Journal of Antibiotics Research
Volume 5 | Issue 1
ISSN: 2574-5980

Research Article Open Access

Exploring the Behavioral Drivers of Antibiotic Prescription in Food Animal's Practitioners

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Received Date: May 30, 2021 **Accepted Date:** September 03, 2021 **Published Date:** September 06, 2021

Citation: Khan YR, Ijaz M, Ali A, Hussain K, Sohail ML, et al. (2021) Exploring the Behavioral Drivers of Antibiotic Prescription in Food Animal's Practitioners. J Antibioti Res 5 (1): 101

Abstract

Irrational use of antimicrobials in food animals is reported as a primary cause of antibiotic resistance (AMR) at the animal human interface with detrimental public health implications. Veterinarians are the main player for antimicrobial usage in food producing animals (FPAs). Therefore, this study was aimed to explore the key determinants of antibiotic prescription behavior among FPAs practitioners and its public health implications. For the purpose, a pre-tested questionnaire was presented to FPAs veterinarians. Out of total 1138, 582 veterinarians responded to the questionnaire. Chi-Square test and multivariable risk analysis through odds ratio was applied to determine the differences ($P<0.05$). Results showed that 18.72% respondents marked their personal prescribing behavior as a driver for drug-resistance. While, 36.42% stated otherwise and 44.88% were unaware about the influence of their prescribing behavior. Interestingly, 79.20% of participants were unfamiliar with the "delayed antibiotic prescription" strategy to reduce antibiotic usage. More than one third of the respondents were found using antibiotics for prophylaxis. Out of 582 respondents, 235 pointed serious lack of guidelines on the matter. To address the attitude of veterinarians towards AMR in middle income countries, there is a dire need of developing appropriate professional training strategies coinciding with proper use of antibiotics in FPAs.

Keywords: Antibiotic Resistance; Prescription Behavior; Middle Income Countries; Food Producing Animals

List of abbreviations: AMR: Antimicrobial Resistance; AMU: Antimicrobial Usage; FPAs: Food Producing Animals; MIC: Middle Income Country; LMICs: Lower Middle Income Countries; HICs: High Income Countries; MDRO: Multiple Drug Resistance Organisms

Introduction

Antimicrobial resistance (AMR) is considered as an all-inclusive health issue in humans and animals [1] and if not curtailed, ten million people might die every year by 2050, as predicted by WHO [2]. Antimicrobial use (AMU) in food producing animals (FPAs) is debatable and their frequent use for growth promotion, feed proficiency enhancement and prophylaxis is believed to be the key factor for AMR development [3]. Therefore, decline in AMU is considered imperative and must be addressed as an urgent matter [4].

Intensive mode of production to meet the rapidly growing demand of livestock products for human population, has led to uncontrolled and unchecked use of antibiotics [5]. This increases population of resistant bacteria and enables it to maintain antibiotic resistant genes [6]. These resistant bacteria can potentially spread to human population, creating a serious menace to public health [7]. Moreover, development of resistant bacteria in food animals halts the treatment of infections, which adversely compromises food security [8]. So, European Union and other global health authorities desire an urgent reduction in use of antibiotics in FPAs to minimize the AMR [9].

In developing economies, the key drivers for the escalation of AMR are indiscriminate and irrational use of antibiotics, improper selection of antibiotics, absence of institutional policies, substandard antibiotics, lack of research and testing facilities and poor animal husbandry practices [10]. Unfortunately, average on farm AMU in Pakistan is higher than other countries in the region, despite the development of national action plan to combat AMR [11]. Emergence and dissemination of antibiotic resistant pathogens from FPAs carry serious public health consequences as well constituting to the reservoirs for resistance elements [12] hence, controlled and rational use of antibiotics in FPAs is mandatory.

Veterinarians hold the responsibility of antibiotics prescription and overseeing the use of antibiotics in FPAs. They play a significant role in re-modulating the existing practices and policies to monitor the AMU [13]. Therefore, it is necessary to comprehensively understand the prescribing practices, attitude, barriers and opportunities for the veterinarians to potentially reduce the use of antibiotics in FPAs [14]. Veterinarians' prescribing behavior and influencing factors are less explored and are still elusive [15]. Gap between the prescribing guidelines and clinical use can be bridged by exploring the key factors influencing the antimicrobial prescribing behavior of the veterinarians. These findings will render policy makers and practitioners with practical ways to implement AMR reduction programs [16].

There is a serious dearth of AMU and AMR data in Pakistan due to poor regulatory framework, unchecked sale of antimicrobials, prescription malpractices and limited resources to conduct research and evaluation [17]. Therefore, this study was aimed to explore the experience, views and factors effecting antibiotic prescribing behavior of veterinarians in FPAs and its public health association. Findings of this study will serve as monitoring baseline and will help policy makers and practitioners to devise strategies for rationalization of AMU in FPAs.

Materials and methods

Survey development

A questionnaire was designed by a multidisciplinary team of experts to provide a framework to respondents for manifestation of their responses regarding antibiotic prescription. The information was gathered in four sections i.e; socio-demographic information, understanding of antimicrobial resistance, use of antibiotics and guidelines/sources of information (Table 1). A thorough review of the literature was done prior to questionnaire designing to ascertain the factors influencing the antibiotics prescribing behavior of veterinarians practicing in similar socioeconomic settings. The questionnaire was structured to decrease the sampling errors by adding questions to avoid inclusion of veterinarians not practicing food animals' medicine. Questionnaire was presented to 12 FPAs practitioners to identify and eliminate any dubious questions and for better validation. Practitioners who took part in the validity test were not included in the study.

S. No.	Questions
1.	Relevance of antibiotic resistance for your daily work?
2.	Influence of your antibiotics prescribing behavior on AMR
3.	What do you think, which sectors should be targeted to slower the development of antibiotic resistances?
4.	Do you use the strategy of delayed antibiotic prescribing?
5.	What are the reasons why antibiotics are prescribed without a hard indication?
6.	Indication for an antibiotic prescription is for me
7.	Discussion of AMR (antibiotic resistance) while prescribing an antibiotic?
8.	If yes? Discuss with whom
9.	Discussion of AMR while not prescribing an antibiotic?
10.	Reasons not to talk about antibiotic resistance (AMR).
11.	Use of practice guidelines for antibiotic therapy
12.	Need for more evidence-based therapy guidelines.
12.	Sources to get current information on antibiotic therapy and AMR?
14.	Which additional information sources would be particularly helpful?

Table 1: Theme of questionnaire

Recruitment and data collection

After thorough revision, questionnaire was sent to 1138 practicing veterinarians (registered with Pakistan Veterinary Medical Council) across the country. Respondents practicing in government setup, at private clinics, dairy and meat production facilities and poultry farms were contacted from February 2019 to January 2021 via professional associations and other professional organizations, professional e-mail lists and social media platforms. Participating veterinarians were categorized into four groups: 'large animal practitioners, 'small animal practitioners, general veterinary practitioners and wildlife practitioners. Small animal category encompassed veterinarians who were practicing dogs and cats medicine. Veterinarians practicing cattle, goats, sheep and poultry medicine were merged to make FPAs practitioners category. Veterinarians who were treating all animals without any strict limitation were categorized into general veterinary practitioners. Whereas, the wildlife veterinarians were practicing wild animal's medicine. Data obtained from veterinarians outside the target group was not included in the statistical analysis for this study.

Statistical analysis

Questionnaire was fed into Epi Data software 3.1 (www.epidata.dk/download.php). After cross checking all the record, descriptive statistics were calculated. All analyses were carried out using SPSS version 26.0 (version 26, IBM, Chicago, IL). Chi-Square test and multivariable risk analysis through Odds ratio was performed to determine the differences, keeping p-value less than 0.05. Different sociodemographic factors were used as variables for subjective involvement. Participants were categorized as they subjectively involved in the response to different queries. A total of 14 queries were analyzed in crossing with eight demographic factors of the participants.

Results

The questionnaire was completed by 582 (51.14%) practitioners. Out of 582 respondents 503 (92.61%) were male while, 79 (7.39%) were female. Mean age was 50.8±7.4 (range 25–71) years and mean work experience was 17.3±6.7 years (Table 2).

Respondents reported a multi-factorial genesis of the rise of multidrug resistant organisms. Of all the responses, the highest number of participants (144/582, 24.74%) reported antibiotic use in poultry farms, followed by the use of antibiotics as growth enhancer

	Parameter		Responders	*P*-values extracted through response of the participants as shown in table 1													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Gender	Males (n) %	503(92.61)	0.35	0.34	0.17	0.60	0.24	0.07	0.71	0.68	0.47	0.06	0.49	0.46	0.33	0.48
		Females (n) %	79(7.39)														
2	Mean Age in years (SD)		50.8±7.4	0.13	0.37	0.90	0.46	0.07	.003	0.89	0.15	0.66	0.04	0.25	0.89	0.06	0.88
3	experience in years (Mean ±SD)		17.3±6.7	0.29	0.07	0.03	0.99	0.28	0.03	0.79	0.99	0.43	0.15	0.85	0.28	0.71	0.25
4	Specialist training (n)%	General Vet Practitioners (GVP)	443 (75.94)	0.34	0.56	0.90	0.38	0.21	0.31	0.11	0.39	0.77	0.36	0.19	0.15	0.21	0.77
		Internal Medicine Vet Practitioners	31 (5.32)														
		Animal Surgeon	62 (10.82)														
		Others	46 (7.90)														
5	Number of livestock at work place? (n)%	<5,000	51(8.76)	0.02	0.21	0.87	0.80	0.35	0.33	0.57	0.97	0.72	0.32	0.75	0.32	0.12	0.52
		5,000–19,000	188 (32.30)														
		20,000–99,000	324 (55.67)														
		>100,000	19 (3.26)														
6	Kind of practice/ specialist (n)%	Large animal/food animal	436 (74.91)	0.86	.003	0.08	0.09	0.25	0.02	0.01	0.75	.003	0.02	0.02	0.47	0.16	0.04
		Small animal	47 (8.07)														
		Mixed animal	88 (15.12)														
		Wildlife medicine	11 (1.89)														
7	Visits/ month (n)%	>300	53 (9.10)	0.32	0.33	.003	0.32	0.49	0.62	0.94	0.33	0.25	0.12	0.09	0.41	0.08	0.08
		301-600	21 (3.60)														
		601-900	105 (18.04)														
		901-1,200	124 (21.30)														
		>1,200	279 (47.93)														
8	Contact to patients/ cases with MDRO	Daily/ Weekly	217(37.28)	0.35	0.36	0.21	0.31	0.10	0.22	0.17	0.46	0.53	0.07	0.34	0.83	0.51	0.24

Table 2: Pearson Chi-square analysis of the demographical data with the response of the participants keeping the asymptomatic significance (2-sided)

23.19% (135/582) and the lowest percentage of antibiotics usage was reported in livestock animals 16.83% (98/582). Antibiotics prescribed by the veterinary practitioners were declared as the main driver for antimicrobials resistance by 12.54% (73/582) participants. Various demographic factors of the FPAs practitioners were found to influence the prescription behavior but only different kind of practices was found statistically significant (*P*<0 05) (Table 2). The results of the survey showed, animal population size is directly related to the daily work load of the veterinarians. Data revealed that 44.84% (261/582) of respondents assumed that their own prescribing behavior was not related to emergence of drug resistance in their respective areas. Veterinarians with longer work experience (>25 years) did not consider their individual prescription behavior as a driver for drug resistance, while veterinarians with shorter work experience (<7 years) responded otherwise.

Lack of proper and up to date guidelines for appropriate antibiotic prescription was complained by 40% (235/582) of the participants; while 51% (295/582) of the respondents rarely or never used any guidelines prior to their routine antibiotic prescription. However, 3% (18/582) veterinarians were prescribing antibiotics as per instructions and guidelines (P<0.05). Experienced practitioners had better understanding of possible strategies to combat AMR (P<0.05). However, age was not significantly linked to prescription behavior (P>0.05).

Out of all the respondents, more than one fourth (26%) were prescribing the antibiotics as a prophylactic tool, despite the absence of any apparent indication, followed by 25% (143/582) practitioners, who were prescribing due to of non-specific diagnosis and 16% (93/582) practitioners were prescribing antibiotics to avoid further complications. Whereas, 12% (67/582) reported that they prescribed antibiotics when further diagnostic tests were too expensive and were out of reach of farmer/owner (P<0.05). Delayed antibiotic prescription strategy was practiced "very often" and "often" by 5.32% and 4.29% (25/582) of the respondents, respectively while, 79.20% (461/582) were not familiar with delayed antibiotic prescription strategy (P<0.05).

Out of all the respondents, 36% (213/582) practitioners reported prescription of antibiotics irrespective of the nature of the signs and symptoms while, 26.97% (157/582) reported rise in rectal temperature and anorexia as primary indications for antibiotic prescription. Acute infections of any origin were the main reason of antibiotic prescription for 19.93% of practitioners and 10.65% (62/582) practitioners were prescribing in case of acute anorexia (P<0.05). Survey revealed that experienced veterinarians were using antibiotic as prophylactic tool non-significantly more often as compared to their less experienced colleagues.

Antibiotic resistance and multidrug resistant organisms had never been a subject of discussion during routine practice for 89% (517/582) of the FPAs veterinarians. While, 1.54% (09/582) discussed the matter "very often" and 2.74% (16/582) discussed it "often". Kind of veterinary practice was found statistically significantly linked to AMR discussion (P<0.05).

During addressing the cases requiring antibiotic therapy, 89.1% (517/582) of the veterinarians "never discussed" the AMR subject with their fellow veterinarians, while, 11.68% (68/582) practitioners "rarely discussed", followed by 8.76% (51/582) who "very often", 2.92% (17/582) who "partly and merely", and 1.37% (08/582) who "frequently discussed" the subject of AMR. During the survey, 85.56% FPAs practitioners revealed that they have never discussed the subject of AMR with human medicine practitioners while, 3.26% (19/582) discussed it with human healthcare professionals. "Lack of concern" was the primary reason of not discussing AMR as per responses of 40.03% (233/582) participants, whereas 34.02% (198/582) participants marked veterinarian's knowledge as the primary reason.

Discussion

Knowledge, attitude and other key drivers for antibiotic prescribing behavior of veterinarians are imperative to design the successful control strategies for reduction of AMU in FPAs [18,19]. This study is aimed to deepen understand the animal-centric, microbe-centric and veterinarian-centric factors influencing antibiotics prescription behavior of the FPAs veterinarians in developing economy. Antibiotic prescription guidelines rely on their clinical, microbiological and pharmacological indications and their implications on

public health [11,20]. Prescription guidelines for the use of antibiotics and evidence presentation for mandatory antibiotic therapy are critical [21]. However, findings of the current study depict the awful scenario where 40.37% of the respondents determined the unavailability of judicious and sufficient guidelines for AMU. Lack of guidelines has been reported as a key driver for inappropriate antibiotic use in several other middle income countries (MICs) [22]. rRported concern of veterinarians over lack of guidelines for veterinarians and pharmaceuticals industry for AMU in Thailand. Likewise, [23] reported the serious dearth of guidelines by any veterinary authority in Greece, which led to heterogeneity and over-prescription of antibiotics, undermining the antibiotic surveillance data in the region and emergence of AMR. Studies conducted among veterinarians revealed that antibiotic usage guidelines can encourage controlled use of antibiotics, which can be beneficial to curtail AMR [16]. Similar constraints have been reported in MICs of African continent, where lack of updated guidelines on AMU and AMR were among the key factors for overuse of antibiotics in animals [5]. Half of the respondents in current survey revealed rare use of guidelines during antibiotic prescription in FPAs. Similar responses were recorded by [15] and [24], who reported insufficient implementation of AMU guidelines by veterinarians in MICs, despite various legislative checks. This can be attributed to several socio-economic factors and professional norms of FPAs practitioners. Middle income countries struggle with sufficient diagnostic facilities because of financial limitations. The cost of microbiological analysis of etiological agent, antimicrobial susceptibility testing, and lack of quick and economical tests have been reported as a primary limitation to the correct antibiotics prescription [20]. Similar factors were found to be involved in erroneous antibiotic prescription during this study. This is linked to the financial aspect of the MICs, which hamper veterinarian's ability to make right decision about antibiotic prescription [24]. Reported escalation in AMU was influenced by financial and infrastructural issues in MICs, similar to the case in Pakistan. It raises a dire need of interventions to address the financial aspect of antibiotic prescription. Similar restraints were found in financially compromised areas of high income countries (HICs) [25]. Despite the enough understanding and knowledge of AMU and AMR, right use of antibiotics was not in practice due to economic, infrastructural, commercial, and social factors, making prescription behavior in HICs not any different than MICs [26]. Pozza G [7] also reported lack of coherence between national guidelines and AMU in HICs. This can be attributed to owner psychology, availability and price of antibiotics [27]. To preserve antimicrobial efficacy, preclinical and clinical trainings are required to ensure the antimicrobial stewardship by the veterinarians through discussion with the clients [28]. The veterinarians were reported to have nominal influence of clients and colleagues expectations despite a high proportion perceiving client pressure [29]. A significantly higher number of respondents (85.5%) had direct conversation with their fellow colleagues regarding AMU while prescribing antibiotics and (8.7%) prescribed the antibiotics due to the influence of clients. Golding SE [30] also reported client pressure as one of the driver for antibiotic prescription. Lack of support and fear of getting sabotaged by fellow colleagues also played its role in less responsible prescription of antibiotics by veterinarians [31]. The fear of losing client, avoiding wide-ranging management advices and financial burden of preventive measures also trigger the unnecessary use of antibiotics by veterinary practitioners [32]. This study reported that some veterinarians were over using antibiotics to avoid further complications, which was also reported by [30]. Veterinarians must remain aware about the potent risk of promoting AMR in their patients or within the community [20,33]. However, in the present study, more than half of the respondents did not consider AMR relevant to their daily work or professional responsibility. Role of veterinarian in curtailing AMR is debated since long but unfortunately, still there exists skepticism about the matter. Contribution of veterinarians regarding AMR is considered insignificant and antibiotic use in livestock was considered moderate [18], which is in line with the findings of the present study. Many studies have reported the transfer of resistant genes at animals and humans interface, although the exact mechanism of their transfer is yet to be fully understood, which create the skepticism of farmers and veterinarians contributing to the lack of antibiotic stewardship. Veterinary practitioners and farmers are declared as the key actors in establishing prudent antimicrobial prescription practices [34]. Veterinarians and farmers not always sense the seriousness of situation and role they can play to combat AMR, which reduces their motivation to change prescription behavior [35].

Another dimension of misuse of antibiotics by veterinarians in FPAs is spread of AMR through food consumption. The foods of animal origin (meat eggs and milk) may have antibiotic residues due to redundant use of the antimicrobials in FPAs [10]. Nadimpalli M [36] also warned about the public health implications of antibiotic misuse in FPAs because of poorly monitored animal production systems in LMICs, to meet the food requirement of growing population. LMICs sight the higher proportion of population increase. Pakistan is no exception where recent studies have reported an increase in AMR [11] and antibiotic residues were found in various

animal origin foods [37,38]. The findings of this study support the increasing trend of AMR where 37.28% respondents contacted MDRO on daily/weekly basis. This study confers the first hand data about the prescription behavior of FPAs practitioners, which is still an unturned stone. The prescription behavior was found to be influenced by resource poor contextual facilities and lack of guidelines for the FPAs practitioners. Moreover, social and professional pressure also influenced the prescribing behavior. The findings of this study will help in designing better policies and strategies to combat AMR by rationalizing the AMU.

Conclusion

This study concludes that poor veterinary infrastructure and relevant expertise, lack of knowledge, awareness and attitude towards AMR are the main hurdles, hampering the rationalization of AMU in FPAs in LMICs. Professional planning and training of veterinarians, improved use of antimicrobials in FPAs, establishment of surveillance systems, instituting and enforcing legislation and combined international actions should immediately be taken to control antibiotic resistance.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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