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First assessment of the knowledge, attitudes, and practices of health actors in Togo and Ivory Coast in regard to antibiotic resistance

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Abstract

Background and Aim: Bacterial resistance to antibiotics has now become a threat to global public health. This study aimed to assess the knowledge, attitudes, and practices of health actors in relation to antibiotic resistance (ABR) in two African countries.

Materials and Methods: A cross-sectional and descriptive questionnaire study was conducted in Ivory Coast and Togo from August 2020 to July 2021. Actors were interviewed both in person 63% (n = 141) and remotely due to COVID-19 restrictions. Qualitative variables were described by frequencies and quantitative variables by the mean and associated standard deviation. The bivariate analysis was conducted through the Chi-square test and exact Fisher test with an acceptable risk of 5%.

Results: The results showed that 88% and 50% of the actors from Togo and Ivory Coast, respectively, had a good knowledge of ABR even if most of the stakeholders had limited knowledge of antibiotics that are banned or of critical importance in human and animal medicine. More than 75% of the actors had good perceptions in regard to ABR and these were significantly related to their profession. As for the factors leading to an increase in ABR, the interviewees perceived self-medication in humans as the main contributing factor. Approximately 70% of the actors admitted to following inadequate practices in terms of the use and/or distribution of antibiotics, and 58% and 46% of them used preventive antibiotic therapy in Togo and Ivory Coast, respectively. Similarly, in the two countries, 39% and 69% of the actors, respectively, claimed that they do not systematically use the antibiogram, and 69% and 61% of drug distributors, also respectively, admitted to occasionally selling antibiotics without a prescription. Finally, more than 80% thought that the authorities in their country did not communicate sufficiently about ABR. Among the actions that could help to combat ABR, actors considered the strengthening of controls on the distribution of antibiotics and the education of nonprofessionals on the importance of antibiotic preservation as priorities.

Conclusion: Although this first study had some limitations, that is, the low number of surveyed actors and non-standardized questionnaire used, it revealed that health actors in Togo and Ivory Coast have a good knowledge and perception in regard to antibiotics and ABR, but also follow inadequate practices.

Keywords: antibiogram, antibiotics, Ivory Coast, public health.

Introduction

The discovery of antibiotics raised hopes that it would one day be possible to control all infectious diseases, especially those caused by bacteria. Unfortunately, the phenomenon of bacterial resistance to antibiotics has put an end to this "illusion" [1]. Indeed, the use of antibiotics has automatically led to the emergence of bacterial strains resistant to these medicines. There is at least one resistance mechanism described for all classes of antibiotics used in human and veterinary medicine, and bacterial resistance to antibiotics has become a threat that all health actors face on a daily basis. Strains that are resistant to all the currently available antibiotics have even been identified worldwide [2] and, according to several predictions, antibiotic resistance (ABR) will kill more people in developing countries [3]. However, due to their minimal surveillance capacities, these countries (particularly in Africa) do not have the same amount of information on the levels and patterns of resistance of pathogenic bacteria that developed countries have [4]. There is, therefore, an urgent need to collect more information on ABR levels and the use of antibiotics in the African continent. For example, in sub-Saharan Africa, data on ABR are scarce and sparse; however, some studies have shown high rates of resistance to several antibiotics in humans [5] and animals [6, 7]. This resistance to antibiotics is the result of several causes, the main one being the sub-optimal use of these substances (i.e., their misuse

in both humans and animals), which leads to the selection of antibiotic-resistant strains that then spread in human and animal populations [8].

In 2016, the World Health Organization (WHO) published its action plan to combat antimicrobial resistance (AMR) and preserve the ability to prevent and treat infectious diseases with safe and effective drugs [9]. Through this strategic document, it encouraged state health authorities to develop their own national action plans in line with the five objectives of the Global Plan of Action, the first of which is to increase awareness and understanding of the AMR problem through effective communication, education, and training. Other international organization, such as FAO [10] and OIE [11, 12], has also prioritized the action of raising awareness, both among the general public and more specifically, among healthcare actors, as it represents an important lever in the fight against ABR. Accordingly, several studies have strived to evaluate the levels of awareness of different actors in regard to ABR to propose appropriate awareness axes. In Africa, studies on the awareness levels of the general population have been conducted in Ghana [13] and Senegal [14] and various countries [15]. Few studies have specifically targeted health actors to document their level of knowledge on the issue of ABR [16, 17].

The present study aimed to assess the knowledge, attitudes, and practices of health actors in relation to ABR in Togo and Ivory Coast, and also to determine their level of awareness about this issue to draw attention to their training needs for the preservation of antibiotics.

Materials and Methods

Ethical approval and informed consent

The consent was obtained from all respondents before the commencement of data collection. Indeed, before each interview, the aim and purpose of the study were explained to actors to get their consent in verbal form. They were also informed of the possibility of refusing to participate at any time in the study by suspending the interview or questionnaire filling. Likewise, the health professionals were guaranteed anonymity during data processing. This study did not require ethical approval.

Study period and location

The survey took place from August 1 to October 1, 2020, in Ivory Coast and from January 1 to July 1, 2021, in Togo. This cross-sectional and descriptive study was conducted in Ivory Coast which has 28 million inhabitants, there are four teaching hospitals, 84 general hospitals, 17 regional hospitals, and 1964 first-contact human health facilities. In terms of main animal health facilities, there are 92 public and 36 private veterinary clinics, and the National Agricultural Development Laboratory. In addition to these facilities, a series of legal instruments for the implementation of the provisions of the International Health Regulations (IHR) (2005) are available in Ivory Coast. Research is regularly carried out on the topic of AMR, particularly academic studies, but there is no national organization that supports it [18]. In Togo, population is estimated at 7.5 million inhabitants and health facilities, such as teaching hospitals (three), regional hospitals (six), general hospitals (40), and first-contact hospitals (412), are present alongside animal health facilities, such as private veterinary clinics and central veterinary laboratories [19]. In terms of human resources, in 2018, 611 physicians and 222 pharmacists were practicing in the country, with 361 and 127 of them, respectively, present only in Lomé and representing more than 50% of all health professionals in Togo [20]. A survey of basic texts related to the IHR (2005) showed the presence of legislation on the public health code in this country. In regard to AMR, Togo established a monitoring system for certain diseases such as AIDS, tuberculosis, and malaria consisting of five laboratories designated for the detection and reporting of antimicrobial-resistant pathogens. In addition, the three university hospitals and six regional hospitals in Togo, as well as four of the 40 district hospitals, have been designated as sentinel sites for the surveillance of infections caused by antimicrobial-resistant pathogens in humans. In contrast, no sentinel sites have been formally designated for AMR surveillance in animal health facilities, and only a limited number of labs are able to detect AMR in animal settings [21].

Study population and sampling

The population examined in this study consisted of human and animal health professionals working in Ivory Coast and Togo. The following inclusion criteria were set for respondents from both countries that freely consented to participate in the study: (1) An animal health professional qualified as a Doctor of Veterinary Medicine who was present and working in the country at the time of the survey; and (2) a qualified human health professional, such as a Doctor of Medicine or a Doctor of Pharmacy, who was present and working in the country at the time of the survey.

Exhaustive recruitment of animal health professionals qualified as veterinary doctors was carried out initially in both countries. Based on the number of veterinary doctors surveyed, a similar number of doctors from public and private health institutions (in particular, University Hospitals and the private clinics of Lomé and Abidjan) were recruited for the survey of physicians. In addition, the sales stations for medicines intended for human consumption were visited in the cities of Lomé and Abidjan to recruit pharmacists willing and available to participate in the survey. The number of recruited pharmacists was also proportional to that of veterinarians and doctors so as to obtain a balance among actors belonging to each category. Overall, 221 human and animal health professionals were investigated in both countries.

Questionnaire and data collection

A questionnaire for health professionals was prepared based on the literature, including similar previous studies, and was used to gather information within an appropriate conceptual framework. A preliminary test was carried out to ensure that the questions were clear and understandable. Two investigators, one for each country, collected data through interviews using questionnaires printed in French. They interviewed 63% (n = 141) of the actors in person and the rest remotely due to COVID-19 restrictions or because the interviewees lived in remote locations far from Abidjan or Lomé. Virtual data were collected using Google forms and the Kobo toolbox.

The questionnaire covered the following four aspects

Socio-demographic and occupational characteristics

Variables such as age, gender, experience, specialization after basic training, training on AMR, or lack of it, were collected.

Knowledge

The knowledge of health professionals in regard to ABR was measured through self-assessment; questions were about antibiotics usage algorithm, the infections for which antibiotics could be used, and those for which resistance was a problem or threat. Questions about prohibited antibiotics, antibiotics of critical importance, and good practices for the use of antibiotics were also included to assess general awareness. The questions were weighted in the same way during the scoring process. Each correct or expected answer from a health professional was worth one point and incorrect answers were worth zero points; consequently, knowledge of ABR was defined as a binary variable (good or low knowledge). Health actors were considered to have good knowledge when the sum of the scores was greater than the average score.

Perception

The interviewees were asked questions about their perception of ABR as the world's leading threat to public health; their awareness of the existence of bacteria resistant to almost all antibiotics and associated concerns due to the absence of new antibiotics on the market. The questions were also weighted in the same way during the scoring process. Each correct answer, or corresponding to the correct perception of the problem, was worth one point, whereas the other answers were worth zero points; consequently, the perception of the ABR problem was defined as a binary variable (good or bad perception). Health actors were considered to have a good perception when the sum of the question scores was greater than the average. In addition to this assessment of perception, the actors were asked further questions about the causes and measures to combat ABR to gather their opinions.

Attitudes and practices

The attitudes and practices of health professionals were measured by evaluating aspects such as the preventive use of antibiotics in patients, the sale of antibiotics without a prescription, routine or non-routine use of the antibiogram, and reactions in case of unsuccessful antibiotic treatments. Each positive attitude or practice was worth one point, while negative or risky attitudes were worth zero points; consequently, this parameter was also defined as a binary variable (i.e., good or bad practices). Health actors were considered to have good practical attitudes when the sum of the question scores was greater than the average score.

Statistical analysis

The collected data were processed in an Excel 2013 spreadsheet, and the descriptive analysis was carried out in SSPS, version 22.1. Qualitative variables were described by absolute and relative frequencies, while some quantitative variables (represented by the scores) were described by the mean and associated standard deviation. The bivariate analysis was conducted through the Chi-square test and exact Fisher test according to the conditions of applicability of each. These tests were used to look for paired associations with an alpha risk of 5%. The following comparisons were made:

- Knowledge (binary variable) and socio-demographic characteristics as dependent and independent variables, respectively;
- Perception (binary variable) as a dependent variable and socio-demographic characteristics plus knowledge as independent variables;
- Attitudes/practices (binary variable) as a dependent variable and socio-demographic characteristics plus perception and knowledge as independent variables. Multivariate analysis was finally used to determine the adjusted odds ratios (AOR) and their confidence intervals.

Results

Socio-demographic and professional characteristics of respondents

Of the 221 health actors surveyed, 36% were physicians, 31% were pharmacists, and 33% were veterinarians. Men represented 71% of the respondents, while only 29% were women; 79% of the respondents were under 45 years of age and 72% had <10 years of professional experience. Almost half of the stakeholders had never received training on AMR (Table-1).

Knowledge of ABR, perceptions, and practices of various health actors

Knowledge of ABR

The results of the survey showed that, in Togo, 84% (102/121) of stakeholders believed they had good or very good knowledge of AMR. The same proportion of respondents (84%) knew that antibiotics are medicines that can be used to treat bacterial infections, while 16% felt they had little knowledge and believed that antibiotics could be used for other types of infections as well. On the other hand, only 8%

Table-1: Socio-demographic and occupational characteristics of respondents.

Variable	Modality	Total (n = 221)	Physician (n = 79/36)	Pharmacist (n = 70/31)	Veterinarian (n = 72/33)	p-value
Country	Côte d'Ivoire	100 (45%)	38 (48%)	30 (43%)	32 (44%)	0.803
	Togo	121 (55%)	41 (52%)	40 (57%)	40 (55%)	
Sex	F	65 (29%)	22 (28%)	27 (39%)	16 (22%)	0.097
	M	156 (71%)	57 (72%)	43 (61%)	56 (78%)	
Age	25–34 years	109 (49%)	52 (66%)	39 (56%)	18 (25%)	0.00
	35–44 years	66 (30%)	19 (24%)	20 (29%)	27 (37%)	
	45–54 years	24 (11%)	5 (6%)	7 (10%)	12 (17%)	
	55 years and over	22 (10%)	3 (4%)	4 (6%)	15 (21%)	
Experiment	0–5 years	117 (53%)	55 (70%)	36 (51%)	26 (36%)	0.00
	6–10 years	43 (19%)	9 (11%)	20 (29%)	14 (19%)	
	11–15 years	20 (9%)	7 (9%)	5 (7%)	8 (11%)	
	16–20 years	14 (6%)	5 (6%)	4 (6%)	5 (7%)	
	20 years and older	27 (12%)	3 (4%)	5 (7%)	19 (26%)	
AMR training	Yes	103 (47%)	34 (43%)	32 (45%)	37 (51%)	0.058
	No	118 (53%)	45 (57%)	38 (54%)	35 (49%)	

AMR=Antimicrobial resistance

(10/121), 24% (29/121), 21% (25), and 19% (23%) of the actors had knowledge, respectively, about banned antibiotics, antibiotics of critical importance in human and animal medicine, and the existence of a guide to good practices for the use of antibiotics that they could consult (Table-2a). Finally, based on the assessment of the overall level of knowledge, which was quantified through the scores obtained from each question, actors were categorized into those with good (88% [107/121]) and low (12%) knowledge. In the former group, a similar level of knowledge was found in both women (89% [25/28]) and men (88% [82/93]). Similarly, there was relatively as much knowledge among actors who had received training on AMR (89% [63/71]) as among actors who had never received it (88% [44/50]) (Table-3a). On the other hand, actors who had no specialization at the end of their basic training had better knowledge (90% [83/92]) than those who had it (88% [24/29]), even if the difference was not significant. In Ivory Coast, 64% (64/100) of actors felt they had a good or very good knowledge of AMR, while 36% felt that their knowledge was limited. In regard to the antibiogram, 88% were aware of its definition, with 80% of actors knowing how to use antibiotics appropriately. Finally, 27%, 28%, and 58% of the actors had knowledge, respectively, of prohibited antibiotics, antibiotics of critical importance in human and/or veterinary medicine, and the existence of a guide to good practices for the use of antibiotics (Table-2b). Based on the scores obtained from each question actors were categorized into two groups: Those with good (50% of the actors) and low (50% of the actors) knowledge. In the first group, men were relatively more knowledgeable (56% [35/63]) than women (41% [15/37]). A comparison of professions revealed that veterinarians 69% [22/32] had relatively more knowledge than physicians (42% [16/38]) and pharmacists (40% [12/30]). Overall, the actors' level of knowledge in regard to ABR in Ivory Coast differed significantly depending on profession (Table-3b). The average scores were 7.22 ± 1.49 and 3.45 ± 1.27 for actors in Togo and Ivory Coast, respectively, ranging from 1 to 11 in the former and from 0 to 6 in the latter. Table-4 shows the distribution of different actors according to their scores and highlights the differences based on occupational category. The knowledge scores in Togo varied from 3 to 9 (6.7 ± 0.40) among pharmacists, and from 3 to 11 (7.6 ± 0.44) among veterinarians. Similarly, in Ivory Coast, the scores ranged from 1 to 6 (3.13 ± 0.4/3 ± 0.45) among human health professionals and from 0 to 6 (3.8 ± 0.5) among animal health professionals. Overall, professionals with sufficient knowledge accounted for 71% of the actors surveyed in both countries.

Perception of ABR by different health actors

The responses obtained from stakeholders in Togo showed that 17% (21/121) had a bad perception of the ABR problem (Table-3). Indeed, 75% (91/121) of them were not aware of the existence of pathogens resistant to almost all antibiotics, and 55% (67/121) believed that the number of new antibiotics on the market that is effective against the development of resistance is increasing (Table-5). The good perception of the ABR problem observed in Togo was significantly related to the actors' profession, with particularly high scores among veterinarians (93% [37/40]), compared to those among pharmacists (85% [34/40]) and doctors (71% [29/41]). In regard to the factors leading to an increase in ABR, the interviewees perceived self-medication in humans as the primary one, followed by the under-dosage of antibiotics during treatments and the administration of antibiotics to livestock carried out directly by farmers (Figure-1a).

The responses from stakeholders in Ivory Coast showed that almost a quarter (24% [24/100]) had a poor perception of ABR, especially the lethal nature of infections due to antibiotic-resistant bacteria, which was noted in most of that quarter of

Table-2: Knowledge of antibiotic resistance among health actors.

(a) Knowledge of health actors on antibiotic resistance in Togo

Variable	Score	Corresponding modality	Total (n = 121)	Physician (n = 41)	Pharmacist (n = 40)	Veterinarian (n = 40)	p-value
How do you assess your level of knowledge about antibiotic resistance?	1	Very good knowledge; Good knowledge	102 (84%)	30 (73%)	35 (88%)	37 (93%)	0.046
	0	Average knowledge; vague knowledge	19 (16%)	11 (27%)	5 (13%)	3 (8%)	
Antibiotics are molecules that can be used to treat infections due to	1	Bacteria	102 (84%)	33 (80%)	36 (90%)	33 (82%)	0.046
	0	Virus; parasites; mushrooms; Bacteria and viruses	19 (16%)	7 (20%)	4 (10%)	7 (18%)	
For what kinds of microorganisms is antibiotic resistance a problem when treating an infection?	1	Bacteria	118 (98%)	38 (93%)	40 (100%)	40 (100%)	0.05
	0	Virus; parasites; mushrooms; Bacteria and viruses	3 (2%)	3 (7%)	0 (00%)	0 (00%)	
Antibiotics kill both commensal and pathogenic bacteria	1	True	72 (60%)	32 (78%)	17 (42%)	23 (58%)	0.005
	0	False; I don't know	49 (40%)	9 (22%)	23 (58%)	17 (42%)	
Healthy humans and animals can carry antibiotic-resistant bacteria	1	True	117 (97%)	39 (95%)	39 (98%)	39 (98%)	0.787
	0	False; I don't know	4 (3%)	2 (5%)	1 (2%)	1 (2%)	
antibiotic resistance develops in both commensal and pathogenic bacteria	1	True	93 (77%)	29 (71%)	32 (80%)	32 (80%)	0.52
	0	False; I don't know	28 (23%)	12 (29%)	8 (20%)	8 (20%)	
Do you know the list of ATBs of critical importance in human health?	1	Yes	29 (24%)	19 (46%)	6 (15%)	4 (10%)	0.000
	0	No	92 (76%)	22 (54%)	34 (85%)	36 (90%)	
First-generation antibiotics are ideal for use as a first-line antibiotic and third- and fourth-generation antibiotics should only be used as a last resort	1	True	65 (54%)	27 (66%)	16 (40%)	22 (55%)	0.064
	0	False; I don't know	56 (46%)	14 (34%)	24 (60%)	18 (45%)	
Patient may contract ATB-resistant bacteria at health center	1	True	118 (98%)	40 (98%)	39 (98%)	39 (98%)	1.000
	0	False; I don't know	3 (2%)	1 (2%)	1 (2%)	1 (2%)	
Do you know of any banned (withdrawn) antibiotic (s) in your field?	1	Yes	10 (8%)	2 (5%)	1 (2%)	7 (18%)	0.032
	0	No	111 (92%)	39 (95%)	39 (98%)	33 (82%)	
Do you know the list of critically important ATBs in animal health?	1	Yes	25 (21%)	4 (10%)	0 (00%)	21 (53%)	0.000
	0	No	96 (79%)	37 (90%)	40 (100%)	19 (48%)	
Are you aware of the existence of a good practice guide to the use of ATBs in your field?	1	Yes	23 (19%)	9 (22%)	7 (18%)	7 (18%)	0.840
	0	No	98 (81%)	32 (78%)	33 (82%)	33 (82%)	

(b) Knowledge of health actors on antibiotic resistance in Côte d'Ivoire

Variable	Score	Corresponding modality	Total (N = 100)	Physician (N = 38)	Pharmacist (N = 30)	Veterinarian (N = 32)	p-value
How do you assess your level of knowledge about antibiotic resistance?	1	Very good knowledge; Good knowledge	64 (64%)	21 (55%)	17 (57%)	26 (81%)	0.048
	0	Average knowledge; vague knowledge	36 (36%)	17 (45%)	13 (43%)	6 (19%)	
The antibiogram is a laboratory biological test that measures bacterial sensitivity *in vitro*	1	True	88 (88%)	29 (76%)	29 (97%)	30 (94%)	0.018
	0	false; I don't know	12 (12%)	9 (24%)	1 (3%)	2 (16%)	

(Contd...)

Table-2: *(Continued).*

(b) Knowledge of health actors on antibiotic resistance in Côte d'Ivoire

Variable	Score	Corresponding modality	Total (N = 100)	Physician (N = 38)	Pharmacist (N = 30)	Veterinarian (N = 32)	p-value
First-generation antibiotics are ideal for use as first-line antibiotics and third- and fourth-generation antibiotics should only be used in as a last resort	1	True	80 (80%)	34 (89%)	20 (67%)	26 (81%)	0.064
	0	false; I don't know	20 (20%)	4 (11%)	10 (33%)	6 (19%)	
Do you know of any banned (withdrawn) antibiotic (s) in your field?	1	Yes	27 (27%)	2 (5%)	8 (27%)	17 (53%)	0.000
	0	No	73 (73%)	36 (95%)	22 (73%)	15 (47%)	
Do you know the list of ATBs of critical importance in human health?	1	Yes	28 (28%)	11 (29%)	10 (33%)	7 (22%)	0.596
	0	No	72 (72%)	27 (71%)	20 (67%)	25 (78%)	
Are you aware of the existence of a good practice guide to the use of ATBs in your field?	1	Yes	58 (58%)	22 (58%)	20 (67%)	16 (50%)	0.414
	0	No	42 (42%)	16 (42%)	10 (33%)	16 (50%)	

ATBs=Antibiotics

interviewees. Indeed, for 88% (88/100) of the actors surveyed, a patient with an infection caused by multidrug-resistant bacteria will heal if he/she can bear the economic cost of treatments. Correct perceptions of the ABR problem were also significantly related to the actors' profession, with considerably better levels observed among pharmacists than among doctors. In regard to the increase in ABR, Ivorian actors perceived self-medication in humans (80%) as the main cause, followed by the administration of antibiotics to livestock directly by breeders (71%) (Figure-1b).

The average scores for the perception of ABR were 2.45 ± 0.96 and 3.27 ± 1.15 for professionals in Togo and Ivory Coast, respectively, ranging from 0 to 4 in the former and from 0 to 5 in the latter. Table-4 shows the distribution of different actors based on their scores and highlights the differences in perception according to the occupational category. Indeed, the scores for perception in Togo varied from 0 to 4 among doctors and pharmacists (2.05 ± 0.97/2.55 ± 0.29) and from 1 to 4 among veterinarians (2.75 ± 0.26). On the other hand, in Ivory Coast, the scores varied from 2 to 5 among pharmacists (3.57 ± 0.25) and from 0 to 5 among veterinarians (3.3 ± 0.44). Professionals with a good perception accounted for 80% of those interviewed in both countries.

Practices of different health actors in relation to ABR

Twenty-eight percent (28% [34/121]) of the actors surveyed in Togo experienced therapeutic failures when using antibiotics, 93% of which admitted to reacting negatively in such circumstances by changing antibiotics, increasing doses, or combining a second antibiotic without additional analyses. Only 7% claimed they had a good attitude when faced with therapeutic failures, requesting additional tests or the antibiogram test or referring the patient to a specialist for further examination. Fifty-eight percent (58% [70/121]) of the actors surveyed used preventive antibiotic therapy, which consists in administering antibiotics to patients for prophylactic purposes. Similarly, only 61% [74/121] of these actors claimed to systematically use antibiograms before the administration of antibiotics. Finally, 69% (55/121) of drug distributors (pharmacists and veterinarians) admitted to occasionally selling antibiotics without a prescription (Table-6a). Overall, it appeared that 72% (87/121) of the actors had bad attitudes or practices in terms of the use and distribution of antibiotics. These inadequate practices were significantly related to the gender and profession of actors, with relatively worse practices reported among men (77% [72/93]) and veterinarians (95% [38/40]) than among women (54%) and pharmacists (50%) (Table-3a). On the other hand, in Ivory Coast, 60% (60/100) of health actors experienced therapeutic failures when using antibiotics, 68% of which admitted to reacting negatively in such circumstances

Table-3: Level of knowledge, perception and good practice of health actors in relation to antibiotic resistance.

(a) Level of knowledge, perception and good practice of health actors in relation to antibiotic resistance in Togo

Variables	Modality	Good knowledge (n = 107/88)	Low knowledge (n = 14/12)	p-value	Good perception (n = 100/83)	Poor perception (n = 21/17)	p-value	Good Practices (n = 34/28)	Bad Practices (87/72)	p-value
Sex	Male (n = 93)	82 (88%)	11 (12%)	0.872	75 (81%)	18 (19%)	0.365	21 (23%)	72 (77%)	0.015
	Female (n = 28)	25 (89%)	3 (11%)		25 (89%)	3 (11%)		13 (46%)	15 (54%)	
Profession	Veterinarian (n = 40)	37 (93%)	3 (7%)	0.341	37 (93%)	3 (7%)	0.031	2 (5%)	38 (95%)	0.000
	Pharmacist (n = 40)	33 (83%)	7 (17%)		34 (85%)	6 (15%)		20 (50%)	20 (50%)	
	Physician (n = 41)	37 (90%)	4 (10%)		29 (71%)	12 (29%)		12 (29%)	29 (71%)	
Age	25–34 (n = 47)	43 (91%)	4 (9%)	0.237	38 (81%)	9 (19%)	0.365	18 (38%)	29 (62%)	0.088
	35–44 (n = 32)	29 (90%)	3 (10%)		25 (78%)	7 (22%)		10 (31%)	22 (69%)	
	45–54 (n = 22)	20 (90%)	2 (10%)		21 (95%)	1 (5%)		3 (14%)	19 (86%)	
	55 and over (n = 20)	15 (75%)	5 (25%)		16 (80%)	4 (20%)		3 (15%)	17 (85%)	
Experiment	0–5 (n = 38)	33 (87%)	5 (13%)	0.305	28 (74%)	10 (26%)	0.493	14 (37%)	24 (63%)	0.087
	6–10 years (n = 27)	25 (93%)	2 (7%)		24 (89%)	3 (11%)		11 (41%)	16 (59%)	
	11–15 years (n = 18)	18 (100%)	0 (00%)		15 (83%)	3 (17%)		4 (22%)	14 (78%)	
	16–20 years (n = 13)	11 (85%)	2 (15%)		11 (85%)	2 (15%)		2 (15%)	11 (85%)	
	20 years and older (n = 25)	20 (80%)	5 (20%)		22 (88%)	3 (12%)		3 (12%)	22 (88%)	
AMR training	Yes (n = 71)	63 (89%)	8 (11%)	0.56	61 (86%)	10 (14%)	0.331	18 (25%)	53 (75%)	0.538
	No (n = 50)	44 (88%)	6 (12%)		39 (78%)	11 (22%)		16 (32%)	34 (68%)	
Knowledge	Good	-	-	-	90 (84%)	17 (16%)	0.263	28 (26%)	79 (74%)	0.214
	Low	-	-		10 (71%)	4 (29%)	-	6 (43%)	8 (57%)	
Perception	Good	-	-		-	-		30 (30%)	70 (70%)	0.426
	Bad	-	-		-	-		4 (19%)	17 (81%)	

(b) Level of knowledge, perception and good practice of health actors in relation to antibiotic resistance in Côte d'Ivoire

Variables	Terms	Good knowledge	Low knowledge	p-value	Good perception	Poor perception	p-value	Best Practices	Bad Practices	p-value
Sex	Male (n = 63)	35 (56%)	28 (44%)	0.214	49 (78%)	14 (22%)	0.378	16 (25%)	47 (75%)	0.494
	Female (n = 37)	15 (41%)	22 (59%)		27 (73%)	10 (27%)		12 (32%)	25 (68%)	
Profession	Veterinarian (n = 32)	22 (69%)	10 (32%)	0.036	24 (75%)	8 (25%)	0.015	9 (28%)	23 (72%)	0.978
	Pharmacist (n = 30)	12 (40%)	18 (60%)		28 (93%)	2 (7%)		8 (27%)	22 (73%)	
	Physician (n = 38)	16 (42%)	22 (58%)		24 (63%)	14 (47%)	0.298	11 (29%)	27 (71%)	
Age	20–29 (n = 61)	27 (44%)	34 (56%)	0.302	42 (69%)	19 (31%)		19 (31%)	42 (69%)	0.684
	30–39 (n = 35)	20 (57%)	15 (43%)		30 (86%)	5 (14%)		9 (26%)	26 (74%)	
	40–49 (n = 2)	2 (100%)	0 (0%)		2 (100%)	0 (0%)		0 (0%)	2 (100%)	
	50 and over (n = 2)	1 (50%)	1 (50%)		2 (100%)	0 (0%)		0 (0%)	2 (100%)	
Experiment	0–5 (n = 79)	40 (51%)	39 (49%)	0,404	56 (71%)	23 (29%)	0.242	25 (32%)	54 (68%)	0.534
	6–10 years (n = 16)	6 (38%)	10 (62%)		15 (94%)	1 (5%)		3 (19%)	13 (81%)	
	11–15 years (n = 2)	2 (100%)	0 (0%)		2 (100%)	0 (0%)		0 (0%)	2 (100%)	
	16–20 years (n = 1)	1 (100%)	0 (0%)		1 (100%)	0 (0%)		0 (0%)	1 (100%)	
	20 years and older (n = 2)	1 (50%)	1 (50%)		2 (100%)	0 (0%)		0 (0%)	2 (100%)	

(Contd...)

Table-3: *(Continued).*

(b) Level of knowledge, perception and good practice of health actors in relation to antibiotic resistance in Côte d'Ivoire

Variables	Terms	Good knowledge	Low knowledge	p-value	Good perception	Poor perception	p-value	Best Practices	Bad Practices	p-value
AMR training	Yes (n = 32)	17 (53%)	15 (47%)	0.83	22 (69%)	10 (31%)	0.316	6 (19%)	26 (81%)	0.232
	No (n = 68)	33 (49%)	35 (51%)		54 (79%)	14 (21%)		22 (32%)	46 (68%)	
Specialization	Yes (n = 29)	24 (83%)	5 (17%)	0.32	22 (76%)	7 (24%)	0.272	9 (31%)	20 (69%)	0.813
	No (n = 92)	83 (90%)	9 (10%)		78 (85%)	14 (15%)		25 (27%)	67 (73%)	
Knowledge	Good	-	-		58 (75%)	19 (25%)	1.000	18 (23%)	59 (77%)	
	Low	-	-	-	18 (78%)	5 (22%)		10 (44%)	13 (56%)	0.069
Perception	Good	-	-		-	-	-	20 (26%)	56 (74%)	
	Bad	-	-	-	-	-		8 (33%)	16 (67%)	0.603

AMR=Antimicrobial resistance

by changing antibiotics, increasing doses, or combining a second antibiotic without additional analyses. Only 32% reported following good practices such as requesting additional tests or the antibiogram, or referring the patient to a specialist. Forty-six percent of the actors used preventive antibiotic therapy. Similarly, only 31% of these actors confirmed that they always use an antibiogram before delivering antibiotics. Finally, 61% (38/62) of drug distributors (pharmacists and veterinarians) admitted to occasionally selling antibiotics without a prescription (Table-6b). Overall, the analysis showed that 72% [72/100] of the actors in Ivory Coast followed inappropriate practices in terms of use and distribution of antibiotics (Table-3b).

The average scores for the attitudes and practices in relation to ABR were 1.59 ± 1.15 and 1.61 ± 1.02 for health professionals in Togo and Ivory Coast, respectively. Scores ranged from 0 to 4 in the two countries. Table-4 shows the distribution of different actors based on their scores and highlights the differences in practice according to the professional category. Indeed, the scores on attitudes and practices in Togo varied from 0 to 4 among doctors and pharmacists (1.02 ± 0.25/2.58 ± 0.34), and from 0 to 3 among veterinarians (1.18 ± 0.25). On the other hand, in Ivory Coast, they varied from 0 to 3 among doctors (1.08 ± 0.27) and from 0 to 4 among veterinarians (1.81 ± 0.38). Professionals with adequate attitudes and practices accounted for only 28% of the actors surveyed in both countries.

Perception of the fight against ABR by health actors and knowledge of the "One Health" approach

The majority of actors in Togo believed that strengthening the control of the distribution of antibiotics (84% [102/121]), educating laypeople on the importance of preserving antibiotics (80%), practicing better hygiene, and adopting better biosecurity measures (60%) were main flagship actions that can contribute to counteracting ABR (Figure-2a). 77% [93/121] of the actors surveyed in Togo had no knowledge of any organization that is addressing the problem of AMR and 81% [98/121] believed that the competent authorities of the country did not provide sufficient information on this matter. Finally, only 45% (55/121) of respondents felt they had a good knowledge of the "One Health" approach (Table-7a). The majority of actors in Ivory Coast also perceived the education of laypeople on the importance of preserving antibiotics (75% [75/100]) and the prohibition of the use of antibiotics for prophylactic purposes in livestock (63%) as flagship actions that can halt the increase in ABR (Figure-2b). As in Togo, 77% [77/100] of the actors surveyed in Ivory Coast had no knowledge of any organization active against ABR and 97% thought that the country's competent authorities did not communicate sufficiently about this subject. Finally, 60% [60/100] of respondents were aware of the "One Health" approach (Table-7b).

Table-4: Stakeholder scores on knowledge, Perceptions, and practices on antibiotics and antibiotic resistance.

Scores	Actors from Togo				Actors of the CI			
	Total (n = 121)	Physician (n = 41)	Pharmacist (n = 40)	Veterinarian (n = 40)	Total (n = 100)	Physician (n = 38)	Pharmacist (n = 30)	Veterinary (n = 32)
ABR knowledge score								
0	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (1%)	0 (0%)	0 (0%)	1 (3.125%)
1	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5 (5%)	3 (7.89%)	1 (3.3%)	1 (3.125%)
2	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	17 (17%)	9 (23.68%)	6 (20.0%)	2 (6.3%)
3	1 (0.8%)	0 (0.0%)	1 (2.5%)	0 (0.0%)	27 (27%)	10 (26.3%)	11 (36.7%)	6 (18.8%)
4	3 (2.3%)	2 (4.9%)	1 (22.5%)	0 (0.0%)	29 (29%)	12 (31.6%)	4 (13.3%)	13 (40.6%)
5	10 (8.3%)	2 (4.9%)	5 (12.5%)	3 (7.5%)	17 (17%)	4 (10.5%)	6 (20.0%)	7 (21.9%)
6	21 (17.4%)	8 (19.5%)	7 (17.5%)	6 (15.0%)	4 (4%)	0 (0%)	2 (6.7%)	2 (6.3%)
7	36 (29.8%)	12 (29.3%)	16 (40.0%)	8 (20.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
8	30 (24.8%)	7 (17.1%)	8 (20.0%)	15 (37.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
9	11 (9.1%)	5 (12.2%)	2 (5.0%)	4 (10.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
10	7 (5.8%)	4 (9.8%)	0 (0.0%)	3 (7.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
11	2 (1.7%)	1 (2.4%)	0 (0.0%)	1 (2.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Average ± SD	7.22 ± 1.49	7.37 ± 0.5	6.7 ± 0.40	7.6 ± 0.44	3.45 ± 1.27	3.13 ± 0.40	3.47 ± 0.45	3.8 ± 0.50
ABR perception score								
0	2 (1.7%)	2 (4.9%)	0 (0.0%)	0 (0.0%)	3 (3%)	2 (5.3%)	0 (0%)	1 (3.1%)
1	19 (15.7%)	10 (24.4%)	6 (15.0%)	3 (7.5%)	3 (3%)	1 (2.6%)	0 (0%)	2 (6.3%)
2	38 (31.4%)	15 (36.6%)	12 (30.0%)	11 (27.5%)	18 (18%)	11 (28.9%)	2 (6.7%)	5 (15.6%)
3	47 (38.8%)	12 (29.3%)	16 (40.0%)	19 (47.5%)	26 (26%)	8 (21.1%)	11 (36.7%)	7 (21.9%)
4	15 (12.4%)	2 (4.9%)	6 (15.0%)	7 (17.5%)	40 (40%)	13 (34.2%)	15 (50%)	12 (37.5%)
5	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	10 (10%)	3 (7.9%)	2 (6.7%)	5 (15.6%)
Average ± SD	2.45 ± 0.96	2.05 ± 0.97	2.55 ± 0.29	2.75 ± 0.26	3.27 ± 1.15	3 ± 0.43	3.57 ± 0.25	3.3 ± 0.44
ABR practice score								
0	22 (18.2%)	12 (29.3%)	2 (5.0%)	8 (20.0%)	16 (16%)	9 (23.7%)	2 (6.7%)	5 (15.6%)
1	39 (32.2%)	17 (41.5%)	3 (7.5%)	19 (47.5%)	28 (28%)	18 (47.4%)	4 (13.3%)	6 (18.8%)
2	37 (30.6%)	11 (26.8%)	15 (37.1%)	11 (27.5%)	38 (38.0%)	10 (26.3%)	16 (53.3%)	12 (37.5%)
3	13 (10.7%)	1 (2.4%)	10 (25.0%)	2 (5.0%)	15 (15%)	1 (2.6%)	6 (20%)	8 (25%)
4	10 (8.3%)	0 (0.0%)	10 (25.0%)	0 (10.0%)	3 (3%)	0 (0%)	2 (6.7%)	1 (3.1%)
Average ± SD	1.59 ± 1.15	1.02 ± 0.25	2.58 ± 0.34	1.18 ± 0.25	1.61 ± 1.02	1.08 ± 0.27	2.066 ± 0.33	1.81 ± 0.38

ABR=Antibiotic resistance

Multivariate analysis of factors related to knowledge, perceptions, and practices

The results of the multivariate analysis showed that professionals with good knowledge of AMR (AOR=2.285; 95% CI [1.018–5.125]) were more likely to follow appropriate practices (Table-8). Similarly, pharmacists (AOR = 2.496; 95% CI [1.044–5.971]) were more likely to follow good practices than veterinarians (Table-8).

Discussion

This study, whose aim was to contribute to the global efforts against ABR, took place in Togo and Ivory Coast. Togo is a small country with a high rate of demographic growth and an estimated population of nearly 6 million [22], while the General Population and Housing Census (RGPH) of Ivory Coast reported a total population of about 22 million inhabitants in 2014 [23]. In both countries, as in many sub-Saharan countries, the health status of the population is precarious as the levels of morbidity and mortality due to infectious diseases are still high [24]. Thus, antibiotics are of paramount importance in the efforts to improve the health of these populations. Prescribers and distributors of antibiotics are important for the control of ABR, which threatens this vital therapeutic arsenal. Indeed, health actors are the most likely to contribute effectively to preventing ABR by advising patients during their consultations. For this to occur, they themselves must have sufficient knowledge about ABR and be aware of the magnitude of the problem [25]. The present study assessed the knowledge and perception of ABR among health actors using the "One Health" approach. The majority of respondents had an adequate knowledge of antibiotics and ABR, although knowledge gaps were noted in relation to a number of important concepts, such as banned antibiotics (or withdrawn from markets), antibiotics of critical importance in human and animal medicine, and guides to the appropriate use of antibiotics. It is essential to fill these gaps because such a lack of knowledge is likely to lead to the use of inappropriate antibiotics and, consequently, to the increase of ABR [26].

The present study showed that antibiotic prescribers and distributors generally had a good perception of the magnitude of the ABR problem, even though a substantial number of actors had poor perceptions in regard to several important aspects. Indeed, for 75% and 30% of the actors surveyed in Togo and Ivory Coast, respectively, pathogens resistant to almost all antibiotics do not currently exist, and for 55% and 17%, the number of new antibiotics available on the market that are effective against ABR is increasing. These misperceptions highlight the need to raise awareness among actors about the

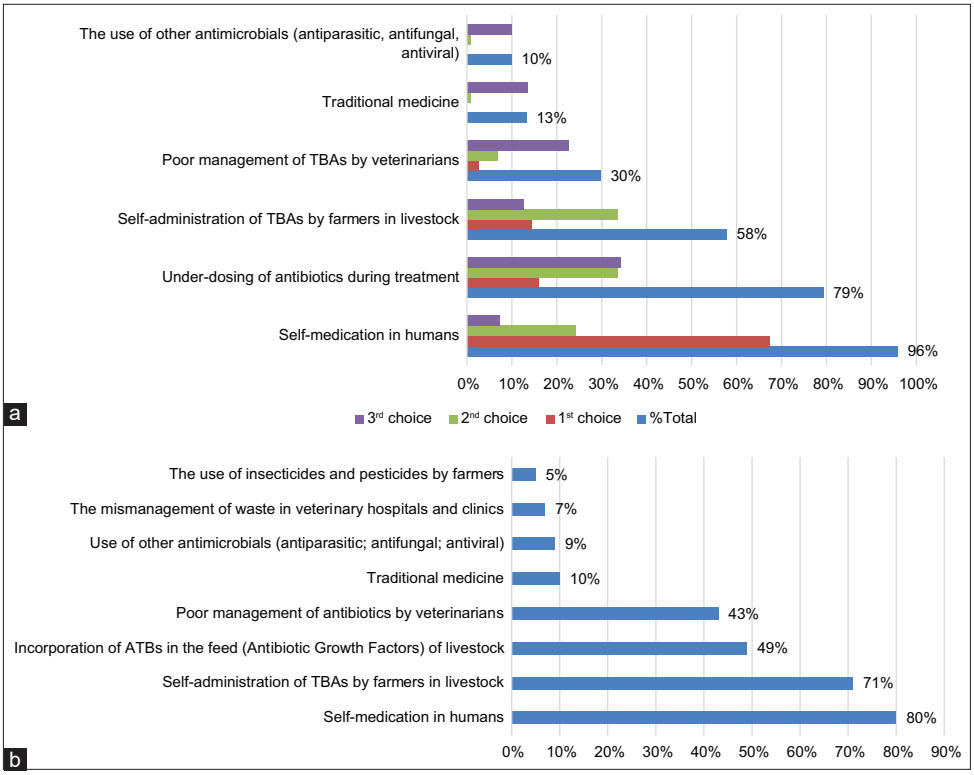

Figure-1: Classification of factors that may contribute to antimicrobial resistance as perceived by health professionals (a) Togo and (b) Ivory Coast.

Table-5: Perception of health actors on antibiotic resistance.

(a) Perception of health actors on antibiotic resistance in Togo

Variable	Score	Corresponding modality	Total (n = 121)	Physician (n = 41)	Pharmacist (n = 40)	Veterinarian (n = 40)	p-value
Antibiotic resistance can be considered the world's leading threat to public health	1	Totally agree; all right	110 (91%)	32 (78%)	40 (100%)	38 (95%)	0.001
	0	Neutral; Disagree	11 (9%)	9 (22%)	0 (00%)	2 (5%)	
bacteria resistant to almost all antibiotics. do not exist for the moment	1	False	30 (25%)	9 (22%)	9 (23%)	12 (30%)	0.647
	0	True	91 (75%)	32 (78%)	31 (78%)	28 (70%)	
the number of new effective antibiotics on the market to combat resistance is increasing	1	Disagree	54 (45%)	13 (32%)	19 (48%)	22 (55%)	0.098
	0	Okay; neutral	67 (55%)	28 (68%)	21 (52%)	18 (45%)	
bacteria resistant to almost all antibiotics are a problem in Europe but not in Togo	1	Disagree	102 (84%)	30 (73%)	34 (85%)	38 (95%)	0.026
	0	All right	19 (16%)	11 (27%)	6 (15%)	2 (2%)	

(b) Perception of health actors on antibiotic resistance in Côte d'Ivoire

Variable	Score	Corresponding modality	Total (n = 100)	Physician (n = 38)	Pharmacist (n = 30)	Veterinarian (n = 32)	p-value
Antibiotic resistance can be considered the world's leading threat to public health	1	Totally agree; All right	87 (87%)	30 (79%)	28 (93%)	29 (91%)	0.164
	0	Neutral; Disagree	13 (13%)	8 (21%)	2 (7%)	3 (9%)	
bacteria resistant to almost all antibiotics. do not exist for the moment	1	False	70 (70%)	27 (71%)	22 (73%)	21 (66%)	0.79
	0	True	30 (30%)	11 (29%)	8 (27%)	11 (34%)	
bacteria resistant to almost all antibiotics are not a concern as the number of new effective antibiotics brought to the market is increasing	1	Disagree	83 (83%)	27 (71%)	30 (100%)	26 (81%)	0.007
	0	Okay; neutral	17 (17%)	11 (29%)	0 (00%)	6 (19%)	
bacteria resistant to almost all antibiotics are a problem in Europe but not in Côte d'Ivoire	1	Disagree	75 (75%)	27 (71%)	25 (83%)	23 (72%)	0.451
	0	All right	25 (25%)	11 (29%)	5 (17%)	9 (28%)	
if the patient can bear the economic cost of an antibiotic-resistant infection he will heal	1	False	12 (12%)	3 (8%)	2 (7%)	7 (22%)	0.113
	0	True	88 (88%)	35 (92%)	28 (93%)	25 (78%)	

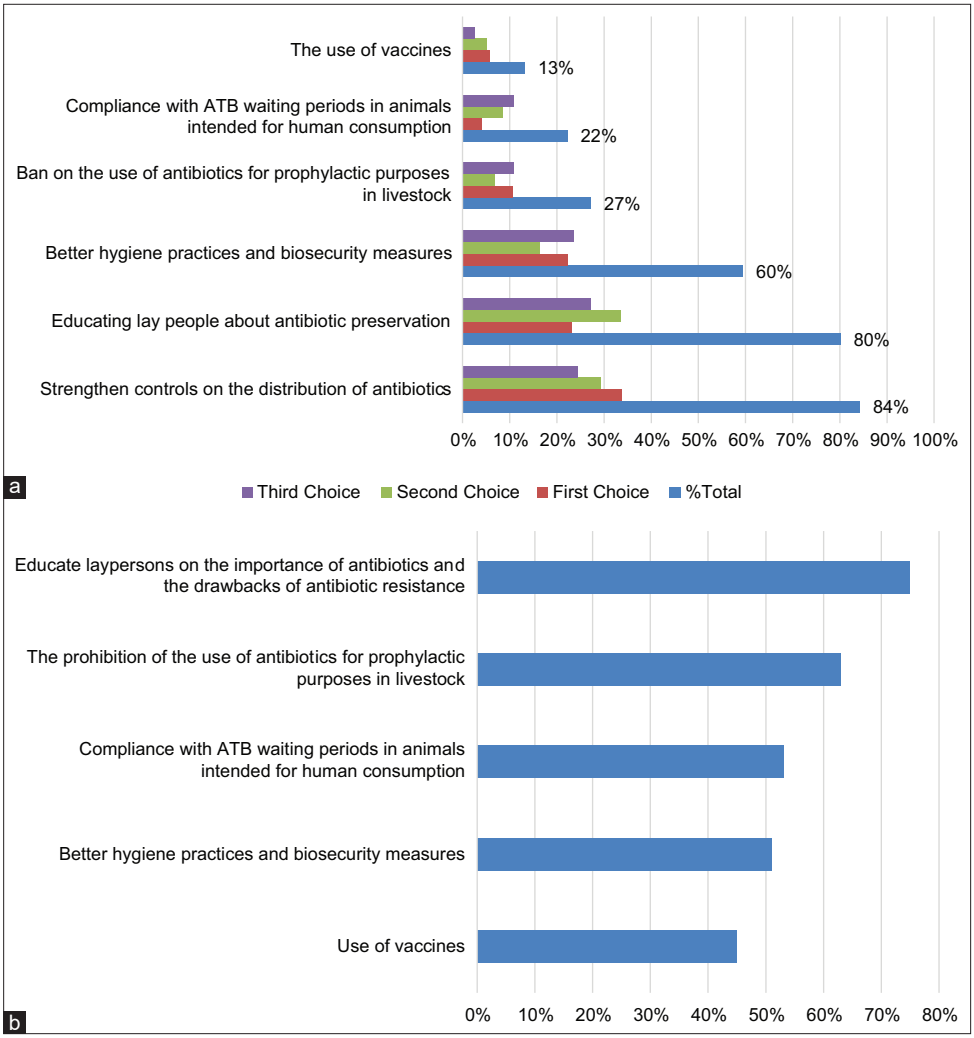

Figure-2: Classification of factors that can contribute to the fight against antimicrobial resistance as perceived by health professionals (a) Togo and (b) Ivory Coast.

extent of the problem. Indeed, several studies have already reported the existence of bacteria that are resistant to all antibiotics [27] and it is now accepted that the number of new antibiotics placed on the market is too limited to counteract the increasing rate ABR [28]. On the other hand, our findings revealed that good perceptions of the problem were significantly related to the actors' profession, with particularly higher scores recorded among veterinarians and pharmacists than among doctors. These results departed from those reported in other studies conducted among veterinary students; indeed, these showed that the overall perceptions and knowledge of antimicrobial stewardship among students at the end of veterinary training were poor [29].

The interviewees perceived self-medication in humans as the first factor contributing to the rise of ABR, followed by the under-determination of antibiotics during treatments and the direct administration of antibiotics by farmers to their livestock. In a study on the use of antimicrobials among animal health actors carried out in 20 sub-Saharan countries, the interviewees mentioned as causes of AMR the over-prescription of antimicrobials even for minor diseases and their inappropriate use, for example, low dosage [17]. Similarly, in a study conducted in Ghana among doctors at a university hospital, the majority identified the overuse of antibiotics in the population and in hospitals, self-medication, and incomplete antibiotic therapy as main factors responsible for the development of ABR [30].

In terms of practices, most of the actors interviewed used preventive antibiotic therapy, which has been widely documented in human medicine [31] and in animal health, where antibiotics are widely used as growth promoters [32] and as prophylaxis to prevent infections caused by poor hygiene [33]. However, these inappropriate practices are strongly discouraged by the WHO, which recommends not to use any of the medically important classes of antimicrobials in food-producing animals to prevent infectious diseases that have not yet been clinically diagnosed [34].

Similarly, in the present study, only a few actors claimed they systematically used an antibiogram before administering antibiotics. However, the use of

Table-6: Practices of health actors in relation to antibiotic resistance (ABR).

(a) Practices of health actors in relation to ABR in Togo

Variable	Score	Terms	Staff (n = 121)	Physicians (n = 41)	Pharmacists (n = 40)	Veterinarians (n = 40)	p-value
Do you frequently observe treatment failures in your antibiotic treatments?	1	No	87 (72%)	29 (71%)	20 (50%)	38 (95%)	0.000
	0	Yes	34 (28%)	12 (79%)	20 (50%)	2 (5%)	
If you eventually experience failure with an antibiotic. what is your first reflex?	1	Request additional tests/antibiogram/ referral to a specialist	8 (7%)	3 (7%)	1 (2%)	4 (10%)	0.392
	0	Molecule change/ Increase dose/ Combine antibiotics	113 (93%)	38 (93%)	39 (98%)	36 (90%)	
Do you use antibiotics as a preventive measure in your patients?	1	No	51 (42%)	10 (24%)	32 (80%)	9 (23%)	0.000
	0	Yes	70 (58%)	31 (76%)	8 (20%)	31 (78%)	
Do you always use the antibiogram before any antibiotic treatment?	1	Yes	74 (61%)	17 (41%)	32 (80%)	25 (62%)	0.002
	0	No	47 (39%)	24 (59%)	8 (20%)	15 (38%)	
Do you often sell or dispense antibiotics without a prescription? (Pharmacists and veterinarians only)	1	No	25 (31%)	-	22 (55%)	33 (82%)	0.000
	0	Yes	55 (69%)	-	18 (45%)	7 (18%)	

(b) Practices of health actors in relation to ABR in Côte d'Ivoire

Variable	Score	Terms	Staff (n = 100)	Physicians (n = 38)	Pharmacists (n = 30)	Vets (n = 32)	p-value
Do you frequently observe treatment failures in your antibiotic treatments?	1	No	34 (34%)	9 (24%)	17 (57%)	8 (25%)	0.007
	0	Yes	66 (66%)	29 (76%)	13 (43%)	24 (75%)	
If you eventually experience a failure with an antibiotic. what is your first reflex?	1	Request additional tests/antibiogram/ referral to a specialist	20 (20%)	8 (21%)	7 (23%)	5 (16%)	0.734
	0	Molecule change/ Increase dose/ Combine antibiotics	80 (80%)	30 (79%)	23 (77%)	27 (84%)	
Do you use antibiotics as a preventive measure in your patients?	1	No	52 (52%)	16 (42%)	23 (77%)	13 (41%)	0.005
	0	Yes	48 (48%)	22 (58%)	7 (23%)	19 (59%)	
Do you always use the antibiogram before any antibiotic treatment?	1	Yes	31 (31%)	8 (21%)	9 (30%)	14 (44%)	0.122
	0	No	69 (69%)	30 (79%)	21 (70%)	18 (56%)	
Do you often sell or dispense antibiotics without a prescription? (Pharmacists and veterinarians only)	1	No	24 (39%)	-	6 (20%)	18 (56%)	0.000
	0	Yes	38 (61%)	-	24 (80%)	14 (44%)	

the antibiogram is one of the strongest recommendations before prescribing any antibiotic therapy [35]. Finally, more than 60% of drug distributors (pharmacists and veterinarians) admitted to occasionally selling antibiotics without a prescription. The dispensing of medicinal products, for either animal or human health, is subject to the submission of a prescription according to pharmaceutical recommendations, especially in the case of antibiotics [36].

Overall, it appears that more than 70% of the actors surveyed in the present study followed inappropriate practices in terms of the use and distribution of antibiotics, which were significantly linked to the actors' knowledge of ABR and their profession. Some studies have highlighted the factors that most influence the behavior of health actors in relation to ABR, including insufficient or inadequate knowledge, information, education, and training [37]. Moreover, theoretical studies clearly have shown that interventions aimed to improve knowledge in relation to antibiotic prescriptions and promote appropriate behaviors can contribute to the reduction of ABR. Thus, efforts to address this urgent problem should focus on improving the knowledge of health actors through training and awareness raising.

In this study, more than 70% of the actors surveyed did not know any organization that is active against AMR, and more than 95% believed that the

Table-7: Perception of the fight against antibiotic resistance (ABR) by health actors.

(a) Perception of the fight against ABR by health actors in Togo

Variable	Terms	Total (n = 121)	Physician (n = 41)	Pharmacist (n = 40)	Veterinarian (n = 40)	p-value
Level of knowledge about the One Health approach	Good knowledge	55 (45%)	15 (37%)	6 (15%)	34 (85%)	0.000
	Waves/Low knowledge	30 (25%)	10 (24%)	14 (35%)	6 (15%)	
	Never heard of	36 (30%)	16 (39%)	20 (50%)	0 (00%)	
Are you aware of a body that deals with the fight against AMR in your country?	Yes	28 (23%)	10 (24%)	8 (20%)	10 (25%)	0.846
	No	93 (77%)	31 (76%)	32 (80%)	30 (75%)	
do you think that the competent authorities in your country communicate sufficiently about AMR	Yes	23 (19%)	10 (24%)	10 (25%)	3 (8%)	0.076
	No	98 (81%)	31 (76%)	30 (75%)	37 (92%)	

(b) Perception of the fight against ABR by health actors in Côte d' Ivoire

Variable	Terms	Total (n = 100)	Physician (n = 38)	Pharmacist (n = 30)	Veterinarian (n = 2)	p-value
Are you familiar with the One Health approach?	Yes	60 (60%)	17 (45%)	12 (40%)	31 (97%)	0.000
	No	40 (40%)	21 (55%)	18 (60%)	1 (3%)	
If so, do you think that in the fight against AMR, the One Health approach is necessary?	Yes	57 (95%)	14 (82%)	12 (100%)	31 (100%)	0.000
	No	3 (5%)	3 (18%)	0 (0%)	0 (0%)	
are you aware of any body dealing with the fight against AMR in Côte d'Ivoire?	Yes	23 (23%)	1 (3%)	10 (33%)	12 (38%)	0.001
	No	77 (77%)	37 (97%)	20 (67%)	20 (62%)	
do you think that the competent authorities of Côte d'Ivoire communicate sufficiently on AMR	Yes	3 (3%)	1 (3%)	0 (00%)	2 (6%)	0.349
	No	97 (97%)	37 (97%)	30 (100%)	30 (94%)	

AMR=Antimicrobial resistance

competent authorities of their country did not communicate sufficiently about the matter. This is not surprising, as Togo and Ivory Coast do not have an official system or department responsible for monitoring and/or acting against ABR. However, this should be the case, as recommended by international organizations such as the WHO and FAO. It is therefore important to establish a national or regional ABR surveillance system, such as the AMR Surveillance Network of the European Center for Diseases, as soon as possible in these countries. This national or regional system would regularly update and disseminate data on ABR through modern platforms such as social networks, e-mails, or other more traditional means, that is, information bubbles or memos.

Most of the actors interviewed in this study believed that strengthening the control of the distribution of antibiotics and educating laypeople on the importance of preserving these substances are flagship actions against the rise of ABR. Strengthening controls require stronger legislation, which is an essential component in the fight against AMR, playing a key role in the prevention of antibiotic abuse, including overuse or misuse. Legislation could thus define the main regulatory measures within a particular sector, establish links between sectors and activities in areas that have an impact on AMR, and, finally, facilitate the coordinated implementation of actions between different sectors [38]. Educating laypeople about the importance of preserving antibiotics is a recommendation of the Global Plan of Action to Combat AMR. Indeed, according to this action plan, the way forward in this challenge is through the "engagement of the whole society" because AMR concerns everyone, regardless of origin, health status, economic situation, lifestyle, or behavior. It will affect not only human health but also animal health as well as agriculture, food security, and economic development. Therefore, everyone should participate in the efforts to preserve the effectiveness of antibiotic drugs [9]. In addition, it should be noted that, within the context of the combat against ABR, other studies have suggested courses of action such as "promoting the development of new antibiotics" and "promoting diagnostic methods that can assist in the management of infectious diseases" [39]. This demonstrates the importance of a multidimensional strategy, preferably using the "One Health" approach, which has been defined as "the collaborative effort of multiple disciplines–working locally, nationally, and globally–to achieve optimal health for people, animals, and our environment" [40]. In this study, <60% of respondents felt they had a good knowledge of the "One Health" approach, which further demonstrates that more efforts are required to raise awareness and train the actors who are called to apply it to counteract ABR effectively.

Table-8: Results of multivariate analysis.

Variables	Knowledge			Perception			Practices		
	Exp (B)	95% CI	SIG.	Exp (B)	95% CI	SIG.	Exp (B)	95% CI	Significance
Country									
Togo	2.203	0.893–5.438	0.087	1.008	0.434–2.340	0.986	1.984	0.933–4.221	0.075
Ivory Coast	1	–	–	1	–		1	–	–
Gender									
Man	0.994	0.445 2.218	0.988	0.839	0.382 1.841	0.661	0.562	0.283 1.114	0.099
Wife	1	–	–	1	– –	–	1	– –	–
Age									
25–34	3.761	0.006–2507.169	0.690	1684487679.307	2.7939749E7–10.1557771448E10	0.000	0.273	0.004–16.987	0.538
35–44	5.640	0.009–3486.361	0.598	1392042520.261	2.5763396E7 –75.214552790E9	0.000	0.342	0.006–19.386	0.602
45–54	5.128	0.242–108.479	0.294	6210265941.567	5.11752687E8–75.363362066E9	0.000	0.307	0.010–9.606	0.501
55+	1	–	–	1	–	–	1	–	–
Profession									
Doctor	0.419	0.142–1.237	0.115	0.438	0.176–1.089	0.076	1.617	0.662–3.954	0.292
Pharmacist	0.365	0.123–1.087	0.070	1.385	0.470–4.084	0.555	2.496	1.044–5.971	0.040
Veterinary	1	–	–	1	–	–	1	–	–
Experiment									
>05	0.624	0.001–409.543	0.887	3.051E–10	6.065E–12–1.535E–08	0.000	12.253	0.203–738.162	0.231
Between 06 and 10	1.068	0.002–643.820	0.984	1.023E–09	2.057E–11–5.091E–08	0.000	10.580	0.190–588.107	0.250
Between 11 and 15	212768795.469	212768795.469–212768795.469	–	7.202E–10	1.511E–11–3.433E–08	0.000	6.326	0.120–333.961	0.362
Between 16 and 20	0.524	0.024–11.297	0.680	4.606E–10	4.606E–10–4.606E–10	0.000	2.963	0.095–92.582	0.536
More than 20	1	–	–	1	–	–	1	–	–
Training on AMR									
No	0.897	0.405–1.985	0.788	1.289	0.607–2.737	0.509	1.508	0.762–2.982	0.238
Yes	1	–	–	1	–	–	1	–	–
Knowledge									
Low knowledge		– –		0.889	0.359–2.200	0.799	2.285	1.018–5.125	0.045
Good knowledge	1	– –		1	–		1	–	–
Perception									
Poor perception							0.851	0.379–1.910	0.695
Good perception							1	–	–

CI=Confidence interval, AMR=Antimicrobial resistance

Conclusion

This survey is the first to provide data on the knowledge, perceptions, and attitudes toward antibiotics and ABR in Togo and Ivory Coast. Despite its limitations, that is, the low number of surveyed actors and the non-standardized questionnaire used, it provides essential information on the level of knowledge and perception of the ABR problem. The survey revealed differences between the actors of Togo and Ivory Coast in terms of knowledge but generally showed that all of them had both adequate perceptions and inappropriate practices. The good perceptions observed offer the opportunity of raising adequate awareness among prescribers and distributors of antibiotics in Togo and Ivory Coast. Based on the results obtained, a number of actions are proposed for consideration by the public authorities of both countries. The main one is to strengthen training and communication initiatives on antibiotics, antibiotic use, and ABR among health workers. In addition, particular attention should be paid to groups of health professionals whose knowledge is not optimal or who feel that they do not have sufficient knowledge or skills to work appropriately with antibiotics in their daily practice. Finally, further studies are needed to determine the factors that drive prescribers and distributors to prescribe or dispense antibiotics even though they know it is not clinically necessary and address this issue.

Authors' Contributions

APB and RB: Conceptualized and directed the study. ZLC and OA: Collected data. APB, ZLC, OA and DWO: Analyzed data. APB: Wrote the first draft. DWO revised the manuscript. All authors have read and approved the final manuscript.

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Competing Interests

The authors declare that they have no competing interests.

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