow veterinarians on antibiotic decisions and (iii) the key role of veterinary corporate groups.

Results: When prescribing antibiotics, junior veterinarians were strongly influenced by senior veterinarians who acted as role models driving clinical practices. Prescribing habits were shared through peer networks in which veterinarians participated throughout their careers. Finally, veterinary corporate groups helped to shape veterinarians' prescribing habits by promoting existing guidelines and even producing in-house recommendations.

Conclusions: We show that, in parallel with official guidelines, prescribing habits circulate among veterinarians and are shared in professional circles. Therefore, antimicrobial stewardship interventions should focus not only on official guidelines and communication channels, but also unwritten professional rules and organizations influencing veterinarians' prescribing practices.

Introduction

Antimicrobial resistance (AMR) has become one of the major challenges of the 21st century,¹ with the rapid emergence and spread of multidrug-resistant bacteria being particularly alarming.² In 2019, AMR was responsible for 1.27 million human deaths worldwide.¹ The economic burden of AMR is projected to be between 1.1% (best-case scenario) and 3.8% (worst-case scenario) of global gross domestic product by 2050, with 28.3 million people

potentially pushed into extreme poverty.³ The overuse and misuse of antibiotics have been identified as important drivers of the emergence and spread of AMR,^{4,5} as antimicrobial use (AMU) creates selective pressures that favour resistant bacteria.⁶ As AMR spreads at different scales (from local to global) and between different compartments (humans, animals and the environment),⁷ AMR is a shared challenge for human, animal and ecosystem health.⁸

Previous research has demonstrated the influence of psychosocial determinants on health. These determinants can be

understood as ‘mediating the effects of social structural factors on individual health outcomes, or conditioned and modified by the social structures and contexts in which they exist’.⁹ They include various social factors (e.g. interpersonal relationships, social networks and regulatory structures) operating at different scales that influence psychological processes, and ultimately health outcomes, at the individual level.^{10,11} In the context of AMU, there is increasing evidence that psychosocial factors such as fear, beliefs, risk perception and interpersonal relationships (including interactions with peers/colleagues) may influence antibiotic prescribing practices in hospitals and the community.¹²

Despite this growing body of evidence from public health research, the psychosocial determinants influencing AMU in the livestock sector remain understudied. Qualitative approaches have been used to explore and better understand the psychosocial determinants of AMU. However, most studies have focused on farmers’ perspectives,^{13–20} examining factors such as farmers’ perceptions of the needs and benefits associated with AMU or their willingness to change AMU habits.^{21,22} To our knowledge, few qualitative studies have explored veterinarians’ perspectives on antibiotics.^{23–25} Yet it is now recognized that a better understanding of prescriber behaviour is needed to improve antimicrobial stewardship (AMS) programmes.²⁶ Moreover, these programmes, together with AMU policies, enable the development of official prescribing guidelines, which are a set of recommendations for clinical practice. Research in hospital settings has highlighted the significant influence of informal social norms and unwritten cultural rules, which the authors have termed *prescribing etiquette*, on the prescribing behaviour of doctors and other healthcare professionals.²⁷ Prescribing etiquette is understood and adhered to by all healthcare professionals.²⁸

The present study aimed to fill the gap on the psychosocial determinants associated with antibiotic prescribing practices in the livestock sector by analysing the informal norms and unwritten rules that influence veterinarians’ prescribing decisions. We conducted a qualitative study on a sample of French veterinarians working in the poultry sector. The poultry sector has been identified as one of the main drivers of AMU and the subsequent development of AMR in a variety of countries and contexts.²⁹ By documenting the processes involved in veterinarians’ decisions regarding antibiotics, the results of this case study will be useful for future AMS interventions.

Methods

The study used a qualitative approach and followed the consolidated criteria for reporting qualitative research (COREQ) guidelines.³⁰

Theoretical framework

The interviews followed the biographical narrative interpretive method (BNIM), which focuses on the narrative expression of life stories, using events to explain social processes and dynamics.^{31,32} BNIM can address stories that bridge the gap between formal codified space (e.g. job roles and responsibilities) and informal uncoded space (e.g. relationships and unwritten cultural rules).³¹ This was applied within an interpretivist framework, which focuses on individuals’ explanations of their own experience, and considers the researcher acts as an interpreter of the participants’ descriptions.³³

Participants and setting

The qualitative approach used in this study provided insight into the context and intentions underlying veterinarians’ prescribing practices. An important feature of this type of study is its ability to closely represent the research participants’ perspectives and provide a rich and nuanced account of the phenomenon under study.³⁴ Our purposive sampling strategy therefore aimed to include a range of participants from different veterinary settings and professional experiences found in the poultry sector in France.

We determined our initial sample size based on our prior knowledge of the sector we were researching and taking into consideration general guidance on sample size in qualitative studies using semi-structured interviews, ranging from 9 to 17,³⁴ from 12 and up³⁵ and from 20 to 30.³⁶ Because of our familiarity with the sector, and knowing that the BNIM approach requires adequate discussion to enable participants to elaborate their life stories with sufficient detail to allow for rich data, we decided to target 16 participants. Participants were selected for invitation to participate based on three inclusion criteria:³⁷ (i) the study area, which included four regions to represent different poultry production systems and farm densities: high density of broiler and layer farms (Bretagne), high density of broiler, layer and duck farms (Pays-de-Loire), high density of fattening duck and free-range broiler farms (Northern Nouvelle Aquitaine) and lower density of poultry farms (Auvergne-Rhône-Alpes); (ii) the type of veterinary practice to represent the different ways veterinarians operate in the field, including both independent practices and practices belonging to veterinary corporate groups (networks of veterinary practices that share management and executive functions as well as staff, infrastructure and facilities) and (iii) the professional experience and years of practice in poultry pathology to represent veterinarians at different stages of their professional careers. Snowball sampling (participants recommending other stakeholders for invitation) was then conducted, and continued until it was judged by the researchers that data saturation was achieved. Data saturation was defined as the point at which similar information was repeated by different interviewees.

Data collection

The interviews were conducted remotely using an online conferencing tool in February 2021 due to the constraints of the COVID-19 pandemic. The interviews were conducted using a semi-structured interview guide to let participants express themselves freely without observing a set order of questions.³⁸

The interview guide was drafted by a veterinarian (A.C., undergraduate) and revised by an epidemiologist with an interdisciplinary background (M.P., PhD) under the guidance of a geographer (G.E., PhD), who had extensive experience regarding BNIM methods and qualitative approaches of the veterinary profession. The BNIM framework was adapted to the research topic (Table 1). The questions were framed to cover the evolution of antibiotic prescribing practices in poultry, the decision-making process and choice of antibiotic treatment in poultry, formal and informal professional learning, and veterinary professional relationships. The thematic guide was tested with the participants during the first two interviews, which were included in the results, and the researchers determined on the basis of the information obtained that no changes were necessary. A.C. conducted all interviews with no other observers present. A.C. had no relationship with the participants, no previous experience in the poultry sector, nor had she previously worked with poultry veterinarians. All full interviews in video-audio format were recorded using the online conferencing tool. The interviews were conducted and transcribed in French, and the transcriptions were then translated into English.

Rapport was established at the start of the interview by the interviewer introducing herself, and the interviewer’s background was considered throughout the data collection and analysis for the influence it may have had on the subsequent thematic analysis of results.

Table 1. Simplified examples of the BNIM and its three components in the thematic guide developed to analyse veterinarians' prescribing behaviours

Components	Simplified examples
Single question for inducing narrative: an initial question deliberately broad enough to allow participants to describe their experiences without interruption	'I'm going to let you do the talking for a while. I'd like you to introduce yourself, tell me the history of your career from the time you left school until today, and describe all the important events (...). Then I'd like you to describe how you view the role of drug prescribing in your work, and talk about interactions you may have with your peers/colleagues about clinical cases or the transfer of cases'.
Particular incident narratives: intermediate questions to explore specific incidents and changes in participants' responses	'What do you, in your first job, get out of being part of this network? What do you think about it? What feedback can you give me?' 'Has anyone joined recently? (...) How did they start off?'
Potential follow-up questions: final questions to allow discussion of relevant points not previously expressed	'Have you ever taken over a case from someone else and disagreed with what they've done and wanted to change it a bit? Or discussed it with them and didn't completely agree?' 'When you first started, how did it go? If you were unsure about something, could you consult a reference, was there a guidebook (...), did the network have a clinical practice framework (...) to steer you through your first cases?'

Verbal informed consent was obtained before each interview, which was recorded and transcribed. Participation in the study was voluntary and unpaid.

Data analysis

The transcripts were analysed using reflexive thematic analysis, whereby themes are constructed from the researchers' interactions with the dataset, rather than being defined in advance of the data collection. This thematic analysis was conducted on anonymized transcripts using QSR International's NVivo v.11 software.³⁹ S.M. (PhD, a veterinarian with a social science background), A.C. and M.P. constructed the analysis grid with the help of C.C., J.E. and N.F. (all sociology PhDs), based on their interpretations of participants' representations of their experiences. S.M. and A.C. proposed their lists of themes and sub-themes and the common ones were presented to the research team until consensus was reached on the final list. Each interview was then coded according to the analysis grid.

The transcripts and findings were not returned to participants for feedback, as it was considered that determined that the construction

of themes and sub-themes was principally reliant on the researchers' subjective interpretations of the participants' explanations, consistent with an interpretivist framework. Nonetheless, the trustworthiness and dependability of findings was through extensive discussion within the interview team in consideration of the analysis grid.

Results

Sixteen veterinarians were invited and all participated in the study (Table 2), 13 of whom belonged to one of the two corporate veterinary groups in France. In terms of poultry sector experience, eight were junior veterinarians (less than 3 years' experience), five were intermediate (3–10 years' experience) and three were senior (over 10 years' experience). The interviews lasted from 41 to 119 minutes.

Three main themes were retained for data analysis: (i) compliance with and deviations from prescribing recommendations, (ii) the influence of fellow veterinarians on antibiotic decisions and (iii) the key role of veterinary corporate groups. Illustrative verbatim quotations from the French poultry veterinarians interviewed are given in Table 3.

Compliance with and deviations from prescribing recommendations

Widespread acceptance of AMU policies

All participants stressed that there has been a major change in antibiotic prescribing practices in France over the last decade. They all recognized that successive AMU policies and AMS programmes have played a key role in this change. Most of the veterinarians interviewed agreed with the regulations and felt that AMU had to be reduced given the public health risk of AMR (V4, Table 3). Veterinarians declared that they followed AMU policies without too much inconvenience, as they felt these policies were in line with their daily practices (V7, Table 3). Some interviewees emphasized that the AMU regulatory framework helped them to convince farmers who would have been otherwise reluctant to reduce AMU. Everyone also noted the impact of private antibiotic-free standards on their antibiotic prescribing practices (V2, Table 3). Initiated by producer organizations or downstream actors (such as retailers or food manufacturers), these standards set down concrete specifications related to AMU (e.g. AMU indicators, type of molecules and clinical context).

Although the veterinarians declared that they were largely complying with AMU recommendations, several participants noted that national regulations and private standards were becoming more stringent regarding AMU indicators (e.g. Animal Level of Exposure to Antimicrobials or Treatment Incidence). They questioned how far quantitative targets for AMU reduction could be pushed and stressed that in some cases this reduction could lead to increased mortality or poor animal welfare on farms (V12, Table 3).

Justification of deviations from official prescribing guidelines: the role of empirical knowledge and experience

Although the veterinarians usually complied with official prescribing guidelines, they identified a limited number of clinical situations in which, based on their own clinical experience in the field, they felt these guidelines were ill-adapted to their antibiotic

Table 2. Characteristics of the French poultry veterinarians participating in the study

ID	Region of France	Type of practice	Experience (Year of graduation)
V1	Pays-de-Loire	Veterinary corporate group A	Junior (2019)
V2	Nouvelle Aquitaine	Veterinary corporate group A	Intermediate (2017)
V3	Nouvelle Aquitaine	Veterinary corporate group A	Junior (2018)
V4	Pays-de-Loire	Veterinary corporate group A	Junior (2020)
V5	Auvergne-Rhône-Alpes	Independent	Junior (2018)
V6	Bretagne	Veterinary corporate group A	Intermediate (2014)
V7	Bretagne	Independent	Junior (2018)
V8	Bretagne	Veterinary corporate group B	Intermediate (2004)
V9	Bretagne	Veterinary corporate group B	Junior (2005)
V10	Bretagne	Veterinary corporate group B	Senior (1984)
V11	Bretagne	Veterinary corporate group A	Intermediate (2016)
V12	Pays-de-Loire	Veterinary corporate group B	Senior (2001)
V13	Pays-de-Loire	Veterinary corporate group A	Senior (2003)
V14	Bretagne	Veterinary corporate group B	Junior (2014)
V15	Bretagne	Veterinary corporate group B	Junior (2012)
V16	Auvergne-Rhône-Alpes	Independent	Intermediate (2015)

V(no.): Veterinarian interviewed; A/B: Veterinary corporate group to which the veterinarians belong (there are two in France); Junior: less than 3 years' experience in poultry; Intermediate: 3–10 years' experience; Senior: over 10 years' experience.

Table 3. Illustrative verbatim quotations from the French poultry veterinarians interviewed

ID	Verbatim quotations
Compliance with and deviations from prescribing recommendations	
<i>Widespread acceptance of AMU policies</i>	
V4	'Quite honestly, the regulations are what they are and I won't argue with them, I think they're fine as is'.
V7	'I wouldn't go so far as to say that I disagree with the regulations, which I understand and accept in terms of AMR and everything that implies. We're faced with cases where there's not many antibiotics left on the shelves (...), which we have to deal with'.
V2	'There's also strong customer demand. And we cannot take sole credit for reducing AMU, the corporate groups do a lot. They put on the pressure, and when you feel that pressure, you find ways of responding'.
V12	'We've managed to reduce, and farmers are aware of the issue, but sometimes we have to tell them: 'yes, but we're not going to let the animals die'. And that's difficult (...), at some point you have to make a decision'.
<i>Justification of deviations from official prescribing guidelines: The role of empirical knowledge and experience</i>	
V1	'One of my supervisors doesn't want to use tiamulin at all any more. He used it one day, and although its sensitivity was good on the antibiogram, it didn't work at all (...). <i>In vitro</i> just isn't like <i>in vivo</i> '.
V2	'For these enterococci cases, there are treatments that can be applied when a batch arrives, in particular lincocin and spectinomycin, which are very effective in the field'.
V6	'For tetracyclines, the SPC dose is 40 mg/kg, whereas today we're prescribing 100 mg/kg (...). For tiamulin, we're lowering the dose for price reasons. We're often at 100 mL/tonne of treatment, whereas the SPC dose is 380 mL/tonne'.
The influence of fellow veterinarians on antibiotic decisions	
<i>Transmission between junior and senior veterinarians: The role of mentoring practices</i>	
V7	'For pathology, I started a bit later, always with a lot of support whenever I had a question or any kind of doubt. I got answers back quickly, so I'd say it went very smoothly. It wasn't too tough. It was nice to start out like this'.
V13	'Whoever is prescribing is obviously free to decide on their own, they are the ones who sign the prescription in the end. Of course, the staff under me are free to make up their own minds, but this freedom is going to have some limits'.
V15	'I'd call him after every visit, and even if I didn't call, he'd keep me informed. All the time, that's what it means to have a mentor, to have an adviser'.
V12	'I'd say to her: 'what do we do? what would you do?'. At first, she wasn't sure (...). I'd say: 'I'd do this or that treatment because I suspect this or that disease, it's this or that antibiotic, and I'd combine it with this or that thing'. It was just to get her thinking'.

Continued

Table 3. *Continued*

ID	Verbatim quotations
V3	'It's true that we rarely disagree on how to manage problems (...). I often used to ask other people in my practice how to handle cases when I was just starting (...). I usually tend to follow their lead, I often find myself agreeing with what they do'.
<i>Agreements and disagreements between peers about the management of clinical cases</i>	
V3	'I talked about it with my peer, after the fact, because I didn't understand why, and he explained: "in my experience, amoxicillin doesn't work in this type of production".'
V2	'I've been known to say: "there might be this, there might be that" (...). I'd ask this peer: "listen, I've got this case, what do you think? Should we do this or that instead?"'
V4	'The idea is to be able, despite occasional differences of opinion, to justify this as part of an overall approach to farmers, so that they don't encounter any inconsistencies, regardless of which vet does what on one of their batches'.
V2	'I don't change my mind about a treatment once its prescribed (...). If I made a mistake about the treatment or I could have done better, I'm not necessarily going to call the farmers back and say: "no, actually, we're going to do this instead"'
The key role of veterinary corporate groups	
V10	'It's a way of gathering information, of creating groups on a subject, of working; someone is going to dig deeper into the problem and then share what they find. That's the advantage of being in a group: you're not alone when you're facing a problem'.
V4	'We have prescription guidelines that are defined at the group level (...). It's a safety net. You tell yourself that there's always a guiding thread that can help you figure out which treatment to prescribe'.
V6	'All the vet practices in the network have a laboratory, and we produce annual statistics on antibiotic sensitivity, by species and for each bacterium. It gives everyone an idea and we can do it either at the national level, or at the regional or departmental level'.
V4	'We have our own software for recording autopsy cases, and this lets us compare equivalent cases, to see what was done (...). You can see the lesion assessment and the complementary test and treatment that have been implemented'.
V4	'It's a global approach to antibiotic reduction (...). It's kind of a way to formalise the use of vaccinations, alternative solutions and biosecurity to reduce AMU (...), ensuring that they are used correctly'.

V(no.): Veterinarian interviewed. The verbatim quotations are a translation from French.

prescribing. They explained why and how, in specific situations, their prescribing practices differed from the recommendations.

Some veterinarians said that, for some specific symptoms, they might choose an antibiotic treatment they believed to be effective based on their own experience in the field, even though there was no scientific evidence to support the mode of action of that treatment (V1, Table 3). Some interviewees also explained that in some specific cases they might choose to overrule restrictions on early antibiotic treatment (V2, Table 3). The veterinarians listed antibiotics that they thought should be used at doses other than those indicated in the summary of product characteristics based on the marketing authorization. The arguments given for using these doses were either better efficacy (the actual dose was higher than the recommended dose) or better cost/efficiency (the actual dose was lower than the recommended dose) (V6, Table 3). Some participants also reported that they deviated from prescribing guidelines to adapt treatments to specific physiological stages (e.g. young animals).

The influence of fellow veterinarians on antibiotic decisions

Transmission between junior and senior veterinarians: the role of mentoring practices

The junior participants emphasized that when they first started working as poultry veterinarians, they did not initially feel sufficiently prepared by their academic training to work with confidence. They insisted on the importance of 'field training',

where recent graduates deepen their knowledge and acquire practical skills through mentoring by senior veterinarians (V7, Table 3). 'Field training' was described as a gradual training process through which they had gained autonomy (V13, Table 3). They began by accompanying senior veterinarians on their rounds to become fully immersed in the daily routine of a veterinary practice. Other professionals, such as farmers and laboratory technicians, also played a role in this practical training, sharing their knowledge on specific topics (e.g. management of environmental parameters in poultry buildings and laboratory diagnostics). In a second stage, junior veterinarians handled farm visits with the remote support of a senior veterinarian who gave advice, shared their experience and helped them to gain confidence in their decision making (V15, Table 3). Over time, the support from senior veterinarians became more sporadic. Junior veterinarians explained that even after their 'field training' had ended, they continued to seek guidance from their mentors because of the enduring nature of their close relationship.

The junior veterinarians declared a progressive increase in familiarity with the clinical reasoning and prescribing habits of their mentors (V12, Table 3). They reported a relative lack of disagreement with their colleagues, which was directly related to the companionship process described previously (V3, Table 3).

Participants described the importance of seniority and hierarchical relationships early in their careers, with junior veterinarians legally prescribing antibiotics under the supervision of their mentors, and senior veterinarians remaining the final decision maker and taking moral responsibility.

Agreements and disagreements between peers about the management of clinical cases

All interviewees stressed the importance of interaction and discussion with other veterinarians, which helped them manage complex clinical cases and unfamiliar farm types when they had doubts or needed help (V3, Table 3). They explained that being able to rely on their peers gave them more confidence when faced with complex clinical cases (V2, Table 3).

For antibiotic treatments, advice from peers was based on both the veterinarian's experience of the indications and the expected efficacy. Discussions with other veterinarians were aimed at achieving a consensus among prescribers about a specific clinical situation. When views differed, veterinarians with less experience generally accepted those with more experience, as field experience took precedence. Interviewees emphasized that it was crucial for their professional credibility to be coherent and consistent when talking with farmers (V4, Table 3). The veterinarians interviewed stressed the importance of not deviating from the established prescription of a peer, so as not to 'contradict' themselves in front of the farmers (V2, Table 3).

The key role of veterinary corporate groups

The interviews revealed that veterinary corporate groups played an active role in structuring interactions between veterinarians. The corporate groups coordinated and supported specific working groups with meetings, teleconferences and various social interactions that stimulated knowledge and discussions about practices between veterinarians. The corporate groups also were formally assigned advisers who could be consulted at any time about particular topics in which they held a certain expertise (e.g. specific production systems and phytotherapy) (V10, Table 3).

Participants pointed out that veterinary corporate groups offered training to their members through an updated catalogue of theoretical and practical courses and seminars on specific topics, including antibiotics. In addition to technical aspects, the training covered soft skills, knowledge of the working environment, and sharing 'group culture'. The courses and seminars, which were delivered by different stakeholders depending on the topic (e.g. public or private consultants, representatives of pharmaceutical distributors), helped to promote a common understanding and vision among the veterinarians in a group. Participants highlighted the importance of such training in terms of theoretical and technical veterinary skills, as well as well-being at work and a sense of belonging to a group.

Interviewees explained how recommendations for AMU reduction were translated by veterinary corporate groups into formal in-house guidelines and 'case portfolios' that were regularly updated by different veterinarians (V4, V6, Table 3). Finally, corporate groups used in-house databases, specific shared software and even in-house social networks to facilitate access to material for comparing cases and drawing on peer experience to inform decision making (V4, Table 3).

In addition to guidelines and portfolios, the veterinarians mentioned the existence of know-how and approaches that were transferred between peers and within networks in a less formalized way (V4, Table 3). One veterinarian described the existence of tacit 'prescription instructions' transmitted in writing

between peers belonging to the same corporate group. However, the veterinarians interviewed pointed out the limitations of guidelines for case management, insisting on the autonomy of prescribers and the need to rely on their own clinical judgement.

Discussion

In recent years, there have been significant changes in AMU at the farm level resulting from public policies implemented in several European countries,^{40,41} including France.⁴²⁻⁴⁴ However, efforts are still needed to strengthen AMS in the livestock sector. While public health research has demonstrated the impact of cultural rules on the antibiotic prescribing habits of doctors and pharmacists,^{27,45-47} the influence of cultural rules is often overlooked in studies considering the prescribing habits of veterinarians.^{48,49}

The present study, based on a case study of poultry veterinarians in France, highlights the crucial influence of informal norms and interactions with peers/colleagues on veterinarians' decisions regarding antibiotics. It thus complements previous research on AMU in the livestock sector, which has focused on farmers' decision-making processes.⁵⁰⁻⁵²

All the veterinarians interviewed described important changes in their antibiotic prescribing practices over the last decade towards a sharp reduction in AMU in the poultry sector. This finding is consistent with the quantitative observations of the annual monitoring programme of veterinary antibiotic sales in France.⁵³ According to the participants, regulation played a key role in this change. The veterinarians interviewed had a positive opinion of public policies, and declared that they complied with regulations and guidelines without too much inconvenience, which is in line with observations made in surveys of veterinarians from other European countries.^{54,55} However, the participants also explained how and why they deviated from official guidelines when prescribing antibiotics in some specific clinical situations. They justified non-compliance with recommended doses based on empirical experience and inadequate scientific evidence. This result is consistent with previous research conducted in hospital settings, which showed that doctors relied on their own clinical knowledge and experience to guide their antibiotic prescribing, often considering their patients were 'special' or 'outside' the boundaries of treatment guidelines.²⁷ Participants seemed willing to deviate from official guidelines in a few cases if they felt that empiric doses would lead to better treatment outcomes. However, studies have shown that doctors feel uncomfortable prescribing 'against the evidence'.⁵⁶

The results of this case study help to understand that knowledge and experience acquired in the field is transferred hierarchically, from more experienced veterinarians to less experienced veterinarians, and within defined and established veterinary corporate structures, where this knowledge and experience are formalized. Hierarchical relationships have also been described in the pig sector, where senior veterinarians exert pressure on junior veterinarians to conform to their prescribing habits,⁵⁷ as is the case here, where junior veterinarians end up doing what senior veterinarians say. This finding is in line with some studies in companion animals and in hospital settings where hierarchical systems have been reported.^{27,47,58,59}

Deviation of antibiotic prescribing from official guidelines would allow veterinarians to tailor treatments to specific situations. However, in the absence of scientific evidence, it is difficult to predict what impact such deviation could have with regards to AMR—these treatments could have higher efficiency with favourable outcomes at lower doses, favouring a reduction in AMU or at higher doses, favouring an increase in AMU. It is possible that interactions between junior and senior veterinarians, and between veterinarians from the same corporate group, may favour the reduction of AMU through training interventions that promote such an approach. Such an approach would be perpetuated by the hierarchical transfer of knowledge from senior to junior veterinarians and from corporate groups to their members. However, the perpetuation within these interactions and the transfer of knowledge may also mean that prescribing practices that encourage increased AMU and thus AMR may be difficult to eradicate.

Our findings also show that prescribing habits circulate among veterinarians and are shared in professional circles. First, interviews revealed that junior veterinarians' antibiotic prescribing was strongly influenced by senior veterinarians through 'field training' and mentorship. We showed that senior veterinarians acted as role models and drove the antibiotic prescribing by junior colleagues, as has been described in human medicine and companion animal medicine.^{28,58} This description of the mentoring process thus adds a new angle to previous work suggesting that less experienced veterinarians are influenced by the knowledge and working habits of more experienced colleagues.⁶⁰ Second, we showed that peer networks contributed to sharing prescribing habits at all stages of veterinarians' careers. In contrast to an earlier study that suggested that some veterinarians only consulted others when their own knowledge was insufficient,⁵⁷ participants in the present study insisted on the importance of routine discussions with their peers, both for diagnosis and treatment. The discussion process aimed to achieve consensus on the treatment decision before any interaction with the farmer, which is consistent with previous work showing that inconsistencies between prescribers can be noted by farmers and affect their trust in veterinarians.⁶¹ This also is in line with the idea of 'non-interference' with prescriptions written by others, which is one of the three rules of prescribing etiquette shown by Charani *et al.* in hospital settings.²⁷ Third, our study emphasized the role of corporate groups in shaping the prescribing habits of veterinarians. The veterinary profession is undergoing a significant evolution, with a shift from independent solo veterinarians to team-based interprofessional veterinary practices and the emergence of veterinary corporate groups.⁶² We demonstrated that these groups were active in promoting existing guidelines and even in producing in-house recommendations on antibiotic treatments which were shared among member veterinarians through several coordinated initiatives, including in-house training sessions, peer working groups and shared digital social networks.

This study shows that there is communication and cooperation between different veterinarians, as noted in the European and French veterinary codes of conduct.^{63,64} These ethical codes permeate antibiotic prescribing, but they often remain unwritten or implicit because they are a product of the veterinarians' experience based on their own criteria, as part of their autonomous decision-making process. This study helps to deepen our

understanding of the characteristics of these unwritten codes, which are not always explicit in veterinary codes of conduct, given the diversity of contexts.^{65,66}

Although the principal implications of our results are for the French poultry sector, our findings are worth discussing in the light of challenges in other livestock species and contexts. Our results may be particularly relevant to production systems such as pig and veal farming, which share similarities with the poultry sector, notably a collective approach to medical treatment and integrated organization of the value chain. Future research could investigate whether knowledge is shared in similar ways in these sectors, and could help inform future interventions to modify AMU prescribing practices.

Our study had a number of limitations. In particular, we did not actively investigate questions relating to gender roles as we considered this beyond the scope of our study. However, given that there have been studies where gender roles among veterinarians have been relevant,⁶⁷ it may be interesting to explore this further in future studies. Other limitations included the geographical areas surveyed, as only those with a high density of poultry farms were included, and social desirability, which may have influenced some responses regarding prescription practices.

Overall, our results show that veterinarians' antibiotic prescribing decisions are influenced not only by clinical elements and official treatment guidelines, but also by a set of unwritten rules resulting from social interactions with their peers. We have demonstrated a prescribing etiquette in the veterinary profession, consistent with the concept developed by Charani *et al.* to describe a set of tacit professional rules that drive doctors' antibiotic prescribing practices.²⁸ These findings therefore not only have implications for the design of AMS interventions in the veterinary sector, but also suggest the possibility of learning from and cooperating with interventions addressing prescribing etiquette in the human health sector, as part of a One Health approach to AMR. As AMR is recognized as an issue which has implications for human, animal and ecosystem health, a One Health or cross-sectoral approach is often advocated.⁶⁸ In addition, social science approaches, such as the one used in our study, have enormous potential to inform the design and implementation of One Health interdisciplinary training interventions,⁶⁹ which can take into account social interactions through their unwritten norms. Our results indicate that efforts to influence AMU-related practices should consider peer interactions and the influence of social groups to promote AMU reduction, as well as unwritten professional rules and organizations (such as mentoring, peer influence and clinical and non-clinical leadership). Such an approach has potential application for informing both veterinary and broader One Health interventions to address AMU behaviours.

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Transparency declarations

The authors declare that they have no commercial or financial relationship that could be perceived as a potential conflict of interest related to this study.

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