Measurement of antibiotic use on poultry farms in Zimbabwe: Evaluation of a tool and procedures

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EXECUTIVE SUMMARY

The emergence of antimicrobial resistance (AMR) as a major global threat to human and animal health and development cannot be overemphasised. Since the misuse and overuse of antimicrobials have been identified as the main drivers of AMR globally, Zimbabwe, through a collaboration between the Department of Veterinary Services (DVS) and the Food and Agriculture Organization (FAO), developed and piloted an antimicrobial use (AMU) tool in the poultry production sector, to quantify antimicrobial use. The purpose of this study was to evaluate the tool and procedures used in the pilot survey and its ability to collect quality AMU data. We identified areas of improvement and developed recommendations for implementation in future AMU surveys in the poultry sector in Zimbabwe.

Methods used to evaluate the tool and procedures.

This research used mixed methods, involving quantitative and qualitative approaches. This involved initially piloting a predesigned antibiotic use (ABU) data collection tool in practice, then assessing the tool's ability to collect quality data, and finally evaluating the procedures that enabled and limited the collection of ABU data. The tool was assessed by evaluating the completeness of data collected in the pilot survey and its consistency, appraising the items included in the tool, and determining the analysability of data collected. The procedures used were evaluated by observing the tool's administration in the field and through a focus group discussion involving all data collectors of the pilot survey.

Key findings

AMU data was collected from a total of 191 farms, about 50% of the initially targeted 384 broiler farms. It was observed that there was considerable missing data on various questions in the tool, including farm georeferences bird populations, and information about the treatment, including the identification of the antibiotic active ingredient and their concentrations, routes of administration, treatment dosage and duration, as well as the age and weight of birds at the time of treatment. Inconsistencies were also noted in the data collected, particularly in the way antibiotics were recorded. The analysability of data collected during the pilot was negatively affected by the missing data, and due to the way specific questions were designed in the tool, in particular, those to do with the treatment of birds with antibiotics, which were found to have excluded the majority of survey respondents from further analyses.

Broiler farms in communal areas were over-represented in the pilot survey due to the majority of data collectors working in these areas. Various challenges were encountered during the recruitment of participants, including farmers not keeping birds at the time of the survey, farmers declining to take part in the study due to lack of incentives, some farms being in remote locations, and political interference. Most data collectors in the pilot survey were recruited from the Agricultural Extension Services (AGRITEX) department within the Ministry of

Agriculture, indicated that the timing of the survey (January to May of the calendar year) was not conducive for them since it coincided with the cropping season in Zimbabwe, which induced high workloads, leaving less time to participate in data collection activities.

Conclusions and recommendations

The pilot AMU survey in broiler production that was conducted serves as an important milestone in establishing a monitoring system for the use of antimicrobials in food-producing animals in Zimbabwe. The evaluation of the tool, together with the procedures used in the pilot survey, as was done in this research, is a necessary additional step to identify areas where the survey went well and vice-versa, in its quest to obtain quality data to inform veterinary antimicrobial stewardship efforts, and policy formulation. To a moderate extent, the pilot tool and procedures used in broilers enabled the collection of AMU data, but some key challenges also arose, mainly related to questionnaire design (i.e. question formulation), data collection procedures, participant recruitment, timing of the survey and inadequate training of data collectors, among other issues.

Several recommendations have therefore been tailored to address the majority of these challenges, including using the 'Drug Bag' method in monitoring the use of antibiotics in poultry, carefully selecting enumerators to ensure representation of different farming scales, adequately training data collectors before surveys and giving them standard operating procedures to use in data collection to ensure consistency. More research needs to be done in this area of monitoring the use of antimicrobials in food-producing animals in Zimbabwe and beyond in order to strengthen capacities to collect quality AMU data, thereby contributing to antimicrobial stewardship efforts and in turn, with the global fight against AMR.

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1 INTRODUCTION

1.1 Background

Antimicrobial resistance (AMR) is acknowledged as one of the main threats to animal and human health worldwide. A key driver for the evolution of bacterial resistant genes is the excessive use of antimicrobials that escalates the favourable mutation in the bacteria (Laxminarayan *et al.*, 2013). Although global estimates of antimicrobial use (AMU) are comparable in animals and humans (118mg/PCU and 133mg/kg respectively), the chances of mutations in animals are higher due to larger animal biomass (Van Boeckel *et al.*, 2017). In addition, antimicrobial use in low (sub-therapeutic) dose in food animals as growth promoters allow a perfect environment for the emergence of AMR (Pokharel *et al.*, 2020). Recent studies have demonstrated an association between the use of certain antimicrobials in animals and the occurrence of AMR in specific clinical isolates from humans (ECDC/EFSA/EMA (2015); ECDC/EFSA/EMA (2017). Hence, reducing AMU in both animals and humans is an essential step in curbing the emergence of AMR in both animals and humans.

To obtain a reduced and more appropriate AMU in food-producing animals and ultimately lower levels of AMR, detailed knowledge of AMU in different countries, sectors, and farms is key. Such information is essential in guiding veterinary antimicrobial stewardship (AACTING website). Across the globe, governments have used various approaches to monitor the usage or consumption of antimicrobials in food-producing animals. One such approach is conducting specific farm-level AMU surveys, and these have been carried out in Europe (53% of studies), the Americas (23%), Asia (13%), Africa (8%) and Oceania (3%) (Cuong *et al.*, 2018). The most common animal species investigated were swine and cattle (43.8% of studies), followed by poultry (24.7%) (Cuong *et al.*, 2018). Farm-level surveys enable researchers to better understand AMU at the species and herd level, and allow for benchmarking and identification of high users.

Some countries obtain antimicrobial consumption data for animals through the collection of national sales data for veterinary antimicrobial medicinal products. One such program is the European Surveillance for Veterinary Antimicrobial Consumption (ESVAC) project, administered by the European Medicines Agency (EMA), with the 2019 report including sales data from 31 countries (European Medicines Agency, 2019). Antimicrobial sales quantification, however has limitations in that dosing differences between antimicrobials are not taken into consideration and also the unavailability of reliable AMU data at the end-user level and prescriber or provider of medicinal products, which is vital for guiding farm and/or sector-specific AMU practices (Levy., 2014; Speksnijder *et al.*, 2015; Carmo *et al.*, 2017).

In the framework of the Global Action Plan on AMR, the World Organization for Animal Health (OIE) built a global database on antimicrobial agents intended for use in animals,

supported by the Tripartite (World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO) and OIE) collaboration. The OIE began collecting annual data through this system in 2015 using a template. Over the years, there has been an increase in the number of countries participating in the data collection such that in the Sixth Edition of the Annual Report on Antimicrobial Agents Intended for Use in Animals, released in 2022, a total of 155 out of 182 had reported use-data to the OIE in the sixth round of data collection. In this report, 70 countries reported antimicrobial quantities with the highest details (Reporting Option 3 of the OIE template), and 35 participating countries made their national reports publicly available. To improve the quality of AMU data reported by participant countries, the OIE is currently developing an Interactive Information Technology (IT) system for AMU data collection which intends to simplify the reporting process, enable faster reporting and analysis, and also enable Member countries to use their own data to get valuable insights and visualise important information (OIE Annual Report on Antimicrobial Agents Intended for Use in Animals, 6th Edition).

In this context, antimicrobial use and consumption surveillance in humans and animals are key in the fight against AMR. In the African region, Kimera *et al.* (2020) reported that most countries that do not have AMU surveillance systems for food production are at different stages in developing them. Zimbabwe currently does not have AMU surveillance systems for food-producing animals but reports antimicrobial consumption (AMC) data to the OIE through the OIE focal point for veterinary antimicrobial products, which is domiciled in the Medicines Control Authority of Zimbabwe (MCAZ).

Poultry meat is the Zimbabwe human population's predominant source of animal protein, with a total of 111 600 tonnes of broiler meat produced in 2020, and 73% of it attributed to the small and medium-scale broiler production sector (Second Round Crop and Livestock Assessment Report, 2020/2021 season). Due to the intensive nature of broiler production and its associated' increased infectious disease challenge, there is probably extensive use of antimicrobials in this sector, but this has never been quantified to date. Given the risk of AMR development as a consequence of AMU, it is essential to monitor antibiotic usage in the poultry production sector to improve AMU stewardship efforts and influence policy development. This study also serves as a baseline for future research on AMU in the animal production sector in Zimbabwe.

Cognisant of the need to initiate AMU surveillance in food-producing animals in Zimbabwe, the Department of Veterinary Services (DVS), in collaboration with the Food and Agriculture Organization Zimbabwe Office (FAO Zimbabwe), developed and piloted a tool for AMU data collection in the broiler production sector in Zimbabwe during the period November 2021 to April 2022. This study aimed to assess the tool and procedures used in the pilot AMU data collection exercise, with the view of improving them to collect quality data in future AMU surveys in food-producing animals in Zimbabwe.

1.2 General objective

To assess the strengths and limitations of the tool and procedures for AMU data collection in a DVS/FAO pilot on selected broiler farms in Zimbabwe.

1.2.1 Specific objectives

1. To determine the feasibility of collecting quality AMU data using the pilot tool.
2. To understand the procedures that enable and limit the collection of quality data.
3. To recommend key features of a future tool and procedures to maximise the completeness and accuracy of data collected.

1.3 Rationale

Farm-level AMU data collection allows for identifying the highest or most problematic AMU users and providing a baseline to evaluate the effect of AMU reduction measures and responsible use campaigns. AMU data generated at the farm level is used in developing antimicrobial stewardship programs and can influence policies about the accessibility and use of antimicrobials. Over the past years, Zimbabwe did not have a surveillance system for monitoring the use of antibiotics in food-producing animals in the country, despite the known extensive use of these products, particularly in the poultry production sector. With the knowledge that AMU is an important driver of AMR development, the use of antibiotics must be continuously monitored so that the risk for AMR development can be ascertained and that appropriate interventions to curb this undesirable event can be formulated.

To initiate AMU surveillance at the end-user level in Zimbabwe, as recommended by the OIE, the Department of Veterinary Services (DVS), in collaboration with the Food and Agriculture Organization (FAO), developed and piloted a tool in the broiler production sector in eight districts of the country. The purpose of this study was to evaluate the performance of the tool and procedures used in the pilot AMU survey, in particular their ability to collect quality AMU data, assess their strengths and weaknesses in this regard, and ultimately proffer recommendations for improving the tool and procedures, to enable them to collect accurate farm-level AMU data.

1.4 Research questions

The study seeks to answer the following questions:

1. How feasible is it to collect quality AMU data on broiler farms using the pilot tool?
2. What procedures enable and limit the collection of quality AMU data?
3. What are the key features to incorporate in future tools and procedures for AMU data collection in poultry?

2 METHODOLOGY

This was a mixed methods study involving quantitative and qualitative approaches. The methods involved three dimensions: first, piloting a pre-designed antibiotic use (ABU) data collection tool in practice; second, assessment of the ability of the tool itself to collect quality data; third, evaluation of the procedures that enabled and limited quality data collection. Following this, recommendations of key features for subsequent tools and procedures were made.

2.1 Implementation of the pilot

2.1.1 Study area

The tool was piloted in eight of the sixty-one districts of Zimbabwe: Marondera, Murewa, Zvimba, Chegutu, Mutare, Mutasa, Bubi and Masvingo. These districts are located in five of the country's eight provinces as follows: Zvimba and Chegutu districts (Mashonaland West province), Marondera and Murewa districts (Mashonaland East province), Mutare and Mutasa districts (Manicaland province), Masvingo district (Masvingo province) and Bubi district (Matabeleland North province). These districts were purposively selected because they are perceived to have the majority of poultry farms in the country.

2.1.2 Pilot tool

An outline of the tool is described here. See Appendix 1 for the complete pilot tool. This tool was developed following the AACTING Guidelines for Collection, Analysis and Reporting of Farm-Level Antimicrobial Use, in the scope of Antimicrobial Stewardship version 1.2 (2019), developed under the Joint Program Initiative on Antimicrobial Resistance (JPI-AMR) AACTING Project.

The pilot tool consisted of five sections, with the first section on 'Description of the farm', which enquires information on the farm's location. The second section enquires on the farmer's demographic information, including age, gender, level of education and experience in broiler production. The third section enquires on the indication for antibiotic usage by farmers, detailing the clinical signs exhibited by birds, that prompted the use of antibiotics. The fourth section enquires on antibiotic usage information, including the antibiotic used, its active ingredients and their concentration, dosage used and route of administration. Also enquired under this section is the number of birds and their weights at the time of treatment, where the antibiotics used were derived and where instructions for antibiotic use were obtained. The last section of the questionnaire briefly enquires on farms' biosecurity including the use of footbaths and disinfection of poultry sheds. All questions were pre-entered, with quantitative response options pre-loaded, onto an Epi Info™ form to be accessible by hand-held devices such as tablets and mobile phones. There were also a few open-ended questions in the tool, including one for the antibiotic administered to the birds.

2.1.3 Data collection team

Eighteen data collectors were drawn from the Ministry of Agriculture's Departments of Agricultural Extension (AGRITEX) and Veterinary Services (DVS). These eighteen individuals were employed by the Zimbabwe's Ministry of Agriculture and worked in the districts purposively selected to participate in the pilot AMU survey. Of these eighteen data collectors, 12 were from the AGRITEX department, while 6 were from DVS. These AGRITEX and DVS extension workers usually worked in their districts by providing advisory services to farmers on livestock production and health, respectively.

The training of data collectors on how to enumerate in the pilot AMU survey was in two phases, firstly the principal investigator went through the questionnaire with the trainees demonstrating to them how they should fill every question in the tool and secondly grouping the trainees into pairs and simulate the actual data collection process, one being the interviewer and the other the interviewee.

2.1.4 Data collection procedures

The AMU pilot study targeted to interview a minimum of 378 active broiler farmers, who were conveniently selected in the eight study districts. Farmers within all scales of broiler production were targeted, and they provided consent before being interviewed. A questionnaire developed using Epi Info™ software was used to interview respondents using hand-held devices (tablets and mobile phones). The questionnaire was intended to take between 15 and 20 minutes to complete. It was also intended that visual cues, in the form of a picture library of common poultry antibiotics, be provided to data collectors to assist farmers in identifying antibiotics they used. See Appendix 2 for the entire pilot protocol.

2.2 Assessment of the AMU tool and procedures

The quality of data collected was central in assessing both the tool and procedures used in the pilot AMU survey. Data quality is a measure of how suited a dataset is to serve its specific purpose. Measures of data quality are based on data quality characteristics such as accuracy, completeness, consistency, validity, and timeliness (Scannapieco *et al.*, 2005). To assess whether the data collection tool's questions and formulation were able to capture accurate and complete data, we took the following steps:

2.2.1 Assessment for data completeness

The AMU pilot dataset was scrutinised for fields with missing information, and the proportion of fields with missing information for each question in the tool was calculated.

2.2.2 Assessment for data consistency

To assess this, the dataset was scrutinised by assessing the responses recorded to particular questions by data collectors and by checking differences in expressions, spellings and capitalisation of letters.

2.2.3 Assessment of items included

Each question was assessed on whether it was appropriate, considering the objectives of the survey, and whether the questions were clear. The order of questions in the tool was also assessed on whether it was logical. The potential for questions in the tool to introduce bias was also assessed.

2.2.4 Analysability of data collected

Data on specific variables in the tool were analysed, focusing on farmers who had treated their birds before the interview, to understand how easily the data could be analysed and interpreted.

2.3 Assessment of the procedures

To evaluate the procedures that enabled and limited the ability of the survey to collect quality AMU data, we took the following steps:

2.3.1 Observations of administration of the tool in the field

The principal investigator observed two data collection sessions of two different broiler farmers by the same data collector. During the interviews, the principal investigator noted the ease with which the AMU tool was administered. This was done by observing how the enumerator asked questions and recorded the farmer's responses. The investigator also observed questions in the tool, which presented challenges for respondents to answer. The survey times, i.e. the time taken to complete the questionnaire were also noted.

2.3.2 Focus group discussion with data collectors

The principal investigator for the pilot AMU survey convened a focus group of the eighteen data collectors after the data collection exercises to discuss their experiences regarding the use of the tool to collect AMU data, together with the procedures used in the survey. The principal investigator guided the discussion, which revolved around the following aspects; sampling of farms, recruitment of participants, survey questions, ease of using the tool, survey timing and workload of data collectors & sustaining AMU surveys (see Appendix 3- Guide for Focus Group Discussion Questions).

3 RESULTS

During the pilot survey, which was conducted over a period of six months (November 2021 to April 2022), AMU data was collected from a total of 191 farms, which was about 50% of the 384 farms which were initially targeted for data collection at the beginning of the survey.

3.1 Assessment of the AMU tool

3.1.1 Assessment of data completeness

Table 1 below shows the extent of missing data in the database for the pilot AMU survey. As seen in the table, data collectors faced considerable difficulty obtaining geo-references for the farms. There was also considerable missing data for the 'Antibiotic usage' section of the questionnaire.

Table 1: Missing data for questions in the AMU tool

Questionnaire section	Question in AMU tool	Proportion of fields with missing data	Percentage of fields with missing data (%)
Description of the farm	Geo-references for broiler farms	85/191	45
Description of the production cycle	Current broiler production system used by broiler farmers	47/191	25
	Number of broiler batches at the farm	62/191	32
Antibiotic usage	Experienced sickness of birds	126/191	66
	Treatment of birds following sickness	9/191	5
	Name of antibiotic product 1	1/73	1
	Name of active ingredient in antibiotic	6/73	8
	Concentration of active ingredient	5/73	7
	Route of administration of antibiotic	13/73	18
	Treatment duration	9/73	12
	Actual treatment dosage used	6/73	8
	Age of birds at treatment	4/73	5
	Weight of birds at time of treatment	15/73	21

3.1.2 Assessment of data consistency

Name of the antibiotic product

On assessing the dataset for this question, there are different spellings for the same product, for example, 'Bremamide' and 'Bremamed', 'Teranox' and 'Terranox'; the name of a product was capitalised in one entry (eg Esb3) and not capitalized in another (esb3). The same antibiotic product was also recorded in different ways by different data collectors. For example, the antibiotic 'Terranox' was entered as either 'Terranox' or 'Terranox Oxytetracycline soluble powder', while 'Astrisul' was recorded as either 'Astrisul' or 'Astrisul TM480'.

Units of measurement for the antibiotic and concentration of the active ingredient

These were pre-included in the tool in order to standardize the way units of measurement for antibiotics and concentrations of active ingredients are recorded during the interview. Options for the units of measurement for the antibiotic pre-included were either grams (gms), millilitres (ml), kilograms (kg) and Litres (Lts). Units of measurement for the concentration of active ingredients include the following: IU/g, IU/ml, mg/g and mg/ml.

3.1.3 Assessment of items included in the tool (appropriateness, clarity, biases)

Anonymity of respondents

The method used in the pilot tool to anonymize respondents (combination of farmer's two or three initials and last three digits of cell phone contact number) is not so effective in hiding their identities. The subsequent question in the tool reveals the identity of the respondent by directly asking their name, which contradicts the intentions of the previous question, and compromises the confidentiality of respondents.

Skip function

The functionality of the skip function was assessed on questions 16, 18, 21 and 25. Despite the recording of the 'No' option to these questions, the tool did not subsequently skip to the next relevant question in the questionnaire.

Inappropriate questions

Questions 22 and 23, which asked about the number of birds which were sick and died, were irrelevant and did not add value to the objective of quantifying antimicrobial use (AMU).

Ordering of questions

The ordering of questions in the tool, at questions 24 and 25, was odd. Question 24 asks about the signs of illness observed in birds, and question 25 asks about whether the birds were treated or not. It would seem rather odd for a farmer not to treat their animals despite them showing signs of illness. In order to address this problem, in the designing of the tool, following the question of illness observed in birds, the next question should directly ask for the product used for treatment and add as an option "I did not apply any treatment". In this way, the farmer will not be given the opportunity to give a 'desired answer' instead of the true one.

Specificity of terms

Question 25 enquires whether any 'medication' was used on the birds. It is important that the term 'medication' is used because, depending on the farmer's level of education, they may not be able to distinguish between antibiotics, antiparasitics, vitamins or even vaccinations. This highlights the importance of using visual cues such as an antibiotic 'drug bag' or picture library, from which farmers can identify the antibiotic product used. In addition to this, the enumerator can request the container of the 'medication' used to verify the type of product used.

Bias

Question 25 can potentially introduce bias on the part of the data collector in a situation where the respondent cannot recall the antibiotic product used, and the data collector discusses with the respondent in an attempt to 'assist' them in identifying the antibiotic. This can be rectified by providing data collectors with an antibiotic drug bag or a picture library for use during the interview. Although there was the intention to do this, these were not provided for this pilot survey.

Questions on antibiotic use (question 25), duration of treatment (question 45), and actual dosage rates used (question 46) can potentially introduce recall biases and social desirability biases, leading to inaccurate AMU data collection. Rephrasing some questions in the tool from past tense to present perfect tense may assist some farmers in understanding some of the survey questions better and lessen recall biases. Such an example would be rephrasing the question 'Did you treat the birds with any medication' to 'Have you ever treated your birds with medication?'

*The AMU tool includes variables recommended by the AACTING guidelines such as the name of the product, pack size, number of packages used, the active ingredient, the strength of active ingredient, actual dose rate used, duration of treatment, route of administration and indication of treatment. The AACTING guideline variable 'Age at treatment was included in the AMU tool but expressed in a form which was not specific as to the actual age of treatment; rather, it grouped ages into three categories (0-2 weeks; 2-4 weeks; 4-8 weeks), which makes it difficult to pinpoint the actual age at treatment, which is essential when estimating the average weights at treatment.

The tool also has provisions for capturing AMU data in circumstances where more than one antibiotic was used in the period under study and where one antibiotic product had more than one active ingredient.

3.1.4 Analysability of data collected

The targeted minimum number of farmers intended to be interviewed in the AMU pilot survey was 378 (18 data collectors × 21 farmers per data collector). However, only 191 respondents were interviewed, giving a response rate of 50%. This may be attributed to several reasons, chief among them the high workloads of some of the data collectors in the rainy season, which coincided with the time of the pilot AMU data collection. Of the 191 farmers who were interviewed, only 73 indicated that they had treated their current broiler batch, meaning that further analyses on AMU data would be based on a denominator of 73, with the remaining 118 respondents who expressed that they had not treated their birds at the time of the visit by data

collectors, eliminated from the denominator. These further analyses would probably result in biased results or estimates, as the responses of the majority of farmers in the survey would not have been taken into account (see Table *2*). This biasing of results is primarily attributable to the way Question 21 was formulated, only focusing on antibiotic use in the "current flock". This could be avoided by designing the question in the present perfect tense or giving the farmer a prolonged time frame from which to enquire about the use of antibiotics. It is important also to note that the sampling strategy used in this case (convenience sampling and snowball sampling) makes estimates derived from data analysis ungeneralisable to the entire national broiler population but tolerable since this was only a pilot study.

From the respondents who indicated using antibiotics in the survey, *Figure 1* below shows the variations in the frequencies of use of different antibiotic classes in broilers.

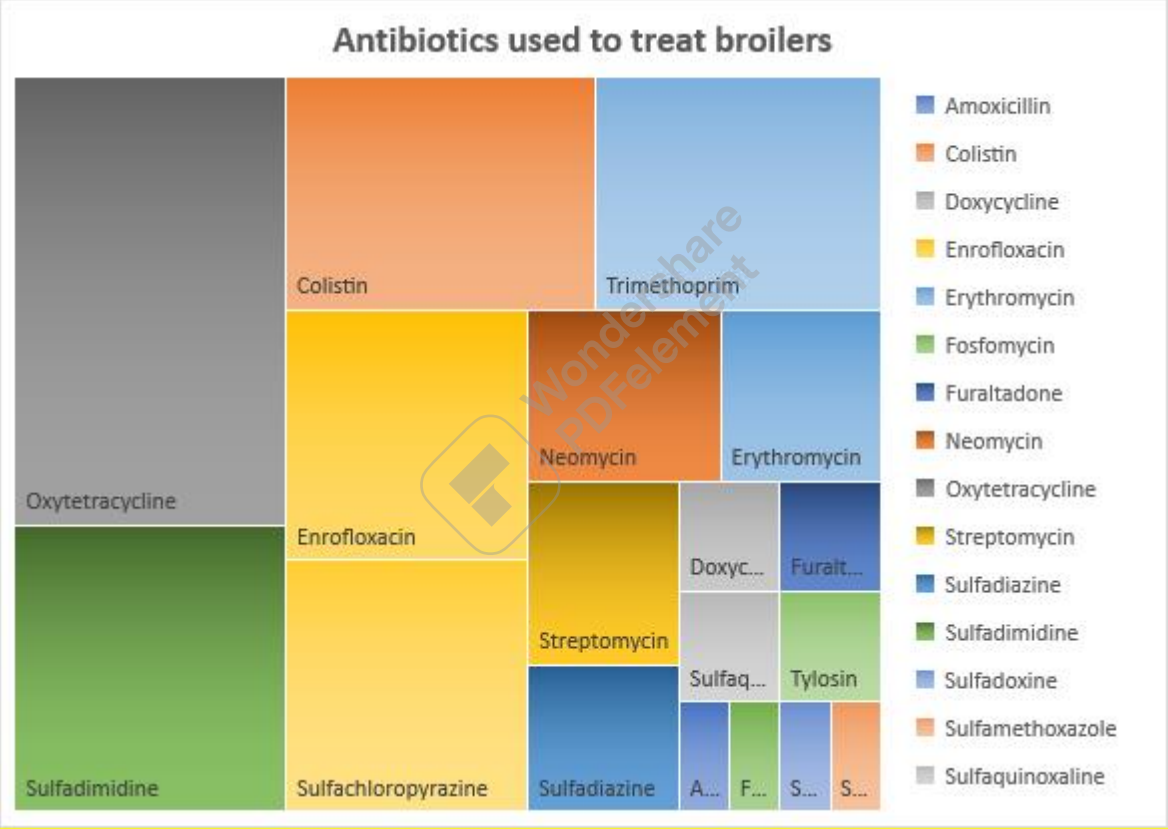

Figure 1: Antibiotics used in broiler production in surveyed districts of Zimbabwe

Table 2: Reasons for using antibiotics, sources of antibiotics and instructions for their use

The question in the AMU tool	**Number of farmers (n=73)**	**Percentage of farmers (%) (n=73)**
a. *Reason for using antibiotics*		
Prevention	25	34
Treatment	44	60
Both Treatment and Prevention	35	48
Growth promotion	3	4
b. Source of antibiotic		
AGRITEX worker	16	22
Veterinary Extension Worker (VEW)	16	22
Agrovet shop	53	73
Veterinary practitioner	11	15
Chick supplier	20	27
Hardware shop	22	30
c. Source of advice for antibiotic use		
AGRITEX worker	13	18
Veterinary Extension Worker (VEW)	3	4
Agrovet shop assistant	37	51
Veterinary practitioner	2	3
Self-prescription	12	16
Other farmers	8	11
Family member	1	1
Neighbour	6	8

As Figure 1 shows, oxytetracycline (29% of respondents; n=73) was the predominantly used antibiotic by broiler farmers in the survey, with different classes of sulfonamides, including sulfadimidine (19% of respondents), sulfachloropyrazine (14% of respondents), sulfadiazine (5% of respondents; n=73); being the next commonly used antibiotic behind oxytetracycline. The results from this survey are consistent with the antimicrobial consumption data for the animal sector in Zimbabwe, reported by the MCAZ to the OIE in 2017 and 2018, which indicated the predominant use of oxytetracyclines and sulfonamides in te animal sector, across livestock species. It is also important to note that from this survey, 14% and 10% of respondents (n=73), respectively, used colistin and enrofloxacin, which are among the high priority critically important antibiotics for human health as classified by the World Health Organization (WHO).

Given the formula used to calculate AMU in farm animals (**Farm level AMU = Unit of measurement (UM) / Animal population at risk)**, the pilot study intended to quantify the volume of antibiotics used by first determining the total mass of different classes of antibiotics used, and adjust them by the total live weight of the broilers at the time of treatment (biomass). For the numerator, specifically for this pilot survey, the unit of measurement was intended to be weight-based, with the total amount of antimicrobials used expressed in milligrams (mg). From the data gathered in the survey, there were variable levels of missing data on the following fields to do with numerator data: Name of active ingredient (6/73), Concentration of

active ingredient (5/73), Unit of concentration for the active ingredient (10/73), Treatment duration (9/73) and Actual dosage of the product (6/73). Due to the extensive nature of missing data on variables to do with the calculation of the numerator, the estimate of the total volume (or mass) of antimicrobials used by the birds was likely to be highly inaccurate.

For the denominator data, the dataset contained the total number of birds treated in three age categories (0-2 weeks, 2-4 weeks and 4-8 weeks). However, it did not indicate the exact age (in days) at which treatment was done, which is important in estimating the weight of the birds in cases where this data was not captured. Four respondents in the survey had missing data on the number of birds treated. Regarding the weights of the birds treated, 15 respondents did not provide data. Furthermore, the weights entered ranged from values such as '0.473' to '1900'. Other values such as '300' and '1.9' were also entered under the 'weight' column, but it was unclear whether the units of weight used to record were grams or kilograms. This problem arose from the tool's design, which did not specify the unit of measurement to be used for the weight of the birds. The pilot survey intended to calculate the denominator for the Farm AMU formula by multiplying the total number of birds by the average weight of each bird at treatment, but estimates which would have been derived in this case would be unreliable due to the aforementioned challenges.

A closer analysis of the dataset further revealed that for farmers who had two broiler batches and administered different antibiotics to both batches, there was no linkage in the tool between each broiler batch and the antibiotic used, meaning it was uncertain on which antibiotic was used in either batch, which also impeded the derivation of accurate estimates of farm-level AMU. This was rooted in the design of the AMU tool.

3.2 Assessment of procedures used in the AMU pilot survey

3.2.1 Observations from the administration of the AMU tool in the field

Profile of respondents

Two data collection sessions were witnessed in the field to assess the ease of using the tool in collecting AMU data. Both interviews were conducted in one district (Marondera, ward 4). Two broiler farmers were interviewed, one a small-scale broiler producer (with 2000 birds), and the other a large-scale commercial broiler producer (with 30 000 birds), under a broiler contract grower scheme run by one of Zimbabwe's largest integrated poultry producing companies.

Aspects observed in both interviews included the time taken to complete the interview session and noting any questions the data collector had problems administering or questions to which farmers had challenges responding to.

Obtaining Consent

Both farmers were interviewed by the same data collector, using vernacular language (Shona), despite the questionnaire being written entirely in English. The farmers were in geographically distinct areas and were interviewed one after the other. For both interviews, the data collector first gave the Participant Information Sheet to respondents for them to read. Both respondents did not read the Information Sheet but requested the data collector to tell them the purpose of the survey. The data collector then briefly described the purpose of the survey and answered the few questions the respondents had. The data collector then gave the respondents the consent form to sign. The first farmer interviewed did not read the consent form (as he could not read English) but requested the data collector to explain the form to him, and then the farmer signed the consent form. The second farmer interviewed read the consent form himself and then signed the form afterwards.

Farm description and Farmer Demographics

The first respondent interviewed was the owner of the birds, but the second respondent was the farm manager, answering on behalf of the farm owner. It was noted that the second respondent had some challenges in remembering the age of the farm owner. The tool failed to collect geo-references of the farms in both interviews.

Antibiotic usage

On asking both respondents if they had experienced illness in their birds, which were both one week old, both indicated that they had treated their birds against 'yolk-sac infections'. The data collector then faced challenges in entering the data of the disease encountered as it was not among the options of signs and symptoms included in the tool. When the data collector enquired if the farmers had treated their birds, they both answered 'yes' and provided the name of the antibiotic used with ease. The interviewer then requested them to present the containers of antibiotics used, which they did, and the data collector read instructions on the drug container label to determine the name of the antibiotic, its manufacturer, the package size and the unit of measurement of the antibiotic, the active ingredient(s) and their concentrations. The first interview was done at the farm entrance, whilst the second was conducted in an office just outside the perimeter wall of the poultry houses. Both respondents easily answered the question of the actual dosage they used in treating the birds using their memory. Both respondents revealed their production records, with the latter (the large-scale commercial broiler producer under the contract scheme) even revealing the age of the birds and their weight at the time of antibiotic treatment, after consulting the treatment records.

Closing the interview

At the end of both interview sessions, the data collector requested farmers not to dispose empty containers of used poultry antibiotics, as they will be used to collect AMU data in future surveys. This initiative can be enhanced by providing the farmers with a container (box or bucket etc.) for them to store the antibiotic containers. When the principal investigator asked

the data collector what he did if the farmer did not recall the name of the antibiotic used and furthermore, does not have the container of the antibiotic used, the following response was expressed; during the pilot AMU survey, the enumerator encountered situations where antibiotics were shared amongst poultry farmers, and that some farmers interviewed did not recall the name of the antibiotic, nor have the antibiotic container, but revealed that they received a portion of an antibiotic from the same container, which was being shared amongst farmers, and revealed the farmer with the antibiotic container. The data collector then traced back to the farmer with the container to obtain information on the container label for AMU data collection purposes. This situation of sharing antibiotics was encountered occasionally for farms in close proximity and was for the sole purpose of sharing the cost of purchasing the antibiotic. The data collector also revealed that in some situations where the farmer could not recall the name of the antibiotic used and that the trace-back to the farmer with the antibiotic container was not possible, it would be recorded in the tool that birds were not treated, when in fact they were. Such a challenge would be difficult to overcome but the use of an antibiotic bag or picture library by data collectors may assist in identifying the product. Still challenges could be encountered on recording the number of boxes or packages the farmer used.

Duration of interviews

It was noted that both interview sessions were about twenty-five minutes long, from start to finish.

3.2.2 Focus group discussion findings

Sampling of farms

The participants (data collectors) indicated that the major factors that influenced their selection of broiler farms to participate in the survey included whether the farms had broiler flocks currently (information obtained by asking the farmers through mobile phones or face-to-face interaction), whether the broiler farmers were going to be part of the future planned AMR farmer field schools (funded by the FAO) in the area, and also the proximity of the farm to their work stations, preferring farms that are nearer and clustered within a specific area.

With regards to whether they managed to interview farmers from all scales of production (small, medium and large-scale), participants indicated that they could not manage to do so due to a number of reasons. The first reason was high workloads for data collectors, particularly for AGRITEX personnel who were involved in the agricultural cropping season activities, including the distribution of inputs (seed, fertilizer etc) and providing technical advice to farmers in the rainy season. Other data collectors worked in areas with only one type of scale of broiler production, predominantly the small-scale type, and hence could only visit these types of farmers. The majority of data collectors did not have large scale commercial broiler farmers in their areas, and hence could not access them.

Most of the farmers interviewed were small and medium-scale poultry farmers in the ‘A1’ and the communal farming sectors as they were enthusiastic and eager to learn new things. A few large-scale commercial farmers, primarily located in the ‘A2’ farms and large-scale

commercial farming areas, were interviewed, as they are generally less enthusiastic about learning new informaton, since they feel that they already have much knowledge on broiler farming. 'A1' and 'A2' farms are part of the Zimbabwe land tenure models, with A1 farms having an average size of 37 hectares, whilst that for A2 farms is 318 hectares (Maguranyanga and Moyo., 2006).

Data collectors generally expressed that they thought those large-scale poultry producers, particularly in broiler contract grower schemes, were excluded from the survey as they also faced challenges accessing them due to strict biosecurity practices on those farms, restricting access of external personnel to the farm. Personnel at some of the contract grower farms declined to be interviewed as they were not permitted by the parent company to divulge information on their farming activities.

Participants indicated that future surveys could include all scales of broiler production provided that resources such as transport and fuel are provided to enable data collectors to visit A2 farms and large-scale commercial farms, which are usually far apart. There is also a need for more time to be allocated for the surveys, particularly for large-scale commercial farms, as data collectors spend considerable time travelling between farms. It was also expressed that farmers in urban areas should also be included in future AMU surveys as there was considerable broiler production in those areas, with urban farmers also having variable knowledge on AMR and the prudent use of antibiotics in poultry production.

Recruitment of participants

There were several challenges data collectors faced in recruiting farmers for the survey. Some farmers who usually kept broilers did not have broilers at the time of the survey but were actually rearing other bird types (layers or free-range chickens) at that point in time. Other farmers declined to participate in the survey upon realising that they were not going to receive incentives (materially or financially) for their participation. Some broiler farms were quite distant from the working stations of the data collectors, making them inaccessible. Political interference also impeded data collection activities of specific data collectors, as they were perceived to be campaigning for themselves in preparation for future electoral processes for the positions of councillors in their respective areas. One participant indicated that two farmers in his area refused to participate in the survey as they erroneously perceived the enumerator to be part of a previous poultry grower scheme that had fleeced them by not paying for their services.

During the survey, the majority of respondents interviewed were farm owners. In the cases where employees were interviewed, they had challenges providing information on the owner, but less on information on the use of antibiotics. One participant suggested that to ensure that only the broiler farm owners are interviewed, the data collector should first phone the farmer before visiting the farm.

To improve farmer recruitment in future surveys, participants suggested that community awareness campaigns be conducted before surveys. To avoid challenges with politicians, it was

recommended that researchers have meetings with the local leadership so that they are aware of the objectives of the project and intended activities before commencing data collection. In the case of rural areas traditional chiefs can be engaged whilst for peri-urban areas, local councillors can be engaged. Another platform which can be used for community outreach is the district administrator's office, which is a central office where all district stakeholders engage through, including various government departments and developmental partner projects.

Survey questions

Some data collectors expressed that the questionnaire was too long such that some farmers got bored of the repeated questions. It was also revealed that most of the farmers interviewed did not keep containers of antibiotics used nor have production records (including treatment records), making AMU data collection difficult and introducing recall bias. Regarding the AMU tool question on the weight of the birds at the time of treatment, some farmers did not know the weight of the birds but estimated the age at which the birds were treated, and the enumerator, using their knowledge and experience, would estimate the weight of the birds at the age indicated by the farmer and record that estimate.

Data collectors also expressed challenges in sending the data from a completed questionnaire to the central database (stored in a cloud server). After clicking the 'Sync with Cloud' at the end of the questionnaire, they would think that the data would have been sent to the central server, only to be told the contrary by the researchers. One participant expressed that the part of sending of collected data to the server was not adequately covered during data collectors' training before the survey.

Regarding the skip function in the questionnaire, participants expressed that it was not operational in all questions where it was relevant, whereby specific responses to certain questions should have led to automatic skipping of a next question(s), for example, on the question of footbaths.

Data collectors indicated that all questions in the tool were clear to farmers, and the questions flowed well. When farmers were asked and indicated the name of the antibiotic used, data collectors went a step further to verify this by requesting the container of the antibiotic used. Farmers who did not have these containers, they were subsequently advised to retain all empty antibiotic containers for future AMU surveys. Participants also expressed that there were situations in which antibiotics used by farmers to treat poultry were borrowed from friends or neighbours, and these farmers neither knew the name of the antibiotic nor the quantities used in administering the medication. In these situations, some data collectors skipped this question and did not record anything.

In some situations where the farmer did not recall the name of the antibiotic, the data collector called out names of antibiotics to the farmer, and the farmer and data collector would agree with the data collector on a 'name' of antibiotic the farmer used. However, the authenticity of this could not be verified. Another data collector said that when the respondent had used antibiotics but did not know the product's name, he would record in the tool that treatment had been done but leave the rest of the fields to do with antibiotic use blank. The issue of sharing antibiotics amongst farmers was reported again, with data collectors attempting to address this by tracing back to the farmer with the antibiotic container. It was also commonly said that some farmers purchased re-packaged antibiotics in veterinary drug shops, with the new container having no label, hence no indication of the name of the antibiotic or its active ingredients. This resulted in a severe challenge in collecting AMU data. Some farmers indicated that they would have disposed antibiotic containers at the time of the interview and subsequently led the enumerator to the disposal site and searched for the container to identify the antibiotic used.

Regarding providing information on the actual dosage used by farmers in using antibiotics, it was noticed that the majority of farmers were comfortable in giving this information in terms of the numbers of teaspoons or tablespoons used by mixing in water, and rarely in terms of grams used. One data collector reported that one farmer had given his birds a human antibiotic by opening certain capsules (name not provided) and mixing the powder in the capsules with water before giving his birds. This, therefore, impeded the enumerator from identifying the antibiotics used and their quantities.

Data collectors expressed that they did not have challenges identifying antibiotic active ingredients in situations where the farmer presented the container. Active ingredients of antibiotics could not be identified when there was no container. Data collectors expressed that providing a picture library of commonly used poultry antibiotics (indicating the package labels) would assist them in identifying active ingredients of antibiotics and their concentrations.

Data collectors indicated that, to a large extent, they thought that the information they gathered from farmers regarding their use of antibiotics was correct. However, they also said they had encountered a few interviews in which they felt that the farmer was providing information to please them and avoid judgement. In contrast, in other situations, the farmer expected some government benefits from the program (in the form of antibiotic donations), hence indicating that they had not used antibiotics when they had done the contrary. One enumerator indicated that she tactfully asked some AMU survey questions to make the respondent comfortable and not make them think that they would be judged or punished for giving specific responses to certain questions.

Ease of using the tool

Most data collectors indicated that the use of EpiInfo® software to collect data was quite complicated compared to the other software they had used, namely Open Data Kit (ODK)® and KoboToolBox®, which were much easier to use. It was revealed that entering data to

questions asked was not difficult, but submitting the completed questionnaire to the server database was difficult. Some data collectors who did not face challenges in submitting the data indicated a need to create a 'sync file' after completing the questionnaire and saving it before sending it. Data collectors expressed that there was a need for more training to overcome this challenge.

Data collectors indicated that they experienced major power challenges in their data collection activities in the field, as their mobile devices ran out of power, thereby slowing down and limiting the number of farmers interviewed. They indicated that the provision of power banks would assist them in overcoming power challenges during data collection in the field. Most data collectors favoured collecting AMU data digitally using data collection software over using. Most data collectors favoured collecting AMU data digitally using data collection software over paper-based questionnaires. However, they said that in situations whereby the mobile devices ran out of power, and there were no power banks provided, paper-based questionnaires would complement digital data collection in order to ensure that resources such as fuel, which would have been used to travel to farms, are used more efficiently. Hence data collectors agreed that both data collection methods could be used in the field. Paper-based questionnaires were also indicated to be unable to collect the GPS coordinates of the area in comparison with digital software tools such as ODK. Further discussions revealed another disadvantage of using paper-based questionnaires is that some errors can occur when entering data from a paper questionnaire into the digital database, leading to data loss.

One data collector expressed that paper questionnaires had the advantage that one could identify mistakes made in data collection, enabling these errors to be corrected before sending the information to a database. The participant further expressed that there was a need for the data collection software to indicate a message that data has been successfully sent to the database and also a need to view a completed questionnaire before submitting the form, just as is the case with KoboCollect or ODK.

Survey times

Participants indicated that survey times depended on the farmer and their level of understanding of the questions asked. Some took a long time to answer specific questions, but others took a short time. The average time taken to complete the questionnaire varied widely, ranging from 30 minutes to 1 hour, especially for farmers with no production records. One of the questions which took a long to answer, especially for elderly respondents, was the one that asked their age, such that some respondents temporarily halted the interview to search for their national identification cards to determine their ages.

Two data collectors indicated that the questionnaire was too long and expressed that the question which asked the farmer's name made some of them suspicious of why their name was required. The data collectors, therefore, requested this question be excluded from the tool. Data collectors expressed that the questions which asked respondents on the number of birds which

were sick and died from diseases in the specific age categories in the tool (0-2 weeks, 2-4 weeks, 4-8 weeks) took considerable time to answer due to problems in recalling the information. Data collectors proposed that these questions be simplified in future AMU tools. Questions in the tool related to actual antibiotic use (eg Name of product, Unit of measurement, Name of active ingredient etc) did not consume much time in the data collection process, provided that the farmer had presented the data collector with the antibiotic container. Considerable time was also taken to complete the tool in situations where there was sharing of antibiotics amongst farmers, and the antibiotic container was with another farmer who was not the one being interviewed.

Data collectors expressed that they encountered a few incidents of lack of engagement by farmers, who complained that the questions were too many, particularly if they were engaged in concurrent work on their farms. One respondent who was interviewed expressed that the questionnaire was too long and suggested partitioning the tool into successive sections which will be asked on different days. The data collector was subsequently told by the farmer to leave their homestead.

Survey timing and workload of data collectors

Data collectors from the AGRITEX department expressed that during the country's rainy season, which generally ranges from October to April, they experience heavy workloads as this coincides with the cropping season. Several government programs related to crop farming which involve cropping inputs distribution and technical visits to crop farms, including crop and livestock assessments, increase their workloads considerably during this time of the year, making it difficult to find time for other activities, such as AMU data collection. Data collectors from the Department of Veterinary Services (DVS) expressed that they had no such challenges and had more time to participate in the AMU survey process, except in situations when there were animal disease outbreaks, such as Foot and Mouth Disease (FMD), which occurred in one data collector's area during the time of the AMU survey, necessitating them to temporarily halt AMU data collection and focus on instituting animal disease control measures. Another challenge expressed by a DVS data collector was the inability to access remote farms due to the extensive damage to roads and flooding of rivers during the rainy season. The DVS data collector also expressed that she was participating in another poultry project prior to the commencement of the AMU survey (The Inclusive Poultry Value Chain), which enabled her to easily identify and recruit broiler farmers for the AMU survey. Of the 18 data collectors who participated in the AMU survey, 12 were from the AGRITEX department, with six from DVS. The data collectors conducted one or two interviews per day, depending on how near farms were to each other.

During the discussion, AGRITEX data collectors expressed that more stakeholder engagement could have been done before the start of the AMU survey to enable data collection to be done more efficiently. This would include engagement of senior district management in the AGRITEX department so that they may exempt some of their extension personnel from some duties in order for them to participate in the AMU data collection process. They also said there

was a need for more technical backstopping of data collectors in the field to ensure that the data collection was proceeding smoothly and to overcome any challenges that may arise.

One data collector expressed that the survey timing was ideal as it would enable monitoring of antimicrobial use in broiler production in the rainy season and compare it with that in the winter season. Data collectors from the AGRITEX department concurred that the survey timing was ideal, despite the challenge of heavy workloads which they faced, but expressed that this can be overcome by prior informing of their line managers in future programs. However, other data collectors expressed that in their areas, farmers predominantly concentrate on crop production in the summer (rainy) season, then focus on broiler production in the winter season, hence suggesting that AMU surveys be done shortly after the end of the rainy season, starting from the month of May.

Sustaining AMU surveys

Data collectors indicated that farmers generally understood the purpose of the survey, especially after data collectors took some time to explain to them what antimicrobial resistance was and its potential impacts. Most respondents either did not have time to read the Participant Informant Sheet or had literacy challenges; hence the data collectors briefly described the purpose of the survey in the vernacular language before seeking the respondents to sign the consent forms. Data collectors indicated that while briefing the farmers on the purpose of the survey, they also told them that there will be repeated AMU surveys in the future, which they did not object to. This gave confidence to data collectors that farmers would be receptive to future AMU surveys. During the AMU survey, some farmers expressed their appreciation for the new knowledge they had received from data collectors on antimicrobial resistance and were willing to participate in future surveys. Some farmers were willing to participate in future AMU surveys as they were sold the opportunity by data collectors to participate in AMR farmer field schools where they would be taught more about good broiler husbandry practices and prudent use of antibiotics. Some data collectors suggested that it would be ideal to consider incentivising farmers with items such as t-shirts and caps, among other items, so that they remain motivated to participate in future AMU surveys.

Data collectors expressed that the government can sustain AMU data collection in food-producing animals by providing the necessary resources to data collectors to enable them to conduct their work, and these resources include mobile data collection devices, motorcycles and fuel. Data collectors also recommended the government to conduct more awareness campaigns on print and electronic media on AMR as the majority of the country's populace was unaware of the problem and its potential impact. Data collectors also recommended that the respective government departments should institutionalise AMU data collection in their activities to ensure sustainability.

Data collectors indicated that feedback of data collected from farmers was critical as it would ensure continued stakeholder buy-in. This feedback to farmers was suggested by participants

to be given in various ways, including using open days or farmer field days and conveying the message through pamphlets (or fliers). Other participants indicated that using depictions such as bar graphs and pie charts to present results from the survey may be acceptable to the more educated and younger respondents but may be unable to communicate to the elderly and less educated farmers, particularly in the communal areas. Instead, they recommended preparing print-outs presenting results in narrative form and in vernacular language, including recommendations to implement in their broiler farming activities. Another participant indicated that survey findings could be presented in the form of graphs and pie charts. Due to the generally increased literacy of farmers in communal areas in recent years in Zimbabwe, these can be presented using platforms such as farmer field days or farmer groups (including farmer WhatsApp groups), as has been done in previous projects. During farmer field days, the extension worker (AGRITEX/DVS) of the area would explain the survey findings to farmers. In farmer groups, the more literate and educated farmers would present the findings of the survey and recommendations to other farmers in the group.

4 RECOMMENDATIONS

4.1 Minimum data to collect in AMU surveillance in broiler production

The following aspects detail the minimum data which should be collected during farm-level AMU surveillance in broiler production;

- *The geographic location*: collecting information on the farm's district or province will enable geographic comparisons of AMU.

- *Antimicrobial active ingredient*: the identity of the class (or classes) of antibiotics used to treat the animals is essential. In situations where the objective is to quantify the amount of antibiotic used, the *weight of antimicrobials used*, i.e. the 'numerator' in the calculation of AMU indicators, is required.

- *Biomass unit*: this includes the identity of the animal species on which AMU is being measured, including its production category. Other information included in the biomass unit is the number of animals treated by the antibiotic and their average weights at treatment, and this is important in situations when the aim is to quantify the antibiotic consumed, as they will be part of the 'denominator' in the calculation of the AMU indicator. This pertains to the total AMU across all routes of administration. The weight of antimicrobial used is essential for the analysis of trends and for the further quantification of AMU (dose-based indicators).

- *Reasons for use*: it is essential to capture the main indications for medical AMU, such as for disease prevention/prophylaxis, disease control/metaphylaxis and disease treatment, or growth promotion. More specific reasons for AMU e.g. respiratory vs gastrointestinal vs other disease treatment, is also desirable but is not a core necessity. Information on 'Reasons for use' is necessary for contextualising AMU and can also be used to assess the impact of regulatory changes on AMU.

- *Time component*: Information on the time period over which the AMU is measured is important for comparing trends over time and gauging AMU changes following interventions. This time period can vary, ranging from multiple years, yearly, monthly, weekly or daily. Various time elements may need to be captured to enable advanced quantification and analysis. This includes the *total days at risk* (which is equivalent to the duration of the growing cycle) when the objective is to calculate the treatment incidence; *when the animals were likely exposed* (age at treatment); *duration of treatment of each antimicrobial administered*, i.e. total days exposed to the antimicrobial; *data coverage* (e.g. one growing cycle or annually).

Table 3 summarises the aspects to be considered for the minimum data required for AMU surveillance in broiler production.

Table 3: Minimum data required for AMU surveillance in broiler production

Aspect	**Explanation**
1. Where	Data should enable regional, national and international comparisons
2. Why	Understanding the reasons for AMU and contextualising animal health conditions by species
3. What	Antimicrobial active ingredient/class
4. Who/when	Details about the exposed and unexposed animal population. Relevant production stages needed to decide when to conduct the survey.
5. How much	Details about the AMU to monitor change in practices, counts and/or quantity of use, eg percentage of farms reporting use

4.2 Recommendations for AMU surveillance in broiler production

By using lessons drawn from the pilot AMU survey, the following recommendations have been formulated for use in future AMU surveys for broilers in Zimbabwe; Table 4 summarises the recommendations for implementation when conducting AMU surveillance in broiler production in Zimbabwe.

Table 4: Recommendations for implementation of AMU surveillance in broiler production in Zimbabwe

Domain	Recommendations
Survey design	• Determine the objective of the survey • Develop a sampling strategy • Determine the sample size
Questionnaire design	• Develop questionnaire in line with survey objectives • Pre-test questions • Translate questions to local languages • Select the data collection software tool for administering the questionnaire • Use an antibiotic bag/picture library • Pre-enter a comprehensive antibiotic list • Enable automatic answering of sub-questions on antibiotic detail • Anonymize respondents with identity numbers • Ensure optimal length of the questionnaire
Procedures	• Determine the frequency of data collection • Engage key stakeholders in the study areas prior to the survey • Select an appropriate time of the year to conduct the AMU survey • Determine the appropriate time of the day to interview farmers • Select the appropriate enumerators for data collection • Adequately allocate resources for data collection activities • Consider whether to incentivise survey participants • Adequately train enumerators on using the AMU tool and procedures for data collection • Develop and implement a monitoring plan for field data collection activities • Institutionalize AMU surveillance in key national organizations.

4.2.1 Survey design

When planning future farm-level AMU surveys, the following aspects need to be considered;

Determine the objective of the survey: When planning to conduct a farm-level AMU survey in the broiler production sector, it is important to spell out the survey's objective. AMU surveys may be done for either research or surveillance purposes. This research may either be for academic purposes or to generate baseline AMU data in pilot surveys, which serve as precursors to more active AMU surveillance systems. Within each objective, one should know beforehand the AMU questions the survey intends to answer. These may fall into four categories, which include 1) to determine the prevalence of antibiotic use on farms, 2) to

determine the type of antibiotics used, 3) to identify the drivers of antibiotic use, including disease conditions, and the knowledge and attitudes of farmers on antibiotic use and, 4) to measure the volume of different antibiotics used. With the objective of the AMU survey known, it is necessary to bear in mind the time period for the survey, whether it will be cross-sectional, where data will be collected on a single point in time, or longitudinal, where data will be collected at multiple time points, such as when comparing AMU patterns in broilers between different seasons.

Develop a sampling strategy: When one has determined the objective of the AMU survey, the next step is to develop a robust sampling plan which minimises sampling biases. In developing the sampling strategy, one has first to identify the target population, and in the case of an AMU survey in broiler production, this may constitute the entire broiler population of a country, at a particular point in time. The next step is to determine the target population, which is the population where the study sample will be drawn from, and this is exemplified by the entire broiler farms in a district or province. Hence, there is a need for a sample frame, consisting of all broiler farms in the intended study area, from which sampling units will be drawn. In situations where the sampling frame is incomplete, a suitable method which applies to the specific context should be applied. Next is to determine the sampling unit, and in this case of farm-level AMU surveys, the sampling unit will be a farm, or group of farms, depending on the sampling strategy. On the selection of the sampling units, one needs to consider the representativeness of the survey, which directly affects the internal and external validity of survey results. In order to achieve representativeness, one may choose probability sampling methods. If the source population is stratified, for example the scaling of broiler farms according to production capacities (i.e. small scale, medium scale and large scale production), stratified random sampling may be used to select sampling units, but ensuring that all strata are adequately represented in the sample through proportional sampling.

Non-probability sampling methods can also be used to select sampling units, depending on the survey objective, and these are particularly useful if resources are limited (convenience sampling) or when there is a need to determine the AMU in an animal population with a unique characteristic (purposive sampling). Multistage sampling can also be used, whereby the primary units (eg provinces within a country), secondary units (eg districts within a province) and tertiary units (eg all farms within selected districts) need to be selected.

Determine the sample size: When a sampling plan for the broiler farm AMU surveys has been developed, the next step is to calculate the sample size for the survey, that is, the number of farms to be included in the study sample. This sample size can be determined by non-statistical and statistical factors. The main non-statistical factor influencing sample size determination are resources available for the survey. Statistical factors affecting sample size determination include the precision of the estimate required, the confidence levels required and required power of the study. Most samples size calculations for surveys usually use a precision of 5%, a confidence level of 95% and a power of 80%. Different levels of these three parameters can however be chosen in the sample size calculation, depending on the objectives of the survey.

There is various software that can be used in the sample size calculation, including the *Epitools* and *Epicalc* software.

4.2.2 Questionnaire design

In order to ensure that accurate, complete and consistent data are collected in AMU surveys in the animal sector, the following aspects need to be taken into account when developing the questionnaire (AMU tool);

Develop questionnaire in line with survey objectives: When formulating the questions to be included in the AMU tool, it is important to bear in mind that the questions be developed in a way which enables the survey to answer either of the of the following research questions, in order to address the survey's objectives;

1. What is the prevalence of antibiotic use on farms?
2. Which types of antibiotics were used?
3. What are the drivers for antibiotic use, including disease conditions, & the knowledge and attitudes of farmers on antibiotic use?
4. What is the volume of antibiotics used?

It is important to note that some questions, particularly the more inquisitive ones on AMU, may need to have accompanying instructions to the interviewer, to enable them to collect more accurate data.

Pre-test questions: It is essential that after completing developing a draft of the AMU survey questionnaire, the tool is pretested on a few respondents, in order to ascertain whether there are any questions which are difficult for respondents to understand and answer, and also questions which may be inappropriate for the purposes of the survey. Cognitive interviews can be used to achieve this, and enables such questions to be redeveloped in order to make them either more easier to understand by respondents, and more appropriate for the survey. Pretesting the questionnaire also ensures that questions are ordered well and that all necessary skip functions in the AMU tool are functional.

Translate questionnaires: In order for both the interviewer and interviewee to comprehend better with the AMU questionnaire, and between them during the interview, it is necessary to translate the questionnaire from English to the two vernacular languages in Zimbabwe, namely Shona and Ndebele. This will give liberty to the interviewer and interviewee to select the appropriate language to use during the interview, enabling data collection to proceed more efficiently.

Select the data collection software tool for administering the questionnaire: There are a variety of software tools that can be used for administering the AMU questionnaire, and collect data, including Open Data Kit ™ (ODK), KoboCollect™ and Epi-Info™. Whichever software tool

is chosen for the survey, it is important that interviewers are competent and comfortable in using it and hence they have to be adequately trained on its use prior to the survey.

Use an antibiotic bag: In order to assist respondents in identifying antibiotics they would have administered to their broilers and also reduce the possibility of recall bias, there is a need to provide the data collector with a drug bag containing antibiotics commonly used in the study area. During the course of the interview, the antibiotics in the drug bag are presented to respondents by the interviewer for them to identify and indicate which product they administered to their birds during the study period. The list of antibiotics included in the drug bag has to be comprehensive, and it can be derived through an exercise done prior to the survey, comprising of members of the study team taking considerable time to visit all veterinary drug retail outlets in the study areas, to take stock of the poultry antibiotics sold in these facilities. In situations where new antibiotics are introduced on the market in-between surveys, the study team will have to re-purchase these before every survey. Each data collector will be assigned his/her own antibiotic bag.

Pre-enter comprehensive antibiotic list: After the respondent indicates the antibiotic they used to the interviewer, through the antibiotic picture library or drug bag, the interviewer proceeds to record this data in the data collection device. It is necessary that during the development of the questionnaire, a comprehensive list of antibiotics commonly used in the study area be pre-entered into a dropdown list of antibiotics so that none are left out. This comprehensive antibiotic list can be derived through the same exercise which was done for obtaining the list for the antibiotic drug bag or picture library.

Enable automatic answering of sub-questions on antibiotic details: If the AMU questionnaire has subsequent follow-up questions on an antibiotic used by the respondent, it is important that during the development of the tool, it should be programmed within the tool that when the interviewer selects the antibiotic used in the primary question, all subsequent questions on the antibiotic linked to this primary question are automatically answered. This helps to save time in the data collection process.

Additional recommendations for questionnaire design

Anonymise respondents with identity (ID) numbers: It is absolutely essential that survey respondents be kept anonymous and that their identities are not revealed in any way. During the development of the questionnaire, this should be taken into account. In order to achieve this, the respondent's identity can be represented by a 'number', for example.

Ensure optimal length of the questionnaire: It is fundamentally important that the questionnaire be comprehensive in order to collect the required AMU data, but it should not be too long, as this might eventually lead to a lack of engagement by the respondent during the interview.

Pretesting of the questionnaire soon after its development should be done in order to determine the average time it takes to complete an interview.

4.2.3 Procedures

The following are recommendations for procedures to be used in AMU surveys to ensure the collection of quality data;

Determine the frequency of data collection

During the planning of AMU surveys, there is a need to determine the frequency of AMU data collection, and this would be informed by the survey's objectives and to some extent, the target audience of the survey findings. There is also the need not to overburden survey participants, and this has a bearing on the frequency of conducting AMU surveys.

Engage key stakeholders in the study areas prior to the survey

In order to ensure stakeholder buy-in and minimise potential disruption of data collection activities, it is necessary that before the survey, key stakeholders in the study areas are identified and appraised on the purpose of the survey, its objectives and how it is intended to be conducted. Depending on the study area, these key stakeholders may include traditional chiefs, the district administrator's office and relevant government departments, such as the departments of Veterinary Services (DVS) and Agricultural Extension Services (AGRITEX). The survey researchers should request a letter of permission from the local district administrator's office through this engagement. The engagement of DVS and AGRITEX is especially important when extension personnel within these departments partake in data collection activities.

Select an appropriate time of the year to conduct the AMU survey

When planning to conduct an AMU survey in broilers, a few considerations have to be made for the program to succeed. Depending on the objective of the survey, one may need to conduct the survey when broilers are being reared on farms. In such a case, the researcher (s) will need to determine broiler production patterns in the study areas to match the survey time with the time of active broiler rearing. Cross-sectional surveys can be done when one needs to investigate AMU in a broiler study population at a single point in time, but for longitudinal studies, such as those intending to compare AMU patterns in different seasons (e.g. summer and winter), the survey can be timed as such, to address the study objectives. The data collectors selected to participate in AMU surveys also affect the time of the year when surveys can be conducted. If DVS extension personnel are selected as enumerators, AMU surveys can be performed at any time of the year as they have more time to complete this work. If extension workers from AGRITEX are selected as enumerators, then AMU surveys can only be conducted during the winter season in Zimbabwe, the period May to August of the year, as

they have high workloads due to crop extension work during the rainy season (October-April period) and hence have no time for AMU data collection activities.

Determine the appropriate time of the day to interview farmers

Also linked to selecting the appropriate time of year to conduct AMU surveys is the need to determine the proper time of each day to interview farmers, as random farm visits may lead enumerators to be turned away by farmers, thereby negatively affecting response rates. Farmers usually have scheduled daily activities which they undertake on their farms, and these may vary from farmer to farmer hence it is necessary for enumerators to engage farmers (e.g. through telephones or mobile phones) before the meeting them to enquire on which time of the day they will be free so that they visit them and appraise them on the survey's objectives, before requesting to interview them.

Select the appropriate enumerators for data collection

To ensure that AMU data collection proceeds smoothly, it is necessary that the appropriate personnel are selected to participate in the survey as enumerators. A prerequisite in selecting these enumerators is that they have ample time to conduct data collection activities with minimal disruptions.

Adequately allocate resources for data collection activities

Researchers must spend considerable time planning the resource requirements for AMU surveys, including motor vehicles, motorcycles and fuel, to enable enumerators to traverse their areas and access remote farms to collect AMU data.

Consider whether to incentivise survey participants.

Due to the need to maintain stakeholder buy-in and also motivate farmers to participate in repeated AMU surveys, one may opt to incentivise the farmers, and this can be done in a variety of ways, including giving feedback on the data they provided previously, through a district or regional report. Farmers may also be motivated by offering participating farmers the opportunity to attend paid training courses on broiler production and health or providing participating farmers with caps or t-shirts.

Adequately train the enumerators on using the AMU tool and procedures of data collection

I.n order for selected enumerators to fully comprehend administering the AMU tool and collecting data, as well as be informed on the procedures they should follow, they need to be adequately trained. The training is conducted by the survey researchers, through a multi-day workshop, with enumerators being taken through on how to administer the questionnaire and record responses. Enumerators will also be trained on the procedures to follow in the data

collection process, from approaching participants and inviting them to participate in the interview (Appendix C); giving participants information and getting consent (Appendix D); organising the interview and finally (Appendix E), carrying out the interview (Appendix F). A data collection simulation exercise for enumerators should also be done during the workshop in order for them to acquaint themselves with the data collection process further. At the end of the workshop, enumerators are given the standard operating procedures to follow when implementing data collection and antibiotic drug bags or picture libraries to take to the field to commence AMU data collection.

Develop and implement a monitoring plan for field AMU data collection activities

A critical step for ensuring that quality AMU data is collected in the field is to develop and implement a plan to monitor data collection activities closely. Firstly, there is a need to ensure that data collectors are using standard operating procedures during the participant recruitment and interview processes, and the study team should verify this through conducting ad hoc field visits to observe the AMU data collection process. Field visits also facilitate the direct interaction of researchers with the enumerators, to hear about their experiences, and also enable researchers to get a perspective over the entire AMU data collection process through observation. Apart from field visits, researchers should also create other platforms for communicating with enumerators in the field to receive feedback on their progress in data collection and whether they are facing any challenges in their data collection activities. These platforms can be in the form of social media groups such as WhatsApp, or virtual meetings (e.g. Zoom), where the researchers meet the enumerators regularly, over the entire period of field data collection. Closely monitoring data collection activities in the field is important because it quickly identifies and addresses any challenges that may arise, enabling the process to proceed more efficiently.

Institutionalise AMU surveillance in key national organisations

To sustain AMU surveillance in food-producing animals, the Government of Zimbabwe, through the Department of Veterinary Services (DVS), should take up and spearhead this program, which is a key activity in the Zimbabwe One-Health National Action Plan for Antimicrobial Resistance 2017-2022. DVS would initiate this by incorporating AMU surveillance in its annual work plans to allocate key resources for use in these activities. DVS should also increase its collaboration with the Medicines Control Authority of Zimbabwe (MCAZ), the organisation responsible for aggregating antibiotic consumption data in the animal sector, for data sharing.

4.2.4 Suggestions for piloting in future AMU surveys

Determine the appropriate mode of communication for survey findings

To facilitate the involvement of broiler farmers in antimicrobial stewardship programs and to maintain their buy-in to enable repeated AMU surveys, it is essential to give them feedback on

the data they would have provided in previous surveys and a variety of ways to disseminate this information to them can be explored. However, it is important to note that these farmers may have different levels of literacy and education, hence the mode of communication has to be context-specific.

In farming communities where the education and literacy levels are relatively high, survey findings may be presented in the form of graphs and pie charts, and recommendations written in the English language, in the form of pamphlets or fliers, or on social media platforms such as WhatsApp or Facebook (Meta). For farming communities which are less literate or educated, message print-outs may be prepared for farmers, but in narrative form and written in the local language. Farmer field days are another platform on which survey results can be presented to farmers, with the extension worker of the area (either DVS or AGRITEX) explaining the findings of the survey to farmers. Farmer groups are another platform on which these results can be disseminated, with the more literate and educated farmers in the group explaining the findings of the survey and recommendations to other members in the group

5 CONCLUSION

The emergence of AMR as a global threat to both animal and human health has highlighted the need to establish systems for monitoring the use of antimicrobials in food producing animals. As part of this development process, this study focused on evaluating a tool designed to collect AMU data, as well as procedures used to collect the AMU data on broiler farms in a pilot survey in Zimbabwe. The tool was assessed on its ability to manage quality AMU data, whilst the procedures were assessed on their ability to enable or limit the collection of quality data.

The AMU dimension the tool focused on was obtaining volumetric data i.e. numerator and denominator data. Outputs from the pilot survey revealed that to a moderate extent, the tool and procedures used were able to collect quality data, but there are some inherent issues in both, which need to be reviewed to further enhance the collection of quality AMU data, which is a key input in veterinary antimicrobial stewardship programs and policy formulation.

The findings of this survey add to the global discourse on AMU monitoring systems and more importantly form part of the framework for establishing these systems in Zimbabwe. It is necessary for further research to be done on farm-level AMU monitoring in order to optimise the quality of data obtained, as well as improve the depth of data obtained. Furthermore, careful thought is needed to decide how farm AMU metrics should be collected and interpreted in relation to data collected at other levels, including provider and macro-consumption data.

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7 APPENDICES

APPENDIX 1: The Survey

ZIMBABWE FFS AMU DATA COLLECTION FORM FOR BROILER FARMS

This Form is designed to primarily collect Antimicrobial Use (AMU) Data at Farm Level for Poultry Broiler Farmers participating in the Farmers Field School in selected districts in Zimbabwe. It can also be used to collect AMU data from broiler farmers not participating in FFS

1. Name of data collector

2. Is the broiler farmer participating in FFS?

3. Date of farm visit

4. Type of farm visit **(If repeat visit jump to question 15)**

Combination of farmers two or three initials and last three digits of cellphone number forms farms unique ID

5. Farm Unique ID

Description of the Farm

6. What is the name of the farmer?

7. What is the name of your farm or village?

8. Name of Province

9. District

10. Latitude

11. Longitude

Get Coordinates

Farmer Demographic Information of the farmer

12. How old is the farmer?

13. What is the gender of the farmer?

14. What is the level of Education?

15. How many years have you been practicing broiler farming?

16. Do you keep other livestock apart from the broilers?

17. Other Livestock kept

- [ ] Goats
- [ ] Rabbits
- [ ] Cattle
- [ ] Sheep
- [ ] Guinea pigs
- [ ] Free Range Chicken
- [ ] Pigs
- [ ] Guinea Fowls
- [ ] Turkey
- [ ] Ducks
- [ ] Quails
- [ ] Pigeons

Other (specify)

18. What is your current production system for the broiler farming?

19. How many batches of broilers do you have at your farm today?

Production Cycle Information for Batches

Batch number	DateIntroc	Age at visit

20. How many broiler birds are present today at the farm?

0-2 weeks old

2-4 weeks old

4-8 weeks old

21. In the current flock, have you experienced any sickness or illness of birds?

22. If yes to question 21, how many birds were sick?

Number of 0-2 weeks old birds sick

Number of 2-4 weeks old birds sick

Number of 4-8 weeks old birds sick

23. If yes to question 21, how many birds died?

Number of 0-2 weeks old birds Dead

Number of 2-4 weeks old birds Dead

Number of 4-8 weeks old birds Dead

Indication for Antibiotic usage

24. Which of the following symptoms did you observe in the sick birds?

- ☐ Diarrhea
- ☐ Loss of Appetite
- ☐ Sneezing/Coughing
- ☐ Swollen Head, Eyes, Neck
- ☐ Nasal Discharge
- ☐ Twisting of Head and Neck
- ☐ Labored/Difficulty in Breathing/Gasping
- ☐ Ruffled Feathers
- ☐ Sudden Death, no symptoms observed
- ☐ Paralysis/Lameness in Wings, Legs
- ☐ Wart-like or wounds on wattles, ear lobes, eyes, and sometimes the feet

Antibiotic Usage

25. Did you treat the birds with any medication?

If the answer to question 25 is Yes, refer to farm records, receipts, invoices, the bucket where farmers collect drugs used or the visual cues on antibiotics provided to fill in the following information on antibiotics used by the farmer. If the answer is No, move to question 158

Refer to information on Active Ingredient (s) and their Concentration (s) on the package label. For combination products having more than one active ingredient and concentation, fill information for each ingredient and concentration separately

Product 1

26. Name of the product 1

27. Name of Company

28. Other company (specify)_prdt1

29. Unit of measurement

30. Package Size

31. Number of Packages used

32. Name of the Active Ingredrient 1

33. Concentration of the Active Ingredient 1

34. Unit measurement for Concentration 1

35. Name of the Active Ingredrient 2

36. Concentration of the Active Ingredient 2

37. Unit measurement for Concentration 2

38. Name of the Active Ingredrient 3

39. Concentration of the Active Ingredient 3

40. Unit measurement for Concentration 3

41. Name of the Active Ingredrient 4

42. Concentration of the Active Ingredient 4

43. Unit measurement for Concentration 4

44. Route of Administration

45. Treatment Duration (In Days)

46. Actual dose rate used (Mixing method used by farmer)

47. Do the product contain vitamins?

48. How many different vitamins are listed in the product?

49. What was the purpose for using the antibiotics?

- ☐ Treat Sick Birds
- ☐ Prevent Healthy Birds From getting Sick
- ☐ Both - Treatment and Prevention
- ☐ Boost Production - Increase weight gain

50. Where did you obtain the antibiotic (refer to product name) that you administered to your chicken?

- ☐ Agritex Officer
- ☐ Veterinary Extension Worker
- ☐ AgroVet Shops
- ☐ Veterinanrian-Private/Public
- ☐ Chick supplier
- ☐ Hardware shops

51. Who provided you with advice on the antibiotics you administered to your chicken?

- ☐ Agritex Officer
- ☐ Veterinary Extension Worker
- ☐ Other Farmers
- ☐ Neighbor (not poultry farmer)
- ☐ Self Prescription
- ☐ Government/Private Veterinarian
- ☐ Agrovet shop assistant/personnel
- ☐ Family Member

52. Treated 0-2 weeks old

53. Treated 2-4 weeks

54. Treated 4-8 weeks

55. Average weight of 0-2 weeks treated

56. Average weight of 2-4 weeks treated

57. Average weight of 4-8 weeks treated

58. Any other antibiotics used?

Product 2

59. Name of the product 2

60. Name of Company

61. Other company (specify)

62. Unit of measurement

63. Package Size

64. Number of Packages used

65. Name of the Active Ingredrient 1

66. Concentration of the Active Ingredient 1

67. Unit measurement for Concentration 1

68. Name of the Active Ingredrient 2

69. Concentration of the Active Ingredient 2

70. Unit measurement for Concentration 2

71. Name of the Active Ingredrient 3

72. Concentration of the Active Ingredient 3

73. Unit measurement for Concentration 3

74. Name of the Active Ingredrient 4

75. Concentration of the Active Ingredient 4

76. Unit measurement for Concentration 4

77. Route of Administration

78. Treatment Duration (In Days)

79. Actual dose rate used (Mixing method used by farmer)

80. Do the product contain vitamins?

81. How many different vitamins are listed in the product?

82. What was the purpose for using the antibiotics?

- ☐ Treat Sick Birds
- ☐ Prevent Healthy Birds From getting Sick
- ☐ Both - Treatment and Prevention
- ☐ Boost Production - Increase weight gain

83. Where did you obtain the antibiotic (refer to product name) that you administered to your chicken?

- ☐ Agritex Officer
- ☐ Veterinary Extension Worker
- ☐ AgroVet Shops
- ☐ Veterinanrian-Private/Public
- ☐ Chick supplier
- ☐ Hardware shops

84. Who provided you with advice on the antibiotics you administered to your chicken?

- ☐ Agritex Officer
- ☐ Veterinary Extension Worker
- ☐ Other Farmers
- ☐ Neighbor (not poultry farmer)
- ☐ Self Prescription
- ☐ Government/Private Veterinarian
- ☐ Agrovet shop assistant/personnel
- ☐ Family Member

85. Treated 0-2 weeks

86. Treated 2-4 weeks

87. Treated 4-8 weeks

88. Average weight of 0-2 weeks treated

89. Average weight of 2-4 weeks treated

90. Average weight of 4-8 weeks treated

91. Any other antibiotics used?

Product 3

92. Name of the product 3

93. Name of Company

94. Other company (specify)

95. Unit of measurement

96. Package Size

97. Number of Packages used

98. Name of the Active Ingredient 1

99. Concentration of the Active Ingredient 1

100. Unit measurement for Concentration 1

101. Name of the Active Ingredient 2

102. Concentration of the Active Ingredient 2

103. Unit measurement for Concentration 2

104. Name of the Active Ingredient 3

105. Concentration of the Active Ingredient 3

106. Unit measurement for Concentration 3

107. Name of the Active Ingredient 4

108. Concentration of the Active Ingredient 4

109. Unit measurement for Concentration 4

110. Route of Administration

111. Treatment Duration (In Days)

112. Actual dose rate used (Mixing method used by farmer)

113. Do the product contain vitamins?

114. How many different vitamins are listed in the product?

115. What was the purpose for using the antibiotics?

- ☐ Treat Sick Birds
- ☐ Prevent Healthy Birds From getting Sick
- ☐ Both - Treatment and Prevention
- ☐ Boost Production - Increase weight gain

116. Where did you obtain the antibiotic (refer to product name) that you administered to your chicken?

- ☐ Agritex Officer
- ☐ Veterinary Extension Worker
- ☐ AgroVet Shops
- ☐ Veterinanrian-Private/Public
- ☐ Chick supplier
- ☐ Hardware shops

117. Who provided you with advice on the antibiotics you administered to your chicken?

- ☐ Agritex Officer
- ☐ Veterinary Extension Worker
- ☐ Other Farmers
- ☐ Neighbor (not poultry farmer)
- ☐ Self Prescription
- ☐ Government/Private Veterinarian
- ☐ Agrovet shop assistant/personnel
- ☐ Family Member

118. Treated 0-2 weeks

119. Treated 2-4 weeks

120. Treated 4-8 weeks

121. Average weight of 0-2 weeks treated

122. Average weight of 2-4 weeks treated

123. Average weight of 4-8 weeks treated

124. Any other antibiotics used?

Product 4

125. Name of the product 4

126. Name of Company

127. Other company (specify)

128. Unit of measurement

129. Package Size

130. Number of Packages used

131. Name of the Active Ingredrient 1

132. Concentration of the Active Ingredient 1

133. Unit measurement for Concentration 1

134. Name of the Active Ingredrient 2

135. Concentration of the Active Ingredient 2

136. Unit measurement for Concentration 2

137. Name of the Active Ingredrient 3

138. Concentration of the Active Ingredient 3

139. Unit measurement for Concentration 3

140. Name of the Active Ingredrient 4

141. Concentration of the Active Ingredient 4

142. Unit measurement for Concentration 4

143. Route of Administration

144. Treatment Duration (In Days)

145. Actual dose rate used (Mixing method used by farmer)

146. Do the product contain vitamins?

147. How many different vitamins are listed in the product?

148. What was the purpose for using the antibiotics?

- ☐ Treat Sick Birds
- ☐ Prevent Healthy Birds From getting Sick
- ☐ Both - Treatment and Prevention
- ☐ Boost Production - Increase weight gain

149. Where did you obtain the antibiotic (refer to product name) that you administered to your chicken?

- ☐ Agritex Officer
- ☐ Veterinary Extension Worker
- ☐ AgroVet Shops
- ☐ Veterinanrian-Private/Public
- ☐ Chick supplier
- ☐ Hardware shops

150. Who provided you with advice on the antibiotics you administered to your chicken?

- ☐ Agritex Officer
- ☐ Veterinary Extension Worker
- ☐ Other Farmers
- ☐ Neighbor (not poultry farmer)
- ☐ Self Prescription
- ☐ Government/Private Veterinarian
- ☐ Agrovet shop assistant/personnel
- ☐ Family Member

151. Treated 0-2 weeks

152. Treated 2-4 weeks

153. Treated 4-8 weeks

154. Average weight of 0-2 weeks treated

155. Average weight of 2-4 weeks treated

156. Average weight of 4-8 weeks treated

157. Any other antibiotics used?

158. Are the birds vaccinated?

159. Vaccinations done

- [ ] Infectious Bursal Disease (IBD) - Gumboro
- [ ] Fowl Pox
- [ ] Newcastle Disease (NCD)

Farm Biosecurity

160. Do you have a footbath at the farm

161. Is the footbath operational?

163. Do you disinfect your poultry fowl runs after all the birds are out?

164. If yes to qustion 163, which disinfectant did you use?

- [ ] Biopharm
- [ ] Virukill
- [ ] Virkon S
- [ ] Maxiviracide
- [ ] Maxibio - protect
- [ ] Paragon
- [ ] Vet ultracide B
- [ ] Blacks disinfectant

Other (specify)

Item No	Date	Units Produced	Quantity used Internally	Units sold	Unit sales price	Total income in USD

Item No	Date	Item Purchased	Quantity purchased	Unit cost (USD)	Total Cost (USD)	Total cost of purchase (USD)	Transport cost	Overall cost (USD)

End of Interview, remeber to save your form by clicking on save button on far right corner of your phone

APPENDIX 2.PROCEDURES FOR THE PILOT AMU SURVEY

Inclusion criteria for participants

The following inclusion criteria will be used: The respondent should be an active broiler farmer who keeps broilers throughout the year, produce a minimum of 50 birds per cycle and the farm must be located within one of the eight districts selected for this study.

Recruitment procedure for participants

The sampling frame of broiler farmers will be recruited through two ways. First, broiler farmers located in any of the eight districts selected, that have been already identified by the Ministry of Agriculture's Departments of AGRITEX and Veterinary Services' extension workers, will be invited to participate in the study. The invitation will be done through the data collectors visiting broiler farmers' households and handing them the Participant Information Sheet, which also additionally serves as an invitation letter to participate in the study. The second way of recruitment is by using a snowballing technique, where potential participants will be identified through initial participants' networks and data collectors will visit their households and give them Participant Information Sheets, which invite them to participate in the study. The snowballing technique will be repeated until the desired sample size is reached. All the participants will be required to give consent for inclusion of their answers in the study.

The use of convenience sampling has a limitation of being unable to generalize results of the survey over the entire broiler population of Zimbabwe but it is however, still valuable to use it for piloting the AMU data collection tool and can provide an approximate estimate of antibiotic use on the farms visited.

Sample size

As the exact number of broiler farmers in the selected areas is unknown, a sample size of 384 broiler farmers is calculated for this study with a confidence level of 95%, response distribution of 50% and margin of error of 5%. Each of the 18 data collectors will be asked to visit between 21-25 farms to achieve this sample size.

Broiler farmers of all production scales (number of birds kept), including the large scale, medium scale and small scale will be purposively included in the study until they reach the saturation point for each sector (quota sampling) which is at least 30-40 participants for each intended subgroup (large, medium, and small scale). However, the number of farmers selected in each production category will depend on the availability of farmers from that category in the study areas.

Data collection procedures

Questionnaire

The questionnaire consists of five sections with the first section on 'Description of the farm' enquires information on the farm's location. The second section enquires on demographic information of the farmer. The third section enquires on the indication for antibiotic usage for farmers. The fourth section enquires on antibiotic usage information, including the type of antibiotic used, its dosage and route of administration. Also enquired under this section is the source of antibiotics used and where advice for antibiotic use is obtained. The last section of the questionnaire enquires on biosecurity including the use of footbaths and disinfection of poultry sheds. The questionnaire takes an average of between 15 and 20 minutes to complete.

In cases where farmers are unsure of the antibiotics they administered the birds, empty antibiotic containers collected in buckets, and treatment records (for farmers who had them) will also be observed by the interviewer. Visual cues, in the form of pictures of antibiotics used to treat poultry in Zimbabwe will also be presented to participants, for them to indicate the antibiotics they used.

Training and pretesting

The developed questionnaire was pretested among data collectors during a training workshop for data collectors on how to administer the tool. Data collectors were grouped into pairs and role-played (simulated) a data collection session, one being the farmer and the other the interviewer. During this interaction, questions in the tool which were not clear were noted, together with leading and hypothetical questions, and these were subsequently refined to improve the tool's clarity. Average survey times were also noted.

Fieldwork

In their respective districts, data collectors will collect AMU data according to the procedure below.

1. On arrival on the farmer's premises, the data collector will give the Participant Information Sheet (Appendix A) to the farmer to read. After the reading is completed, the data collector will describe the nature and purpose of the visit (AMU data collection) to the farmer and explain what the collected AMU data was going to be used for. The data collector also will reassure the farmer that their identity would not be revealed and that all data gathered would be confidential and stored in a computer in a password protected file.
2. The data collector will then request for permission from the farmer to interview them, with agreeing farmers signing a Participant Consent Form (see Appendix B).
3. The data collector will request the farmer to conduct the interview near to the poultry houses where the broilers are kept, in order to verify some of the responses provided by the farmer.

4. The data collector will then begin the data collection process using the questionnaire. On administering the questions on antibiotic usage, the data collector will ask the farmer if they had retained empty antibiotic packages (used for treatment), or if they kept treatment records for the current flock. If the farmer indicates that they are available, the data collector will request for them and inspect them to verify the accuracy of the information provided by the farmer. If neither of the two options are available, the data collector will show the farmer pictures of common poultry antibiotics used in Zimbabwe and request the farmer to indicate which one they used to treat the current flock. During the data collection process, the data collector will also observe if the poultry houses have footbaths.
5. On completing administering the questionnaire, the data collector will then save the data gathered in the hand-held device and thank the farmer for providing the information.

The questionnaire was developed using the EpiInfo 7 software will be uploaded into the hand-held devices (tablets and mobile phones) of all data collectors prior to the commencement of the survey. Data collectors will administer the tool using their hand-held devices, with data automatically uploaded into EpiInfo 7.

The researchers and data collection team will communicate in a WhatsApp group where data collectors will share experiences (with no identifiable details about farms or farmers) and suggestions for collecting data with the tool. These reflections and suggestions will be collated and used to assess the feasibility of data collection activities and to shape guidance for future use of the tool and procedures.

Statistical analysis

The collected data in the EpiInfo 7 database will be cleaned and analysed using the same software. The statistical analysis will address the research questions outlined above. The analyses to be performed are of two types: descriptive statistics, with resultant frequencies of specific variables; and analytical statistics, which will explore the association between specific variables. The primary outcome of interest is the level of antibiotic use. Benchmarking will be done to identify low and high use, for the purposes of analysis of associations with predisposing factors.

Ethical considerations

Study participants will be given a Participant Information Sheet (see Appendix A), which briefly explains the nature and purpose of the study. All study participants will provide informed consent prior to administration of the questionnaire. Respondents will also be reassured by data collectors at the beginning of the interview that their responses would be kept confidential, together with their identities, through a unique identification system for the farmer and the farm. All data collected will be stored in a computer file that is password-protected,

and only accessible to the research team. Respondents will also be given an option to withdraw from the interview at any time, if they feel uncomfortable during the interview session.

Ethical clearance for the research study will be sought from the Zimbabwe National Animal Research Ethics Committee (NAREC).

Limitations of the study

The convenience sampling technique in this study facilitates the easy identification of research participants, but results from the study cannot be generalised to the entire national broiler population. The number of districts included in the study (eight), out of the country's sixty-one districts, may also not be representative of the entire country. However, since this is a pilot survey to test the AMU data collection tool, convenience sampling may be valuable in this respect.

The data collectors participating in this survey are government workers drawn from two Ministry of Agriculture departments, namely AGRITEX and Veterinary Services. Given this background, the survey respondents (farmers) are susceptible to social desirability bias, in which they give favourable responses to the interviewers, masking the actual reality. This will, in part, be mitigated by triangulating with other sources of information such as empty antibiotic packets, treatment records and visual cues. The data collectors were also trained to provide as much reassurance as possible to respondents on confidentiality.

APPENDIX 3. FOCUS GROUP DISCUSSION QUESTIONS FOR PILOT AMU SURVEY

Sampling of farms

- What factors influenced your selection of farms in the field?
- Did you manage to approach farms from all scales of poultry production (small, medium and large scale)? If not, what were the reasons? Were there any challenges encountered in interviewing farmers of the different scales of production ? Are there any types of farms that you think we should try to include, but we didn't?
- Do you think it is feasible for a future survey to include all production scales? Are there different approaches you can think of to include various kinds of farms?

Recruitment of participants

- AMU data was collected from about 50% of the targeted number of farmers. Did you face any challenges in recruiting farmers for the survey?
- Were there any farmers who refused to participate in the survey? If yes, who were these farmers? What do you think were their reasons for refusing to participate?
- Who on the farm did you manage to interview? Do you think they are the best representative to complete the survey with, or are there others whom you think we should try to target, and how might we do this?
- What do you think should be done in future surveys to improve farmer recruitment?

Survey questions

- When you were completing the survey, did it go as we planned back in Harare or did the process end up being different in terms of completing the various questions on your device? (probe eg for whether they asked the questions to the farmer or completed them themselves)
- Were questions in the survey tool clearly written and easy to understand for the farmers? If not, which were they and why did farmers not understand them?
- From your opinion, did the questions flow well? How did the question skip functions perform in the tool?
- How was the antibiotic used by farmers to treat broilers identified? Did farmers face challenges in recalling antibiotics used and durations of treatment? If farmers did not know the antibiotic used, how was this addressed?
- Did the list of antibiotic options in the tool cover all antibiotics? Were there no antibiotics provided by the farmers which were not provided as an option in the tool?
- Were there any challenges in identifying the active ingredient of antibiotics and its concentration? If so how do you think this challenge can be addressed?
- After completing the farmer interviews, do you think that the responses you received from farmers were a true reflection of what happens on the farms?

Ease of using tool

- How easy was it to use the Epiinfo tool? Have you ever used other data collection software apart from Epiinfo? If yes how do they compare with Epiinfo in terms of ease of use?
- Did you face any challenges in the collection and saving of data? If yes, what were these challenges?
- Did you experience any power challenges in you data collection activities?
- How do you compare data collection using data collection software and that of using paper-based questionnaires? Should paper based questionnaires be used in future AMU surveys?

Survey time

- It was indicated during the pretesting phase that survey times ranged from about 15 to 20 minutes. How long did you take to administer the tool in the field?
- Do you feel like the questionnaire was too long? If so, which questions took the most time to complete in the survey? Did you experience any lack of engagement by farmers due to the length of time of the survey?

Survey timing and workload

- Did you experience any workload challenges during your administration of the survey? If so, what were the reasons for the challenges? How do you think this challenge can be overcome in future surveys?
- In your opinion, was the survey done at the most optimal time of the year. If yes, what are the reasons? If no, what are the reasons?

Sustaining AMU surveys

- From your experience during the AMU survey, do you think repeating the surveys is possible? Did farmers understand why the AMU surveys are being done?
- What do you think should be done by government in order to sustain AMU data collection in food producing animals in Zimbabwe?
- If we are to give feedback to farmers, what format do you think this should be given in? What would they like to know / and how should we visualise this for them?

APPENDIX A. PARTICIPANT INFORMATION SHEET

Food and Agriculture Organization of the United Nations

Study Title: Antibiotic use in broiler production in Zimbabwe

Principal investigator: XXX

Invitation

You are being kindly invited to take part in this survey. Before you decide to do so, it is important you understand why the survey is being done and what it will involve. Please take time to read the following information carefully and ask the interviewer questions if there is anything that is not clear or if you would like more information. You are free to decide whether or not you wish to take part. Thank you for reading this.

What is the project's purpose?

This pilot study aims to establish farm-level Antimicrobial Use surveillance in food-producing animals, starting with the broiler production sector. Antimicrobial Use data generated at the farm level will be used in developing antimicrobial stewardship programs and influence national policies related to antimicrobial use, all in an effort to curb the development of Antimicrobial Resistance.

Why have I been chosen?

You have been chosen because you are a consistent broiler farmer and thus, can provide information on how you are using antibiotics to treat your birds.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part you will be able to keep a copy of this information sheet and you should indicate your agreement in the Participant Consent Form. You can still withdraw at any time and you do not have to give a reason.

What will happen to me if I take part?

You will be interviewed for a time period estimated to be about XX minutes, with questions based on a questionnaire.

What are the possible benefits of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will provide a framework for the establishment of farm-level Antimicrobial Use surveillance in food-producing animals in Zimbabwe, contributing to the global fight against Antimicrobial Resistance.

What are the possible disadvantages and risks of taking part?

Participating in the research is not anticipated to cause you any disadvantages or discomfort.

Will my taking part in this project be kept confidential?

All the information that we collect about you during the interview will be kept strictly confidential. You will not be able to be identified or identifiable in any reports or publications. The data collected from you will be securely stored in a password-protected file in a computer. Data collected may be shared in an anonymised form to allow reuse by the research team and other third parties.

What will happen to the results of the research project?

Results of the research will be used to write a report, and may be published. You will not be identified in the report or publication.

APPENDIX B. PARTICIPANT CONSENT FORM

Study Title: Antibiotic use in broiler production in Zimbabwe

Principal Investigator: XXX

I confirm that I have read and understood the information about the project as provided in the Participant Information Sheet.

I have had an opportunity to ask questions and the interviewer has asked questions about the study to my satisfaction.

I understand that my participation is voluntary and that I am free to withdraw from the interview at any time, without having to give a reason and without any consequences.

I understand that my information recorded in the investigation will remain confidential and no information that identifies me will be made publicly available.

I agree for the data collected from me to be used in future research and publications.

By signing below, I am indicating my consent to participate in the study.

_____	_____	_____
Name of Participant	Date	Signature
_____	_____	_____
Name of person taking consent	Date	Signature

APPENDIX C.STANDARD OPERATING PROCEDURE FOR APPROACHING AND INVITING PARTICIPANTS TO INTERVIEWS

SOP# 1:		**SOP TITLE:** Approaching and inviting participants to interviews
Effective Date:		**Written by:**
Date Reviewed:	**Approved by:**	**Approved Signature:**

I. PURPOSE: To describe the procedures for identifying and approaching broiler farmers to participate in interviews

II. RATIONALE: We plan to conduct interviews with broiler farmers in selected districts in Zimbabwe in order to determine their usage of antibiotics during broiler rearing. The use of antimicrobials has been found to be the most important driver of Antimicrobial Resistance (AMR), which is now an important global public health problem. The monitoring of antibiotic use in broiler production is important in that data collected will be used as input in intervention development, as well as policy formulation, all with the aim of combating the development of AMR in livestock production. Face to face interviews have been selected as the data collection method as they enable direct interaction between the interviewer and the interviewee, and enable narratives of individuals to be elicited, with the interviewer recording these responses.

III. SUPPLIES AND MATERIALS

- Letter of permission from government authority
- Participant Information Sheet
- Broiler Farmer Log
- Electronic mobile device with questionnaire (tablet/mobile smartphone)
- Pens
- Portable power bank

IV. TARGET AUDIENCE

- Interviewers
- Investigators
- Project managers

V. DEFINITIONS

- Broiler farm: In this SOP, a broiler farm is an establishment where broilers are reared.
- Broiler farmer: This refers to the individual who manages the broilers, from the time of placement of chicks up to the time of slaughter.
- Interviewer: This refers to the member of the study team carrying out the interview.

VI. PROCEDURES

A. Stakeholder engagement

- Prior to the start of the study, the study team, comprising the principal researcher and his/her research assistants meet with district officials in the departments of Veterinary Services (DVS) and AGRITEX, as well as the District Administrator, to appraise them on the purpose of the study and how it is to be done. A subsequent visit to the traditional leaders (in areas where this applies) should be done to appraise them on the project.
- The study team will request a letter of permission from the district administrator, to conduct the study in their area, with assistance from DVS and AGRITEX.
- Through the engagement between the study team and district officials from DVS and AGRITEX, extension workers in the study areas from the two departments will be selected and assigned to participate in the study as interviewers.

B. Approaching broiler farmers

- Using the knowledge of their areas, the interviewer will identify and list consistent broiler farmers in their respective areas on a Broiler Farmer Log.
- Each interviewer should identify and list XX broiler farmers on the Broiler Farmer Log.
- The interviewer should visit every farmer on the Broiler Farmer Log at their homesteads and introduce the study according to the script below:

Script for inviting potential broiler farmer survey participants

"Hello. My name is…….. and I work for the Department of Veterinary Services/AGRITEX. We are conducting a survey to assess the usage of antibiotics in broiler production in your locality. The monitoring of antibiotic usage in broiler production is one of the important ways that can be used to combat the development of antimicrobial resistance, which is currently a global public health threat.

We have considered you to participate in this study since you are a consistent broiler farmer in your area. Can we tell you more about the interviews now?"

- In general, the introductions, informed consent discussions and interviews will be conducted in English; however, appropriate local languages should be used as needed to ensure that the broiler farmers understand the conversations.

C. Reviewing the Information Sheet and obtaining verbal consent from broiler farmers

- Interviewers should record the date they first visit farmers on the column labelled 'Date visited' of the Broiler Farmer Log. If the farmer expresses interest in learning more about the survey, the interviewer will give them the Participant Information Sheet to read, and once they provide verbal consent to participate in the survey, the interviewer should record 'Yes' in the column labelled 'Farmer enrolled' of the Broiler Farmer Log. If the farmer then signs the Participant Consent form, and is interviewed immediately, the interviewer should record the date of the interview under the column labelled 'Date of Interview Completion' in the Broiler Farmer Log.

- If the farmer gives their verbal consent to participate in the survey but unable to be interviewed immediately, circle 'Yes' in the Broiler Farmer Log in the column labelled 'Farmer enrolled'. Reschedule a date for the interview with the broiler farmer and record this date in the Broiler Farmer Log under the column labelled 'Date of rescheduled visit'. The interviewer should revisit the farmer on this rescheduled date and if written consent is provided and the interview completed, the interviewer will then record this date in the 'Date of Interview completion' column of the Broiler Farmer Log.

- If the broiler farmer shows no interest and refuses to learn more about the study, the researcher records 'No' under the 'Farmer enrolled' column of the Broiler Farmer Log and thanks the farmer for their time and leaves their premises.

- In order to replace farmers who would have refused to participate in the study, on the Broiler Farmer Log, the interviewer will need to add other broiler farmers in the area onto the Broiler Farmer Log list, either through their knowledge or through asking other broiler farmers.

VII. ATTACHMENTS

- Participant Information Sheet
- Participant Consent form
- Broiler Farmer Log

VIII. DOCUMENTATION

XXX Protocol

APPENDIX D.STANDARD OPERATING PROCEDURE FOR GIVING INFORMATION TO PARTICIPANTS AND GETTING CONSENT (INTERVIEWS)

SOP# 2:		**SOP TITLE:** Giving information to participants and getting consent (interviews)
Effective Date:		**Written by:**
Date Reviewed:	**Approved by:**	**Approved Signature:**

IX. PURPOSE:

To describe the procedures for giving information to potential participants, inviting them to participate in the study and getting their consent, as part of the recruitment process.

X. RATIONALE:

We plan to conduct interviews with broiler farmers in selected districts in Zimbabwe in order to determine their usage of antibiotics during broiler rearing. The use of antimicrobials has been found to be the most important driver of Antimicrobial Resistance (AMR), which is now an important global public health problem. The monitoring of antibiotic use in broiler production is important in that data collected will be used as input in intervention development, as well as policy formulation, all with the aim of combating the development of AMR in livestock production. Face to face interviews have been selected as the data collection method as they enable direct interaction between the interviewer and the interviewee, and enable narratives of individuals to be elicited, with the interviewer recording these responses.

XI. SUPPLIES AND MATERIALS

- Letter of permission from government authority
- Participant Information Sheet (with copies translated into appropriate languages)
- Broiler Farmer Log
- Participant Consent forms
- List of inclusion and exclusion criteria for participants
- SOP for identifying and approaching potential participants (SOP 1)
- Pens

XII. TARGET AUDIENCE

- Interviewers
- Investigators
- Project managers

XIII. DEFINITIONS

- Broiler farm: In this SOP, a broiler farm is an establishment where broilers are reared.
- Broiler farmer: This refers to the individual who manages the broilers, from the time of placement of chicks up to the time of slaughter.
- Interviewer: This refers to the member of the study team carrying out the interview.

XIV. PROCEDURES

D. Giving information about the study

- Prior to commencing this SOP, the correct procedures for identifying and inviting broiler farmers to participate in the study must have been followed.
- If the broiler farmer has expressed interest in finding out more about the study and potentially participating, explain to them that you will give more detailed information about what participating in the study will involve, so they can choose whether or not they wish to participate.
- If the broiler farmer has not expressed interest, or states that they do not wish to find out more about the study as they are not interested in participating thank them for their time and depart from their premises.
- Establish whether the broiler farmer wishes to read through the Participant Information Sheet themselves (and which language is preferred) or whether they would prefer you to read through the sheet with them.
- If reading the information sheet to the broiler farmer, be sure to read slowly and clearly with sufficient pauses to make sure the broiler farmer is listening and understanding. If perceived necessary, briefly summarise the key points of the study and nature of participation using the script below, to ensure comprehension.
- If the broiler farmer is reading the information for themselves, when they have finished give a quick summary of the information, including key points about their participation and its consequences, to check comprehension (see script below).

Script for summarising the study and nature of participating

"So to summarize, the survey aims to assess the usage of antibiotics in broiler production in selected districts of Zimbabwe. You have been selected to participate in this study since you are one of the consistent broiler farmers in your district, which is part of several districts selected for this survey. If you wish to participate, you would be asked to be interviewed, with the interview lasting around XX minutes. The data from the interview would be kept confidential and your name would be anonymised.

There are no immediate benefits to you for participating in this project, but it is anticipated that the information you provide will assist in the development of interventions to combat AMR development, including veterinary antimicrobial stewardship programs and policy formulation. Participating in the study is also not anticipated to cause you any disadvantages or discomfort. Please note that participation is voluntary and you can choose to withdraw at any time. If you have any further questions or complaints about the study you can contact XXX on XXX."

- Ask the broiler farmer if they have any questions about the study or if there are any parts of the information sheet that they do not fully understand. Answer any questions or queries fully and check their comprehension to your answers.
- Reiterate that participation is voluntary and should they consent to participate, they may withdraw from the study at any time.
- Ask the broiler farmer if they would like to keep a copy of the information sheet, and in which language. Give them the information sheet, as appropriate.

E. Inviting participation

- Once the information sheet has been read through and/or explained, and all questions about the study have been answered, ask the broiler farmer if they wish to participate in the study.
- If the broiler farmer says 'Yes', circle 'Yes' in the 'Farmer enrolled' column of the Broiler Farmer Log. Move onto section C, Procedures for getting consent.
- If the broiler farmer says 'No', circle 'No' under the 'Farmer enrolled' column of the Broiler Farmer Log. Thank the farmer for their time and depart their premises.
- If the farmer is unsure, discuss with the farmer and agree a date for a rescheduled visit. Record this date under the column 'Date of rescheduled visit' in the Broiler Farmer Log. Thank them for their time and leave their premises.

F. Obtaining consent from participants

- Depending on the broiler farmer's preference, ask them to read through the consent form, or read it aloud to them in the appropriate language.
- Ask them to sign the consent form if they are in agreement with the statements on the form.
- If the broiler farmer does not wish to think more about participation and is no longer interested, record 'No' in the 'Farmer enrolled' column of the Broiler Farmer Log.
- For broiler farmers who agree to participate and have signed the consent form, ask whether they are available to complete the interview immediately. If so, move onto SOP3 and SOP4, to organise and conduct the interview.
- If the broiler farmer is not able to participate in the interview immediately, reschedule the interview and record the date in the Broiler Farmer Log column 'Date of rescheduled visit'.
- When the interview is successfully completed, record the date in the column 'Date of interview completion' in the Broiler Farmer Log.

XV. Attachments

- Information Sheet
- Broiler Farmer Log

XVI. Documentation

XXX Protocol.

APPENDIX E.STANDARD OPERATING PROCEDURE FOR ORGANISING THE INTERVIEW

SOP#3:		**SOP TITLE:** Organising the interview
Effective Date:		**Written by:**
Date Reviewed:	**Approved by:**	**Approved Signature:**

I. PURPOSE

To describe the procedures for organising interviews with broiler farmers

II. RATIONALE

We plan to conduct interviews with broiler farmers in selected districts in Zimbabwe in order to determine their usage of antibiotics during broiler rearing. The use of antimicrobials has been found to be the most important driver of Antimicrobial Resistance (AMR), which is now an important global public health problem. The monitoring of antibiotic use in broiler production is important in that data collected will be used as input in intervention development, as well as policy formulation, all with the aim of combating the development of AMR in livestock production. Face-to-face interviews have been selected as the data collection method as they enable direct interaction between the interviewer and the interviewee and enable narratives of individuals to be elicited, with the interviewer recording these responses.

III. Supplies and Materials

- Letter of permission
- Information sheets (with copies translated into appropriate languages)
- Completed consent forms
- Broiler Farmer Log
- Electronic mobile device with a questionnaire (tablet, mobile smartphone)
- Pens
- Portable power bank

IV. TARGET AUDIENCE

- Investigators
- Interviewers
- Project managers

V. DEFINITIONS

- Broiler farm: In this SOP, a broiler farm is an establishment where broilers are reared.
- Broiler farmer: This refers to the individual who manages the broilers, from the time of placement of chicks up to the time of slaughter.
- Interviewer: This refers to the study team member carrying out the interview.

VI. PROCEDURES

Organising a venue for the interview

- After the broiler farmer has consented to participate in the survey and is ready to be interviewed, the interviewer will request to interview the farmer at their premises. The interview site must be relatively quiet, private, and free from distractions.
- The broiler farmer selects and prepares a site on their premises where the interview will be conducted and prepares a seating arrangement that is comfortable for them and the interviewer. On the other hand, and at the same time, the interviewer will be ensuring that their equipment (electronic mobile devices) is ready for data collection.
- The broiler farmer then invites the interviewer to the selected interview site so the interview can begin.

VII. ATTACHMENTS

- Broiler Log Form

VIII. DOCUMENTATION

- XXX Protocol

APPENDIX F.STANDARD OPERATING PROCEDURE FOR CARRYING OUT THE INTERVIEW

SOP# 4:		**SOP TITLE:** Carrying out the interview
Effective Date:		**Written by:**
Date Reviewed:	**Approved by:**	**Approved Signature:**

I. PURPOSE:

To provide all interviewers with a uniform and standard way of conducting interviews with all the selected interviewees in the study areas

II. RATIONALE:

An interview will be conducted to gather information on antibiotic use in broiler farms in Zimbabwe. The data collected will help develop interventions to combat the development of antimicrobial resistance (AMR), focusing on the poultry sector.

III. METHOD

The interviewer will conduct face-to-face interviews with every selected participant who consents to participate. This will be a one-time only involvement of this broiler farmer.

IV. SUPPLIES AND MATERIALS

- Letter of permission
- Broiler Farmer Log
- Electronic mobile device with a questionnaire (tablet, mobile smartphone)
- Portable power bank
- Pens
- A picture library of common poultry antibiotics/ antibiotic drug bag

V. DEFINITIONS

- Broiler farm: In this SOP, a broiler farm is an establishment where broilers are reared.
- Broiler farmer: This refers to the individual who manages the broilers, from the time of placement of chicks up to the time of slaughter.

- Interviewer: This refers to the study team member carrying out the interview.

VI. PROCEDURES

- When the consent form has been completed, inform the participant that you will begin the interview, which will involve asking questions from a questionnaire pre-recorded on the electronic mobile device, with their responses recorded on the mobile device. A sample introductory statement which you use is below:

"Now that you have completed the consent form, I will ask you questions about the use of antibiotics in your broiler farming activities. All your responses will be kept securely, and your name will not be used anywhere. The answers you provide will not be identifiable in any published reports. I hope you will spend some time here to complete this. And kindly remember that you are free to withdraw from the interview at any time.

Do you have any questions before we start?"

- Ask the interviewee questions in the tool sequentially and immediately record their responses using the mobile device. Take note of and follow all instructions in the questionnaire, indicating how to ask specific questions and enter responses.
- As the interviewer proceeds through the questionnaire, when they reach the section titled 'Antibiotic Use (Drug Bag Method)', they should read the paragraph (in bold font) to the respondent to introduce how data will be collected from them using the Drug Bag method. At this time, the interviewer presents the bag and the medicines contained within to the interviewee. Read all the 'Hints' on each question, which assist the interviewer in how pile sorting should be done for that particular question. Encourage respondents to give narratives behind their pile sorting of medicines and actively listen to these narratives.
- When the interviewer has completed asking questions in the questionnaire and entering responses, they should enter the date of conducting the interview in the Broiler Farmer Log column labelled 'Date of interview completion.

Closing the interview

- Check your questionnaire to ensure that all portions have been filled properly. If everything is in good order, save the data by clicking the 'save' icon at the top-right corner of the screen.
- Thank the broiler farmer and ask if he/she may have any questions which may have arisen during the interview.
- Answer all questions that they may bring up.
- Conclude as follows:

"That's all the questions we had for you. Thank you for your patience and cooperation. We will be in touch with you in case we need to make further enquiries on the topic with you, and we will be available should you need to contact us for any reason related to this interview. Thanks again for everything, have a pleasant day/evening."

- Assure them again of your promised confidentiality, then depart from their premises.

VII. ATTACHMENTS

XXX

VIII. DOCUMENTATION

XX Protocol

APPENDIX G.BROILER FARMER LOG

Name of Farmer	Date visited	Farmer enrolled		Date of rescheduled visit	Date of interview completion
1.		Yes	No		
2.		Yes	No		
3.		Yes	No		
4.		Yes	No		
5.		Yes	No		
6.		Yes	No		
7.		Yes	No		
8.		Yes	No		
9.		Yes	No		
10.		Yes	No		