



**PRESCRIPTION BEHAVIOR, CONSUMPTION, USE AND WASTE MANAGEMENT OF ANTIBIOTICS/
BIOCIDES IN BELGIUM IN VETERINARIANS AND PRIMARY CARE PROVIDERS WORKING WITH SOCIO-
ECONOMICALLY DISADVANTAGED POPULATIONS**



Colofon

Title

Prescription behavior, consumption, use and waste management of antibiotics/ biocides in Belgium in veterinarians and primary care providers working with socio-economically disadvantaged populations.

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ABBREVIATIONS

AMR Antimicrobial resistance

WHO World Health Organization

WOAH World Organization Animal Health

GPs General practitioners

TDF Theoretical Domain Framework

OHA One Health Approach

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SUMMARY

Antimicrobial resistance poses a global threat to public health. Belgium remains one of the leaders in Europe in terms of antibiotic usage and the use of broad-spectrum antibiotics. There is a need for a one health approach to combat AMR, meaning that both veterinary and human primary healthcare are specifically considered for this project. Antibiotic prescribing is a common issue, and the obstacles to prescribing quality in both settings are comparable. To shape future initiatives, there is a need for a better understanding of the barriers and facilitators that can lead to behavior change regarding antibiotic use and prescribing practices. Additionally, more insight is required into antibiotic consumption among socioeconomically vulnerable individuals, as antibiotic usage in this population tends to be higher than in more privileged individuals. Lastly, there is a need for more insight into how public campaigns regarding antibiotics can be evaluated.

To address these needs, three work packages were proposed. These work packages cover various aspects of antibiotic use management and biocides, both in veterinary and human medicine. The Theoretical Domain Framework served as the theoretical basis to assess which domains are already being addressed and contribute to appropriate antibiotic-related behavior, and which domains require more support.

Work package 1 focused on the perception of nineteen veterinarians regarding antibiotic and biocide use, waste disposal, and antibiotics by means of focus groups. Findings emphasized the importance of guidelines, veterinary expertise, and tailored communication between veterinarians and pet owners. They suggested initiatives targeting both owners and supporting veterinarians to encourage a potential shift in mentality towards appropriate antibiotic use. Work package 2 investigated how sixteen general practitioners handle antibiotic and biocide use among socioeconomically vulnerable patients through in-depth interviews. The importance of guidelines emerged, along with the need for good communication skills to engage with patients and address potential lower health literacy and external factors influencing their need for antibiotics. General practitioners expressed the need for more culturally sensitive campaigns that consider the lived experiences of this target group. Work package 3 aimed to evaluate the impact of public campaigns on antibiotic use, identifying specific indicators for both veterinary and human medicine by means of scoping review of twenty two articles. It underscores the need for tailored indicators to evaluate campaigns based on objectives and target audiences. Overall, the research highlights the complexity of antibiotic use and management and the necessity for targeted interventions at different levels to promote appropriate antibiotic use.

In summary, the focus could be on: 1) tailoring guidelines to specific populations (e.g., different species, people in socioeconomically vulnerable positions) and formulating concrete actions to make them feasible for practice, 2) tailoring communication interventions to support veterinarians and GPs in addressing ideas, concerns, and expectations of pet owners and patients, 3) supporting veterinarians and GPs in fostering a shared vision and support for appropriate antibiotic prescribing practices within and across practices, 4) developing tailored campaigns targeting specific demographic groups with specific objectives, 5) establishing clear guidelines and frameworks for waste disposal and biocides, and 6) defining evaluation strategies based on campaign objectives and target audience.

SAMENVATTING

Antimicrobiële resistentie vormt een wereldwijde bedreiging voor de volksgezondheid. België blijft een van de leiders in Europa op het gebied van antibioticagebruik en het gebruik van breedspectrum antibiotica. Er is behoefte aan een One Health benadering om resistentie te bestrijden, wat betekent dat zowel dierengeneeskunde als humane eerstelijnszorg worden betrokken in dit project. Het voorschrijven van antibiotica is een veelvoorkomend probleem, en de obstakels voor het voorschrijven van kwaliteit in beide settings zijn vergelijkbaar. Om toekomstige initiatieven vorm te geven, is er behoefte aan een beter begrip van de barrières en facilitators die kunnen leiden tot gedragsverandering met betrekking tot antibioticagebruik en voorschrijfpraktijken. Bovendien is er meer inzicht nodig in het antibioticagebruik onder sociaaleconomisch kwetsbare personen, aangezien het antibioticagebruik in deze populatie doorgaans hoger ligt dan bij meer bevoorrechte individuen. Tot slot is er behoefte aan meer inzicht in hoe publiekscampagnes over antibiotica kunnen worden geëvalueerd.

Om hierop een antwoord te formuleren, werden drie werkpakketten voorgesteld. Deze werkpakketten behandelen verschillende aspecten van het beheer van antibioticagebruik en biociden, zowel in de diergeneeskunde als in de humane geneeskunde. Het Theoretical Domain Framework diende als theoretische basis om te beoordelen welke domeinen al worden aangepakt en bijdragen aan gepast antibiotica gerelateerd gedrag, en welke domeinen meer ondersteuning nodig hebben.

Werkpakket 1 richtte zich op de perceptie van negentien dierenartsen met betrekking tot het gebruik van antibiotica en biociden, afvalverwijdering en antibiotica door middel van focusgroepen. De bevindingen benadrukten het belang van richtlijnen, diergeneeskundige expertise en op maat gemaakte communicatie tussen dierenartsen en huisdiereigenaren. Ze suggereerden initiatieven die zich richten op zowel eigenaren als het ondersteunen van dierenartsen om een mogelijke verschuiving in mentaliteit naar passend antibioticagebruik aan te moedigen. Werkpakket 2 onderzocht hoe zestien huisartsen antibioticagebruik en het gebruik van biociden bij sociaaleconomisch kwetsbare patiënten behandelen via diepte-interviews. Het belang van richtlijnen kwam naar voren, samen met de noodzaak van goede communicatieve vaardigheden om met patiënten in gesprek te gaan en potentiële lagere gezondheidsvaardigheden en externe factoren die hun behoefte aan antibiotica beïnvloeden, aan te pakken. Huisartsen drongen aan op meer cultuurgevoelige campagnes die inspelen op de leefwereld van deze doelgroep. Werkpakket 3 had tot doel de impact van publiekscampagnes over antibioticagebruik te evalueren, waarbij specifieke indicatoren voor zowel diergeneeskunde als humane geneeskunde werden geïdentificeerd via een overzicht van tweeëntwintig artikels. Het benadrukte de noodzaak van op maat geselecteerde indicatoren om campagnes te evalueren op basis van doelstellingen en doelgroepen.

Samenvattend zou de focus kunnen liggen op: 1) het afstemmen van richtlijnen op specifieke populaties (bijvoorbeeld verschillende diersoorten, mensen in sociaaleconomisch kwetsbare posities) en het formuleren van concrete acties om ze haalbaar te maken voor de praktijk, 2) het afstemmen van communicatie-interventies ter ondersteuning van dierenartsen en huisartsen bij het aanpakken van ideeën, zorgen en verwachtingen van huisdiereigenaren en patiënten, 3) het ondersteunen van dierenartsen en huisartsen bij het bevorderen van een gedeelde visie en ondersteuning voor passende voorschrijfpraktijken van antibiotica binnen en tussen praktijken, 4) het ontwikkelen van op maat gemaakte campagnes gericht op specifieke demografische groepen met specifieke doelstellingen, 5) Het

opstellen van duidelijke richtlijnen en kaders voor afvalverwijdering en biociden, en 6) Het definiëren van evaluatiestrategieën op basis van campagnedoelstellingen en doelgroep.

RESUME

La résistance aux antimicrobiens constitue une menace mondiale pour la santé publique. La Belgique reste l'un des leaders en Europe en termes d'utilisation d'antibiotiques et d'utilisation d'antibiotiques à large spectre. Il est nécessaire d'adopter une "One Health Approach" pour lutter contre la RAM, ce qui signifie que les soins de santé primaires vétérinaires et humains sont spécifiquement pris en compte pour ce projet. La prescription d'antibiotiques est un problème courant, et les obstacles à une prescription de qualité dans les deux contextes sont comparables. Pour façonner les initiatives futures, il est nécessaire de mieux comprendre les barrières et les facilitateurs qui peuvent conduire à un changement de comportement en matière d'utilisation des antibiotiques et de pratiques de prescription. De plus, une meilleure compréhension de la consommation d'antibiotiques chez les personnes socialement vulnérables est nécessaire, car l'utilisation d'antibiotiques dans cette population tend à être plus élevée que chez les personnes plus privilégiées. Enfin, il est nécessaire d'avoir une meilleure compréhension de la manière dont les campagnes publiques sur les antibiotiques peuvent être évaluées.

Pour répondre à ces besoins, trois paquets de travail ont été proposés. Ces paquets de travail couvrent différents aspects de la gestion de l'utilisation des antibiotiques et des biocides, tant dans la médecine vétérinaire que dans la médecine humaine. Le cadre théorique des domaines théoriques a servi de base théorique pour évaluer quels domaines sont déjà abordés et contribuent au comportement approprié lié aux antibiotiques, et quels domaines nécessitent un soutien supplémentaire.

Le paquet de travail 1 s'est concentré sur la perception de dix-neuf vétérinaires concernant l'utilisation des antibiotiques et des biocides, l'élimination des déchets et les antibiotiques au moyen de groupes de discussion. Les résultats ont souligné l'importance des lignes directrices, de l'expertise vétérinaire et de la communication sur mesure entre les vétérinaires et les propriétaires d'animaux. Ils ont suggéré des initiatives ciblant à la fois les propriétaires et soutenant les vétérinaires pour encourager un changement de mentalité potentiel vers une utilisation appropriée des antibiotiques. Le paquet de travail 2 a étudié comment seize médecins généralistes gèrent l'utilisation des antibiotiques et des biocides chez les patients socialement vulnérables grâce à des entretiens approfondis. L'importance des lignes directrices est apparue, ainsi que la nécessité de bonnes compétences en communication pour engager le dialogue avec les patients et aborder les éventuelles lacunes en alphabétisation en santé et les facteurs externes influençant leur besoin d'antibiotiques. Les médecins généralistes ont exprimé le besoin de campagnes plus sensibles sur le plan culturel qui tiennent compte des expériences vécues de ce groupe cible. Le paquet de travail 3 visait à évaluer l'impact des campagnes publiques sur l'utilisation des antibiotiques, en identifiant des indicateurs spécifiques pour la médecine vétérinaire et humaine au moyen d'une revue de la littérature de vingt-deux articles. Il souligne la nécessité d'indicateurs sur mesure pour évaluer les campagnes en fonction des objectifs et des publics cibles. Dans l'ensemble, la recherche met en évidence la complexité de l'utilisation et de la gestion des antibiotiques et la nécessité d'interventions ciblées à différents niveaux pour promouvoir une utilisation appropriée des antibiotiques.

En résumé, l'accent pourrait être mis sur : 1) adapter les directives aux populations spécifiques (par exemple, différentes espèces, personnes en situation de vulnérabilité socio-économique) et formuler des actions concrètes pour les rendre réalisables en pratique, 2) adapter les interventions de communication

pour soutenir les vétérinaires et les médecins généralistes dans la prise en compte des idées, des préoccupations et des attentes des propriétaires d'animaux de compagnie et des patients, 3) soutenir les vétérinaires et les médecins généralistes dans la promotion d'une vision partagée et du soutien pour des pratiques appropriées de prescription d'antibiotiques au sein et entre les pratiques, 4) développer des campagnes sur mesure ciblant des groupes démographiques spécifiques avec des objectifs précis, 5) établir des directives claires et des cadres pour l'élimination des déchets et des biocides, et 6) définir des stratégies d'évaluation basées sur les objectifs de la campagne et le public cible.

BACKGROUND

BACKGROUND

The introduction of antibiotics has allowed major improvements in morbidity and mortality by preventing and treating infections. Despite playing a pivotal role in modern medicine, antibiotics have given rise to the concerning issue of antimicrobial resistance (AMR) (1, 2). The primary driver of AMR is the inappropriate and excessive use of antibiotics in human and veterinary medicine, as well as in agriculture (3). This has created a complex and dynamic landscape where commonplace infections become increasingly difficult to manage, and routine medical procedures like surgeries and chemotherapy carry higher risks (3). Consequently, AMR has emerged as a major threat to public health, jeopardizing the effectiveness of crucial medical interventions and the ability to combat infectious diseases (4).

The World Health Organization (WHO) and the World Organization for Animal Health (WOAH) have expressed significant concerns about AMR. They advocate for actions to reduce and optimize prescriptions and usage of antimicrobials/ antibiotics (5-7). Ideally, addressing AMR involves various components outlined in the One Health Approach (OHA) (7). OHA is characterized by a collaborative effort across different settings to provide solutions for human, animal, and environmental health. Especially AMR is intricately connected to all these dimensions within the OHA (8).

Both, in human and animal health, primary care serves as an important context for the prescription of antibiotics (9, 10). Similarities can be drawn between primary care in companion animal practices and primary care for humans in general practice (11). Both address individuals during consultations, encounter similar indicators for medical care (11). In both human and veterinary medicine, practitioners prescribe medications, including antibiotics, based on factors such as the indication for treatment, the severity of illness, limited diagnostic testing, underlying risk of complications, and, if available, adherence to (inter)national guidelines (12). Guidelines designed to enhance quality of antibiotic prescribing are accessible for both sectors. However, despite the existence of these guidelines, the issue of excessive and inappropriate prescribing remains a significant challenge in both human and veterinary primary care settings (10).

There are two main gaps requiring specific attention. The first gap pertains to veterinary medicine, while the second gap is centered on consumption in human primary care medicine, particularly emphasizing people in socioeconomic vulnerable positions. Concerning the first gap, there is limited knowledge about the prescribing practices of veterinarians in companion animals (13). It is crucial to gain insights into the current approaches to antibiotic prescribing before formulating any recommendations aimed at promoting optimal behavior in this regard. Additionally, within the framework of One Health, understanding these practices is vital as the health of companion animals directly influences the health of individuals within the same household (14). The second gap revolves around human antibiotic prescribing and consumption in primary care within socioeconomically vulnerable populations (15). Research already indicated a correlation between lower socioeconomic status and increased antibiotic prescriptions (16). Belgian data reveals higher antibiotic use among patients with increased allowances compared to those without, and this difference is even more pronounced among patients categorized as having a chronic condition and lower education level (17). General practitioners perceive a greater need for antibiotics of people in vulnerable positions, even considering factors such as the perceived ability to self-care, the likelihood of re-consultations, the risk of complications, and the impact of not working when making prescribing decisions (18). Addressing the health gap and health inequalities necessitates acknowledging the diverse needs, especially among socioeconomically vulnerable groups. Future actions, campaigns, and

policies should cater to the needs of all citizens, with tailored approaches for specific target groups to effectively address health disparities. Those future actions must be integrated into the everyday reality of prescribers. Therefore, it is crucial to begin by understanding the contexts of both human and veterinary medicine to formulate recommendations that encourage appropriate prescribing behavior.

Nevertheless, numerous initiatives have been implemented to promote awareness of antibiotics. These efforts encompass events like the European Antibiotic Awareness Day, aiming to foster proper antibiotic usage among both the general public and prescribers (19). Despite the initial success of this campaign, its impact diminishes over time, as indicated by the Eurobarometer, revealing that many patients lack sufficient awareness of the appropriate use of antibiotics. Moreover, there is a need to gain a clearer understanding of the specific aspects a campaign should emphasize and how its effectiveness should be evaluated (20).

In addition to the crucial role of antibiotics, responsible management of biocides is equally significant. Biocides, which are antimicrobial agents present in disinfectants and cleaning products, can also contribute to the emergence of antimicrobial resistance (AMR) (21). The widespread use of biocides has notably surged, particularly since the onset of the COVID-19 pandemic. Therefore, it is essential to accord proper attention to biocides within the framework of a One Health approach.

To conclude the discussion on the identified gaps and concerns, it is imperative to initially comprehend the perspectives and experiences of primary care physicians and veterinarians concerning antibiotic prescribing and usage. Building on this understanding, recommendations can be developed to promote behavioral changes that align with more appropriate antibiotic policies.

To achieve this objective, three research questions, each corresponding to a distinct work package, are suggested.

Work package 1

RQ: How do veterinarians perceive their use of antibiotics/ biocides, the disposal of antibiotic and biocidal waste, and the consumption of pet antibiotics by pet owners?

Work package 2

RQ: How do general practitioners who work with socio-economically vulnerable groups perceive antibiotic prescribing behavior, antibiotic consumption, and the use and disposal of antibiotics and biocides?

Work package 3

RQ: What are the possibilities to evaluate the impact of public campaigns on antibiotics on the public and prescribers and which process indicators can be used for this?

Figure 1 Overview research questions per work package

Each work package will be presented separately. What follows is a the general methodology that has been applied for all work packages.

METHOD

GENERAL METHOD

The most suitable methodology for each work package was employed. The detailed description of these approaches will be described individually. Across all work packages, the Theoretical Domain Framework (TDF) was consistently utilized. The TDF has been developed and validated by behavioral scientists to identify barriers and enables to adopting particular behaviors. The TDF has fourteen domains which are distillations of psychological constructs from behavior change theory. The TDF has served as a consistent framework across the three distinct work packages, enabling a comprehensive examination of strategies to address the fundamental mechanisms promoting behavior change. This with the overall aim to enhance appropriate antibiotic use and prescription practices and prescription practices (14).

Table 1 Domains Theoretical Domain Framework

Domain	Explanation
Knowledge	An awareness of the existence of something.
Skills	An ability or proficiency acquired through practice.
Social/ professional role and identity	A coherent set of behaviors and displayed personal qualities of an individual in a social or work setting.
Belief about capabilities	Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use.
Optimism	The confidence that things will happen for the best, or that desired goals will be attained.
Beliefs about consequences	Acceptance of the truth, reality, or validity about outcomes of a behavior in a given situation.
Reinforcement	Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus.
Intentions	A conscious decision to perform a behavior or a resolve to act in a certain way.
Goals	Mental representation of outcomes or end states that an individual wants to achieve
Memory, attention, and decision process	The ability to retain information, focus selectively on aspects of the environment, and choose between two or more alternatives.
Environmental context and resources	Any circumstances of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behavior.
Social influences	Those interpersonal processes that can cause an individual to change their thoughts, feelings, or behaviors.
Emotion	A complex reaction pattern, involving experiential, behavioral, and physiological elements, by which the individual attempts to deal with a personally significant matter or event.
Behavioral regulation	Anything aimed at managing or changing objectively observed or measured actions.

RESULTS

WORK PACKAGE 1

How do veterinarians perceive (1) their use of antibiotics/ biocides, (2) the disposal of antibiotic and biocidal waste, and (3) the consumption of pet antibiotics by customers?

AIM

The first work package aims to gain more insight into how veterinarians perceive their use of antibiotics/biocides, the disposal of antibiotic and biocidal waste, and the consumption of pet antibiotics by pet owners.

DESIGN

In this work package, a qualitative design was employed, involving focus groups with veterinarians. Qualitative design emphasizes the comprehension and interpretation of phenomena from the perspectives of those experiencing the phenomenon. This approach is particularly well-suited for delving into meanings and subjective experiences of individuals or groups within their natural contexts. The focus is on describing and/or understanding the behavior. The chosen qualitative approach proves ideal for this work package, enabling a nuanced exploration of veterinarians' experiences and detailed examination of behavior-related determinants. This, in turn, facilitates the development of interventions targeted at reducing antibiotic resistance.

SETTING

This study is conducted among both Flemish and Walloon veterinarians who are representative of the entire veterinarian population in Belgium. These veterinarians work under various arrangements, including self-employed status, as employees, or as (co-)owners of practices. Additionally, veterinarians affiliated with a group are also included in the recruitment process.

SAMPLE

For the focus groups, companion animal veterinarians were recruited as participants. The recruitment approach involved purposive and convenience sampling, wherein veterinarians fitting the predefined study profile were selected from the researchers' network via newsletters, social media, and professional organizations. For the purposive sampling, predefined criteria were used to identify veterinarians with experience in prescribing antibiotics and handling biocides and waste management. Convenience sampling involves recruiting veterinarians from the personal network of the researchers. Recruitment responsibilities rest with the research team at Ghent University's Faculty of Veterinary Medicine and the partners at ULiège. The recruitment process aims to ensure diversity by considering variations in years of work experience, practice type, geographic location, and gender. Participants are remunerated with a €20 voucher for their participation.

DATA COLLECTION

To address the research question, focus groups were convened in both the Dutch-speaking and French-speaking regions of the country. Focus groups allow for discussion and interaction among the participants capturing different perspectives into one overall understanding. A topic guide was developed based on the TDF and existing literature and discussed within the research team. The topics covered the veterinarian's experiences in prescribing antibiotics, communication with pet owners, (government) campaigns, the use of biocides, and the disposal of antibiotics and biocides. After each focus group, the topic guide was adjusted to address remaining knowledge gaps. These focus groups were conducted digitally using Teams. A moderator who is trained in qualitative interviewing, either a member of the core research team for Dutch-language sessions or a designated French-speaking researcher, led each focus group. An observer attended each session to record notes throughout and relay additional questions to

the moderator and took field notes. The researchers leading the focus groups are trained in qualitative research methodologies. The anticipated duration for each focus group was set at 90 minutes.

DATA ANALYSIS

The focus groups were audio-recorded and transcribed verbatim. The analysis of the focus groups was characterized by an iterative process and unfolded in two distinct phases, namely an inductive and a deductive phase (22). In the initial phase, an inductive analysis approach was employed, allowing for an open exploration of the data. This inductive analysis followed a thematic method, involving coding, formulation of sub-themes, and the development of overarching themes (23). Initially, the two Dutch-language focus groups were independently analyzed by ZdM (veterinarian) and DB (qualitative research expert), researchers within the project team. In order to enhance trustworthiness of the findings, ZdM and DB collaboratively reviewed their analyses, reaching consensus on formulated codes and subthemes. At different stages of the analysis process, researchers' triangulation was performed by discussing the (preliminary) results with the core research team SA (qualitative research expert and implementation scientist), ADC (veterinarian), and JD (veterinarian). The preliminary findings were shared and deliberated upon with the core research team, leading to an initial refinement of the analyses. Following this, the French-language focus group underwent a similar analysis. The outcomes of these analyses were presented and discussed during the steering committee meeting on December 13 2023, allowing another round of validating the results. The presentation and discussion of results aimed to offer an integrated understanding of the behavioral components requiring attention to enhance responsible antibiotic prescribing practices. In the second phase, the findings coming from the inductive analysis were deductively compared with the domains of the Theoretical Domain Framework allowing to detect similarities or differences with the results found in the focus groups.

RESULTS

A total of 19 veterinarians participated in three focus groups. An overview of the participants is given in Table 2. The focus groups lasted between 74 and 87 minutes. A distinction in participants was made between their years of working experience, setting, working area.

Table 2 Characteristics participants

	Number
Sex	
Women	12
Men	6
Unknown	1
Years of experience	
0-5y	4
6-10y	2
11-20y	4
>21y	6
Unknown	3
Level	
First line	16
Secondary line	2 (+2 combination)
Unknown	2
Practice	

Solo	4
Group	8
Centre	3
Hospital	1
Unknown	3

Inductive analysis

Six themes (Table 3) could be elicited from the transcripts.

Table 3 Overview themes

Themes

1. The principles guiding the decision-making process for antibiotic prescriptions.
2. The rationale informing the selection of treatment options.
3. The importance of communicating within and across practices.
4. The initiatives taken to increase awareness about the proper use of antibiotics.
5. The factors considered in relation to biocides.
6. The strategies currently in place for managing waste disposal.

Theme 1: The principles guiding the decision making process for antibiotic prescriptions

1.1 Underpinning decisions for antibiotic prescribing with guidelines and protocols

The participants expressed that the formulation of guidelines could establish a standardized approach for determining the appropriateness of prescribing antibiotics. Such guidelines would serve as a reference to well-thought decisions. The significance of guidelines extends to a broader policy applicable across veterinary practices, promoting a uniform approach for antibiotic prescribing. The participants believed that having consistent guidelines will reduce instances of owners seeking multiple opinions or expressing dissatisfaction in online reviews. Despite the numerous advantages highlighted by the participants, not everyone seemed supportive. The primary concern was that the veterinarian's expertise would be undervalued, and adherence to guidelines would impede therapeutic freedom. This sentiment underscores the importance of allowing room for exceptions. The flexibility to make exceptions should be particularly allowed in emergencies or in specific cases depending on the animals' characteristics (e.g., Newfoundlander with pyoderma). It was shared that this flexibility will allow veterinarians to maintain their therapeutic autonomy, making decisions based on their professional judgment.

"I think that the combination of guidelines with room for exceptions. An aggressive cat, it has to remain workable." (FG1, P4)

1.2 Using diagnostic tools to support the decision of prescribing antibiotics

The participants mentioned that diagnostic tools or examinations serve various purposes in veterinary practice. The first purpose pertains to the crucial role they have in determining the root cause of an animal's medical issue, distinguishing between viral and bacterial origins. This enabled the veterinarians to initiate a suitable and well-considered treatment before relying to antibiotics. The second purpose concerns cases where antibiotics have already been prescribed, indicating a prior decision to administer

antibiotics, perhaps because the animal required urgent treatment. In such cases, diagnostic tests are used to determine whether this treatment is appropriate or if adjustments are necessary.

It is important to note that not all participants administered diagnostic tests (such as antibiograms). Veterinarians with substantial evidence from clinical examinations were less inclined to perform tests. Additionally, in situations where the animal's overall clinical condition, such as fever or an infected wound, justifies the use of antibiotics, diagnostic tools may not be utilized.

The participants also encountered a financial barrier when deciding whether to undergo testing or not. Currently, these tests are not reimbursed, potentially influencing the choice to forgo testing altogether. Consequently, veterinarians are expressing a need for an examination of potential reimbursement options.

"We're also trying to do more and more antibiotic susceptibility tests, the limiting factor being the price. I do a lot of dermatology after antibiotic testing, but I don't do it systematically, because I use my microscope." (FG3, P2)

1.3 Acknowledging the veterinarians' expertise in decision making

A common worry among the participants was that the potential adoption of guidelines may not fully acknowledge their expertise and practical experiences, as mentioned in "1.1". The knowledge acquired through hands-on experience appears to be just as crucial as the scientific evidence derived from diagnostic tests and guidelines in the decision-making process of whether to prescribe antibiotics or not. Veterinarians have expressed the need for a reasonable degree of therapeutic autonomy, emphasizing the importance of being able to prescribe treatments they deem most suitable based on their judgment and experience.

"I'm not the biggest advocate for standard protocols and such, I shudder a bit at that. You may pass that along as a scientific basis, but I think you have to give the veterinarian the freedom to still do what they ultimately want with that." (FG2, P4)

1.4 Considering the owners' characteristics in the decision-making process

The participants indicated that they consider the owners' characteristics and highlighted two primary factors. First is the matter of the owner compliance, a factor the veterinarian evaluates. The level of adherence to therapy significantly influences the veterinarian's decision on whether and which antibiotics to prescribe. For example, if a veterinarian foresees that an owner would not consistently follow a treatment regimen, they may be hesitant to prescribe antibiotics. Drawing from the veterinarians' experiences, owners may struggle to consistently adhere to treatment plans, potentially leading to prolonged healing for the animal or, over time, contributing to antibiotic resistance.

"It's also the problem of compliance as we were talking about treatment duration. Sometimes it's really the complexity of compliance, so we'll sometimes have to prolong treatments because the risk of poor compliance is really present"
(FG3, P2).

The second factor tied to owners' characteristics involved both the financial capacity of the owner and their financial motivation. Veterinarians often expressed a preference for monitoring appointments or conducting additional examination before recommending antibiotics. In response, owners may express

concerns about the overall cost of the treatment. Alternatively, veterinarians indicated that they consider the owner's financial constraints when determining a treatment plan, opting for alternatives if the owner is unable to afford the prescribed treatment.

In conclusion for theme 1, the multifaceted decision-making process in veterinary medicine, particularly regarding antibiotic prescriptions, involves a balance between guidelines, diagnostic tools, veterinarian expertise, and consideration of owners' characteristics. The formulation of guidelines is recognized as a valuable tool for standardizing approaches to antibiotic prescribing, offering a reference point for decisions. However, maintaining flexibility within these guidelines, especially in emergencies or unique cases, is crucial to preserving veterinarians' therapeutic autonomy and expertise. Diagnostic tools play a pivotal role in identifying the root cause of medical issues, guiding appropriate treatments and confirming ongoing antibiotic therapies. The acknowledgment of veterinarians' practical experience and expertise is highlighted as imperative, suggesting that guidelines should not undervalue their judgment. Additionally, the decision-making process involves a nuanced consideration of owners' characteristics, including compliance and financial capacity, influencing the prescription choices and treatment plans. Striking a harmonious balance between these elements is essential for effective and compassionate veterinary care, ensuring optimal outcomes for both animals and their owners.

Theme 2: The rationale informing the selection of treatment options.

2.1 Being aware of the availability of antibiotics

The participants experienced that veterinary medicine is confronted by a significant challenge due to the diverse requirements for antibiotics across different animal species and conditions. This variability makes it challenging to consistently prescribe precise doses for every situation. Failure to administer accurate doses poses a potential risk to antibiotic resistance over time, underscoring the importance of a careful and tailored approach to prescribing antibiotics in veterinary practice.

"The problem we also have with chickens is that first-line antibiotic is not available in small quantities. That's often in 100g or 100ml sachets, but to treat one domestic chicken, that's... That's not where we're going to get it right for antibiotic resistance either, of course, so we do have a problem there often."

(FG1, P5)

2.2 Exploring alternative therapies to avoid antibiotics

The participants mentioned that they have been exploring alternative treatment options due to advancements in technology and updated scientific knowledge. The increasing availability of alternatives in the market aims to reduce the reliance on antibiotics. While participants expressed openness to these alternative therapies, challenges such as limited availability and high costs often impede their widespread adoption. Particularly, veterinarians specializing in dermatology are considering options like shampoo, laser therapy as potential alternatives for antibiotics.

"What I also like, lately in ear preparations is that there are quite a few options for otitis after all, with Malassezia's for example... or with bacterial infections that are not yet treatable with preparations without antibiotics that really do work quite effectively." (FG2,P6)

Another emerging trend that was shared involved delaying antibiotic prescriptions and encouraging owners to schedule follow-up appointments. Veterinarians may opt to observe the animal's condition for a bit longer before resorting to antibiotics. However, this approach sometimes contradicts the owners' desire for a swift resolution to their animal's health issues. In this context, a comparison was drawn with human medicine, where check-up appointments are more regularly scheduled to monitor an individual's health status. This analogy aims to convey to pet owners that adopting a wait-and-see approach could potentially serve as a viable treatment for their animals. Despite the inclination of owners toward swift solutions, the financial constraints and capacities of owners also come into play. Notably, the absence of reimbursement in veterinary medicine adds to the desire for quick solutions, as owners may find it challenging to afford multiple checkup appointments.

2.3 Learning from international good practices to enhance appropriate antibiotic use

The participants emphasized the importance of seeking examples from international contexts to adapt and learn from each other. They believe that this approach is crucial in developing a consistent antibiotic policy essential for addressing antibiotic resistance. Examining successful and unsuccessful practices from other countries is seen as a pivotal step in refining guidelines and establishing a unified policy.

"Scandinavia has already made more progress. For quite some time now, they have prohibited prescription of antibiotics without... It is worthwhile to explore their approach and learn from their experiences. We are not the first country to grapple with this issue, and there are countries that have already implemented more stringent measures." (FG1, P4)

In conclusion for theme 2, the subthemes highlight the difficulty in prescribing precise antibiotic doses across different animal species and conditions, emphasizing the need for a careful and tailored approach to avoid contributing to antibiotic resistance. The exploration of alternative therapies is mentioned, with veterinarians showing openness but facing challenges such as limited availability and high costs. The theme also touches upon the emerging trend of delaying antibiotic prescriptions and encouraging follow-up appointments, drawing a comparison with human medicine. Additionally, veterinarians stress the importance of learning from international practices to develop a consistent antibiotic policy and address antibiotic resistance comprehensively.

Theme 3: The importance of community within and across practices

3.1 Acknowledging the importance of communication between veterinarians and owners

The participants underscored the significance of effective communication with pet owners. Communication served a dual purpose: firstly, educating owners about the risks associated with antibiotics and antibiotic resistance, and secondly, discussing treatment types or options while conveying that antibiotics may not always be the most advisable choice. Taking the time to listen to owners' concerns and providing thorough information about the chosen therapy contributed to building trust between veterinarians and owners. This trust is crucial for fostering owners' compliance with the prescribed therapy.

While the emphasis on communication emerged strongly in the focus groups, some veterinarians noted that they ultimately hold the decision-making authority. They possess the theoretical expertise and

authority to determine the most appropriate treatment. In this context, the owner may be viewed as a passive recipient, as it is the veterinarian's responsibility to decide when and how antibiotics should be used.

“It is true that owners are generally receptive to our decisions, and I believe that we should assert our authority a bit more. Ultimately, as veterinarians, it is our responsibility to determine when to prescribe antibiotics and when to refrain from doing so.” (FG2, P5)

3.2 Investing in communication across practices

The participants highlighted that within a group practice, there is already consistent collaboration among themselves to reinforce the significance of responsible antibiotic prescribing. They function as an internal control mechanism in such environments. Beyond the confines of the practice, it is essential to explore communication strategies aimed at aligning antibiotic policies. Participants emphasized that this approach enables them to convey a more cohesive message to pet owners. They have observed that owners are more likely to seek consultations even when a specific veterinarian avoid prescribing antibiotics upon request. To achieve this, veterinarians emphasized the importance of communicating within and across practices to maintain a consistent policy regarding antibiotic prescribing.

“I’d like to touch upon the mindset among veterinarians within our group practice, which comprises both younger and slightly older colleagues. You can observe that the younger colleagues are somewhat more concerned about antibiotic resistance, and the older colleagues share these concerns in some extent. However, we do support and motivate each other in addressing this issue. We frequently engage in discussions about how to handle different cases, considering various options.” (FG1, P2)

In conclusion for theme 3, veterinarians emphasize the crucial role of effective communication with pet owners regarding antibiotics. This involves educating owners about associated risks and resistance, discussing treatment options, and conveying that antibiotics may not always be the best choice. Building trust through attentive listening and comprehensive information is vital for owner compliance. Despite the importance of communication, some veterinarians assert their decision-making authority based on expertise. Within group practices, veterinarians serve as internal controls, emphasizing responsible antibiotic prescribing. Collaboration in these settings is already robust, but extending communication strategies beyond the practice walls is recommended to align antibiotic policies and convey a unified message to pet owners. Veterinarians note that synchronized policies and adherence to beneficial guidelines can address challenges, such as owners seeking consultations specifically for antibiotics even when a veterinarian deems them unnecessary.

Theme 4: The initiatives taken to increase awareness about the proper use of antibiotics.

4.1 Supporting a mind shift in veterinarians and owners for enhancing appropriate antibiotic use

The participants highlighted the necessity for a shift in attitude when it comes to antibiotic prescribing, citing the example of the change in regulations for Convenia (a long working antibiotic that requires only one injection) as a prominent illustration. The tendency to quickly prescribe antibiotics, especially in cases of aggressive cats, was frequently mentioned. There is a growing awareness among veterinarians about the need to delay antibiotic prescriptions due to the escalating concern about antibiotic resistance.

In addition to veterinarians, owners also require a change in attitude. To achieve this, they need better education on the risks of antibiotics and the importance of exercising patience. Veterinarians drew parallels with human medicine, emphasizing that owners often wait and attend check-up appointments with general practitioners, a behavior that does not consistently translate to their approach to veterinary care. Drawing this comparison during consultations can enhance owners' awareness of responsible antibiotic use for their animals.

“There’s a distinct mindset difference among pet owners compared to individuals who visit a general practitioner. When the family doctor suggest taking a few days to figure things out, people are generally accepting. However, when it comes to pets, the expectation is for them to improve preferably on the same day or the day after reflecting an entirely different mindset.” (FG2, P2)

4.2 Raising awareness in public to increase knowledge about appropriate antibiotic use

The participants emphasized the significance of public campaigns targeting both the general population and their fellow professionals to enhance awareness and understanding of the importance of responsible antibiotic use. They noted that existing campaigns occasionally fall short of their objectives as they may not effectively reach or inform the intended audience in a way that is engaging. For instance, traditional methods like distributing flyers are often overlooked and may not sufficiently educate the public to bring about the desired change in antibiotic use. Veterinarians stressed the need for meticulously crafted campaigns tailored to specific target groups to ensure maximum impact and effectiveness.

“I was suggesting that while having flyers is beneficial, we might also consider engaging in social media campaigns with visually appealing content. Something that’s eye-catching and attractive – that’s the key. Perhaps, even incorporating a humorous yet informative pun that could go viral and effectively educate our clientele.” (FG3, P3)

4.3 Organizing continuous learning programs to gain knowledge about appropriate antibiotic use

The participants underscored the significance of adopting a lifelong learning approach to stay well-versed in the latest developments concerning antibiotics. They emphasized that their practices are heavily influenced by recent research discoveries, updated guidelines, and similar advancements. Additionally, veterinarians highlighted the importance of comprehensive continuing education. Ideally, they aim to diversify their educational sources by selecting programs from various organizations and lecturers to gain a broad perspective. It was also noted that both individual veterinarians and veterinary organizations share the responsibility of allocating ample attention and resources to ensure ongoing education.

“I believe it might be beneficial not always to learn from the same instructors during continuing education courses. This way, you avoid constantly reinforcing your existing thought patterns. It can be valuable to occasionally hear perspectives from instructors in foreign countries to gain diverse insights.” (FG 1, P5)

In conclusion for theme 4, veterinarians advocate for a mindset shift in antibiotic use, citing the need to reevaluate prescribing practices, particularly in cases like Convenia and quick antibiotic decisions for aggressive cats. Awareness grows about delaying prescriptions due to rising antibiotic resistance concerns. Owners also need an attitude change, requiring education on antibiotic risks and patience. Drawing parallels with human medicine during consultations enhances awareness. In raising public awareness, veterinarians stress the importance of targeted campaigns tailored to specific groups for effective communication. Traditional methods may fall short, emphasizing the need for meticulous strategies. Continuous learning is crucial, with veterinarians highlighting the lifelong learning approach, incorporating diverse sources for a comprehensive perspective. Both individual veterinarians and organizations share the responsibility of dedicating resources to ongoing education.

Theme 5: The factors taken into account in relation to biocides.

5.1 Implementing guidelines directed by the company

The participants conveyed a lack of comprehensive understanding regarding biocide measures within their practice. Often, these veterinarians were part of a larger chain or network where they adhered to the products and guidelines prescribed by the corporate. In such cases, their awareness and control over specific biocides measures may be constrained, as they primarily followed the standardized procedures set forth by the overarching organization or chain to which they belonged. As such, the implementation of these measures was largely guided by the policies and protocols established at the chain level rather than being independently determined by the individual veterinarians in the practice.

5.2 Applying knowledge gained at university

Based on the participants' experiences, novice veterinarians tend to primarily follow the guidelines they were taught during their training. This observation suggests that there may be a deficiency in comprehensive and clearly defined policies for the uniform and unambiguous application of appropriate biocides use in veterinary practices. The reliance on training guidelines indicates a potential gap in the provision of standardized and explicit protocols specifically addressing the use of biocides. Consequently, there may be a need for more robust and accessible policies that guide novice veterinarians in the consistent and effective implementation of biocides measures within their practice.

“To be honest, this was part of the curriculum at the faculty, and I still adhere to those teachings. For instance, when it comes to surgical field disinfection, I follow the guideline of using 1% isobetadine.”
(FG2, P2)

5.3 Being aware of the impact on the environment

The participants mentioned that they consciously selected products, taking into account the minimizing impact on nature and the ecosystem. Veterinarians may prioritize eco-friendly or sustainable options, considering factors such as the materials used, production processes, and the overall ecological footprint of the chosen products.

“We are gradually moving towards incorporating products based on probiotics, extending their usage to disinfecting cages, hospitalization areas, and so forth.” (FG3, P4)

In conclusion for theme 5, in the implementation of guidelines directed by the company, veterinarians often exhibit limited awareness of biocide measures, relying on the products and guidelines set by the chain they work for. Novice veterinarians primarily follow training guidelines, indicating a lack of clear policies for consistent biocide use. Additionally, veterinarians demonstrate environmental awareness by making product choices that aim to minimize their impact on nature and the ecosystem.

Theme 6: The strategies currently in place for managing waste disposal.

6.1 Lacking a clear waste policy

The participants noted the absence of a clear waste policy and currently utilize available options, like the yellow container for needles. There exists some confusion about the policies and the proper waste sorting. The current measures in place are enforced by veterinarians, indicating a dependence on established regulations.

“Essentially, it seems like we should dispose of compresses, pads, and even the diapers beneath our patients, which may have some runoff, into those yellow containers. However, I haven't observed this practice much. It appears that only academic institutions consistently follow this protocol, whereas in regular practices, everything is placed in special containers picked up by waste disposal companies and eventually incinerated. Thus, I question the necessity of tossing empty chlorhexidine cans into the yellow container, as it can quickly fill up, especially if you dispose of a large 10-liter can of Ecutan. In such cases, the box might be full, or you'd have to cut it open.” (FG2, P3)

Deductive analysis

For the deductive analysis, the data from the inductive analysis were mapped with the domains of the Theoretical Domain Framework. These domains can provide information about which of them already influence any behavior. By mapping the data in this way, insight is gained into which domains already contribute to certain behaviors, in this case, appropriate prescribing of antibiotics, and which domains can still be reinforced.

The participants have knowledge about diagnostic tests, which they also use in some cases to determine the necessity of antibiotics. Additionally, they are constantly looking for diagnostic tools to determine whether antibiotics are necessary or to support their reasoning (*knowledge*). They possess the appropriate skills to adjust their decision on whether to prescribe antibiotics based on the capabilities and willingness of the owners (*skills*). The participants also indicated that through their years of training, they have built up sufficient expertise and thus embody their identity as veterinarians capable of determining when antibiotics are necessary (*social/professional role and identity + beliefs about capabilities*). In other words, it is a combination of the available tools, theoretical knowledge, and expertise of the owners, along with the characteristics of the owners and the animal, that determine the extent to which antibiotics are prescribed.

The participants also had a positive attitude towards combating antibiotic resistance (*positivism*). They acknowledged the importance of continuing to address this issue and taking responsibility for it. They were also aware of the problem of antibiotic resistance and expressed a willingness to contribute to

reducing the risks associated with it (*beliefs about consequences*). Additionally, veterinarians served as a control mechanism for each other and raised awareness of the importance of mindful prescribing (*social influences + behavioral regulation*).

Focused on biocides and waste management, the participants indicated that if they work for a corporation, they follow its guidelines and utilize the materials provided by them (*environmental context and resources*).

While considerable attention has been devoted to improving knowledge regarding antibiotics and antibiotic resistance, there are still opportunities for improvement. Among veterinarians, there is little knowledge regarding the AMCRA guidelines, which were hardly mentioned during the interviews (*knowledge*). There could be more effort put into creating visibility and awareness of these guidelines. Additionally, veterinarians indicated that there should be more emphasis on lifelong learning with knowledge exchange across different borders (*reinforcement*). Lastly, more awareness needs to be created among owners regarding the responsible use of antibiotics or which campaigns need to be established to inform and educate the owners (*reinforcement*).

Participants are knowledgeable about the use of diagnostic test, using them to support them in prescribing antibiotics or confirming them in the already prescribed treatment. Years of training and experience shape their identity as skilled veterinarians. They show a positive attitude towards combating antibiotic resistance and advocate for responsible use. Veterinarians monitor each other's prescribing habits and follow corporate guidelines. However, gaps in knowledge persists, particularly regarding AMCRA guidelines, suggesting a need for increased awareness and education efforts, in both veterinarians and pet owners.

WORK PACKAGE 2

How do general practitioners who work with socio-economically vulnerable groups perceive antibiotic prescribing behavior, antibiotic consumption, and the use and disposal of antibiotics and biocides?

AIM

The second work package aims to explore the dynamics of how socioeconomically disadvantaged people in Belgium, along with their general practitioner (GP), manage the utilization, disposal, and application of antibiotics and biocides. This will support the development of precise and potentially tailored messages and interventions.

Simultaneously, this work package will explore how general practitioners navigate the realm of biocides. This includes examining motivation, criteria, and indications for purchasing biocides, ensuring their correct usage, implementing effective waste policies, and exploring potential influences of COVID-19 on these practices.

DESIGN

Similar to work package 1, a qualitative design was used, involving individual interviews with general practitioners (GPs). This approach was well-suited for delving into the experiences of GPs regarding antibiotics and biocides in socioeconomically disadvantaged people. This facilitates the development of interventions aimed at reducing antibiotics.

SETTING

This research focuses on primary care in Belgium, specifically on general practitioners (GPs). Primary care is a regional responsibility, which means it is organized differently in Flanders than in Wallonia. It offers directly accessible care to everyone. GPs work both independently in solo practices, as well as independently or as part of a group practice, or in a fixed-rate practice. The practice model determines how a GP is financed and organized.

SAMPLE

To conduct in-depth online individual interviews, general practitioners (GPs) engaged in providing healthcare to socioeconomically disadvantaged populations were enlisted. The selection process involved an initial document analysis to identify organizations, GPs, and areas with relevant experience. The identified GPs, primarily situated in community health centers and associated with organizations like Doctors of the World, spanned across Belgium. Similar to WP1, the recruitment strategy employed purposive and convenience sampling. The established inclusion criteria were as follows:

- Willing and capable of providing informed consent for study participation.
- Age 18 years of older
- Currently employed in Belgium as GP involved in antibiotic prescribing
- Currently working with socio-economically disadvantaged people
- Proficient in Dutch, French, or English

Additionally, the recruitment aimed to ensure diversity among participants concerning age, gender, years of experience, and geographic location. The sample size will be determined by data saturation resulting from an iterative data collection and analyzing process, indicating no emergence of new themes in subsequent interview data. However, an estimated 15-20 interviews are anticipated. Participants were remunerated with a €20 voucher for their participation.

DATA COLLECTION

Potential participants received invitations via email or telephone contact. An invitation was complemented by a Participation Information Leaflet that contained further study details. Participants contacted via telephone received brief verbal information, with supporting materials sent through email. Those interested were then scheduled for an interview. For French-speaking GPs, recruitment and data collection were overseen by partners at ULiège. GPs who were willing to participate, took part in one in-depth interview. Interviews were carried out remotely, either by telephone or video call by MS Teams, based on the participant's preference. Depending on the native language of the participant, a native speaker trained in qualitative interviewing conducted the interviews. The interviews followed a semi-structured interview guide. This interview guide was built on a combination of information gathered from the literature, insights from the TDF, and expertise of the research team, both in Dutch and French. To start, introductory questions about the background characteristics of the participant and their practices or organizations were asked. This was followed by questions about antibiotic prescription behavior specifically for socioeconomically disadvantaged people and related communication with their patients. Probes were used if needed to gather more information on these processes, barriers, and facilitators when working with socioeconomically disadvantaged people. Consequently, participants were asked to express their opinions about existing and desired initiatives to improve how antibiotics are prescribed and used. The anticipated duration for each interviews was set at 60 minutes.

DATA ANALYSIS

The interviews were audio-recorded and transcribed verbatim. Similar to WP1, the interviews were analyzed in two ways, namely an inductive and deductive way. First, an inductive approach was employed allowing for an open exploration of the data. This inductive analysis followed a thematic method, involving coding, formulation of sub-themes, and the development of overarching themes (23). Different levels of triangulation were applied during the analyzing process. Initially, three interviews were analyzed by the lead (DB), presented, and discussed with the principal investigator (SA). Subsequently, the remaining interviews were analyzed and discussed again with experts in working with vulnerable disadvantaged people. Based on this discussion, the final themes were created. At different stages of the analysis process, researchers triangulation was performed. Second, the data was deductively linked to the domains of the Theoretical Domain Framework. This second phase allowed to identify the domains on which interventions aimed to reduce antibiotic resistance have to respond.

RESULTS

A total of 16 general practitioners participated in this study. An overview of the participants is given in Table 4. The interviews lasted between minutes. A distinction in participants was made between their years of working experience, setting, working area.

Table 4 Overview participants

	Number
Sex	
Women	7
Men	9
Years of experience	
0-5y	4
6-10y	3
11-20y	5
>21y	3
Unknown	1
Practice	
Solo	1
Group	1
Community health center	5
Maison medical	7
Multidisciplinary center	2

Inductive analysis

Table 5 Overview themes

Themes

1. Profile of socio-economically vulnerable people
2. Factors considered when prescribing antibiotics in socio-economically vulnerable people
3. Involving patients and the patients' social context in decision-making
4. Facilitating communication with patients about antibiotics and improve self-management
5. Raising awareness about appropriate antibiotic use in the patient's lifeworld

Theme 1: profile of socio-economically vulnerable people

Prior to delving into detailed discussions with GPs regarding their interactions and prescription practices with socioeconomically vulnerable patients, initial questions were asked to profile this population. The findings revealed various characteristics associated with socioeconomically vulnerable patients, including eligibility for increase allowance, low health literacy, and immigrant background leading to language barriers. It became evident that GPs could not precisely define 'socioeconomically vulnerable people' by a single set of criteria. Nonetheless, various factors were found to be associated with this population and should therefore kept in mind when understanding the results.

Theme 2: Factors considered when prescribing antibiotics in socio-economically vulnerable people

GPs emphasized that they approach patients in vulnerable positions no differently than those in stronger positions during initial treatment. They inquire about the patient's concerns and expectations for the consultation, proceeding with the clinical examination to establish a proper diagnosis and treatment plan. In their perception, throughout this process, they adhere closely to the prescribed BAPCOC guidelines, providing relevant information to the patient.

Although the prescription habits of GPs may not initially appear differently between vulnerable and non-vulnerable patients, certain differences have become evident through the interviews. More consideration is given to the level of health literacy of each patient when determining the appropriate course of treatment and management. External factors are also taken into account in the overall decision-making process.

2.1 Considering level of health literacy

GPs noticed that patients in vulnerable situations are more likely to actively request antibiotics. One potential reason for this, shared by the GPs, is that those patients possess lower health literacy skills. Consequently, they face challenges articulating their health issues and expressing their expectations for treatment. Frequently, they resort to using the term "antibiotics" as a way to express the desire for a strong medication. This might lead to the rapid mention of antibiotics during consultations. Because of this, GPs emphasized the need to take into account how well a patient understands health information and how well they express themselves about what is actually concerning them. Based on this, GPs structured their clinical research to illustrate to the patients the reasons behind whether antibiotics would be suitable or unsuitable as a treatment.

"You can explain the underlying physiological mechanism for resistance much easier to someone who does understand it with high health literacy." (P4)

The level of health literacy also influenced the GP's treatment decisions. While guidelines form the foundation for prescribing antibiotics, GPs were more adaptable when it came to patients with lower health literacy levels. In certain situations, they might be more flexible with the guideline principles. For instance, if a person has low health literacy, they might not fully grasp the safety netting instructions like "wait a while longer" or "go to the doctor's emergency room if your condition worsens." Because of this, doctors were more inclined to prescribe antibiotics, especially when it was the beginning of the weekend or a busy period in the patient's life (e.g., exam period). A GP does not want to take the risk that the patients has not understood the safety netting advice. This way, the doctors prevented the patient's health from getting worse over the weekend without any safety plan.

"... If it weren't for the exams, I would likely have suggested waiting for two days initially. However, this doesn't necessarily simplify matters, as it often entails that if they visit on Tuesday and wait two days without improvement, we see them again on Thursday, leading to additional workload. Therefore, due to my awareness of potential resistance and a desire to proceed in a responsible, directive manner, I make such decisions." (P2)

2.2 Considering external patient-related factors

The GPs highlighted the importance of considering external factors that impact a patient when making treatment decisions. This consideration is significant for all patients, but it becomes especially crucial for those dealing with socioeconomic vulnerability. For example, the cost of medication can be a factor, and GPs acknowledged that they might choose antibiotics over other medications initially because these are relatively cheap, other over the counter medication is more expensive. GPs mentioned that they have to be aware that antibiotics not necessarily address the underlying problems such as stress resulting from inadequate housing that often cause the problems. Therefore, it is crucial to always take the entire situation into account and work on other issues than the physical ones.

"There's always a certain amount of difficulty everywhere, and it's not really prescribing antibiotics that represents the greatest difficulty [e.g., bad housing]." (P14)

In conclusion for theme 2, GPs prioritize equitable treatment for all patients, regardless of vulnerability, through thorough consultations and adherence to guidelines. Health literacy influences treatment decisions, with vulnerable patients more likely to request antibiotics due to challenges in articulating ideas, concerns, and expectations. GPs accommodate these differences by adapting guidelines for clearer understanding as they do not have the necessary skills or tools to elicit patient expectations and to address their concerns. They find it also difficult to explain safety netting advice and they are worried that the patient will not understand it. They also consider external factors like socioeconomic status, acknowledging financial constraints that may impact medication choices. While antibiotics alleviate symptoms, they may not address underlying issues such as housing-related stress, emphasizing the need for holistic patient care beyond physical ailment.

Theme 3: Involving patients and the patients' social context in decision-making

GPs emphasized the importance of involving and attentive listening to patients in order to clarify the ideas, concerns and expectations of the patient. This approach allows them to delve deeper into patients' requests for antibiotics and understand their underlying ideas, concerns, and expectations. Such attentive listening fosters a sense of being heard among patients, thereby enhancing trust in the GP. Additionally, GPs noted that not only the patient themselves but also their social context should be considered or be informed about antibiotics in case of infectious diseases.

3.1 Discussing the underlying needs of the patients for antibiotics

As previously mentioned, patients in vulnerable positions are more inclined to request antibiotics, often due to limited health literacy and previous experiences. Additionally, the underlying reasons for antibiotic requests were highlighted, with an example provided by a GP recounting an incident where a patient in their practice experienced a fatality due to delayed antibiotic administration. For this patient, the request for antibiotics stemmed from the concern of not receiving timely assistance and deteriorating or even dying, as she has experienced it in her own surroundings. Consequently, GPs emphasized the importance of identifying the root cause behind antibiotic demands and engaging in discussions about patient concerns. Addressing these concerns can alleviate any uncertainties patients may have and strengthen trust in GPs. GPs underscored that such efforts also contribute to patients' comprehension of the rationale

behind antibiotic prescriptions, thereby enhancing their understanding of their own medical conditions, but this is not always an easy task in these population group.

"I don't think they need more antibiotics than others...." (P10)

3.2 Informing the social context of the patient about antibiotics

Some GPs emphasized the significance of informing not only the patient but also their immediate surroundings about the medical conditions and the necessity of antibiotics. They provided an example wherein, in the event of infectious diseases, it is crucial to educate the patient's household members about necessary precautions. This approach facilitates raising awareness within the patient's environment and promotes a better understanding of the situation at hand.

"Collective approaches too, of a certain population, we have families, which are large, or if, for example, there's a bacterial infection that can be contagious, there we're going to be much more vigilant." (P16)

In conclusion for theme 3 GPs stress the importance of attentive listening to patients to understand their antibiotic requests and underlying needs, particularly for vulnerable individuals with limited health literacy. They share examples, such as a patient's fear stemming from a prior fatality due to delayed antibiotic treatment, highlighting the necessity of addressing patient concerns to build trust. Moreover, GPs advocate for informing not only patients but also their social context about antibiotics, citing the importance of educating household members about precautions, especially in cases of infectious diseases. This approach fosters awareness within the patient's environment, enhancing understanding.

Theme 4: Facilitating communication with patients about antibiotics and improve self-management

Effective communication between GPs and patients, particularly those in vulnerable circumstances, is paramount. Using language that patients comprehend is a critical aspect of explaining treatment plans or the rationale behind the necessity, or lack thereof, of antibiotics. Additionally, the ability to transparently illustrate the basis for prescribing decisions on antibiotics is essential.

4.1 Using the patient's language

GPs emphasized the importance of tailored communication. By investing time in finding communication methods that align with the patient's level of understanding, GPs can ensure that information is effectively conveyed, particularly when faced with language barriers. GPs primarily employed tools such as Google Translate, visual aids, concise statements, and straightforward language to facilitate understanding and to check if the patient has understood the information given by the GP.

"... By just taking time and not using weird terms and also writing it down. I use a lot of bills and post-its." (P3)

4.2 Using diagnostic tools to prove inappropriateness of antibiotics

GPs observed that patients needed evidence to be sure that antibiotics are not always essential. To illustrate this clearly, GPs employed a CRP device. By utilizing this device to prove the unnecessary need for antibiotics, patients were swiftly convinced of the GPs reliable judgment. Such a device proved beneficial, alongside a comprehensive clinical examination wherein the doctor provides information about the course of action and resultant conclusions, which, in certain instances, sufficed to help patients comprehend the non-necessity of antibiotics.

"But again, what really helps me in our practice is that CRP device. What I've noticed already, in case of doubt, I've really been able to say eight times out of ten, should I not have it, I might have given it given the doubt. But with that CRP device, I've actually mostly been unable to give it. And initially we had that in practice to just detect serious disease. But the reverse is proving more valuable to me." (P4)

In conclusion for theme 4 effective communication between GPs and vulnerable patients is crucial, especially regarding explaining antibiotic use. GPs prioritize using language patients understand to explain treatment plans. They employ tools like Google Translate and visual aids to overcome language barriers. GPs emphasize the importance of transparently demonstrating the rationale behind prescribing or not prescribing antibiotics. Some use CRP devices to provide evidence of whether antibiotic are necessary, while others rely on comprehensive clinical examinations to persuade patients. Overall, GPs invest in communication methods tailored to patient comprehension levels to ensure effective conveyance of medical information but this needs experience and time.

Theme 5: Raising awareness about appropriate antibiotic use in the patient's lifeworld

GPs emphasized the significance of enhancing patient awareness regarding appropriate antibiotic use. They underscored that it is mostly their duty to sufficiently educate and inform patients. Additionally, different stakeholders have their responsibility to raise awareness in the general population about the appropriate use of antibiotics. As well, there exists a responsibility of the government to deliver accessible and comprehensible information to facilitate the development of this awareness.

5.1 Accessibility of information

GPs highlighted the scarcity of accessible materials like flyers and brochures. They stressed the necessity for materials in various languages, containing simplified explanations and more illustrative forms of communication. Furthermore, it is crucial to consider the lifeworld of the target population and provide tailored messages. This entails utilizing social media to engage the target demographic and organizing information sessions in communities or on the streets to reach patients in socioeconomically disadvantaged positions.

"Campaigns should be done through doctors, pharmacists, CPAS, sickness funds, ... Within one's own living environment actually. To work as much as possible within one's own environment." (P5)

5.2 Impact of government campaigns

GPs also mentioned government initiatives aimed at raising awareness and educating the general population about antibiotic use. However, they noted that these campaigns often fall short. This is

primarily due to their failure to effectively reach the lifeworld of vulnerable individuals. Additionally, the campaigns frequently include extensive text that may not be comprehensible to those with low health literacy. GPs suggested that the government should offer more targeted materials and focus on specific populations to enhance the effectiveness of such initiatives.

"I think it's important to get the message out in the media. Social media, on buses, on trains, in hospitals." (P12)

In conclusion for theme 5 GPs stress the importance of improving patient awareness regarding appropriate antibiotic use, primarily their responsibility. They also highlight the need for accessible and understandable information, suggesting government involvement. GPs express concerns about the limited accessibility of materials and the ineffectiveness of government campaigns, which often overlook vulnerable populations and lack readability for those with low health literacy. They advocate for materials in multiple languages with simplified explanations and illustrations. Additionally, they recommend utilizing social media and community information sessions to reach socioeconomically disadvantaged individuals, urging the government to adopt more targeted approaches.

Deductive analysis

Similar to work package 1, in work package 2 as well, the linkage with the Theoretical Domain Framework is established. This allows us once again to assess which domains have already been reinforced and which domains still need to be addressed in order to strive for a certain behavior, in this case appropriate antibiotic prescribing.

The participants had a good understanding of the guidelines they used as a basis for their antibiotic decisions (*knowledge*). Additionally, they possessed skills, mainly communication skills, to elicit patient expectations regarding antibiotics by, for example, using Google Translate or illustrations to communicate with patients (*skills*). They also felt responsible for informing and raising awareness among patients about the potential consequences of excessive antibiotic use (*social/ professional role and identity*). In their decision-making process, they were mindful of increasing antibiotic resistance and aimed to prescribe appropriate therapy despite this awareness (*beliefs about consequences*). Additionally, they considered additional factors such as health literacy and external influences. It is this combination of thorough clinical examination while considering the patient's characteristics and exceptional circumstances that ensures antibiotics are prescribed in a well-founded manner. By taking time for clinical examination and employing proper communication skills, the patient's trust in the GP would probably increase.

However, the participants indicated that the current campaigns miss their target as they fail to reach the vulnerable population. It is therefore important to also focus on raising awareness in this population and increasing knowledge regarding antibiotic use and antibiotic resistance (*knowledge + reinforcement*). They recommended tailoring these efforts to the patients' lifestyles and circumstances (*social influences*).

Participants had knowledge of antibiotic guidelines and had communication skills to assess patient expectations and inform them about antibiotics. They felt responsible for raising awareness about antibiotic use and resistance in patients. However, campaigns often miss the vulnerable population, highlighting the need for tailored awareness initiatives, adapted to the patients' lifeworld and circumstances.

WORK PACKAGE 3

What are the possibilities to evaluate the impact of public campaigns on antibiotics on the public and prescribers and which process indicators can be used for this?

AIM

The aim of the third work package is to identify (1) the possibilities to evaluate the impact of public campaigns on antibiotic use on the public and prescribers and (2) the process and outcome indicators to evaluate the impact of public campaigns on antibiotic use.

METHOD

A scoping review according to the framework as presented by Arksey and O'Malley was conducted (24). This framework consists of five steps to guide this process: 1) identifying the research question, 2) identifying relevant studies, 3) selecting studies, 4) charting the data, and 5) collating, summarizing, and reporting the results.

Step 1: identifying the research questions

The research question for this scoping review is two-folded: 1) What are the possibilities to evaluate the impact of public campaigns on antibiotics on the public and prescribers? 2) Which process and outcome indicators can be used to evaluate the impact of public campaigns on antibiotics?

Step 2: identifying relevant studies – search strategy

The emphasis of this project lies on adopting a one health approach, the decision was made to encompass literature including both human medicine and veterinary medicine in this scoping review.

PICO Element	Key words	Search terms and strategy
Population	Broad population Prescribers Primary care Prescribers veterinary medicine	Public OR citizen* OR community OR Primary care OR GP OR General practitioner OR Public Health OR ambulatory care Public OR citizen* OR client* OR owner* OR farmer* OR veterinarian* OR veterinary medicine OR small animal* OR companion animal* OR vet* OR animal clinic* OR animal practice* OR livestock* OR pig* OR poultry OR public health OR animal husbandry OR dairy farm* OR farm* OR cattle
Intervention	AMR/antibiotics Campaign	AND Antibiotic* OR AMR OR biocide* OR Antimicrobial resistance AND Campaign* OR Mass media OR Social Media
Comparison	No campaign	
Outcome	behavior (prescription, consumption, use), awareness, attitudes, or competences	Behavior* OR Prescription* OR consumption OR use OR awareness OR attitude* OR competence* OR Skills* OR antibiotic stewardship

Step 3: study selection

The same in- and exclusion criteria were formulated for human and animal health. Studies were included when they: 1) were written in English, French, or Dutch, 2) were published since 2012, 3) were conducted in high income countries, 4) involved either general population, primary care providers, or veterinary medicine, 5) involved an evaluation of a public campaign related to antibiotics, biocides, or AMR, 6) related to a behavior, awareness, attitude, intention, or competence, 7) contained original research. Studies were excluded when they: 1) were written in other languages than English, French, or Dutch, 2) published before 2012, 3) related to clinical trials, 4) were aimed at patients or residents in nursing home or long-term care facility, 5) took place at specialist care settings, 6) were aimed at children <18 years, 7) did not relate to antibiotics, biocides, or AMR, 8) were not related to behavior, awareness, attitude, intention, or competence, and 9) did not contain original research. For human health, studies were excluded when they took place in secondary care.

Step 4: charting the data

A self-developed template, made in Excel, was used to charter the data. This template existed of the following parts: 1) author, 2) year, 3) study aim, 4) region/ country, 5) target population, 6), data source, 7) type of study, 8) setting, 9) period, 10) campaign, 11) link to Theoretical Domain Framework, 12) indicator, and 13) outcomes.

Step 5: collating, summarizing, and reporting the data

The data were analyzed according to the domains of the TDF (25). In a first step, the studies were screened for indicators to evaluate campaigns regarding antibiotics and antibiotic resistance. In a second step, those indicators were mapped onto the domains of the TDF, if possible.

RESULTS

The results are described in two parts. A first part delineates the findings derived from the literature, thus the results of the literature and the scoping review. Subsequently, these findings were discussed upon in an expert panel aimed at refining the next steps for defining the indicators and making them applicable to evaluate campaigns regarding AMR.

Scoping review

The literature search regarding human health yielded 817 unique articles to screen of which 22 were included. The included studies were published between 2013 and 2022 of which sixteen were conducted in Europe, two in Canada, one in Hong Kong, and three studies did not address a specific country. Two out of 22 studies applied a qualitative design while the others applied a quantitative design including cross-sectional studies, retrospective cohort design, impact evaluation, long term evaluation, pre-post design time series, or pilot study.

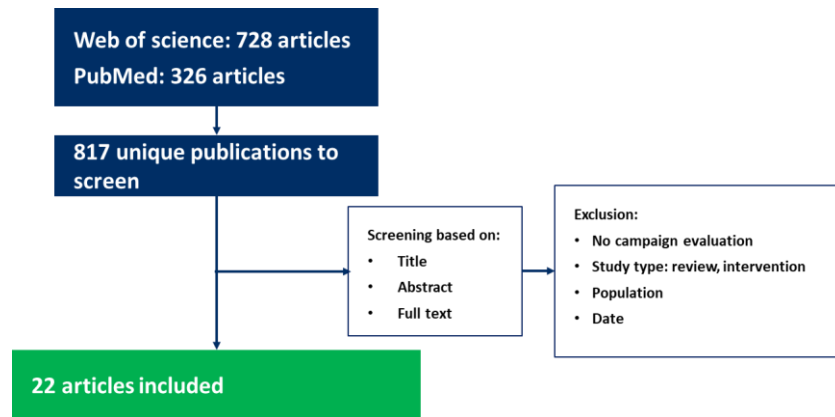


Figure 2 Flow chart

The literature search regarding animal health yielded in 1019 articles to screen of which 4 were included. Those studies were conducted between 2016 and 2019 in England, Switzerland, and the USA. Three studies applied a quantitative design including a cross-sectional study and retrospective cohort design, one study had an undefined methodology.

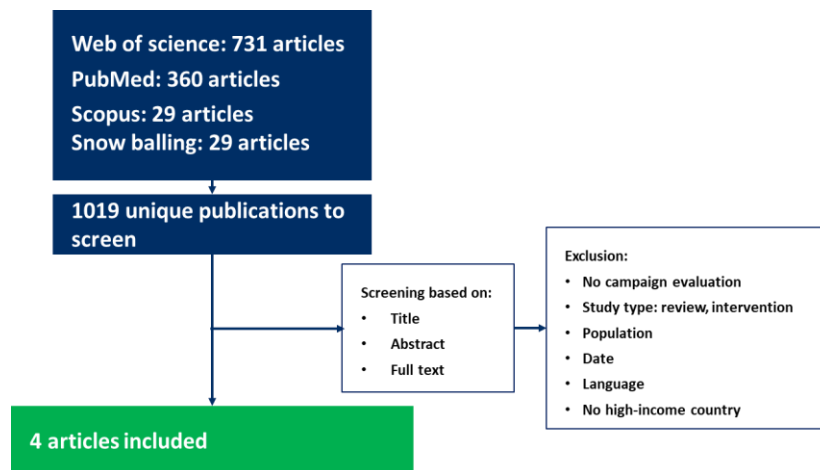


Figure 3 Flow chart

Drawing from the literature, a differentiation can be made between general indicators and those associated with the Theoretical Domain Framework. It should be emphasized that these indicators cannot be universally applied to all campaigns, but that it is crucial during campaign development to determine the targeted domain and select the associated indicators. Their application is exemplified later in this section. Initially, an outline of the indicators recognized in the literature is provided, distinguishing between human and veterinary medicine.

General indicators

Three general indicators have been identified, commonly applied across multiple studies to evaluate antibiotic (resistance) campaigns: demographics, consumption rates, and information.

Demographics

In the articles of human health, demographics were described in three out of 22 articles (26-28) , and in two out of four articles focusing on animal health (29). The description of demographics holds significance in defining the targeted population for the campaign, facilitating proper and standardized research. Moreover, by describing the characteristics of the campaign population, it becomes clearer to identify the targeted population and enhancing the reproducibility of the campaign.

In the domain of human health, the literature describes commonly age and sex as the general demographics . Depending on the type of research, it was described whether the participants or targeted population were working in a health-related profession. In campaigns concerning antibiotic guardians, studies specifically asked for the pledge group. In another study, the population-adjusted rates of respiratory tract infections was used to describe the demographics (27).

In the domain of animal health, studies describe the animal species and the owner characteristics. The latter is more specified in gender, education level, and the number of pets someone has (29).

Consumption

Out of 22 articles for human health, four provided descriptions of antibiotic consumption to evaluate the effectiveness of campaigns (28, 30-32). Indicators delineated to measure consumption included the number of prescriptions per 1000 inhabitants per year, the number of defined packages per 1000 inhabitants per day, the antibiotic use during the past year, and the antibiotic prescribing per province, drug, and class.

Another study examined the ongoing effectiveness of a campaign aimed at reducing the non-prescription dispensing of antibiotics (33). Researchers monitored the dispensation of antibiotics to patients, assessing whether they were provided with antibiotics without a prescription.

Information

In a study evaluating public knowledge in Poland, researchers also investigated the sources through which the public acquired information about antibiotics (34). Consequently, they examined the various information sources accessed by the public on the sources of knowledge on antibiotics and the most trustworthy sources of information.

General indicators	
Construct	Indicators
Demographics	<ul style="list-style-type: none"> • Prescriptions per 1000 population per year (using age and gender specific denominator) • Number of defined packages (DIP) per 1000 inhabitants per day • Whether antibiotic was dispensed • Antibiotic use during the past year
Consumption	<ul style="list-style-type: none"> • Pledge group, age, sex, use of social media, whether working in a health-related profession

	<ul style="list-style-type: none"> • Population-adjusted rates of respiratory tract infections indicted antibiotic prescribing by province, drug class, and age • Veterinarian: gender, kind of workplace, geographical location • Owner: gender, education, median time spent in exam room, number of pets
Information	<ul style="list-style-type: none"> • Source of information

Indicators linked to the Theoretical Domain Framework

The TDF enables us to explore the potential influences on a behavior, in this case the prescription and utilization of antibiotics. Throughout the studies, three domains were identified: knowledge, beliefs, and intentions. In veterinary medicine, the studies encompass five domains: knowledge, beliefs, behavioral regulation, and social influences.

Human health

Knowledge

Knowledge in the TDF is about improving publics' awareness about appropriate antibiotic use, knowledge about antibiotic resistance, and understanding the consequences of overuse. Seven out of 22 articles applied the domain as knowledge as one of the main outcome indicators (26, 30, 34-38). In those studies, a distinction was drawn between general knowledge regarding antimicrobial resistance and knowledge specific to campaign messages or, in other words, the awareness of a specific campaign. Furthermore, differentiation was made between knowledge assessed via questionnaires/surveys and self-reported knowledge. Regarding general knowledge assessment, five questions were often posed, including 'antibiotic kill viruses', 'antibiotics are effectively against cold and flu', 'unnecessary use of antibiotics makes them become ineffective, 'taking antibiotics of has side-effects' such as diarrhea', 'you can share antibiotics with others' (34, 36, 37).

In the assessment of campaign-specific knowledge, one study examined the adoption and utilization of education and training materials supporting antimicrobial resistance resources within NHS primary care in England (39). Another study focused on understanding the implementation of resources and campaigns supporting antimicrobial resistance. Yet other studies, counted how many times their website was accessed (40) or how antibiotic guardians became aware of the campaign (41). At another campaign level, one study examined whether and how countries had conducted antibiotic awareness campaigns and which key messages were conveyed to the public (42).

Regarding the self-reported knowledge, one study assessed the effectiveness of a United Kingdom-wide campaign by examining self-reported knowledge before and after individuals became antibiotic guardians (26). Adding to campaigns of antibiotic guardians, the reasons of signing up as a guardian, choice of pledge and pledge group, and responses to becoming an antibiotic guardian including the extent to which the pledge was followed (41). Similarly, a study in Hong Kong evaluated the impact of a 'safe use of antibiotics' campaign through a population-based telephone survey using a pre-post design (36).

Typically, knowledge assessment followed a pre-post design, involving an initial assessment before the campaign launch and a subsequent evaluation afterward.

Beliefs

In the TDF a distinction is made between ‘beliefs about capabilities’ and ‘beliefs about consequences’. The first refers to the individuals’ confidence in their ability to adhering to appropriate antibiotic use, including completing prescribed courses. The latter refers to the understanding of perceptions about the benefits of proper antibiotic use, as well as the negative outcomes of antibiotic misuse. In the studies, a focus is put on patient attitudes, behaviors, and motivations in relation to antibiotic usage, prescribing practices, and engagement with antimicrobial resistance campaigns. Specifically, in exploring attitudes and behaviors regarding antibiotics one study investigated the patient expectations of antibiotic prescription, use of antibiotics without prescription, reason for discontinuation of antibiotic therapy, and if the current use of antibiotics be restricted in order to keep them effective in the future (34). Another study examined the motivations behind individuals becoming antibiotic guardians and the factors influencing their choice of a particular pledge (26). Similarly, another study conducted a qualitative investigation into the process of pledging to a campaign, focusing on public perceptions of antibiotics among individuals who had chosen to pledge as antibiotic guardians (31).

Intentions

Intentions involve measuring individual’s intentions to adhering to recommended antibiotic use guidelines and identifying factors that influence these intentions. However, among the studies included, there was no mention of specific indicators used to measure adherence to guidelines. Only one study delved into behavior related to a pledge made in an antibiotic guardian campaign. This study aimed to capture the attitudes of public antibiotic guardians toward antibiotic use and illness post-pledge (31). The role of these antibiotic guardians was to promote appropriate health behaviors regarding antimicrobial resistance. In order to investigate the associated behavior, a qualitative study employing semi-structured interviews was conducted, covering topics such as ‘pledging to the campaign’, ‘prescribing’, ‘antibiotic use’, and ‘propagating campaign awareness’.

Theoretical Domain Framework	
Domain	Indicators
Knowledge	<ul style="list-style-type: none"> • Questions exploring implementation of resources and campaigns to support antimicrobial stewardship • Questions: ‘Antibiotic kills viruses’, ‘Antibiotics are effective against cold and flu’, ‘Unnecessary use of antibiotics makes them become ineffective’, ‘Taking antibiotics often has side-effects such as diarrhea’, ‘You can share antibiotics with others’ • General knowledge before and after becoming an antibiotic guardian
Beliefs	<ul style="list-style-type: none"> • Patient expectations of antibiotic prescription • Use of antibiotics without prescription • Reason for discontinuation of antibiotic therapy • Motivation for becoming an antibiotic guardian • Reason for choosing for a specific pledge • Pledging to a campaign • Reasons for taking antibiotics
Intentions	<ul style="list-style-type: none"> • Behavior in relation to pledge

Animal health

Knowledge

Knowledge was assessed in two studies at three different levels: knowledge about antimicrobial resistance, knowledge about the guidelines, and awareness about the campaigns. Another distinction was made between knowledge at the level of the pet owner and knowledge of the veterinarian.

To assess knowledge about AMR, questions about antibiotics and antibiotic resistance were asked to pet owners (29) such as providing their own definition of AMR to determine their baseline knowledge (29). Additionally, to evaluate familiarity with awareness studies, pet owners were prompted to match statements from posters about antibiotics and AMR with responses of ‘true’, ‘false’, or ‘don’t know’ (29). At another level, knowledge about the AMU guidelines or FEVACA posters were also assessed (43).

Beliefs

Out of four articles, only one addressed the domain of ‘belief’ by evaluating the perceived effectiveness of campaigns at veterinarians.

Behavioral regulation

Behavioral regulation is defined in the TDF as anything aimed at managing or changing objectively observed or measured actions. Evaluation of behavior involved asking veterinarians questions like ‘Do you discuss the issue of AMR with your clients?’ and ‘Do you have more conversations about AMR since the poster campaign?’ (29). Another study used surveys to examine if the understanding about antibiotics was increased and relatedly if prescription behavior in certain cases was changed (43). Furthermore, attention was given to assess the changes in prescription behavior before and after the implementation of an online antimicrobial stewardship tool in either cats (44) and dogs (45) by analyzing the electronic patient records.

Social influences

In the TDF social influences are defined as those interpersonal processes that can cause an individual to change their thoughts, feelings, or behaviors. In one study, researchers explored whether clients had influence on veterinarians’ antibiotic prescription practices, and whether these prescribing patterns differed when posters were displayed in the practice (29).

Theoretical Domain Framework	
Domain	Indicators
Knowledge	<ul style="list-style-type: none"> • Questions regarding to the content of a poster • Paraphrasing the content of a poster • Questions on antibiotics and antimicrobial resistance • ‘Antibiotics are only needed for treating infections in your pet caused by bacteria’ • ‘Bacterial infections in dogs and cats get better on their own’ • Awareness of vets of guidelines for AMU • BSAVA guidelines and posters • FECAVA recommendations and posters

	<ul style="list-style-type: none"> • Did pet owners notice a poster on AMU and AMR in the waiting room?
Beliefs	<ul style="list-style-type: none"> • Perceived effectiveness of a poster by veterinarians and veterinary technicians
Behavior	<ul style="list-style-type: none"> • Prescription habits and their appropriateness before and after implementation of an online Antimicrobial Stewardship Tool • Did you discuss the issue of AMR with your clients? Increase in conversations on AMR? (Since poster)

Expert panel

After the initial analyses for the scoping review, a preliminary overview of the indicators was compiled and presented to an expert panel. The aim of the expert panel was to translate these indicators into an applicable set, tailored to the Belgian context, which allows for the evaluation of future one health initiatives related to antibiotic resistance.

For the composition of the panel, individuals with expertise in either antibiotic usage in veterinary medicine and human medicine, or with expertise in theories of behavior change, were sought. Ten experts were contacted through the research team's network. The final expert panel consisted of eight individuals from various institutions, such as research institutions, governmental agencies, or professional associations. This allowed for diverse perspectives to be considered regarding the evaluation of campaigns and their associated indicators. Prior to the expert panel, experts were provided with a list of preliminary indicators. The following questions were asked to reflect upon prior the panel: 1) Which indicators are important, 2) How can these indicators be adapted into a relevant set relevant for the Belgian context?, and 3) What key insights can be derived as lessons learned to consider when formulating future One Health campaigns? These questions then served as a guide during the expert panel.

Throughout the discussion with the panel, it quickly became apparent that it is not feasible to propose a standardized set of indicators. This would mean that every campaign being implemented could be evaluated in a similar way. As a result, it became difficult to determine which indicators are important and could be proposed as a core set. The main conclusion of the expert panel was that it is crucial to tailor the choice of indicators according to the specific objectives of each campaign and its intended audience. For instance, is the campaign aimed at raising awareness about responsible antibiotic use among the general public? Is it geared towards educating general practitioners and reinforcing adherence to guidelines? Alternatively, does it prioritize enhancing communication between veterinarians and pet owners?

Designing an evaluation strategy with associated indicators requires attention from the outset when planning a new campaign. It is important to consider the intended objectives of the campaign and the target audience. These two factors will guide the evaluation strategy. For example, for campaigns aimed at raising awareness of responsible antibiotic use, it is important to assess whether the campaign has been noticed, rather than assessing improvements in communication skills of, for example, GPs. To illustrate, an example of the 'Letstalkantibiotics' campaign/ website and comic 'Tante Biotica' is given to demonstrate which indicators can potentially be applied to evaluate this campaign.



Letstalkaboutantibiotics <https://letstalkantibiotics.be/>

This campaign targets both humans and animals, focusing on addressing common questions related to antibiotics and antibiotic resistance through a dedicated website. Initially, its aim is to enhance understanding and awareness of antibiotic resistance. Questions such as "Is it true that bacteria can become resistant to antibiotics?" or "I have the same symptoms as last time, can you advance me a box of antibiotics?" or "My cat has a cold, can antibiotics help?" are addressed, providing accessible explanations on the appropriateness of antibiotic use.

In other words, the campaign targets the entire population with the aim of increasing knowledge among every citizen. Additionally, it raises awareness about antibiotic usage and the potential consequences of overuse. This campaign can be linked to the 'knowledge' domain of the Theoretical Domain Framework, whereby by increasing this knowledge, it will also potentially influence the behavior of the citizen regarding antibiotics.

Based on the results of the scoping review, the following indicators can be linked to this campaign, which can be integrated into an evaluation strategy:

- Questions for assessing the knowledge: 'Antibiotic kills viruses', 'Antibiotics are effective against cold and flu', 'Unnecessary use of antibiotics makes them become more effective', 'Taking antibiotics often has side-effects such as diarrhea', 'You can share antibiotics with others', 'Antibiotics are only needed for treating infections in your pet caused by bacteria'.

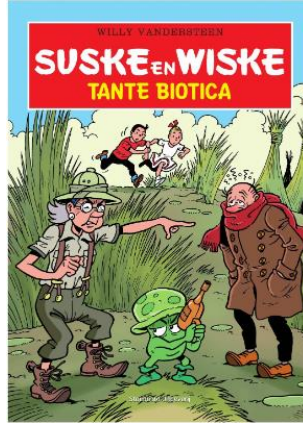
These questions can be tailored to the content of the questions addressed by the campaign. This allows for assessing whether the campaign has been implemented and has reached the intended audience.

- General knowledge before and after the implementation of the campaign of the public:

To evaluate the campaign's impact and effects, it is important to have an understanding of the knowledge both before and after the campaign's implementation. This could, for example, be mapped out through the questions described above. This also allows to gain insight into the extent to which knowledge regarding antibiotics and antibiotics resistance has improved.

- Questions for assessing the campaign awareness:

This contains evaluating whether the public successfully engaged in the campaign and what key messages were retained. This also allows to gain insight into the uptake of the campaign.



Suske en Wiske – Tante Biotica

'Tante Biotica' is a special edition of Suske en Wiske which aims to increase awareness about appropriate antibiotic usage in a humorous yet educational manner. It formed a pivotal component of a comprehensive awareness campaign organized by BAPCOC. Moreover, radio advertisements were aired, and brochures disseminated, communicating the central message that antibiotics are ineffective against influenza and the common cold.

So, once again, it is a campaign targeting the broad population to impart knowledge and raise awareness about antibiotics in an accessible manner. The evaluation of this campaign is in line with how the indicators were referenced in the previous example.

At first glance, the campaigns primarily focus on the knowledge and awareness of the general population. Based on the expert panel, it will be important in the future to become aware of specific target groups with specific actions. For example, targeted efforts towards GPs can be made to teach communication skills for engaging with individuals with low health literacy or limited knowledge regarding antibiotics. By providing them with tailored materials to inform and raise awareness among this population, it can be assessed whether there has been a change in behavior among the physicians on one hand, and whether the knowledge and awareness among this patient population have improved on the other.

DISCUSSION

SUMMARY of the RESULTS

Work package 1

The first work package aimed to gain more insight into how veterinarians perceive their use of antibiotics/biocides, the disposal of antibiotic and biocidal waste, and the consumption of pet antibiotics by pet owners. A total of nineteen veterinarians participated in three focus groups, yielding in six themes. These themes underscored the significance of guidelines alongside veterinary expertise in antibiotic prescribing decisions and the results of diagnostic tools in prescribing antibiotics. Additionally, owner characteristics also influenced therapy decision, with increasing awareness among veterinarians regarding alternative treatment options to mitigate antibiotic use. Effective communication between veterinarians and owners also emerged as crucial, emphasizing the need to inform owners about antibiotic appropriateness. To end, initiatives to promote a mindset shift towards appropriate antibiotic usage were discussed, along with the absence of clear waste policies and guidelines for biocide use and waste management.

Work package 2

The second work package aimed to explore the dynamics of how socioeconomically disadvantaged people, along with their GP manage the use, disposal, and application of antibiotics and biocides. Therefore, sixteen GPs participated in individual in-depth interviews resulting in five themes. GPs prioritize equitable treatment based on guidelines for all populations. However, when dealing with socioeconomically vulnerable patients, GPs consider factors such as health literacy levels and patient-related factors (e.g., stress because of bad housing) when prescribing a therapy. Consequently, they adapt guidelines to suit these particular cases. They highlighted the importance of communication skills to have a better understanding of the patient needs and their ask for antibiotics. Therefore, GPs employed tools such as Google Translate and visual aides to overcome language barriers and invest in communication strategies to inform patients about appropriate antibiotic use. They advocated for government involvement in improving patient awareness and accessible information, recommending materials in multiple languages and targeted approaches via social media and community sessions to reach vulnerable populations effectively.

Work package 3

The aim of the third work package was to identify ways to evaluate public campaigns' impact on antibiotic use among the public and prescribers, as well as to determine process and outcome indicators for evaluating these campaigns by means of a scoping review. A two-folded research question was formulated: assessing the possibilities to evaluate public campaigns' impact and identifying process and outcome indicators. The review encompassed 22 studies from human and veterinary medicine, focusing on behavior, awareness, attitudes, and competencies related to antibiotic usage. The results were analyzed according to the Theoretical Domain Framework (TDF). Findings were divided into human and animal health sections. In human health, indicators related to knowledge, beliefs, and intentions were identified, along with general indicators such as demographics, consumption rates, and information sources. Similarly, in animal health, knowledge, beliefs, behavioral regulation, and social influences were examined. The expert panel emphasized the need for tailored indicator selection based on specific campaign objectives and target audiences.

DISCUSSION of the RESULTS

This project adopts a One Health Approach, exploring both veterinarians in companion animals and GPs. Because antibiotic resistance is not limited to individual concerns, but demands a comprehensive societal approach at multiple levels in multiple domains, reflections will be made on those different levels. For the sake of clarity, the discussions of the different work packages will be described separately.

Work package 1

Veterinarians mentioned that guidelines are important to establish a standardized approach for underpinning their decisions regarding antibiotics. However, they also indicated that they are insufficiently aware of the existing AMCRA guidelines and do not know where to consult them. Yet, it is important to provide sufficient visibility to these guidelines. A Danish study has already demonstrated that veterinarians are willing to using guidelines and that these can have a positive influence on antibiotic prescribing (46). Indeed, a first step is to prioritize veterinarians' willingness to use these guidelines. It is important to demonstrate to veterinarians the significance that guidelines can effectively contribute to reducing antibiotic resistance and were not created to undermine their knowledge and expertise. By acknowledging their knowledge and expertise and starting from their role as veterinarians and the responsibility they have to consistently apply these guidelines, it is possible to appeal to the recognition they may need for an attitude change regarding their prescribing behavior. A possible strategy is to use testimonies from fellow veterinarians in which veterinarians who initially resist the use of the guidelines can still identify with their colleagues and thereby translate them into their own practice. A second step can then be to enhance awareness and visibility of guidelines and reassuring veterinarians that these guidelines serve as a reliable basis for antibiotics-related decisions is crucial. Nevertheless, veterinarians in the focus groups highlighted that they wanted to be recognized for their expertise. Therefore, it is all more important to capitalize on veterinarians' willingness to engage with these guidelines.

In their experience, veterinarians strive to be consistently in antibiotic prescriptions. However, they mentioned that several factors influenced their decision-making regarding antibiotics. Veterinarians referred to pet owners' adherence to therapy and their (financial) willingness to invest in treatments. Previous research has already shown that owners often have limited knowledge to assess the risks of antibiotics and antibiotic resistance (47). Therefore, it is advisable for veterinarians to assess whether owners will be able to carefully follow the prescribed therapy. In addition, research has already shown that the financial constraints of the owner play a role in using diagnostic tests to determine the necessity of antibiotics and to prescribe possible alternative therapies. It is one of the factors that must be taken into account in the fight against antibiotic resistance (48). Thus, veterinarians also make assessment of the owner to determine their therapy.

In some cases, owners already have a clear request for antibiotics. An online survey conducted in the field of veterinary medicine aimed to evaluate pet owners' knowledge, opinions, expectations, and communication preferences regarding antibiotics. The study revealed that a quarter of the owners expressed feelings of surprise, disappointment, or frustration when their veterinarian did not prescribe antibiotics (49). In the focus groups of work package one, it emerged that veterinarians felt pressure from pet owners to prescribe antibiotics. They perceived that if they did not do so, the owners were inclined to seek out another veterinarian who would prescribe antibiotics for them and sometimes write a bad review. This could lead veterinarians to prescribe antibiotics more readily than they themselves would

prefer. Therefore, it is important for veterinarians to be able to educate owners about the importance of appropriate antibiotic use. They can do this by leveraging owners' knowledge of antibiotics and antibiotic resistance. For this, the right skills need to be taught to veterinarians to communicate about this with the owners.

Apart from emphasizing a strong relationship between veterinarians and owners to encourage appropriate antibiotic use, the focus groups also underscored the importance of a supporting practice or organization. A well-known example are the stewardship programs that have been established in veterinary medicine (50). These programs aim to administer antibiotics judiciously, prioritizing the most effective treatment options only when essential, thereby contributing significantly to combating antibiotic resistance. Furthermore, alongside these stewardship programs, a suggestion is to assign a champion within the practice can also be crucial. This individual can assume a monitoring role, fostering responsible prescription practices within the practice setting, and raise if there should be more attention to appropriate prescribing. Regardless, it is crucial for a practice to acknowledge the necessity of taking action against antibiotic resistance. This can also contribute to the mind shift that veterinarians have to undergo for more appropriate antibiotic prescribing.

Besides the focus on the relationship between the veterinarian and the pet owner and actions that can be taken within the practice, veterinarians were also questioned about their support for government campaigns. In efforts to raise awareness, posters were exposed, and flyers were distributed emphasizing the significance of proper antibiotic usage and the potential risks associated with them. However, they did not experience that they reach pet owners or the general population to raise awareness about appropriate antibiotic use and thus contribute to the battle against antibiotic resistance.

A final component of the focus groups addressed policies regarding biocides and waste management. The conclusion drawn was that guidelines imposed by the practice or corporate were adhered to. American research has already shown that when guidelines are imposed by the corporate, veterinarians are inclined to follow them (51). This reflection could be important for a more standardized policy regarding biocides and waste management. However, it is advisable to initially focus on raising awareness and knowledge about antibiotic resistance, and then take action regarding biocides and waste.

In conclusion, veterinarians can be supported in different ways to increase appropriate antibiotic prescribing and use by owners:

- 1) Change believes about guidelines and their appropriateness among veterinarians.
- 2) Enhancing awareness of AM CRA guidelines through improved visibility and applicability.
- 3) Offering communication techniques to veterinarians to inform pet owners about appropriate antibiotic use.
- 4) Supporting the introduction of champions and stewardship programs to support appropriate antibiotic prescription in the practice.
- 5) Focusing on lifelong learning initiatives where (international) best practices regarding antibiotics are shared to stay informed about the latest developments.
- 6) Increasing awareness regarding antibiotic use through tailored campaigns designed for specific target populations (e.g., dog owners).
- 7) Creating guidelines for waste disposal and biocides.

Work package 2

GPs mentioned that they approach patient consultations without discrimination, providing similar treatment to every one of them. They asserted that their clinical reasoning adheres closely to established BAPCOC guidelines to maintain objectivity. However, it emerged during interviews that additional factors influence antibiotic prescribing decisions. These factors encompass patient expectations, the GP's experience and interpretation, considerations within the framework of safety netting, as well as external underlying patient characteristics. Similar observations have been noted in other studies, indicating that antibiotic prescriptions are influenced not only by objective criteria like guidelines but also by a constellation of subjective factors (52), which is in line with the process of clinical reasoning (53).

Initially, GPs highlighted their practice of attentively listening to patients' expectations and concerns. Should there be a clear request for antibiotics, they adjust their clinical approach to ensure patients understand the rationale behind not prescribing antibiotics in certain scenarios. They stressed the importance of probing further into these expectations by asking more questions. For GPs, this represents a crucial aspect of building patient trust, particularly among those in socioeconomically vulnerable situations. GPs expressed the necessity of exerting additional effort to establish trust in these cases. This attitude aligns with findings from previous research, which highlighted the significance of trust in determining the appropriateness of antibiotic treatment (54). The initial exploration of patients' concerns and expectations aligns with the ICE (ideas, concerns, and expectations) approach (55). It is essential to give this phase sufficient attention, as it has the potential to result in decreased prescribing (55). Using this information, GPs tailored their clinical approach accordingly. When a patient expresses a desire for antibiotics and the GP senses a lack of confidence, they typically allocate more time for the clinical examination, pose additional questions, and provide a thorough explanation of the examination findings. It is important to dedicate sufficient time and attention to discussing expectations and providing explanations about antibiotics, as this is often what socioeconomically vulnerable people are familiar with, but it may not always be necessary. In essence, the GP adjusts their actions to meet the needs of the patient.

GPs strive to apply the guidelines as consistently as possible. However, they mentioned that several factors influenced their decision-making regarding antibiotics. GPs indicated considering the health literacy of the patient, especially for those in vulnerable positions. Additionally, external factors such as housing conditions and financial constraints play a significant role in prescribing antibiotics. Both health literacy and external factors are important to consider in understanding antibiotics and the prevalence of antibiotic resistance in socioeconomically vulnerable patients. Regarding health literacy, previous research has already described how limited health literacy contributes to higher antibiotic consumption. This group often has less knowledge about antibiotic resistance and is more likely to express expectations for antibiotics (56, 57). Additionally, GPs tend to follow patient expectations, leading to more antibiotic prescriptions. Consistent with this reasoning, future initiatives should focus on supporting GPs in dealing with challenges associated with low health literacy (56). This makes it important to sufficiently tailor guidelines to certain populations, such as vulnerable people. In this way, to provide sufficient tools to general practitioners to take into account these different factors. A possible action that can be taken is to adapt guidelines to specific populations where consideration is already given to the level of health literacy and external factors. The guidelines should also describe how they should ideally be applied in such populations so that GPs can take the appropriate actions.

In light of external factors, research has already demonstrated that individuals in socioeconomically vulnerable positions are more susceptible to infections due to poor housing, less varied nutrition, etc. (58, 59). Consequently, this population legitimately requires more antibiotics. However, as a GP, it is crucial to take these factors into account. Therefore, addressing antibiotic use and resistance in socioeconomically vulnerable individuals requires a multifaceted approach (59). This issue cannot be solely resolved through biomedical research or within the confines of a clinical setting; rather, it necessitates steps at various levels, considering the different determinants of health (60). The GPs were already aware of the importance of painting a broader picture of the patient. However, they indicated using additional tools to support themselves in this regard. In one case highlighted in the interviews involved the utilization of a CRP device. Employed to validate the GP's diagnosis, it effectively demonstrated that antibiotics were unnecessary. This device serves as a valuable tool for assessing potential bacterial infections, typically applied when uncertainty arises. The example underscores the practice of using the CRP device to prove patients against unnecessary antibiotic usage. Nonetheless, it is crucial for GPs to maintain critical thinking during clinical examinations and justify their diagnoses independently, even without relying solely on such support. It is also important that GPs are provided with supportive methods or tips for communicating with vulnerable patients. This can be framed within safety netting, where GPs communicate with their patients in an appropriate manner and in understandable language (e.g., clearly indicate when you have a fever, and write down the number of antibiotic doses for the required number of days, etc.).

In addition to highlighting the importance of a trustful relationship between the GP and the patient, the interviews also emphasized the significance of supporting the practice or organization. In line with the suggestions for veterinary medicine, there is also a focus on stewardship programs in humane medicine that should be supported (61-63). It is an international well-known and effective strategy for increasing awareness about antibiotics. This will allow for a critical examination of one's own actions and thus strengthen awareness regarding appropriate antibiotic prescribing behavior.

Just like in veterinary medicine, the GPs supported the campaigns disseminated by the government. In efforts to raise awareness, posters were exposed, and flyers were distributed emphasizing the significance of proper antibiotic usage and the potential risks associated with them. An important point to note here is that GPs indicated that the materials and campaigns currently conducted by the government are inadequate for the majority of the population, especially for those in vulnerable positions. Materials are only available in a few languages, contain a lot of text that many people do not understand, and lack illustrations. On top, many of those campaigns are also aimed at the general population and do not specifically target populations. Based on previous research, it has already been recommended to target campaigns towards specific groups and to reach the general population at a later stage (64). Considering the socioeconomically vulnerable population, it is advisable to focus on community engagement, involving individuals in local organizations or key community figures to take on the role of sensitizing and informing this population about appropriate antibiotic use (59, 64). Here, testimonies from key figures within specific communities, for example, can also help raise awareness that antibiotic resistance can occur within one's own environment.

Additionally, the government must take responsibility for providing GPs with the necessary materials. The GPs indicated that the primary role in informing and educating patients lies with them, but they require the appropriate support to do so. Therefore, it is important for the government to consider the message they want to convey and the target population they want to reach when developing new campaigns. The initiatives should also take into account various factors such as increasing knowledge among GPs

regarding antibiotics and encouraging them to use guidelines. Additionally, there should be sufficient emphasis on developing adequate communication skills to inform and raise awareness among patients, and contextual factors should be considered to prescribe appropriate therapy.

In conclusion, GPs can be supported in different ways to increase appropriate prescribing and use:

In conclusion from the preceding paragraphs, it can be suggested to focus on:

1) Tailor guidelines to specific populations such as people in socio-economically vulnerable positions and formulate concrete actions to make them feasible for practice.

Guidelines should also provide information on what GPs can offer to patients when antibiotics are not necessary or provide them with clear safety netting advice.

2) Tailored communication interventions to support GPs in addressing ideas, concerns, and expectations in people with socioeconomically vulnerability.

3) Support GPs in fostering a shared vision and support for appropriate antibiotic prescribing practices within and across practices.

4) Develop tailored campaigns targeted towards specific demographics, such as people in socioeconomically vulnerable positions, with specific objectives.

Targeted messages may speak more effectively to certain concerns about caring for their illness.

Work package 3

These findings should also be reflected in the development and evaluation of campaigns. One of the key findings of the third work package was also that, from defining the objective and developing a new campaign, attention must be paid to the desired outcome and the determinants to be addressed. So, it is important to consider 'what do we want to do and who do we want to reach.' This subsequently determines the evaluation strategy and indicators. A recent scoping review proposed that the evaluation of One Health initiatives should explicitly define the research question, delineate the system including inputs, outputs, and interactions, outline the theory of change, and employ suitable methods capable of capturing the entire system affected by initiative-driven changes, while valuing outcomes accordingly (65). Although the included studies in work package three do not employ a clear framework for evaluating the campaigns, it is advisable to use a theoretical framework as the basis for developing the evaluation method. Another scoping review identified a variety of methods and indicators for evaluating One Health initiatives. Various frameworks were discussed: NEOH framework, PRECEDE-PROCEED Model, Rifkin's Spider Gram, CDC Framework for program evaluation. Each of these frameworks provides guidance for both the development of initiatives and their evaluation (66). Additionally, during implementation, consideration must be given to facilitators and barriers that will determine the effectiveness of the implementation. The evaluation strategy and related indicators should be aligned accordingly (66). However, more emphasis should be placed on the development of evaluation strategies for One Health campaigns in general. While there is increasing focus on employing a One Health approach, especially in the context of antibiotic resistance, the availability of evaluation strategies remains scarce (67, 68). The suggestion is therefore to reflect on what needs to be evaluated at different levels for each campaign, ranging from the individual level of the citizen to the policy level. The domains of the Theoretical Domain

Framework can provide inspiration for this. The theoretical frameworks can provide the framework and structure to underpin the evaluation strategy.

In conclusion, it is suggested to:

- 1) Defining the target population and campaign objectives and tailor the evaluation strategy accordingly.
- 2) Underpinning the evaluation strategy with existing theoretical frameworks.
- 3) Investing in developing evaluation strategies tailored to One Health Campaigns.
- 4) Reflecting on what needs to be evaluated at different levels.

Key messages

Based on the previous discussions and results from the various work packages, eight general key messages can be put forward:



Raise awareness that each veterinarian and GP have a role to play in antibiotic stewardship and that every effort counts.

Individual level



Enhance awareness and knowledge in a narrative that resonates with the experiences of veterinarians and GPs.



Guidelines should provide information on what GPs can offer to patients when antibiotics are not necessary or provide them with clear safety netting advice.



Focus on which competencies veterinarians and GPs need to embody to raise awareness about appropriate antibiotic use.



Encourage critical reflection of veterinarians and GPs regarding their prescribing behavior.

Organizational level



Invest in communication across practices to initiate a general plan for antibiotic prescribing.



Support the introduction of champions and stewardship programs to support a critical thinking in practice.

Policy level



Tailor messages resonating with the target population and consider the 'what do we want and who do we want to reach' for developing campaigns.

Strengths and limitations

This project comes with some strengths and limitations. The main strength of this project is its adoption of a One Health approach, which encompasses both veterinary and human medicine. However, regarding GPs, the sample was predominantly from capitation practices, which may partially influenced the results for GPs who, for example, work in fee for service practices, thus considered a weakness. There was little willingness from independent GPs working in a fee for service system to participate in the research due to the many requests to participate in research or busy work schedules. An additional weakness is the sole focus on antibiotic prescribers, without considering the patient perspective or the perspective of pet owners. However, this topic will be addressed in the upcoming year as theses of GPs in training. Another strength is the ongoing attempt throughout work packages one and two to triangulate as much as possible. This involves discussing the (preliminary) results at various points throughout the iterative analysis process, which strengthens the trustworthiness of the findings. Finally, this project offers insight into antibiotic prescribing behavior through carefully selected research methodologies and provides guidance for future initiatives.

CONCLUSION

In conclusion, the One Health Approach undertaken in this project, encompassing both veterinary and human primary care, has provided valuable insights into antibiotic consumption and prescribing behaviors. Work packages 1 and 2 highlighted the importance of adherence to guidelines, while also recognizing the influence of patient and owner expectations, owner and pet characteristics, health literacy, and external factors on prescribing decisions. Both veterinarians and GPs emphasized the significance of effective communication and tailored approaches to address individual owner and patient needs. Furthermore, the necessity of supporting practices or organizations in fostering responsible prescribing practices was underscored. Work package 3 emphasized the need for tailored evaluation strategies for public campaigns, considering specific objectives and target audiences. Moving forward, there is a need to focus on enhancing knowledge and awareness among veterinarians and GPs, developing communication skills, fostering a shared vision for appropriate prescribing, tailoring campaigns to specific populations, and establishing clear guidelines for waste management. Furthermore, evaluation strategies should be aligned with campaign objectives and address facilitators and barriers to implementation effectively, drawing inspiration from theoretical frameworks such as the Theoretical Domain Framework. Overall, these findings provide valuable guidance for future initiatives aimed at combating antibiotic resistance through a comprehensive, multi-level approach.

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