

PHARMACEUTICAL PRODUCT WITHDRAWAL PERIODS IN MONGOLIA: CURRENT
SITUATION AND EFFORTS TO IMPROVE KNOWLEDGE AND PRACTICES

by

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Abstract

Mongolia is a nation with a long and rich history of herding livestock as the main source of food. Since independence from the Soviet Union in 1990, it has undergone many adjustments in the livestock industry including the introduction of many new drugs for livestock during a period of transition to a free-market economy, which has made it difficult to make and enforce regulations on things such as withdrawal periods. The issue of withdrawal periods and drug residues is attracting more attention, especially as the industry seeks to gain access to foreign markets.

V.E.T. Net NGO Mongolia is an organization of American and Mongolian veterinarians working to further the education of veterinarians and livestock herders in Mongolia on various aspects of animal husbandry. V.E.T. Net provided the opportunity to conduct a survey of herders and veterinarians to assess current knowledge, attitudes, and practices regarding withdrawal periods. Additionally, training materials for veterinarians and herders were prepared for use by V.E.T. Net to promote adherence to withdrawal periods.

This field experience report sets the stage by looking at the current situation of livestock herding, veterinary medicine, meat and milk supply, and drug residue regulations and testing in Mongolia, followed the results and interpretation of the herder and veterinarian surveys conducted. Finally, the recommended direction of subsequent work regarding withdrawal periods in Mongolia is discussed.

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Abbreviations

CC	cubic centimeter
CVM	College of Veterinary Medicine
FMD	Foot-and-mouth disease
ID	Identification
IRB	Institutional Review Board
KSU	Kansas State University
MPH	Master of Public Health
MRL	Maximum residue limit
MVMA	Mongolian Veterinary Medical Association
NGO	Non-governmental organization
UHT	Ultra-high temperature
V.E.T. Net	V.E.T. Net Mongolia NGO
WP	Withdrawal period or withholding period

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Finally, I am grateful to the Lord for giving me the opportunity and ability to study, learn, and get valuable experience. May it all be for His glory.

Preface

My capstone project was designed to investigate the current knowledge and practices of herders and veterinarians in Mongolia regarding withdrawal periods. In addition, I developed educational materials for both veterinarians and livestock herders to promote awareness of and adherence to withdrawal periods.

The project was facilitated by V.E.T. Net Mongolia, a non-governmental organization (NGO) based in Ulaanbaatar, Mongolia. The topic of my field experience was chosen by the Mongolian veterinarians on staff with V.E.T. Net Mongolia, as a result of perceived need for education in this area. Surveys of herders and veterinarians were obtained from June through August 2012 by V.E.T. Net personnel during trips to the countryside to conduct herder trainings. Surveys were obtained from 237 herders in 7 provinces (*aimags*) and from 63 veterinarians in 15 provinces. The survey was reviewed by the KSU IRB and found to be exempt. During my project, I developed and field tested a presentation to educate veterinarians regarding the importance of adhering to withdrawal periods. I also developed a 2-page insert for herders on the basics of withdrawal periods, to be inserted into the herder handbook and drug catalog that V.E.T. Net distributes widely to herders. I toured the Ulaanbaatar facilities of Makh Impex, a plant belonging to Makh Market, one of the leading meat processing plants in Mongolia, and discussed their drug residue testing program with Otgontungaa Chultemsambuu, the general health inspector at the Makh Impex meat plant (Chultemsambuu 2012). Enkh TUYA Tserendorj, the head of the Food Hygiene and Residue Testing Laboratory, a unit of the Central Veterinary Laboratory, was also very helpful and informative about the situation in Mongolia regarding regulation of withdrawal periods and testing for drug residues (Tserendorj 2012). Finally, Erdenekhuu Shagdarsuren, Vice President of the Mongolian Veterinarian Medical Association, provided valuable insight into the overall structure and oversight of veterinary medicine in Mongolia (Shagdarsuren 2012).

Chapter 1 - Livestock Rearing and Veterinary Medicine in Mongolia

Historical and Cultural Perspective

Mongolia is a land famed for its nomadic and pastoral lifestyle. Since before the time of Genghis Khan, the existence of local tribes on the Mongolian steppe has been based on herding animals (Weatherford 2005). Mongolian food revolves around meat and milk products. The ger (yurt) is still the only shelter used by herders in the countryside, and many town and city dwellers reside in a ger on a plot of land within the town.

Under the Soviet Union, cities were built, primary and secondary education made readily available, and many other services developed, including veterinary services. Herds were collectivized and herder practices, such as rotation between grazing areas, were dictated by the government. As owner of all the livestock in Mongolia, the government dictated and supplied all veterinary care via government veterinarians, including when to vaccinate or deworm, as well as when and how animals were harvested. Because of their near total control over livestock production in this way, the government was able to enforce withdrawal periods.

Independence from the Soviet Union came to Mongolia in 1990, and with it came a reversion to private ownership of livestock. Veterinary services also changed, as they were no longer centrally controlled and supported.

Current Situation

Animal Ownership, Identification, and Records

As of 2010, 68% of Mongolia's total population of 2.7 million live in urban areas (Anon. 2011b). Ulaanbaatar itself has an official population around 1 million, though unofficial estimates range up to 1.5 million. Of those not living in cities or towns, nearly everyone raises livestock in a nomadic fashion, moving about 3-4 times per year. According to Erdenekhuu Shagdarsuren (2012), vice president of the Mongolian Veterinary Medical Association, there are around 160,000 herders in Mongolia, over 45 million head of livestock, and around 4,500 veterinarians. Most herders view numbers of animals as an indication of wealth and status, an attitude which promotes keeping animals in the herd for as long as possible, even in the face of

historically high livestock prices (Naranbadrakh 2012; Lhagvasuren 2012; Bekh-Ochir 2012; R. Ballenger 2012).

Currently, herders own the animals in their herds, though it is not uncommon for a herder to have animals belonging to relatives or friends in his herd. The ownership of animals is tracked by various combinations of paint, ear markings such as holes or bits of colored twine, and brands. Cattle and yaks do have plastic numbered tags verified by the local government veterinarian. Individual animals (apart from bovines) do not usually have unique identifiers.

Herders very rarely keep production or medical records regarding their livestock. The Mongolian Veterinary Association (MVA) produces a record-keeping booklet to be kept by herders but filled out only by veterinarians as they vaccinate or treat animals in that herd (Shagdarsuren 2012). (I have not seen this booklet out in the field, though by the time I found out about it, it was too late to ask herders or veterinarians in the countryside about it.) The purpose of this booklet is for the *suum* (county) level government inspector veterinarians to verify that the veterinarians in his *suum* are providing adequate service to the herders in their area.

Veterinary Services

Veterinary services in Mongolia are mostly privatized at present, with many vets holding another job to supplement their income. The herders are slowly developing a mentality that it is financially advantageous to pay for vaccinating and deworming their livestock. For the past couple of years, the government has had a program to supply free livestock vaccinations and avermectin dewormers. Veterinarians uniformly dislike the program because of the effect it has on undermining the emerging mindset of being worth it to pay for veterinary services (M. Ballenger 2012; Bekh-Ochir 2012; Lhagvasuren 2012; Naranbadrakh 2012).

Veterinary education consists of a 5 year post high-school program at the agricultural university in Ulaanbaatar. The majority of hands-on experience within the veterinary school seems to consist of trips to the countryside to vaccinate livestock for diseases such as brucellosis and foot-and-mouth disease. There are currently about 4,500 veterinarians in Mongolia according to Erdenkhuu Shagdarsuren. The Mongolian Veterinary Medical Association is in the process of determining the licensing system for veterinarians in Mongolia (Shagdarsuren 2012; Erdenkhuu 2012).

Veterinarians are largely tasked with vaccinating and deworming, and they treat sick animals to various degrees, depending on their skill and experience level. For instance, while one veterinarian related doing four equine C-sections this year (three of the mares lived), I would estimate that most of the practicing veterinarians have not done a C-section in any species.

Meat Supply

Mature animals are chosen from the herd for consumption by the herder family as needed. Most slaughter of cattle and horses takes place in the fall (late September through November), as the colder weather allows for storage of large quantities of meat in the absence of refrigeration. Sheep and goats are mostly consumed in the warmer months, being possible to consume a whole carcass in a relatively short time before the meat spoils. In the traditional Mongolian concept of foods that heat and cool the body, horse meat is considered to be a cold-weather meat, while goat meat is a warm-weather meat.

The urban population usually buys meat through informal markets. Meat is commonly slaughtered by herders and brought to Ulaanbaatar to sell. In addition to meat, live animals are brought to market in the city either by the herder himself or more commonly by middlemen and sold by the side of the highway or other informal venues. There are also about 25 slaughter plants in Mongolia total, estimated to supply 20% of the meat consumed in the cities as well as most of the meat bought by the mining companies to feed their employees ((Bekh-Ochir 2012)).

Some meat (mostly mutton and goat meat) is exported to China, Russia and the Middle East (Bekh-Ochir 2012), though the government has set a limit on the quantity exported because of a desire to retain high numbers of livestock. I would also suspect a desire to keep domestic meat prices low is also a factor. Russia is mostly closed to imports of Mongolian meat because of brucellosis and FMD, though apparently one large beef farm purported to have 10,000 head of cattle in Selenge province is segregated enough that they are allowed to export to Russia (Lhagvasuren 2012).

Milk Supply

Milk products are a staple among herders, and in Mongolian life in general. Milk tea is the most common drink, and a whole variety of dried yoghurts, butter, and more are made from milk. Fortunately, the milk for all of these products (except for fermented mare's milk) is boiled before consumption.

The formal market for milk consists largely of reconstituted imported milk powder or UHT pasteurized milk. Selenge province, with more rainfall and therefore more feed, has a small dairy industry consisting of small scale dairy farms. The milk produced for sale is brought to Ulaanbaatar by passenger train daily and sold (often by third parties) on the informal market. Some herders have contracts with grocery stores. There are several milk processing plants in Mongolia (Bekh-Ochir 2012).

Drug Residue Regulations and Testing

At present, concern about drug residues is restricted to meeting standards for export, and very little attention is being paid to domestically consumed meat and milk. This year (2012), a national program related to drug residues was passed by the government, but funding for it has not been allocated yet (Tserendorj 2012). There are no Mongolian-made regulations regarding maximum residue limits (MRL's) or withdrawal periods, and no regulatory testing is taking place on animal products destined for domestic consumption. The working standards at this point are the MRL's put forth by the Codex Alimentarius Commission (CAC 2012).

At present, the withdrawal periods for each medication are a factor of who is producing the product and which country that product is made for, since withdrawal periods differ between countries. For instance, products to be sold in Europe generally have a longer withdrawal period than those sold in the United States. This can lead to a variety of withdrawal periods for the same active ingredient. For instance, I found a bottle of 1% ivermectin produced in Mongolia labelled as having a 7-day meat withdrawal period, while a Chinese bottle of 1% ivermectin was labelled as having a 35-day meat withdrawal period. Though this is probably the extreme, it represents some of the confusion that can be caused by the current situation.

I had the opportunity to interview Otgontungaa Chultemsambuu, the general health inspector at the Ulaanbaatar plant of Makh Impex, one of the largest meat processing companies in Mongolia. As a company (not related to government standards or requirements in my understanding), they have recently started testing for residues of chloramphenicol, penicillin, and ivermectin, using ELISA assays. Currently they are testing 4-5 animals per province per year at the beginning of the slaughter season (September – November) (Chultemsambuu 2012). Thin females are selected for testing, and chloramphenicol, penicillin, and ivermectin residues are checked for by ELISA assays. It was unclear whether more drugs are among those tested for.

Efforts are being made to gain access to the Russian and European markets, and testing for drug residues is taking place at the Food Hygiene and Residue Testing Laboratory, a unit of the Central Veterinary Laboratory. The Food Hygiene and Residue Testing Laboratory was specifically created in 2002 for the purpose of meeting the requirements set by importing parties for testing on meat to be exported. The current testing abilities are not yet up to the standard required by European countries (Tserendorj 2012).

One factor complicating Mongolia's ability to export to Europe seems to be the detection of chloramphenicol residues in Mongolian meat. Veterinarians in Mongolia do not use chloramphenicol (Naranbadrakh 2012; Bekh-Ochir 2012). Berendsen et al. (2010) have demonstrated the presence of naturally-occurring chloramphenicol in herbs and grass, and hypothesize that the residues detected in Mongolian meat were a result of the animals grazing plants with chloramphenicol residues.

Access to Pharmaceuticals and Vaccines

Mongolia does have a system for licensing and registering veterinary drugs. Starting in the mid-1990's when few drugs were available, V.E.T. Net has worked to register and import key veterinary medications, so that local veterinarians have the tools they need. Presently, there are over 500 veterinary drugs registered in Mongolia, and many medications are brought in and used without the required license (Tserendorj 2012). For instance, there are about 15 different ivermectin products from several different countries, many of which are not licensed. In addition to not being licensed, these ivermectin products contain widely varying concentrations of active ingredient, according to tests coordinated by V.E.T. Net (Mitchum 2012; R. Ballenger 2012). The ivermectin dewormer that the government is supplying to herders has to be used at 2-3 times the labelled dose of 1 CC per sheep in order to have an effect (Bekh-Ochir 2012). Other products are thought to be similarly variable in quality.

While access to veterinary medications has been improving over the last two decades, the regulatory system in Mongolia has not kept up – not surprisingly, given the rapid pace of change in the country as a whole. The Soviet system of veterinary care instilled at least some concept of a withdrawal period for medications and vaccines. However, with their authority gone and none to replace it, the practice of withdrawal periods has been left to personal preference for each herder. In general, poor regulations and/or enforcement surround the importation, use, quality,

and withdrawal periods of drugs. The variability in quality of drugs presents additional difficulty in establishing withdrawal periods. Inadequate testing for drug residues leads to poor monitoring, identification, and documentation of violative residues or lack thereof. This situation decreases Mongolia's access to export markets for their meat, resulting in lower income for the country. The veterinarians at V.E.T. Net felt that focusing on the issue of withdrawal periods was the most important public health contribution that V.E.T. Net could make.

Chapter 2 - Survey Methods and Limitations

Methods

Because there were no data detailing knowledge, attitudes, and practices regarding withdrawal periods for meat and milk products among herders and veterinarians, two separate surveys (see appendix a) were prepared by V.E.T. Net veterinarians to obtain a basic understanding of the situation. The herder survey was distributed to herders during educational meetings conducted by V.E.T. Net around the country from June through August 2012. The survey for veterinarians was distributed both during V.E.T. Net work in the provinces and during a continuing education seminar in the capital.

For data analysis, herders were grouped into seven categories based on the size of their herd: 0 animals, 1-50, 50-100, 101-250, 251-500, 501-1000, and >1000. This allowed for easier comparison of differences in responses based on how many animals they had.

Limitations

Herder Survey

Some herders declined to complete the herder survey, while numerous others partially completed the survey. No data were obtained regarding the participation rate, but based on my personal experience with conducting the surveys, I estimate that $\frac{1}{2}$ to $\frac{3}{4}$ of the herders offered the survey responded in some way. In part, refusal to participate was apparently because the herders had difficulty reading and/or comprehending the questions. Once I realized this early on during the collection of surveys, I asked whether the survey needed to be re-worded, and was assured that the wording did not seem to be the issue - rather, it seemed to be simply unfamiliarity with the topic and sometimes limited reading ability. This is a possible source of participation bias, because the herders that refused to participate were possibly less educated or had less familiarity with withdrawal periods. The effect of this possible bias would be an over-estimation of knowledge of withdrawal periods. Another often-observed reason for declining to complete the survey was simply a sense of impatience after having participated in the herder training session. Herders are not accustomed to sitting and listening for one to two hours at a time, and they often had other activities that they needed to tend to.

Because the herder survey was conducted during V.E.T. Net training sessions, geographic distribution of the responses was not randomized throughout the country, but was determined by where V.E.T. Net personnel were going. The western province (aimag) of Zavkhan (spelled “Dzavhan” on the map in figure 3.2) accounted for 141/237 (59%) of the surveys collected, with 6 other provinces accounting for the remaining 96 (41%) responses. This can be attributed to the higher number of trips to Zavkhan by V.E.T. Net. It should be noted that in general, Zavkhan had a lower response rate when comparing individual questions based on how many were answered ($p = 0.001$, using a 2-tailed paired T-test of response rates). Of the 30 surveys excluded from data analysis (see chapter 3 -), 24 (80%) were from Zavkhan, compared to 117 (57%) from Zavkhan among those retained for analysis.

Age would have been a useful piece of demographic information to collect on the survey, something that was realized belatedly. One very possible reason that age would have an effect on knowledge and practices regarding withdrawal periods is the fact that older herders would be familiar with practices under Soviet control, which did take withdrawal period into account. Thus, older herders may be more conscious of withdrawal period and drug residues than younger herders, who have not had the Soviet influence.

Veterinarian Survey

The veterinarian survey was more representative in geographic distribution than the herder survey, due in large part to the ability to survey veterinarians at the continuing education seminar in Ulaanbaatar. This allowed for surveys to be collected from veterinarians in 15 provinces, rather than the 7 provinces represented in the herder surveys.

One issue was noted regarding the veterinary survey. After all the surveys were collected, it was noted that no veterinarians chose “corticosteroids” as one of the most commonly used medications among their clients, though dexamethasone is commonly used. Upon investigation, it was found that most veterinarians would likely not mentally associate dexamethasone with being a “corticosteroid”.

Chapter 3 - Survey Results

Herder Survey

Response Rates

Many herders only partially completed the survey. Surveys were excluded from the data analysis if none of the 5 questions regarding withdrawal periods (questions 3-7) were answered and if only question 1 (numbers of animals) or question 2 (drugs used in the last 6 months) was answered. With these criteria, 30 surveys were excluded from analysis, leaving 207 surveys for analysis. Of the 207 left, response rates for individual questions were 66-94% (table 3.1).

Table 3.1 – Response Rates for Individual Questions

	Number of Responses (of 207)	Response rate
<i>Question 1</i>	195	94.2%
<i>Question 2</i>	179	86.5%
<i>Question 3</i>	133	64.3%
<i>Question 4</i>	157	75.8%
<i>Question 5</i>	156	75.4%
<i>Question 6</i>	166	80.2%
<i>Question 7</i>	144	69.6%
<i>Question 8</i>	157	75.8%
<i>Question 9</i>	137	66.2%

Looking at the correlation of responses (answered or not) to individual questions (table 3.2), it is noticeable that there is moderate to high correlation for questions 3-8 when looking at correlation of response between sequential questions. It may be noted that questions 3-7 are the ones related to withdrawal period.

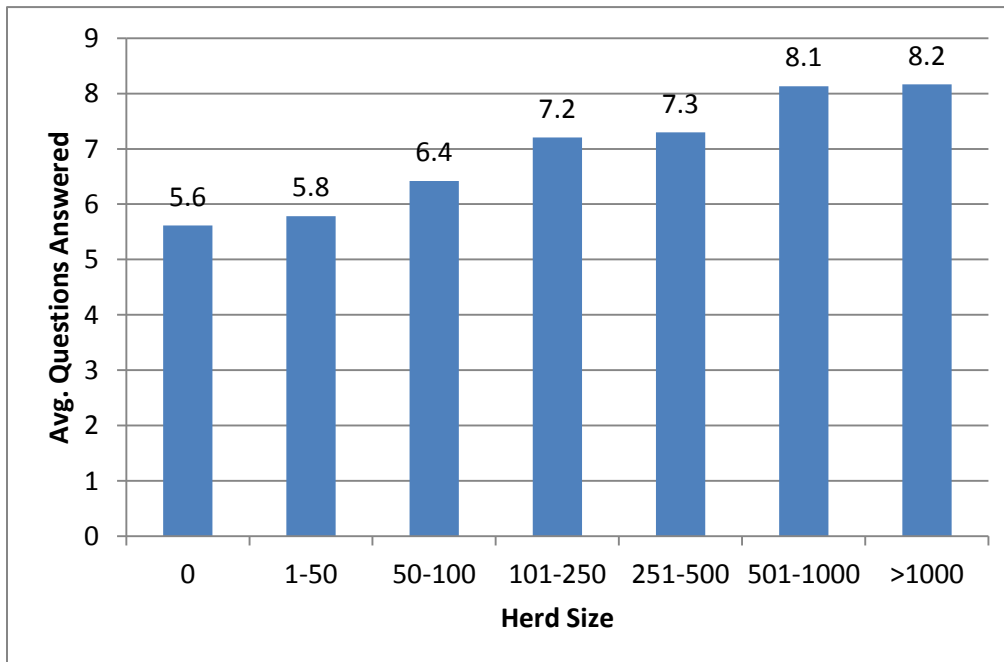
Table 3.2 – Correlations of Responses to Questions

	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
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<i>Q1</i>	0.08	0.12	0.05	0.05	-0.07	-0.07	-0.09	0.17
<i>Q2</i>		0.21	0.21	0.23	0.16	0.23	0.21	0.08
<i>Q3</i>			0.64	0.49	0.36	0.32	0.33	0.34
<i>Q4</i>				0.57	0.31	0.34	0.37	0.19
<i>Q5</i>					0.64	0.50	0.52	0.33
<i>Q6</i>						0.62	0.68	0.29
<i>Q7</i>							0.66	0.41
<i>Q8</i>								0.36

A correlation was found between herd size and the number of questions answered (figure 3.1). Regression analysis indicates that the number of questions answered increases with herd size, though the r^2 is low at 0.054.

Figure 3.1 – Average Questions Answered by Herd Size



Geographic Distribution

As mentioned above, the distribution of survey responses was not representative, particularly because of the over-representation of Zavkhan. Zavkhan is in mountainous western

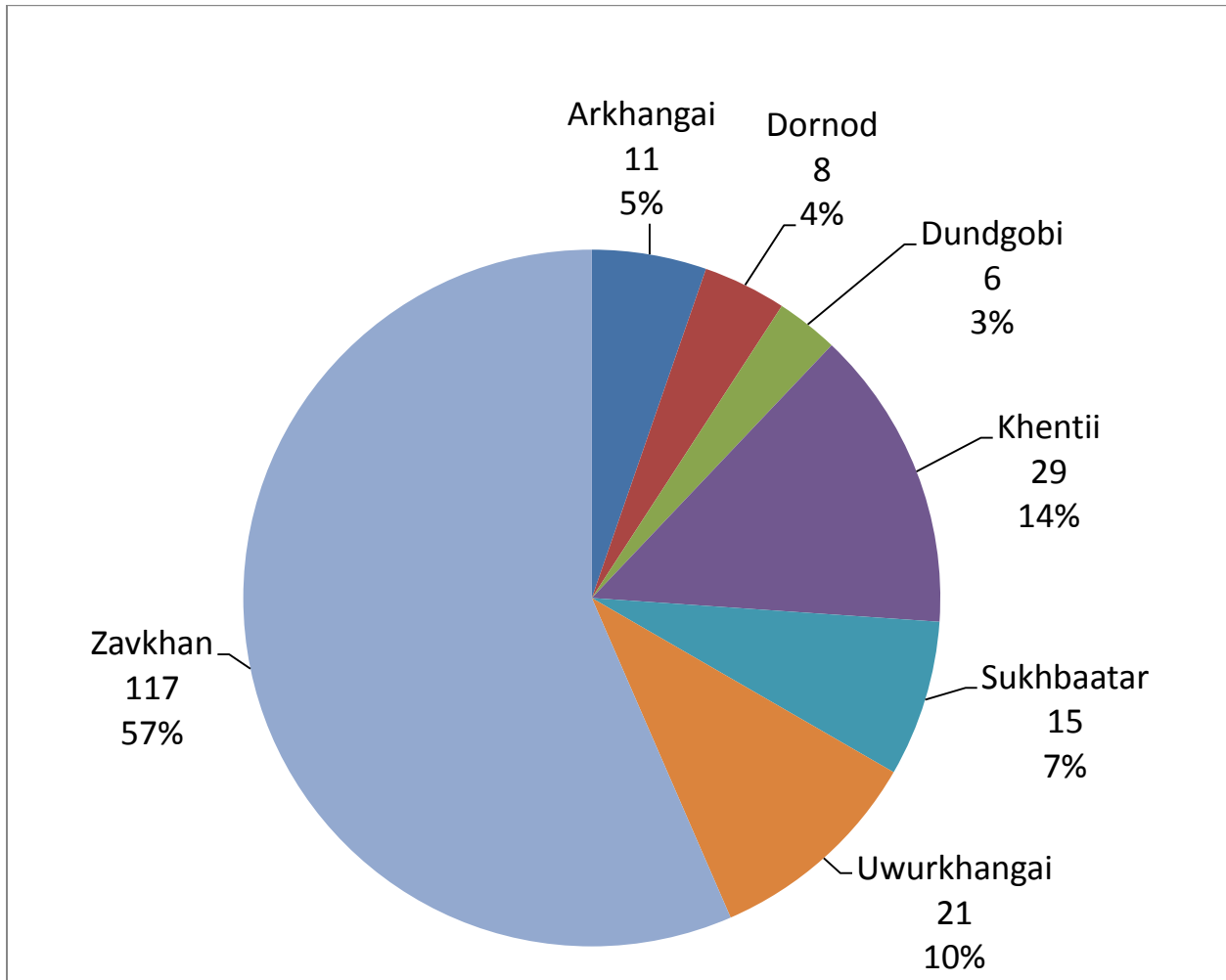
Mongolia, where producers raise more yaks, few cattle, and no camels. The terrain makes raising animals more difficult, and in general the herds are smaller. Overall, Zavkhan had lower response rates to questions 3-8 ($p \leq 0.01$ using a test for equal proportions on response rates to individual questions), but it does not appear that Zavkhan differed much from the other provinces in patterns of responses. Though smaller herds were associated with answering fewer questions and were less likely to respond correctly to questions 3 and 5, this pattern held true for other provinces as well.

Figure 3.2 – Map of Mongolia with Provinces (Aimags)



(Anon. 2009a)

Figure 3.3 – Herder Surveys Obtained per Province (Aimag)



Question 1 – Numbers of Animals

Question 1 of the herder survey queried herders about the numbers of livestock. Total numbers of animals and numbers of each type of animal were obtained. In case of a discrepancy between the total number of animals reported and the sum of animals reported by type, the later was used for analysis, being considered to be more exact. Response rate for question 1 was 94.2% (195/207). Four of the thirteen non-responders did provide figures in question 9 for numbers of animals slaughtered, sold, lost, or died, indicating that they do in fact have animals. Likewise, 9 responded to question 2, that they had used medicines on their livestock in the last 6 months. In the analysis, all 13 non-responders for question 1 were excluded from calculations

regarding the average herd size for question 1. One-way ANOVA of total number of animals across provinces revealed a significant relationship ($p=0.0001$).

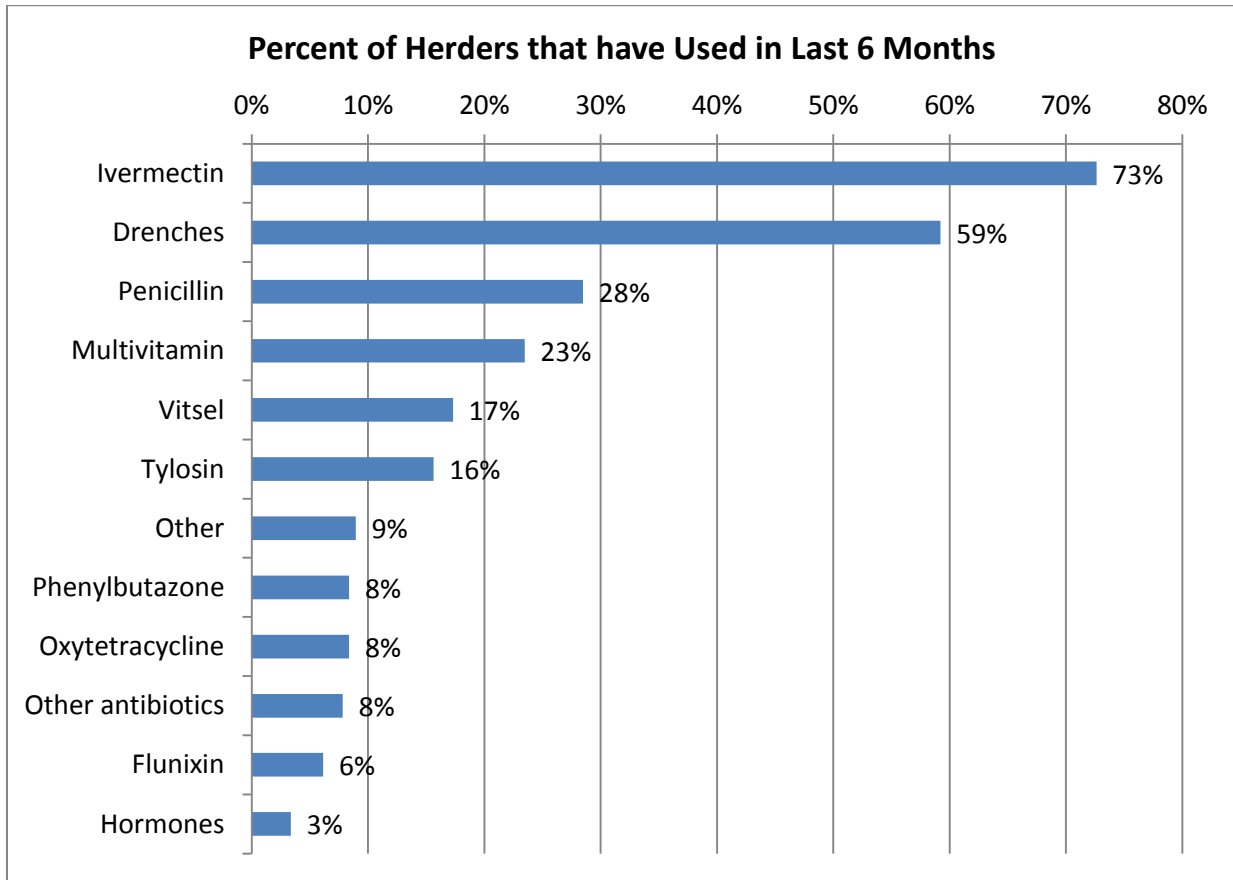
Table 3.3 – Median Numbers of Animals by Province (n)

<i>Type of Animal</i>	Arkhangai (11)	Dornod (8)	Dundgobi (5)	Khentii (27)	Sukhbaatar (13)	Uwurkhangai (21)	Zavkhan (110)	All (195)
<i>All Animals</i>	240	104	550	140	243	130	106	133
<i>Sheep</i>	150	29	300	61	160	55	54	63
<i>Goats</i>	70	40	230	67	120	60	50	55.5
<i>Cows / Yaks</i>	12	10	0	37.5	29	5	5	10
<i>Horses</i>	12	26	0	15	30	10	7	10
<i>Camels</i>	0	3.5	30	1.5	2.5	0	2	2

Question 2 – Drug Usage

In question 2, herders were asked which drugs they had used in the last 6 months. Of the 179 responders, 3 indicated that they do not use any of the drugs listed. The 28 non-responders were excluded from the calculations for question 2. Excluding the non-responders does raise the apparent usage rates, by 10% at most (from 63% to 73% in the case of ivermectin). However, it appears that those who did not respond most likely simply skipped the question rather than that they have not used these drugs, as indicated by the fact that on average they responded to fewer questions than those who did respond in some way to question 2 (4.5 vs. 7.3, respectively). Including non-responders in the calculations does not change the overall picture of significant differences in usage rates when segregated by herd size.

Figure 3.4 – Drug Usage in Last 6 months, Percent of Herders

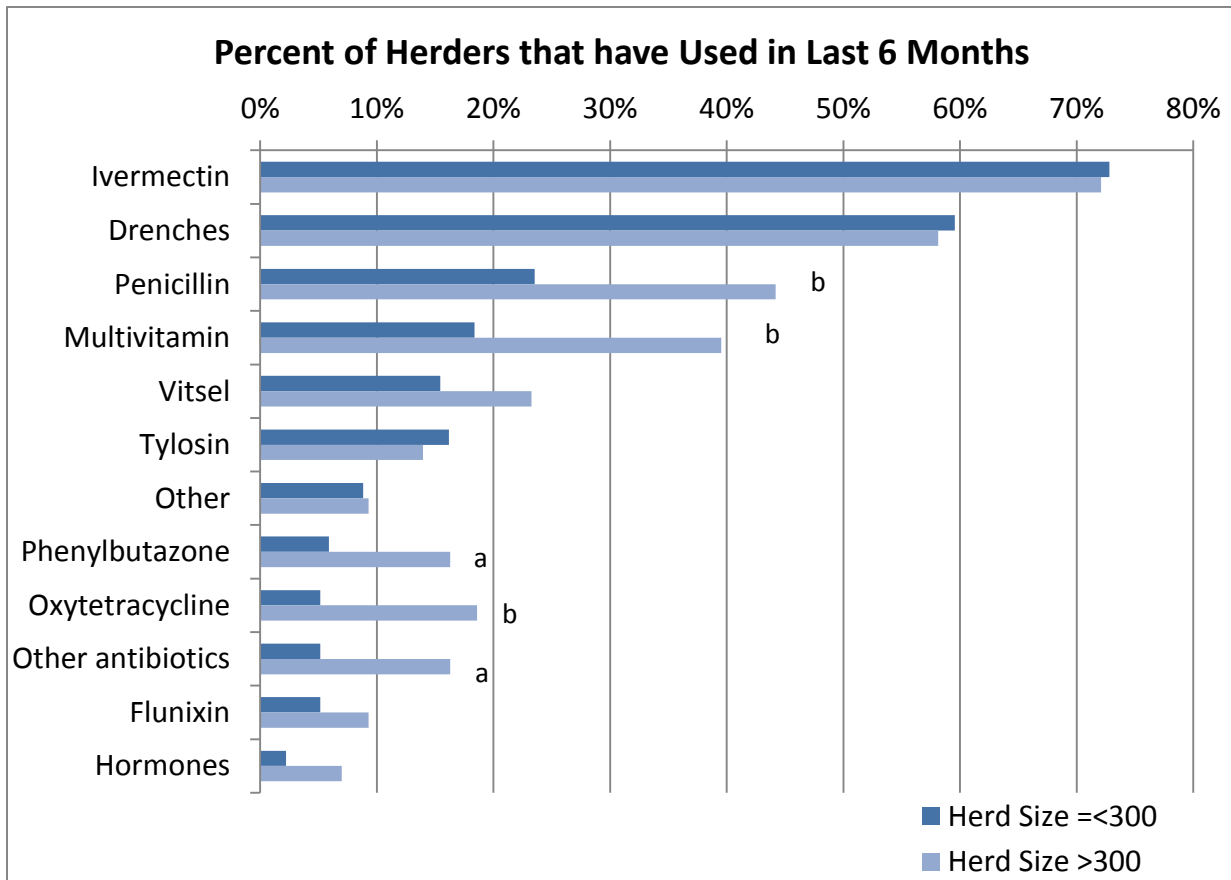


Ivermectin and “drenches” (fenbendazole and albendazole) were by far the most used at 73% and 59% of herders, respectively; with penicillin, multivitamins, Vitesel (vitamin E / selenium) and Tylosin coming in from 16-29%. The only factor observed to have an effect on usage of medicines was herd size. In general, herders with more animals were more likely to use penicillin, multivitamins, phenylbutazone, oxytetracycline, and other antibiotics (figure 3.5).

A general trend towards higher usage of drugs among herders with more animals was noted. Regression analysis of herd size versus number of drugs used yields an r^2 of 0.052 and a p-value < 0.001. Using the test of comparison of equal proportions was used to compare two groups segregated by herd size, a significantly higher proportion of herders with larger herds reported use of penicillin, multivitamin, phenylbutazone, oxytetracycline, and other antibiotics (p < 0.04). This was most noticeable when a cutoff of 300 for herd size was used to segregate the data. Cutoffs ranging from 100 to 500 were tried.

ANOVA revealed a trend toward differing drug usage among provinces, approaching significance ($p = 0.066$). However, no pattern in the variation was observed, and no practical significance was found for analyzing the differences.

Figure 3.5 – Drug Usage in Last 6 months, Percent of Herders by Herd Size



a: $p < 0.04$. b: $p \leq 0.01$

Question 3 – What is Withholding Period?

Question 3 asks what the withholding period of a drug means. The response rate for question 3 was 64% (133/207). The correct answer was b: The amount of time you should wait to eat the meat or drink the milk of an animal that has been treated with a drug. Though the question was multiple choice, 5 people wrote in “don’t know”, and 9 chose more than one answer.

The question of whether to include the non-responders as incorrect answers or whether to exclude them from the analysis is difficult. Inclusion in the analysis would be assuming that the question was unanswered because the herder did not know the correct answer. Exclusion would assume that those who skipped the question had other reasons for skipping it than not knowing the correct answer. Being impossible to distinguish, analyses are done for both situations. Percent correct is compared below across herd size and number of drugs used in the last 6 months (from question 2). Very few significant differences were found between provinces for question 3.

Table 3.4 – Question 3 Responses

<i>Question: What do you think the withholding period of a drug means?</i>		Including Unanswered	Excluding Unanswered
<i>Answer</i>	#	% (of 207)	% (of 133)
<i>A. The amount of time it takes the drug to start working in the animal</i>	9	4%	7%
<i>B. The amount of time you should wait to eat the meat or drink the milk of an animal that has been treated with a drug</i>	78	38%	59%
<i>C. The amount of drug that should be given to the animal based on the disease</i>	5	2%	4%
<i>D. The amount of time that you can safely store the drug before it becomes ineffective</i>	27	13%	20%
<i>Don't know</i>	5	2%	4%
<i>Multiple Answers</i>	9	4%	7%
<i>Unanswered</i>	74	36%	

Effect of Drug Usage on Question 3 Response

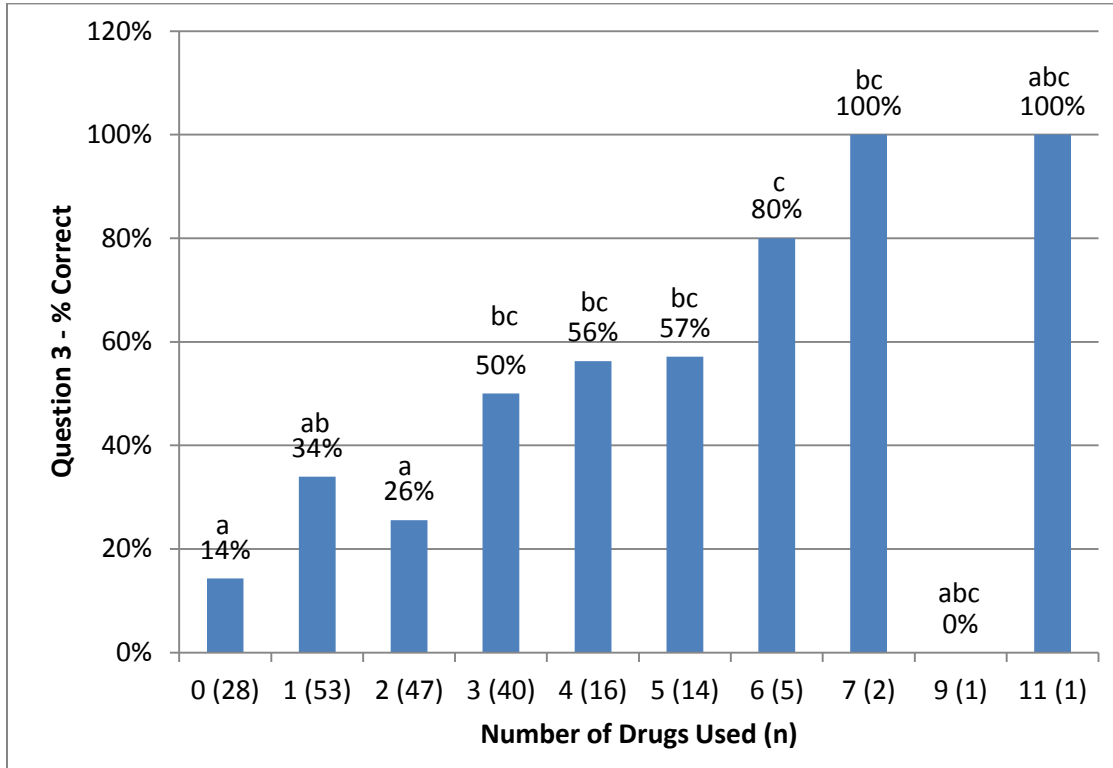
The possible effects of herd size and number of drugs used on likelihood of answering question 3 correctly were investigated using logistic regression, both including and excluding the unanswered responses. Investigating the effects independently (univariate logistic regression),

the number of drugs used is a significant predictor of answering question 3 correctly, regardless of whether the unanswered questions were included in the analysis (table 3.5). Herd size is only significant when evaluated independently from number of drugs used and when including the unanswered questions in the analysis. This indicates that drug usage accounts for much more of the variation in answering question 3 correctly than herd size does. Though herd size was significant in a univariate model, herd size and interaction were not significant predictor variables in multivariate models where drug usage was included (drug usage + herd size, drug usage + herd size + interaction), and did not significantly improve the models when comparing the models by likelihood ratios ($p > 0.10$).

Table 3.5 – Question 3 – Comparison of Univariate Logistic Regression Models

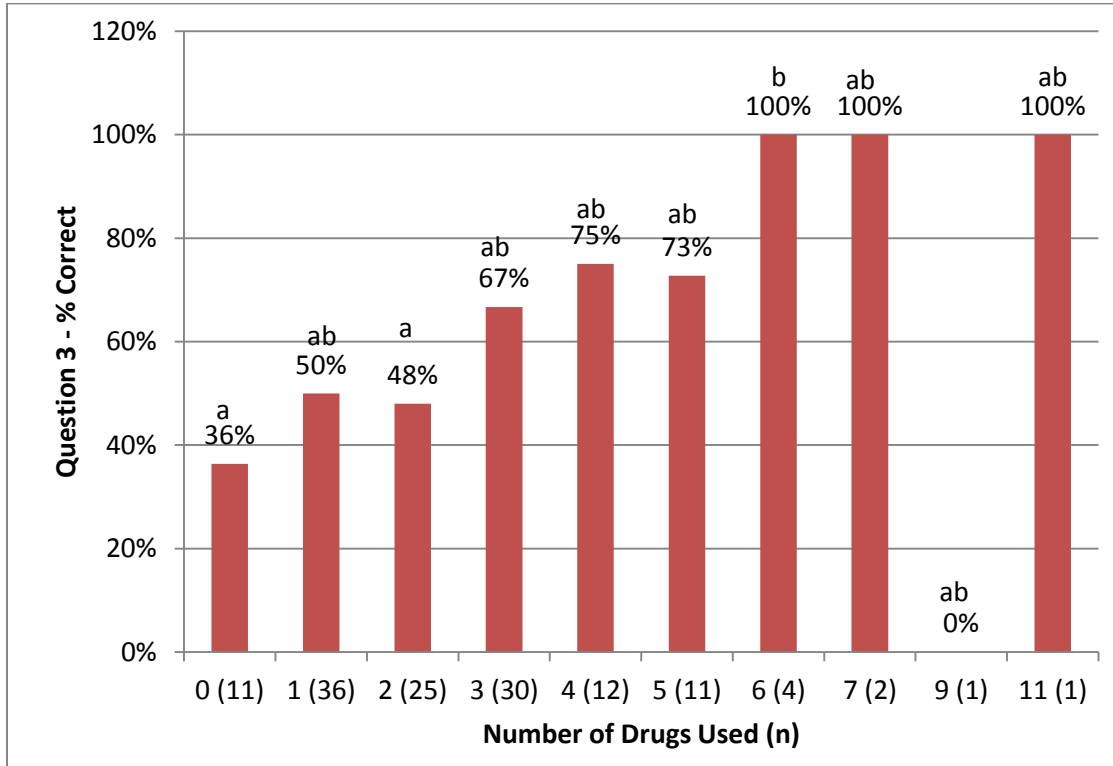
<i>Model</i>	Including Unanswered		Excluding Unanswered	
<i>Variable</i>	p-value	r²	p-value	r²
<i>Herd Size</i>	0.0229	0.023	0.2096	0.010
<i>Drug Usage</i>	0.0001	0.066	0.0061	0.047

Figure 3.6 – Question 3 – Correct Answers by Number of Drugs Used, Unanswered Included



Categories with different superscripts are different at $p < 0.05$.

Figure 3.7 – Question 3 – Correct Answers by Number of Drugs Used, Unanswered Excluded



Categories with different superscripts are different at $p < 0.05$.

Question 4 –Observance of Milk Withdrawal Period

Herders were asked in question 4 what they do with the milk when they give their cow an injection of penicillin for mastitis. The response rate for question 4 was 76%. Correct answers were to only give milk to animals and/or throw the milk away for the next few days. In addition, among other written-in answers, waiting 14 days or using the milk at another time were considered to be correct.

Table 3.6 – Question 4 Responses

<i>When your cow gets mastitis and you give it an injection of penicillin what do you usually do?</i>		Including Unanswered	Excluding Unanswered
<i>Answer</i>	#	% (of 207)	% (of 157)

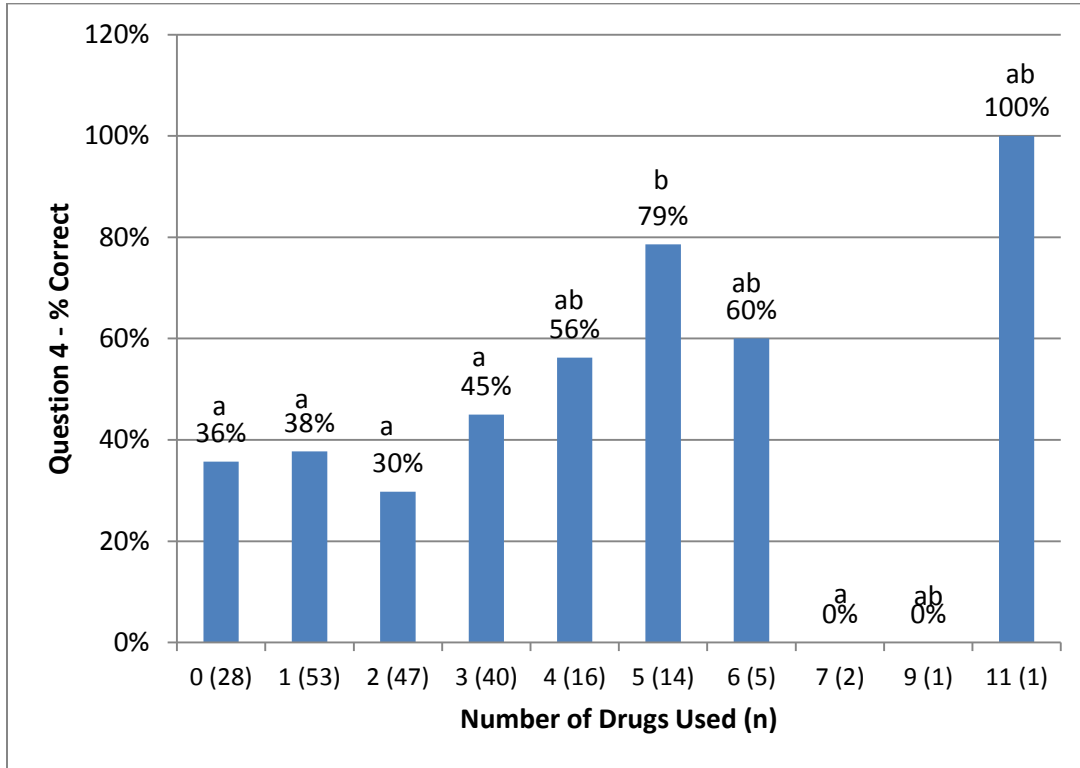
<i>A. Keep milking it and consuming the milk</i>	7	3%	4%
<i>B. Boil all the milk from the cow before consuming</i>	47	23%	30%
<i>C. Only give milk to dogs or the calf for the next few days</i>	44	21%	28%
<i>D. Throw the milk away for the next few days</i>	37	18%	24%
<i>E. Other</i>	7	3%	4%
<i>Wait 14 days / use at another time</i>	5	2%	3%
<i>Multiple Answers</i>	11	6%	7%
<i>Unanswered</i>	50	24%	
<i>Total Correct</i>	86	42%	55%

When compared across herd size, province, and number of drugs used, only drug usage was a significant predictor variable of a correct answer to question 4, and then only when including the unanswered questions.

Table 3.7 – Question 4 – Comparison of Univariate Logistic Regression Models

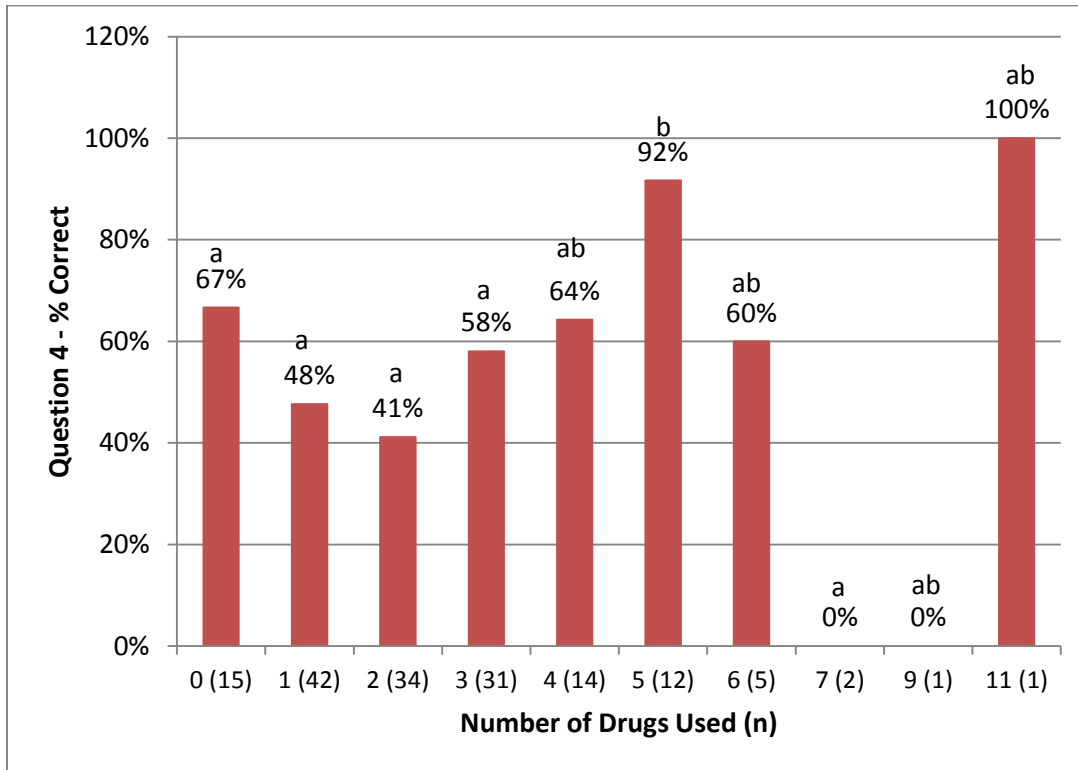
<i>Model</i>	Including Unanswered		Excluding Unanswered	
<i>Variable</i>	p-value	r²	p-value	r²
<i>Herd Size</i>	0.0786	0.012	0.4115	0.003
<i>Drug Usage</i>	0.0253	0.019	0.2901	0.005

Figure 3.8 – Question 4 – Correct Answers by Number of Drugs Used, Unanswered Included



Categories with different superscripts are different at $p < 0.05$.

Figure 3.9 – Question 4 – Correct Answers by Number of Drugs Used, Unanswered Excluded



Categories with different superscripts are different at $p < 0.05$.

Question 5 - Observance of Meat Withdrawal Period

To assess herder practices regarding meat withdrawal period, herders were presented with a situation in which an animal with a bad wound was killed after giving antibiotic injections. The response rate for question 5 was 75%. Correct answers were considered to be to feed the carcass to the dog and/or leave the carcass where it is for wild animals to eat. Among the written-in answers, 5 wrote to bury the animal and one wrote not to use the meat, which was also counted correct.

Table 3.8 – Question 5 Responses

<i>You have an animal that is wounded and have been giving it antibiotic injections for a week. You gave the last injection yesterday. The last few days the wound</i>		Including Unanswered	Excluding Unanswered
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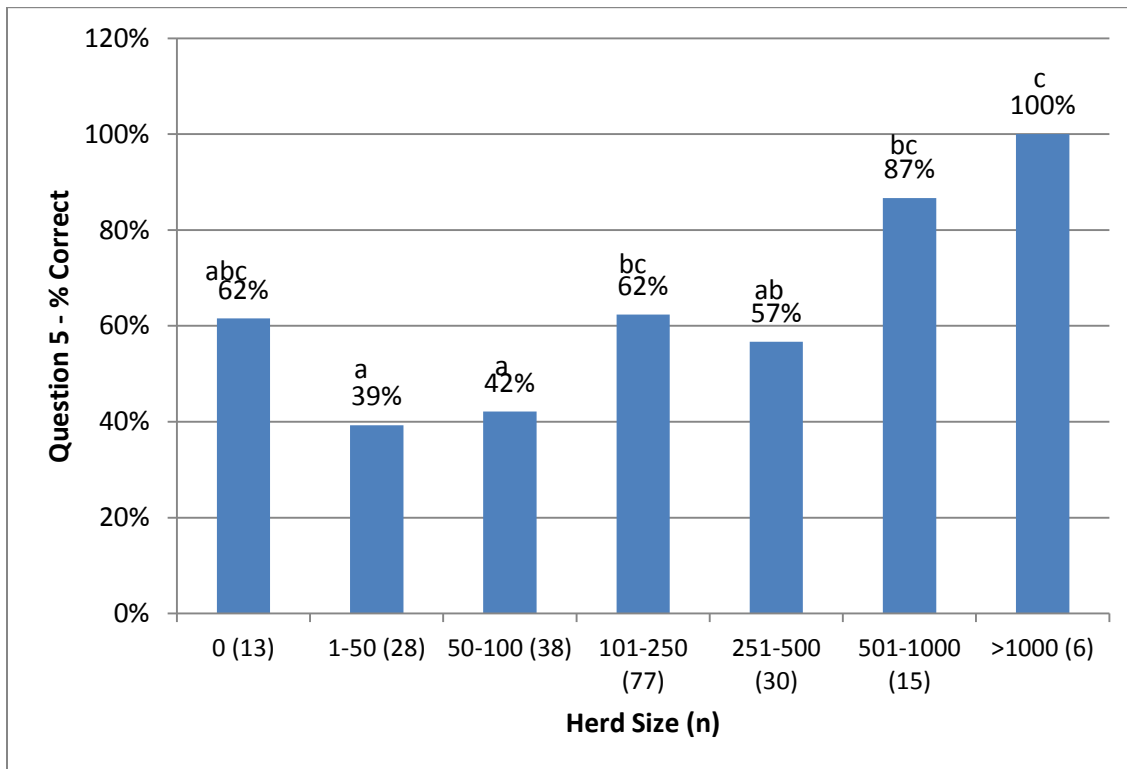
<i>has become very bad and you decide to kill the animal. What do you do with the meat?</i>			
Answer	#	% (of 207)	% (of 156)
<i>A. Use the meat for your family and friends</i>	10	5%	6%
<i>B. Feed it to the dog but do not eat it yourself</i>	43	21%	28%
<i>C. Try to sell the meat</i>	10	5%	6%
<i>D. Leave the animal where it is and let the wild animals eat it</i>	70	34%	45%
<i>E. Other</i>	14	7%	9%
<i>Bury the animal / do not use</i>	6	3%	3%
<i>Multiple Answers</i>	3	1%	2%
<i>Unanswered</i>	51	25%	
Total Correct	119	57%	76%

Herd size was found to have a significant relationship with correct responses when unanswered questions were included in the analysis (table 3.9, figure 3.10), but not when unanswered questions were excluded from analysis (figure 3.11). In contrast to questions 3 and 4, drug usage was not significantly related to responding correctly.

Table 3.9 – Question 5 – Comparison of Univariate Logistic Regression Models

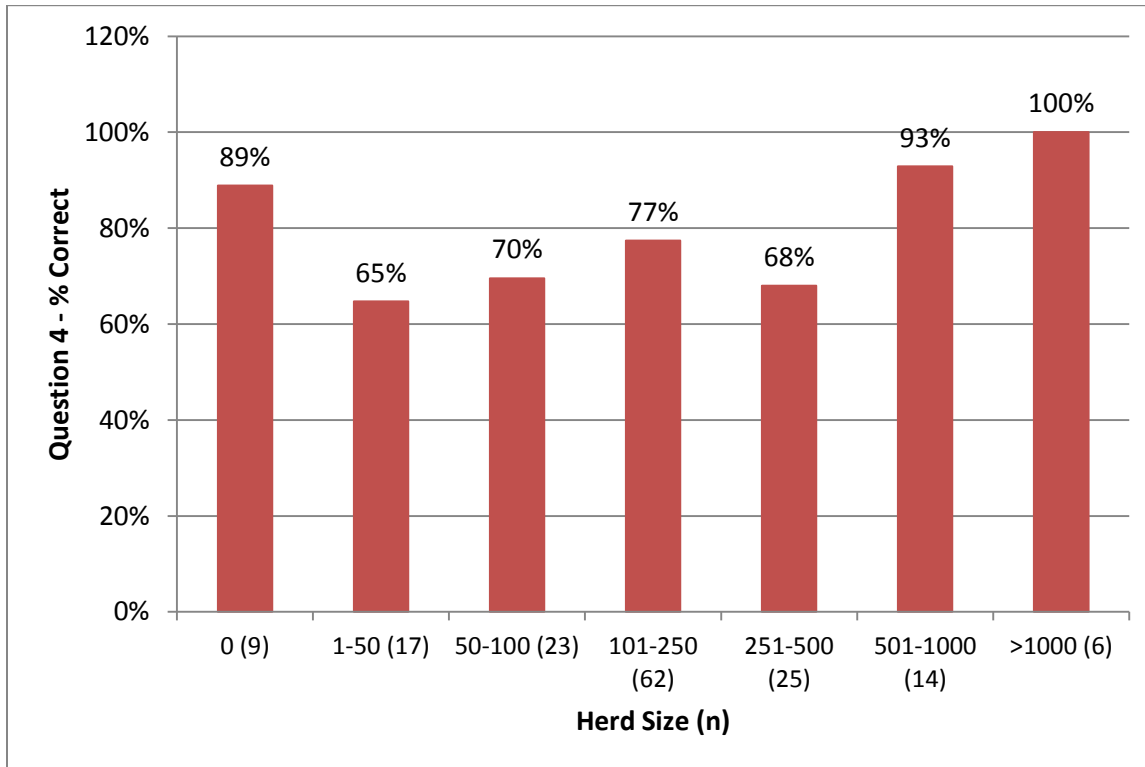
<i>Model</i>	Including Unanswered		Excluding Unanswered	
<i>Variable</i>	p-value	r²	p-value	r²
<i>Herd Size</i>	0.0045	0.042	0.1500	0.016
<i>Drug Usage</i>	0.0887	0.011	0.9908	0.000

Figure 3.10 – Question 5 – Correct Answers by Herd Size, Including Unanswered



Categories with different superscripts are different at $p < 0.05$.

Figure 3.11 – Question 5 – Correct Answers by Herd Size, Excluding Unanswered



No differences significant at $p = 0.05$.

Question 6 – Where to Find Withdrawal Period Information

Question 6 of the survey dealt with where a herder might find more information regarding the withdrawal period of a drug. The response rate was 80%. Consulting a veterinarian and/or the bottle label were counted as correct. No trends were observed across herd size or province, but number of drugs used again proved to be a significant factor but only when the unanswered surveys were excluded (table 3.11).

Table 3.10 – Question 6 Responses

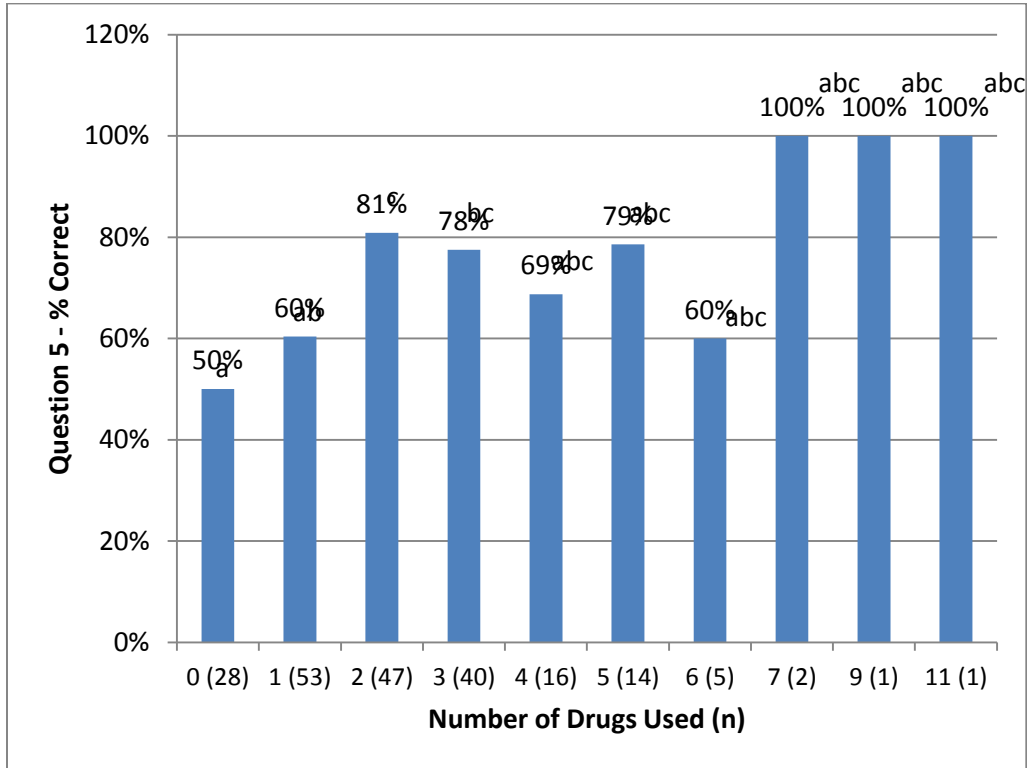
<i>Where would you go to find the information about a drug's withholding period?</i>		Including Unanswered	Excluding Unanswered
Answer	#	% (of 207)	% (of 166)
<i>A. I don't know</i>	14	7%	8%

<i>B. I would ask my veterinarian</i>	94	45%	57%
<i>C. I would read the label on the bottle</i>	40	19%	24%
<i>B & C</i>	10	5%	6%
<i>D. I would ask my friends</i>	2	1%	1%
<i>E. Other</i>	1	0%	1%
<i>Multiple Answers</i>	5	2%	3%
<i>Unanswered</i>	41	20%	
<i>Total Correct</i>	144	70%	87%

Table 3.11 – Question 6 – Comparison of Univariate Logistic Regression Models

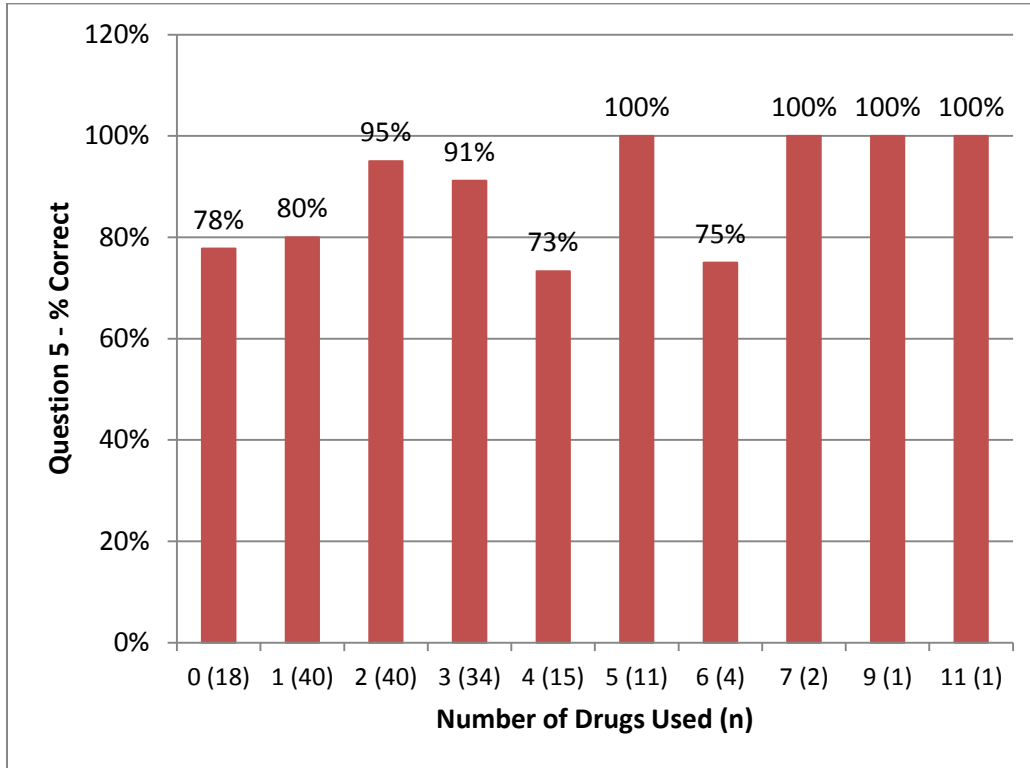
<i>Model</i>	Including Unanswered		Excluding Unanswered	
<i>Variable</i>	p-value	r²	p-value	r²
<i>Herd Size</i>	0.1903	0.008	0.5892	0.003
<i>Drug Usage</i>	0.0169	0.026	0.2316	0.012

Figure 3.12 – Question 6 – Correct Answers by Number of Drugs Used, Unanswered Included



Categories with different superscripts are different at $p < 0.05$.

Figure 3.13 – Question 6 – Correct Answers by Number of Drugs Used, Unanswered Excluded



Categories with different superscripts are different at $p < 0.05$.

Relationships among Withdrawal Period Answers

To determine whether correct answers to the withdrawal period questions were correlated, 2x2 tables were created of the numbers of correct and incorrect responses for each pair of questions, and Chi-squared tests were used to compare the distribution. The p-values of these Chi-squared tests are presented in table 3.12. The herders who answered one question correctly were also significantly more likely to answer other questions regarding withdrawal periods correctly. This remains true even when unanswered questions are excluded (except for question 6, regarding where to find information on withdrawal periods). It therefore appears that those who know what a withdrawal period is (question 3) are also more likely to observe a withdrawal period for milk (question 4) and meat (question 5).

Table 3.12 – Chi-Squares of Relationship of Correct Answers between Pairs of Questions

<i>P-values</i>	Unanswered Included			Unanswered Excluded		
	Q4	Q5	Q6	Q4	Q5	Q6
<i>Q3</i>	0.0000	0.0000	0.0001	0.0547	0.0332	0.6564
<i>Q4</i>		0.0000	0.2008		0.0498	0.3780
<i>Q5</i>			0.0000			0.5403

Question 7 – Adverse Effects of Drug Residues

Question 7 asked herders to correctly identify possible adverse effects of consuming foods with drug residues. The response rate was 70%, or 144 people responding with 181 total answers (each person circling an average of 1.3 answers. Of the options, the ones considered correct were cancer, allergic reactions, liver problems, and death (eg, via aplastic anemia). Incorrect answers were diarrhea, vomiting, seizures, and nothing will happen.

Table 3.13 – Question 7 Responses

<i>What do you think could happen to you if you eat meat and milk from animals that have recently been treated with drugs? (Circle all that you think could happen)</i>		
<i>Answer</i>	Number	Percent
<i>Allergic Reaction</i>	38	21%
<i>Cancer</i>	31	17%
<i>Death</i>	23	13%
<i>Diarrhea</i>	15	8%
<i>Liver Problems</i>	9	5%
<i>Nothing will happen</i>	11	6%
<i>Seizures</i>	5	3%
<i>Vomiting</i>	14	8%
<i>Other</i>	35	19%
<i>Total Correct</i>	101	56%

Question 8 – Topics for Further Training

Herders were given an opportunity to list which three things they would like to receive further training in. The response rate was 76% (157 herders).

Table 3.14 – Question 8 Responses

<i>Which 3 topics would you most like to receive training about? (only circle 3)</i>		
<i>Answer</i>	Number	Percent
<i>Increasing production</i>	75	18%
<i>Herd management</i>	49	12%
<i>Veterinary drug usage</i>	53	13%
<i>Business</i>	45	11%
<i>Infectious disease control</i>	45	11%
<i>Fast Horse</i>	41	10%
<i>Parasite control</i>	37	9%
<i>Neonatal care</i>	38	9%
<i>Zoonotic diseases/public health</i>	13	3%
<i>Nutrition</i>	12	3%
<i>Other</i>	8	2%
<i>Marketing</i>	5	1%

Question 9 – Animal Attrition

The response rate for question 9 was 66%. Table 3.15 summarizes the figures on a numbers and percent basis.

Table 3.15 – Question 9 Responses

	Median, #	Median, % of herd	Minimum, %	Maximum, %
<i>Slaughtered</i>	10	6.1%	0.4%	40.0%
<i>Sold</i>	10	4.9%	0.5%	28.2%

<i>Lost</i>	2	1.6%	0.4%	14.1%
<i>Died</i>	5	2.8%	0.2%	40.0%

Veterinarian Survey

Sixty-five veterinarian surveys were collected from 15 provinces. On inspection, it was found that two veterinarians had filled the survey out twice – once during a V.E.T. Net visit to the countryside, and once during the continuing education seminar in Ulaanbaatar. There being minor differences between the two responses of each veterinarian, the first survey was used and the second was ignored. These two surveys were the only two deemed necessary to remove from the database, leaving 63 surveys available for analysis.

Response Rates

The veterinary survey had a much higher response rate for each question than the herder survey, ranging from 95-100% response rates. This may have been because it had fewer questions, because the veterinarians were more comfortable with filling out surveys, or both.

Table 3.16 – Response Rates for Individual Questions

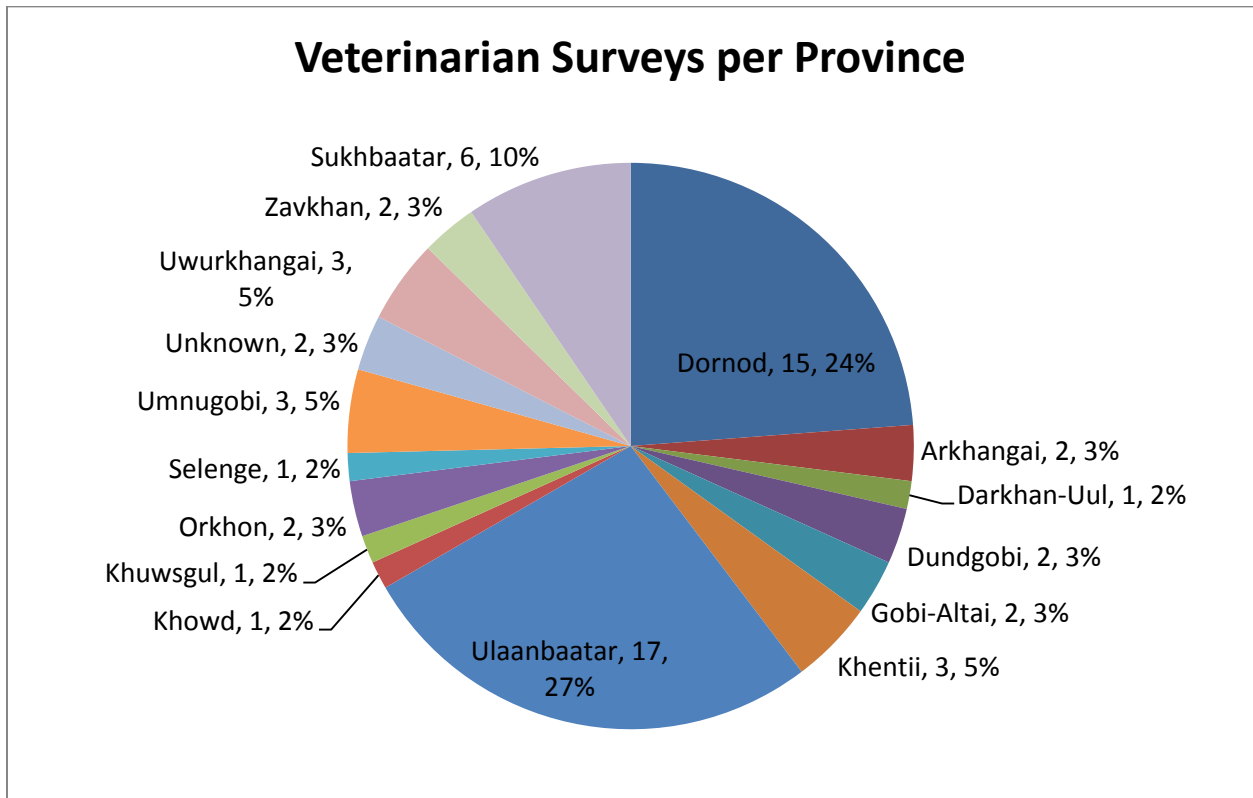
	Number of Responses (of 63)	Response Rate (%)
<i>Question 1</i>	63	100%
<i>Question 2</i>	62	98%
<i>Question 3</i>	62	98%
<i>Question 4</i>	63	100%
<i>Question 5</i>	60	95%
<i>Question 6</i>	62	98%

Geographic Distribution

Though there were more provinces represented in the veterinary survey than the herder survey, most of the responses (51%) came from Ulaanbaatar and Dornod. The large number from Ulaanbaatar is not surprising, considering that Ulaanbaatar accounts for 35-50% of

Mongolia’s population, the veterinary school and government laboratories and services are in Ulaanbaatar, and the continuing education seminar (at which more than half of the surveys were collected) was held in Ulaanbaatar. The large representation of Dornod in the dataset is due to enthusiastic participation of Dornod veterinarians in the continuing education seminar. This may be in part because Dornod has many horses, and the seminar was on equine topics.

Figure 3.14 – Geographic Distribution of Veterinary Surveys



Number of Years Working as a Veterinarian

Of the 63 veterinarians surveyed, 49 indicated the number of years they have worked as a veterinarian. A few of those who did not list their years of experience are known to be veterinary students. The years of experience ranged from 1 to 45, with a median of 17.

Question 1 – Veterinary Advising on Milk Withdrawal Period

Question 1 of the veterinary survey asked how a veterinarian would advise a client regarding the milk from an animal treated with long-acting penicillin. As with the herder survey

question regarding milk withdrawal, correct answers were giving the milk to the calf and/or throwing it away for the next few days (answers C and D). It turns out that all of those listed as “other” also wrote in the milk withdrawal time for Norocillin as either 3 or 7 days. Three days is correct for the length of withdrawal period, but both were counted as correct for question 1, since the question was geared more towards ascertaining how the veterinarian was recommending the milk be handled, rather than a correct recollection of the withdrawal period. Among those choosing C or D, 3 people wrote in a 14-day withdrawal period, 1 person wrote 7 days, and 2 people listed 3 days for the milk withdrawal period.

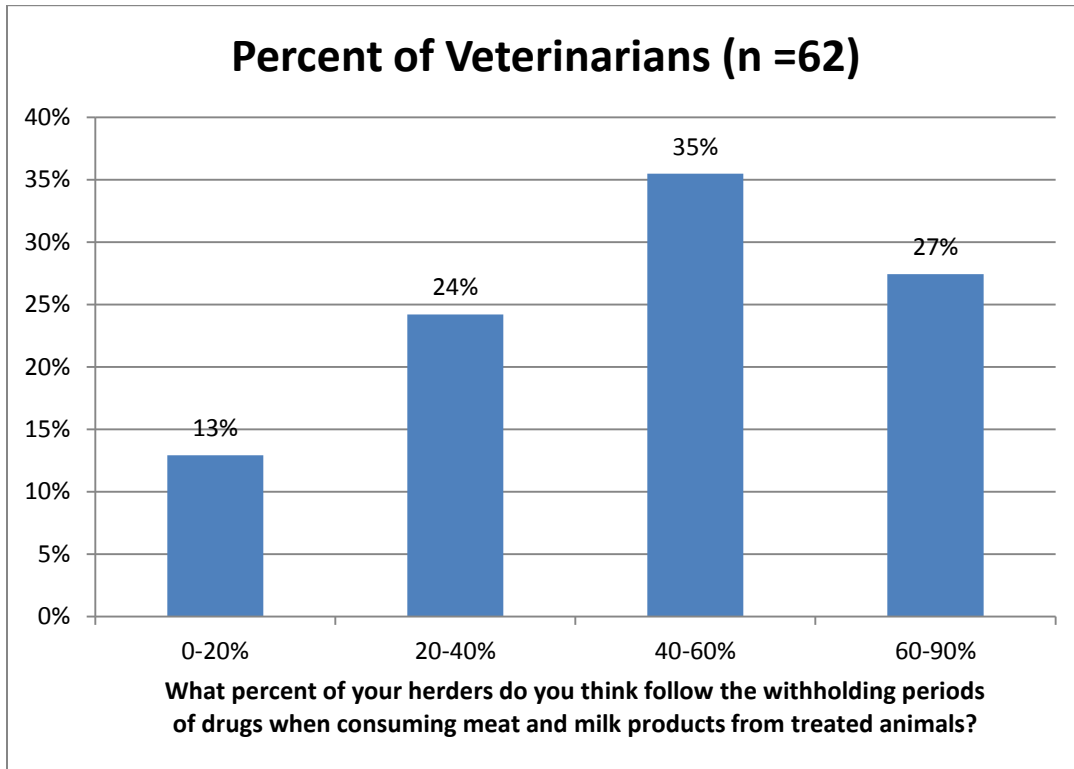
Table 3.17 – Question 1 Responses – Advice Given Regarding Milk Withdrawal Period

<i>You visit one of your herders that has a sick cow and you give it an injection of Norocillin (penicillin). They ask you if they should keep milking the cow and drinking the milk. How do you respond?</i>	Number	Percent
<i>A. Keep milking it and consuming the milk</i>	2	3%
<i>B. Boil all the milk from the cow before consuming</i>	12	19%
<i>C. Only give milk to the calf for the next few days</i>	13	21%
<i>D. Throw the milk away for the next few days</i>	29	46%
<i>C & D</i>	1	2%
<i>Unanswered</i>	1	2%
<i>Other</i>	5	8%
<i>3 days milk withdrawal</i>	2	
<i>7 days milk withdrawal</i>	3	
<i>Total Correct</i>	48	76%

Question 2 – Proportion of Herders Following Withdrawal Periods

This is a rather subjective question, asking the veterinarians to estimate the proportion of herders they work with that observe withdrawal periods.

Figure 3.15 – Proportions of Herders Estimated to be Observing Withdrawal Periods



Question 3 – Knowledge Base Question

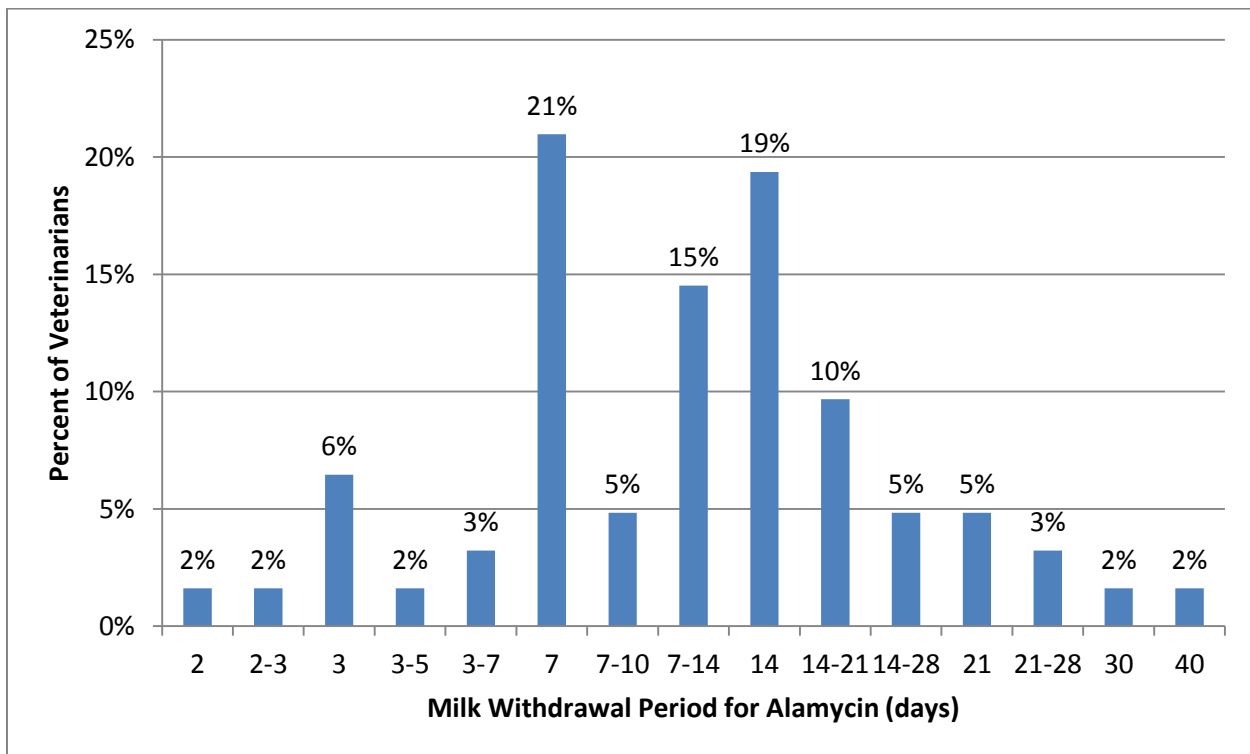
Question 3 asked veterinarians to provide the milk withdrawal period of Alamycin, the most common long-acting tetracycline in Mongolia. The labelled drug withdrawal period is 7 days. Of 62 responses, 13 (21%) identified simply 7 days, while another 14 (23%) included 7 days in the range given. Overall, 9 (15%) underestimated and 40 (65%) overestimated the withdrawal period.

Table 3.18 – Question 3 Responses – Milk Withdrawal Period of Alamycin

<i>Do you know what the withholding period is for drinking milk from animals that have been treated with Alamycin injection? ___ Days</i>	Number	Percent
2	1	2%
2-3	1	2%
3	4	6%

3-5	1	2%
3-7	2	3%
7	13	21%
7-10	3	5%
7-14	9	15%
14	12	19%
14-21	6	10%
14-28	3	5%
21	3	5%
21-28	2	3%
30	1	2%
40	1	2%
Correct (7 days), or Correct Number is Within Range Given	27	44%

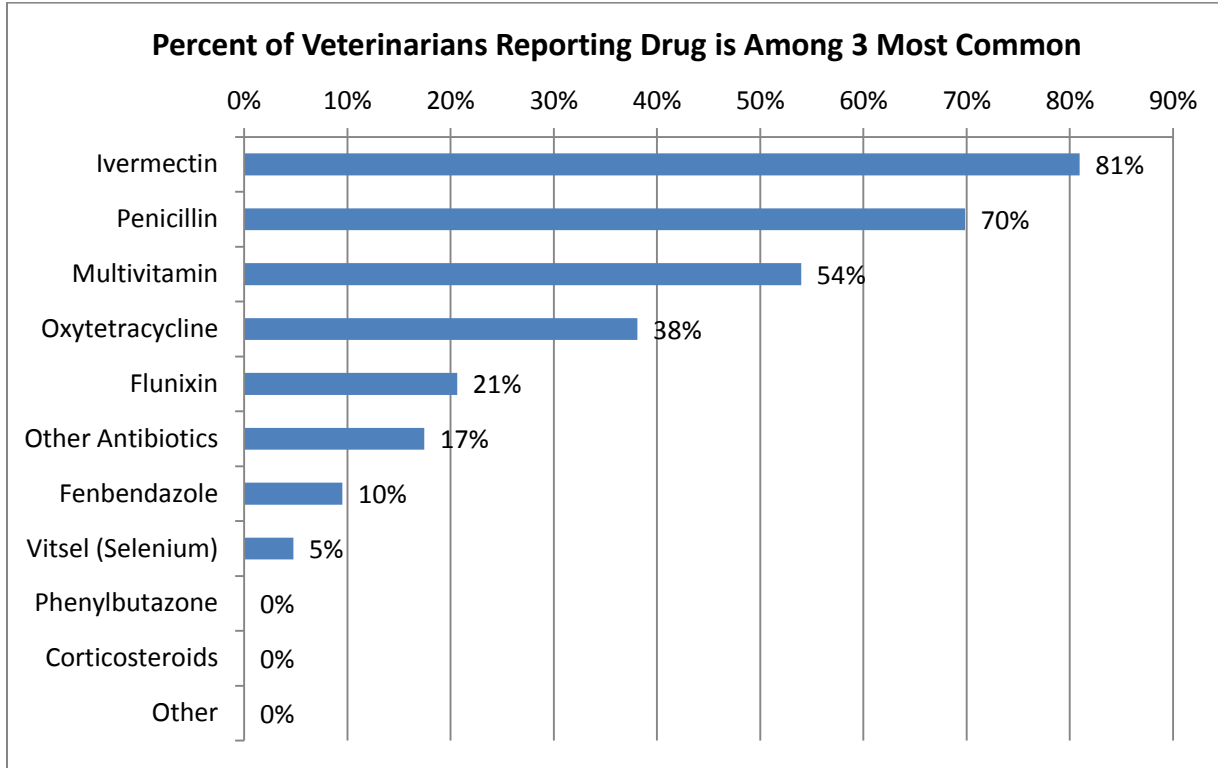
Figure 3.16 – Responses on Milk Withdrawal Period of Alamycin



Question 4 – Drugs Most Commonly Used

For question 4, veterinarians identified what they perceived to be the three most commonly used drugs among their herders.

Figure 3.17 – Which 3 drugs are the most common ones used by your herders?



Question 5 – Adverse Effects of Drug Residues

Question 5 in the veterinarian survey was the same as question 7 in the herder survey, asking veterinarians to correctly identify possible adverse effects of consuming foods with drug residues. The response rate for this question was the lowest of all the questions, but still high at 95% (60/63). Of the options, the ones considered correct were cancer, allergic reactions, liver problems, and death (eg, via aplastic anemia). Incorrect answers were diarrhea, vomiting, seizures, and nothing will happen.

Table 3.19 – Question 5 Responses – Adverse Effects of Drug Residues

<i>What do you think could happen to you if you eat meat and milk from animals that have recently been treated with drugs? (Circle all that you</i>		
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<i>think could happen)</i>		
<i>Answer</i>	Number	Percent
<i>Allergic reaction</i>	22	23%
<i>Cancer</i>	20	21%
<i>Death</i>	3	3%
<i>Diarrhea</i>	8	8%
<i>Liver problems</i>	24	25%
<i>No problems</i>	3	3%
<i>Seizures</i>	2	2%
<i>Vomiting</i>	6	6%
<i>Other</i>	8	8%
<i>Total Correct</i>	69	72%

Question 6 – Importance of Teaching Withdrawal Periods

Question 6 was another subjective question, asking veterinarians to gauge how important it is to teach herders about withdrawal periods.

Table 3.20 – Question 6 Responses – Importance of Teaching Withdrawal Periods

<i>How important do you think it is to teach herders withdrawal times of drugs? (1-not important, 5-very important). Please honestly give your opinion.</i>	Number	Percent
<i>1</i>	2	3%
<i>3</i>	3	5%
<i>4</i>	2	3%
<i>5</i>	54	89%
<i>Grand Total</i>	61	100%

Chapter 4 - Discussion

Herder Survey

Response Rates

The correlation between herd size and number of questions answered may be related to the level of education or knowledge of the herder, their comfort level in answering something they were unsure about, or other factors.

Knowledge and Observance of Withdrawal Periods

The trend of answering question 3 and 4 more correctly with increasing number of drugs used is encouraging. This may be a reflection that those who use a wider variety of medicines are more likely to know what a withholding period is and follow the withdrawal period regarding milk. However, it should be noted that though the trend does exist, it still only accounts for a small amount of the variation as measured by r^2 , so drug usage cannot be used as a major predictor of whether or not a herder knows what a withdrawal period is or whether they follow a milk withdrawal period.

Question 5 (regarding meat withdrawal) differed from questions 3 and 4 in that drug usage became a non-significant predictor of answering correctly, while herd size became significant. In general, herders were also more likely to follow some sort of meat withdrawal period (57%-76%) than they were to know what the term “withdrawal period” means (38%-59%) or follow a milk withdrawal period (42%-55%). It is impossible to say whether this is due to actually being more aware of the issue when it comes to meat or due to the way the questions were asked. However, this tendency may be useful for appropriately targeting herders in education efforts.

It is noteworthy that the single most common response (23%) for milk withdrawal practice is boiling the milk before consumption. Though beneficial in terms of killing pathogens, boiling the milk will do little or nothing for removing drug residues from the milk. This misperception is one that should be addressed in further education of herders (chapter 5).

I would summarize the results of the herder survey by saying that in general, herders with more animals use a wider variety of medicines on their livestock. The number of drugs used by a herder within the last 6 months is in turn the single best predictor of a herder’s likelihood of

knowing what a withdrawal period is and following milk withdrawal periods. However, herd size is the most significant predictor for adhering to meat withdrawal periods. In addition, herders who know what a withdrawal period is also are more likely to adhere to withdrawal periods for meat and milk. Though these trends are present, there is much variability, and many of the herders who use many different drugs or have large herds do not know or follow withdrawal periods.

Veterinary Survey

One question that would have been useful to ask is what proportion of time the veterinarian discusses withdrawal period when a drug is prescribed for a food animal. This was indirectly addressed in question 2, about the percent of their herders that they believe follow the withdrawal periods.

Question 1 – Veterinary Advising on Milk Withdrawal Period

Veterinarians surprisingly answered nearly as often as herders (19% and 23%, respectively) that boiling milk from animals treated with a drug is adequate to make the milk safe to drink. This is disconcerting, considering the higher level of education by veterinarians than by herders. As with herders, it presents an opportunity for further education.

Question 3 – Knowledge Base Question

Considering that many more veterinarians over-estimated the milk withdrawal period of Alamycin than underestimated it, this in some ways is good, indicating erring on the side of caution. However, if veterinarians are erroneously advising herders to discard milk for a longer period of time than they need to, it may discourage herders from actually following the recommended withdrawal period.

Question 4 – Drugs Most Commonly Used

It is interesting to note the comparisons between herders' self-reported use of drugs (figure 3.4) and veterinarians' estimation of the three most commonly used drugs (figure 3.17). A direct comparison cannot be made because the questions are asking two different things (which medicines the herder used in the last 6 months, versus which are the most common 3 medicines). Besides that, the question to herders asks about "drenches" whereas the question to

veterinarians asks specifically about Fenbendazole. In addition, the sample population of herders that the question to veterinarians is asking about and the sample population of herders directly queried are two different populations, at least because of the difference in geographic distribution of respondents. However, some differences are striking enough to warrant the belief that there are real differences in perception.

In general, veterinarians appear to under-report the use of Fenbendazole. Of the herders, 59% reported using “drenches” (understood to be Fenbendazole and albendazole) in the last 6 months, second only to ivermectin (73%) in use, and double that of penicillin (28%). However, only 10% of veterinarians report Fenbendazole as one of the three most commonly used drugs, with penicillin (70%) taking second place to ivermectin (81%). Additionally, penicillin and oxytetracycline appear to be over-represented in the veterinarians’ estimation of use compared to the herders’ reported use.

Question 6

With veterinarians being the key link in promoting the proper use of withdrawal periods, this question about how important they feel it is to teach herders is appropriate. However, coming at the end of a survey on withdrawal periods, it is likely that the responses are skewed to indicate they feel more strongly about it than not.

Chapter 5 - Next Steps

Herder Education

Herders are ultimately the final determiner of whether withdrawal periods are followed, and thus are a key to achieving a meat and milk supply in Mongolia free from drug residues. If any subgroup is to be targeted, it appears that those herders who use fewer than average numbers of medicines on their livestock and those with smaller herds are the best ones to target. However, though statistically significant, the correlation between these two variables and understanding and practice of withdrawal periods is not strong, indicating to me that there is still a need to educate all herders.

Overall, it appears that adherence to milk withdrawal periods are lower than meat withdrawal periods. As such, it may be prudent for relatively more emphasis to be placed on the importance of not consuming milk from recently-treated animals.

One specific misconception that should be addressed during herder education regarding withdrawal periods is the belief that boiling milk renders it safe to consume. While true from the standpoint of pathogens, this is not true when it comes to drug residues.

Encouraging herders to keep good treatment records will be important for enabling them to adhere to withdrawal periods. Along with treatment records, some system of individually identifying treated animals (if not every animal) is necessary. (It is understood that cattle and yak are already individually identified, so this pertains more to sheep, goats, and horses.) Herders may be able to remember themselves which animals have been recently treated, but animal ID and treatment records would prevent confusion and reduce mistakes. Good treatment records would also help buyers have confidence that the animals for sale truly are free of drug residues, adding value to the animals and encouraging repeat sales.

Veterinarian Education

Though the herder is the ultimate determiner of adherence to withdrawal periods, I believe that the education of veterinarians will be relatively more important. I believe this because of the multiplier effect: veterinarians have an opportunity and responsibility to remind their clients of a drug's withdrawal period each time they prescribe its use or sell the drug. If veterinarians regularly discuss withdrawal periods with their clients, not only will more herders

be impacted than V.E.T. Net or any other entity can reach, but individual herders will be reminded more often to follow withdrawal periods.

For the reasons mentioned above, veterinarians should also be encouraged to help their herders keep treatment records and practice identification of all animals.

It appears that veterinarians do not typically consider withdrawal periods when deciding on a treatment plan. Planning for what to do with an animal that does not respond to treatment is important. If a drug with a long withdrawal period is used in an animal unlikely to respond to treatment, the use of that drug prevents salvage slaughter of the animal. Likewise, unnecessarily choosing to use a drug with a long milk withdrawal period (e.g., Alamycin vs. Norocillin) makes adherence to the milk withdrawal period more burdensome. Encouraging veterinarians to account for withdrawal periods when developing treatment plans will help make adherence to withdrawal periods more practical.

Most veterinarians appear to have a better understanding of withdrawal periods than herders. As noted in chapter 4, however, it is disturbing that 19% of veterinarians answered that boiling milk from an animal undergoing treatment with Norocillin is adequate for making the milk safe for consumption. This is a misconception that must be addressed among veterinarians as well as herders.

Regulation and Enforcement

It is encouraging to hear that Mongolia is making progress toward implementing regulations regarding drug residues and withdrawal periods (Tserendorj 2012). This will not only help to improve the safety of the domestic food supply but also position Mongolia to be able to export meat and milk to a variety of countries. After setting standards for maximum residue limits, Mongolian authorities need to implement withdrawal periods to meet those standards. The current situation is too confusing in which whichever withdrawal period happens to be on the bottle is used, being dependent on regulations set by whichever country the product was produced for. Moving towards a more centralized and formal market structure (processing plants, distribution chains, etc.) will help facilitate adequate sampling for drug residues. Enforcement mechanisms must be appropriate to the local situation in Mongolia, and will depend on the ability to trace livestock products back to their origin. Appropriate regulation and

enforcement is necessary to give force to any effort to improve the safety of Mongolian meat and milk. Without it, all talk of herder and veterinary education is only that – talk.

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Appendix A – Surveys

Herder Survey in English

Herder Survey

I understand these questions will be used in a research project to better understand how I care for my animals, and that my participation is completely voluntary. The survey should take about 5 minutes to complete and I understand that if I decide to participate in this study, I may stop answering questions at any time without penalty or loss of benefits; and I do not need to provide a reason for stopping my participation. The information I provide will only be used for this research project and no other agency or people will see it.

Thank you for your honest answers. _____ (Initials of participant)

Name _____ Aimag _____ Soum _____ Bag _____

of family members _____ Veterinarian Name _____

1. How many animals do you have?

_____ sheep _____ goats _____ Cows/yaks _____ Horses _____ Camels

2. Which medications have you given to your animals in the last six months? (circle all that apply)

penicillin oxytetracycline Tylosin other antibiotics

flunixin phenylbutazone Hormones

Drenches Vitsel (selenium) Multivitamin Ivermectin

Other _____

3. What do you think the withholding period of a drug means?

- The amount of time it takes the drug to start working in the animal
- The amount of time you should wait to eat the meat or drink the milk of an animal that has been treated with a drug
- The amount of drug that should be given to the animal based on the disease
- The amount of time that you can safely store the drug before it becomes ineffective

4. When your cow gets mastitis and you give it an injection of penicillin what do you usually do?

- a) keep milking it and consuming the milk
- b) Boil all the milk from the cow before consuming
- c) only give milk to calves for the next few days
- d) do not consume the milk for several days
- e) other_____

5. You have an animal that is wounded and have been giving it antibiotic injections for a week. You gave the last injection yesterday. The last few days the wound has become very bad and you decide to kill the animal. What do you do with the meat?

- a) Use the meat for your family and friends
- b) Feed it to the dog but do not eat it yourself
- c) Try to sell the meat
- d) Let the wild animals eat it if it died away from housing areas
- e) Other_____

6. Where would you go to find the information about a drug's withholding period?

- a) I don't know
- b) I would ask my veterinarian
- c) I would read the label on the bottle
- d) I would ask my friends
- e) Other_____

7. What do you think could happen to you if you eat meat and milk from animals that have recently been treated with drugs? (Circle all that you think could happen)

Nothing will happen Diarrhea Vomiting Cancer
 Allergic reaction Liver problems Death Seizures other_____

8. Which 3 topics would you most like to receive training about? (only circle 3)

Infectious disease control Neonatal care Parasite control
 Increasing production Business Nutrition
 Fast Horse Zoonotic diseases/public health Veterinary drug usage
 Herd management Marketing Other_____

9. Last year how many animals did you lose?

Reason for loss	# of lost animals
Slaughtered for food	

Sold	
Lost	
Died (Disease, weather, wounds etc)	

Thank you for answering these questions. They will be used in a research project to better understand how animals are cared for in this region. Only the researchers directly involved in this study will have access to the answers you provided to this survey.

Veterinarian Survey in English
Survey Questions for veterinarians

I understand these questions will be used in a research project to better understand how I care for my animals, and that my participation is completely voluntary. The survey should take about 5 minutes to complete and I understand that if I decide to participate in this study, I may stop answering questions at any time without penalty or loss of benefits; and I do not need to provide a reason for stopping my participation. The information I provide will only be used for this research project and no other agency or people will see it.

Thank you for your honest answers. _____ (Initials of participant)

**Name _____ Aimag _____ Soum _____ # of
herders _____**

of years working as a vet: _____ Clinic name _____ Phone _____

- 1. You visit one of your herders that has a sick cow and you give it an injection of Norocillin (penicillin). They ask you if they should keep milking the cow and drinking the milk. How do you respond?**
 - a. yes
 - b. no
 - c. do not know
 - d. milk is consumable after it is boiled
 - e. other _____

- 2. What percent of your herders do you think follow the withholding periods of drugs when consuming meat and milk products from treated animals?**
 - a. I don't know
 - b. 0-20%
 - c. 20-40%
 - d. 40-60%
 - e. 60-90%

- 3. Do you know what the withholding period is for drinking milk from animals that have been treated with Alamycin injection?**
_____ days

4. Which 3 drugs are the most common ones used by your herders? (circle only three)

penicillin oxytetracycline other antibiotics flunixin phenylbutazone corticosteroids
Ivermectin Fenbendazole Vitsel (selenium) multivitamin Other_____

5. What problems do you think can come from eating the meat and milk of animals that have recently been treated with drugs?

No problems Diarrhea Vomiting Allergic reaction
Cancer Liver problems Death Seizures other_____

6. How important do you think it is to teach herders withdrawal times of drugs? (1-not important, 5-very important). Please honestly give your opinion.

1 2 3 4 5

Thank you for answering these questions. They will be used in a research project to better understand how animals are cared for in this region. Only the researchers directly involved in this study will have access to the answers you provided to this survey.

Herder Survey in Mongolian

Малчдын санал асуулга

Энэ санал асуулга нь малчдын малын эмийн хэрэглээ ба мал заазлах (нядлах) тухай мэдээлэл авахад хэрэглэгдэнэ. Өөрийн бодол санаагаар асуулгыг 5 мин багтаан бөглөнө үү. Таны өгсөн мэдээлэлийг төслийн судалгаанаас гадуурх зорилгоор ашиглахгүй болно.

Доорх асуултууд миний бие мал маллагаандаа хэр зэрэг анхаарал тавьдаг гэдгийг илүү сайн ойлгуулах зорилготой судалгааны төсөлд ашиглагдах бөгөөд би энэхүү судалгаанд сайн дураар оролцож байгаа гэдгээ ойлгож байна. Судалгаа бөглөхөд 5 минут зарцуулах шаардлагатай ба хэрэв би тус судалгаанд оролцох шийдвэр гарган асуултанд хариулах явцдаа асуултанд үргэлжлүүлэн хариулахаа хэзээ ч зогсоож болох ба энэ тохиолдолд ямар ч торгууль, хохирол хүлээх шаардлагагүй гэдгээ ойлгож байна. Мөн тус судалгаанд оролцохгүй болсон шалтгаанаа тайлбарлах албагүй болно. Миний мэдээллийг зөвхөн энэхүү судалгааны төсөлд ашиглах ба өөр ямар ч байгууллага, хүмүүст үзүүлэхгүй.

Үнэн зөв хариулсанд талархал илэрхийлье. _____ (гарын үсэг)

Нэр _____ Аймаг _____ Сум _____ Баг _____

Ам бүлийн тоо _____ Малын эмчийн нэр _____

1. Нийт малын тоо хэд вэ? _____

Хонь _____ Ямаа _____ Үхэр/сарлаг _____ Адуу _____ Тэмээ _____

2. Сүүлийн 6 сарын хугацаанд та малдаа дараах эмнүүдээс хэрэглэсэн үү?
(Сонгож дугуйлна уу)

пенициллин	окситетрациклин	Фармазин	өөр антибиотикүүд
флуниксин (үрэвслийн эсрэг эм)	Фенилбутазон (доголын эм)		Дааврын бэлдмэл
Туулга	Витесел (Селен)	мультивитамин	Ивомек
Бусад _____			

3. Малын эмийн биемахбодид хадгалагдах хугацаа гэж юу вэ?

а) Мал амьтны биемахбодид эмийн үйлчилгээ эхлэх хугацаа

- b) Эмийн эмчилгээ хийсэн мал амьтдын мах эсвэл сүүг хэрэглэхгүйгээр хүлээх хугацаа
- c) Өвчин эмгэгээс хамаарч малд олгох эмийн хэмжээ
- d) Эмийн үйлчилгээ алдагдахаас өмнө эмийг аюулгүйгээр хадгалах хугацаа

4. Үнээний дэлэнгийн үрэвслийн үед пенициллинийг булчинд таривал та:

- a) Саалийг үргэлжлүүлэн, сүүг хүнсэндээ ашигладаг
- b) Үнээний сүүг хэрэглэхээсээ өмнө сайтар буцалгаж хөөрүүлж хэрэглэнэ
- c) Дараагийн хэд хоногт сүүг зөвхөн тугалд нь хөхүүлнэ
- d) Дараагийн хэд хоногт сүүг хүнсэнд ашиглахгүй
- e) Бусад _____

5. Та малдаа шархны эмчилгээ гэж бүтэн долоо хоногийн турш антибиотик тарьж, сүүлийн тунг нь өчигдөр тарьсан. Улмаар шарх хүндэрсэн тул алхаж чадахаа больжээ. Тэгээд нядлахаар шийдсэн бол та яах ёстой вэ? Дараахаас сонгоно уу?

- a) Өөрсдийн хүнсэндээ эсвэл найздаа мах болгож өгнө
- b) Хүнсэнд хэрэглэхгүй, нохойд өгнө
- c) Мах болгож худалдана
- d) Жалганд аваачиж хаяна
- e) Бусад _____

6. Малын эмийн биемахбодиос гадагшлах хугацааг та хаанаас олж мэдэх вэ?

- a) Мэдэхгүй байна
- b) Малын эмчээсээ асууна
- c) Эмийн сав баглаан дээрх заавар танилцуулгыг унших
- d) Найзаасаа л асууна
- e) Бусад _____

7. Эмийн эмчилгээ хийлгээд удаагүй байгаа малын мах, сүүг хүнсэнд ашиглавал яах вэ? (Таамаглаж байгаа хариултуудаа дугуйлна уу)

Ямар ч муу зүйл болохгүй Гүйлгэнэ Бөөлжинө Хавдар үүсгэнэ
 Харшлын хариу урвал илэрнэ Элэгний өвчин үүсгэнэ Үхэж болно
 Таталт илэрнэ Бусад _____

8. Та ямар сэдвээр илүү сургалт авахыг хүсч байна вэ? (зөвхөн 3-ыг дугуйлна уу)

Халдварт өвчний хяналт Төлийн арчилгаа, эмчилгээ Паразит өвчний хяналт

Малын ашиг шимийг нэмэгдүүлэх Бизнесийн сургалт Тэжээллэг
 Хурдан морины сургалт Зооноз өвчин/нийгмийн эрүүл мэнд
 Мал эмнэлгийн эмийн хэрэглээ Малын арчилгаа маллагаа
 Маркетинг Бусад _____

9. Өнгөрсөн жил хэдэн мал хоргодсон бэ?

Хорогдлын шалтгаан	Хорогдсон малын тоо
Хүнсэнд хэрэглэсэн	
Худалдсан	
Алдсан	
Үхсэн (өвчин, цаг агаар, гэмтэл бэртэл г.м.)	

Асуултанд хариулсанд талархал илэрхийлье.

Veterinarian Survey in Mongolian

Малын эмч нарын санал асуулга

Доорх асуултууд миний бие мал маллагаандаа хэр зэрэг анхаарал тавьдаг гэдгийг илүү сайн ойлгуулах зорилготой судалгааны төсөлд ашиглагдах бөгөөд би энэхүү судалгаанд сайн дураар оролцож байгаа гэдгээ ойлгож байна. Судалгаа бөглөхөд 5 минут зарцуулах шаардлагатай ба хэрэв би тус судалгаанд оролцох шийдвэр гаргаад асуултанд хариулах явцдаа асуултанд үргэлжлүүлэн хариулахаа хэзээ ч зогсоож болох ба энэ тохиолдолд ямар ч торгууль, хохирол хүлээх шаардлагагүй гэдгээ ойлгож байна. Мөн тус судалгаанд оролцохгүй болсон шалтгаанаа тайлбарлах албагүй болно. Миний мэдээллийг зөвхөн энэхүү судалгааны төсөлд ашиглах ба өөр ямар ч байгууллага, хүмүүст үзүүлэхгүй.

Үнэн зөв хариулсанд талархал илэрхийлье. _____ (гарын үсэг)

Нэр _____ Аймаг _____ Сум _____ Утас _____

Малын эмчээр ажилласан жил: _____ Мал эмнэлгийн нэр _____

1. Үнээ нь өвчилсөн малчныд очоод Нороциллин (пенициллин) тарьж өгчээ. Малчин танаас үнээний сүүг ашиглаж болох эсэх талаар асуувал та хэрхэн хариулах вэ?
 - A. Саалийг үргэлжлүүлэн, сүүг хүнсэндээ ашигладаг
 - B. Үнээний сүүг хэрэглэхээсээ өмнө сайтар буцалгаж хөөрүүлж хэрэглэнэ
 - C. Дараагийн хэд хоногт сүүг зөвхөн тугалд нь хөхүүлнэ
 - D. Дараагийн хэд хоногт сүүг хүнсэнд ашиглахгүй
 - E. Бусад _____

2. Эмчилгээ хийлгэсэн малынхаа мах, сүүг ашиглах хугацааг эмийн биемахбодид хадгалагдах хугацаанд заасны дагуу таныг тайлбарлаж өгсний дараа малчдын хэдэн хувь нь үүнийг ёс журмын дагуу дагана гэж бодож байна вэ?
 - a. Мэдэхгүй байна
 - b. 0-20%
 - c. 20-40%
 - d. 40-60%
 - e. 60-90%

3. Аламицин тариаг эмчилгээнд хэрэглэсэн тохиолдолд малын сүүг хэр хугацааны дараа хүнсэнд хэрэглэх ёстой вэ?

_____ Хоног

4. Аль эмийг малчид тань илүү өргөн хэрэглэдэг вэ? (зөвхөн гуравыг л дугуйлна)

пенициллин окситетрациклин өөр антибиотууд флуниксин фенилбутазон
кортикостероидууд Ивермектин Фенбендазол Витесел (цайр)
мультивитамин Бусад_____

5. Эмийн эмчилгээ хийлгэж байгаа малын мах, сүүг ашиглавал яах вэ?

Ямар ч муу зүйл болохгүй Гүйлгэнэ Бөөлжинө Харшлын хариу урвал
илэрнэ

Хавдар үүсгэнэ Элэгний өвчин үүсгэнэ Үхэж болно Таталт илэрнэ Бусад

6. Малчинд эмийн эмчилгээ хийлгэсэн малын мах ба сүүг хэзээ хэрэглэх тухай малчинд хэлж өгөх нь хэр чухал гэж та бодож байна вэ? (1-чухал бус, 5-маш чухал). Та шударгаар хариулна уу.

1

2

3

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Асуултанд хариулсанд талархал илэрхийлье.

Appendix B – Educational Material on Withdrawal Periods: For Inclusion in the V.E.T. Net Herder Handbook and Drug Catalog

Drug residues in meat and milk can harm your health!

Possible health effects include:

- Allergic reactions
 - Cancer
 - Liver disease
 - Infections that cannot be treated with antibiotics
 - Bone marrow destruction
 - Birth defects
 - Death
-
- ❖ To avoid these effects, always observe the withdrawal period listed on the medicine or vaccine.
 - ❖ The withdrawal period is the amount of time you should wait to eat the meat or drink the milk of an animal that has been treated with a drug. This time allows the animal to remove the medicine from their body.
 - ❖ During the withdrawal period, throw away any milk from a milking animal (boiling it is not enough), and do not kill the animal for meat until after the withdrawal period.
 - ❖ If you have any questions, ask your veterinarian.
 - ❖ Some medicines do not have a withdrawal period, but always check.

Table B.1 – Withdrawal Periods (# of Days) for V.E.T. Net Drugs

Withdrawal Periods (# of Days) for V.E.T. Net Drugs

Drug		Cattle / Yaks	Sheep	Goats	Horses	Camels	Pigs
Ecomectin 1% Ivermectin	Milk	14	14	14	--	14	--
	Meat	35	42	42	21 (horse paste)	42	28
Ecomintic 100 Fenbendazole	Milk	5	5	5			
	Meat	14	7	7			
Ecotraz Plus Pour-on	Milk	0	0	0			
	Meat	7	7	7			
Ecotraz 250 Amitraz	Milk	8 hours	8 hours	8 hours			
	Meat	7	7	7			1
Ecotel 2.5% Praziquantel	Milk	0	0	0			
	Meat	1	1	1			
Norocillin LA Penicillin	Milk	3	3	3	3	3	3
	Meat	14	14	14	14	14	14
Alamycin LA Oxytetracycline	Milk	7	7	7	7	7	--
	Meat	28	21	21	28	28	14
Norodine Trimethoprim Sulfa	Milk	7	7	7	7	7	
	Meat	21	21	21	21	21	
Tylbian 20% Tylosin, Фармазин	Milk	3	2	2			--
	Meat	14	14	14			21
Kreolin Creosote	Meat		25	25			15
Flunixin	Milk	2	2	2	2	2	
	Meat	14	14	14	28	14	
Phenylbutazone	Milk	14	14	14	14	14	
	Meat	40	40	40	40	40	

Appendix C – Educational Presentation on Withdrawal Periods: For Continuing Education of Veterinarians


Withdrawal Periods - Why Follow Them?

Stephan Gibson, DVM


Possible Adverse Effects

- Allergic reactions
 - Penicillin
 - Sulfonamides
 - Tetracycline
- Antibiotic resistance
 - All antibiotics
- Cancer
- Aplastic anemia (irreversible bone marrow suppression)
 - Phenylbutazone
 - Chloramphenicol
- Birth defects


Penicillin (Norocillin)




- Allergic reactions
 - 10 IU (0.6 µg) / person can cause a reaction
 - 3-10% of individuals are allergic
 - Anaphylactic reactions have occurred from meat residues
 - Itching, severe difficulty swallowing & breathing
- Antibiotic resistance
 - **Withdrawal period**
 - Meat: 14 days
 - Milk: 3 days



Oxytetracycline (Alamycin)




- Antibiotic resistance
 - 2 mg / person / day can cause resistance in human intestinal bacteria
- Allergic reactions
- Changes in blood cell count
- Discoloration of teeth
 - **Withdrawal period**
 - Meat: 28 days
 - Milk: 7 days



Chloramphenicol

- **APLASTIC ANEMIA**
 - Irreversible suppression of bone marrow
 - → death!
- **DO NOT USE IN FOOD ANIMALS**

Sulfonamides (Norodine)



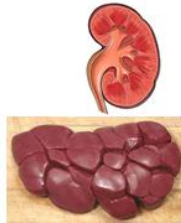
- Allergic reaction (skin rash)
- Antibiotic resistance
- **Withdrawal period**
 - Meat: 21 days
 - Milk: 7 days

Gentamicin

- Antibiotic resistance
- Kidney damage
- Hearing loss



- **Withdrawal period**
 - Meat: 18 months
 - Milk: 5 days



Tylosin (Тылбиа, Фармазин)

- DO NOT USE IN HORSES
 - → fatal diarrhea is possible
- Possible side effects of residues
 - Antibiotic resistance
 - Disruption of intestinal microbes in humans



- **Withdrawal period**
 - Meat: 21 days
 - Milk: 3 days

Antibiotic Resistance

- Low levels in meat & milk can kill susceptible bacteria in humans → only resistant bacteria grow
- Resistance genes can jump between species of bacteria
- Result: resistant infections in humans

Residues in Milk

- Any antibiotic in milk can kill the bacteria that ferment milk, stopping the fermentation process
 - airag
 - aruul
 - yoghurt



Flunixin

- **Give intravenously**
- If given in the muscle, can cause muscle necrosis → death

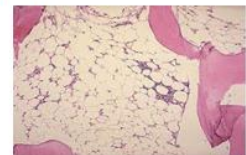


- **Withdrawal period**
 - Meat: 28 days
 - Milk: 2 days



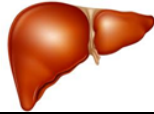
Phenylbutazone

- **Bone marrow effects**
 - Aplastic anemia (bone marrow suppression) → DEATH
- Hypersensitivity
- Cancer
- Kidney damage
- GI ulcers
- When possible, use other drugs
 - **Withdrawal period**
 - Meat: 40 days
 - Milk: do not use



Ivermectin (Ecomectin)

- Withdrawal period
 - Meat: 42 days
 - Milk: 14 days



Fenbendazole

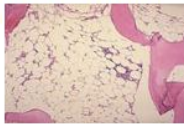
- Withdrawal period
 - Meat: 14 days
 - Milk: 5 days

Praziquantel (Ecotel)

- Withdrawal period
 - Meat: 1 day
 - Milk: 0

Albendazole

- Birth defects in children if pregnant women are exposed in early pregnancy
- Aplastic anemia



- Withdrawal period
 - Meat: 3 months(?)
 - Milk: do not use

Kreolin

- Cancer
- Damage to liver, kidney, brain
- Use protective clothing, gloves, and masks when applying

- Withdrawal period
 - Meat
 - Goats & sheep: 25 days
 - Pigs: 15 days

Xylazine & Ketamine

- Withdrawal period:
 - Meat: 21 days
 - Milk: 5 days

Vaccines

- Follow labelled withdrawal time
- Possibly contain
 - Antibiotics
 - Modified live viruses / bacteria
 - Brucella
 - Adjuvants (aluminium, oil, etc.)

Summary

- Withdrawal periods promote human health
- Know the withdrawal periods for each drug you use
 - Usually written on the label
 - Contact V.E.T. Net if more information needed
- Remind clients of the withdrawal periods every time you recommend or give a drug

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