A survey of zoonotic diseases contracted by South African veterinarians

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ABSTRACT

A survey of 88 veterinarians employed at the Faculty of Veterinary Science, University of Pretoria, South Africa, was carried out to investigate the occurrence of zoonotic diseases among South African veterinarians. The survey found that 63.6 % of veterinarians interviewed had suffered from a zoonotic disease. Veterinarians predominantly involved in farm animal practice were 3 times more likely to have contracted a zoonotic disease than those working in other veterinary fields. Fifty-six percent of disease incidents were initially diagnosed by the veterinarians themselves. Fifty-three percent of incidents required treatment by a medical practitioner, but the majority (61 %) of incidents did not require absence from work. The incidence density rate for contracting a zoonotic disease was 0.06 per person year of exposure. Kaplan-Meier survival analysis estimated that the probability of having contracted a zoonotic disease was 50 % after 11 years in practice. The risk of contracting a zoonotic disease appeared to be higher early in practice. The most common mode of transmission was by direct contact. Approximately 46 % of South Africans still live in rural areas and regularly come into close contact with farm animals. The implications of this in the light of this survey's results are discussed.

Key words: prevalence, South Africa, survey, veterinarians, zoonoses.

Gummow B **A survey of zoonotic diseases contracted by South African veterinarians**. *Journal of the South African Veterinary Association* (2003) 73(3): 72–76 (En.). Section of Epidemiology, Department of Production Animal Studies, Faculty of Veterinary Science, University of Pretoria, Private Bag X04, Onderstepoort, 0110 South Africa.

INTRODUCTION

Many of the human diseases that are new, emerging and re-emerging at present, are caused by pathogens that originate from animals or products of animal origin[2]. These include transmissible spongiform encephalopathies, enterohaemorrhagic *E. coli*, Hantavirus infections, Napah virus infections, West Nile viral encephalitis and Influenza A viruses.

The World Health Organisation (WHO) defines zoonoses as 'those diseases and infections that are naturally transmitted between vertebrate animals and man'. It has long been known that zoonotic diseases can rapidly cause extensive human suffering and death. For example, during an outbreak of Rift Valley fever in Kenya in 1997/98[8], 89 000 cases and 150–250 deaths were reported.

On the other hand, zoonoses can manifest as non-dramatic erosive diseases, such as taeniasis and dipylidiasis, placing pressure on health systems and draining the economy of a country. It has been calculated that in the USA in 1985, human salmonellosis alone caused financial loss of some 3 billion dollars. This estimate did not include expenses ensuing from the sequelae of salmonellosis, or from the legal action undertaken by victims of food poisoning[1].

In any given region or society, the particular disease agents, the frequency with which zoonotic transmission occurs and the resulting public health impact reflect the nature of the local human–animal relationships as well as climatic conditions and socioeconomic circumstances.

Table 1 provides a list of what have previously been considered the most important zoonotic conditions found in South Africa[1,11]. It illustrates that many zoonotic diseases are known to occur in South Africa and shows that most of the diseases can be associated with farm animals or a rural environment. The question therefore arises: what are the risks to South African veterinarians, and the general public who routinely come into contact with these animals?

Given that many emerging diseases come from animals and that the human population in South Africa is increasingly immunocompromised as a result of acquired immune deficiency syndrome (AIDS), it is concomitantly of importance to consider the role of zoonotic diseases. This survey aims at assessing the risks of acquiring zoonotic diseases by South African veterinarians.

MATERIALS AND METHODS

The survey included all veterinarians working at the Faculty of Veterinary Science, University of Pretoria, Pretoria, South Africa, in December 2001. They comprised the single largest group of employed veterinarians, from the various disciplines in the profession, located at one place in South Africa and could therefore be relatively easily interviewed.

During the interview-based, questionnaire survey, each veterinarian was personally interviewed and answers to questions recorded on a data capture sheet. The information was entered into Microsoft Access (Office 2000, Microsoft Corporation, Redmond, USA) for collation and analysed using EpiInfo 2002 (Centers for Disease Control and Prevention, US Department of Human and Health Sciences, USA).

The questionnaire required responses to the following:

1. Surname.
2. Initial.
3. Date of birth.
4. Sex.
5. Year of graduation as a veterinarian.
6. Species that you have most predominantly worked with during your career – choose one: small animal, large animal, mixed, other (please specify).

Table 1: **Zoonoses that have traditionally been regarded as important in South Africa.**

Viral diseases	Bacterial diseases	Helminth infections	Other
Rift Valley fever	Anthrax	Toxoplasmosis	Psittacosis
Rabies	Brucellosis	Taeniasis	S A tick bite fever
Congo haemorrhagic fever	Leptospirosis	Dipylidiasis	Ringworm
	Salmonellosis	Hydatidosis	Cat scratch fever
	Campylobacteriosis	Larval migrans	
	Erysipeloid		

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Received: February 2003. Accepted: July 2003.

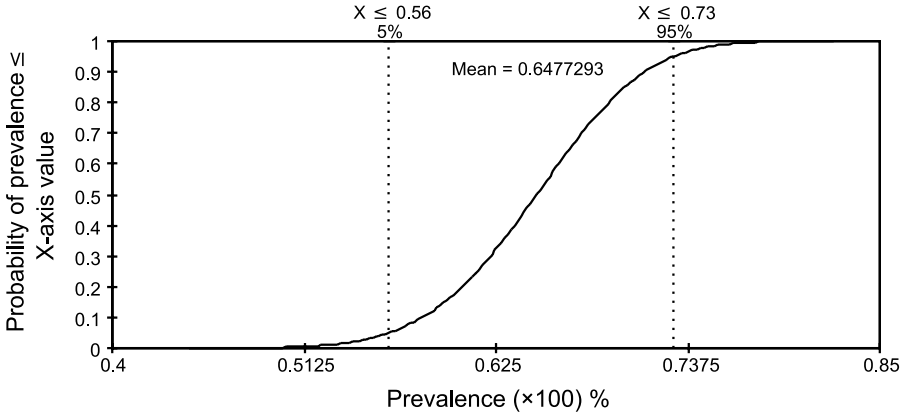

Fig. 1: **Cumulative distribution curve showing the expected true prevalence of South African veterinarians that have contracted a zoonotic disease.**

7. Has your career predominantly involved, fieldwork, clinic/hospital work, both, other (please specify)?
8. What zoonoses have you contracted during your life? Please refer to attached document for a list that may help you remember.
9. For EACH zoonosis please state:
   a. Whether it was contracted by: direct contact (*e.g. post mortem*), vector (*e.g.* tick), other means (specify).
   b. Whether the diagnosis was made by: yourself, a general practitioner or a specialist (specify).
   c. What year did you suffer from the zoonoses?
   d. What province were you in when you contracted the zoonoses?
   e. How many days sick leave did you have to take?
   f. Did you require treatment from a medical practitioner?
   g. What was the treatment?
   h. What type of work were you doing at the time of contracting it: large animal, small animal, mixed, research, recreation, other (specify).
   i. Any other facts that you may think will help with the survey.

Question 8 referred to a list of 70 of the more commonly found zoonotic diseases as defined by the WHO. This was not an all-inclusive list of zoonotic diseases and was aimed at jogging an interviewee's memory as to what diseases he/she may have contracted.

RESULTS

In total, 88 veterinarians were interviewed. Fifty-six (63.6 %) of the veterinarians had suffered from one or more zoonoses. Amongst these veterinarians, 93 incidents of zoonotic disease (Table 2) were reported, ranging from 1 to 6 incidents of disease per veterinarian, with a mean of 1.66 incidents. Thirty-two (36.4 %) veterinarians could not recall ever having contracted a zoonotic disease (Table 2). Recurrent infections of the same disease were not considered.

Assuming the sample was representative of the population of South African veterinarians, then the true prevalence of zoonotic disease can be simulated stochastically using a beta distribution function and Latin hypercube sampling[12]. Fig. 1 shows the cumulative distribution curve for the estimated true prevalence of South African veterinarians that have experienced a zoonotic disease. Given the sample size, the true prevalence could range from a minimum of 45 % to a maximum of 82 %.

Table 3 shows the percentage of incidents of disease according to the occupation category of veterinarians at the time when they contracted the zoonoses.

The category 'Farm animal practice' included mainly incidents of disease while working with bovines (31 incidents) and single incidents while predominantly working with equines, porcines and poultry. Specialist veterinarians that contracted zoonoses were exclusively pathologists. Other specialist categories considered were anatomy, anaesthesiology, dentistry, helminthology, exotic animals, surgery and pharmacology, but none of these veterinarians had contracted zoonoses. The odds ratio of a veterinarian involved in farm animal practice of contracting a zoonotic disease was 3.11 ($1.04 < OR < 11.23$) compared with all other categories and 3.58 ($0.93 < OR < 15.13$) compared only with small animal practitioners.

In 55 % of the 93 incidents of disease, the initial diagnoses were made by the veterinarian themselves. Thirty-two percent were diagnosed by a general medical practitioner and 10 % were diagnosed by a specialist physician. The remainder were 3 rabies exposure cases.

Fifty-three percent of incidents ($n = 49$) required treatment by a medical practitioner.

Table 4 shows the number of days sick leave required for each incident of disease, grouped into intervals.

The majority of incidents (61 %) did not require an absence from work. Forty-four percent ($n = 24$) of these incidents were cases of ringworm. Of those diseases requiring up to 7 days sick leave, tick bite fever made up the bulk of cases. Diseases that consistently required a long absence from work were notably Rift Valley fever (RVF) and brucellosis. The days sick leave for 4 incidents are not shown because of uncertainty by the interviewee about the time spent on sick leave or because there were several bouts of the disease.

Table 5 shows the percentage of veterinarians, grouped by year of graduation, that reported having contracted zoonoses. With the exception of the 1960–1969 period, the table confirms what is expected, that the longer a veterinarian has been in practice the greater are his/her chances of contracting a zoonotic disease.

From the records of 47 of the 56 veterinarians that had had zoonoses, it was possible to calculate the number of years from graduation until contracting their 1st zoonotic disease. The modal number

Table 2: **Zoonotic diseases contracted by the veterinarians interviewed and the number of incidents reported for each disease.**

Zoonoses	Number
None	32
Ringworm	24
Tick bite fever	21
Rift Valley fever	8
Brucellosis	7
Cutaneous larval migrans	4
Sarcoptes	4
Malaria	3
Q-fever (*Coxiella burnetti*)	3
Rabies exposure	3
Psittacosis	2
Shistosoma	2
Taeniasis	2
Candida	1
Corynebacteria	1
Erysipelothrix	1
Orf	1
Pseudocowpox	1
Rabies	1
Salmonella	1
Shigella	1
Toxoplasma	1
West Nile fever	1

Table 3: **Percentage of incidents of disease per occupation category at the time of contracting the disease.**

Occupation category	% of incidents
Farm animal practice	37
Small animal practice	20
Mixed animal practice	14
Specialist veterinarian	7.5
Research veterinarian	6.5
Other	15

Table 4: **Days absent from work per zoonoses.**

Zoonoses	No sick leave	1–7 days	6–14 days	>14 days
Brucellosis	3	0	0	3
Candida	1	0	0	0
Cutaneous larval migrans	4	0	0	0
Corynebacteria	1	0	0	0
Erysipelothrix	1	0	0	0
Malaria	0	1	0	1
Orf	0	1	0	0
Pseudocowpox	0	1	0	0
Psittacosis	1	0	1	0
Q-fever	0	2	1	0
Rabies	0	0	1	0
Rabies exposure	3	0	0	0
Ringworm	24	0	0	0
Rift Valley fever	1	3	3	1
Sarcoptes	3	1	0	0
Shigella	0	0	1	0
Schistosoma	1	1	0	0
Taeniasis	2	0	0	0
Tick bite fever	8	11	1	0
Toxoplasma	0	0	0	1
West Nile fever	1	0	0	0
Total	54	21		6
Percentage	61	24	9	7

of years to contracting the 1st zoonotic disease was 1 year with an average of 6.5 years (SD = 7.5). It was also possible to calculate an incidence density rate using person years in practice as the denominator[10]. There were 47 veterinarians that contracted a zoonotic disease over 833 person years at risk, thus giving an incident density rate of 0.06 per person year of exposure (*i.e.* a South African veterinarian has on average a 6 % chance of contracting a zoonoses for every year of exposure). Another method used to estimate risk to veterinarians was by means of a Kaplan-Meier survival analysis. Survival analysis is the study of the distribution of lifetimes. That is, the study of the elapsed time between initiating an event (in this case when the veterinarian graduated) and a terminal event (in this case when a veterinarian 1st contracted a zoonotic disease). Table 6 shows the results of a linear (Greenwood) Kaplan-Meier survival analysis expressed in quantiles of survival time, where survival refers to the chances of not contracting a zoonotic disease and failure refers to the chances of contracting at least 1 zoonotic disease.

The median point (0.5) is at 11 years, *i.e.* half the veterinarians had contracted a zoonotic disease within at least 11 years of practice. Figure 2 shows the Kaplan-Meier survival plot as well as the pointwise confidence intervals. In the plot, time refers to years and survival to the proportion of veterinarians not having contracted a zoonotic disease. The shape of the plot shows that a veterinarian has a much higher chance of contracting a zoonotic disease early in their time in practice and that this risk levels off if they have not yet contracted a zoonotic disease. It is important to note that the plot

Table 5: **Percentage of veterinarians according to graduation date that reported having contracted a zoonotic disease.**

	<1960	1960–1969	1970–979	1980–1989	1990–1999	>2000	Total
No zoonoses	1	5	3	10	12	1	32
Zoonoses	5	3	17	14	17	0	56
Total	6	8	20	24	29	1	88
% that contracted a zoonoses	83	37	85	58	59	0	64

Table 6: **Kaplan-Meier survival analysis results expressed as quantiles.**

Proportion surviving	Proportion failing	Survival time (years)	Lower 95 % CL* survival time	Upper 95 % CL survival time
0.95	0.05	1	1	
0.9	0.1	1	1	
0.85	0.15	1	1	2
0.8	0.2	2	1	2
0.75	0.25	3	1	3
0.7	0.3	3	2	5
0.65	0.35	4	3	8
0.6	0.4	5	3	10
0.55	0.45	8	4	11
0.5	0.5	11	5	18
0.45	0.55	12	7	22
0.4	0.6	18	10	22
0.35	0.65	28	11	28
0.3	0.7	28	15	28
0.25	0.75		22	28
0.2	0.8		28	28
0.15	0.85		28	28
0.1	0.9			28
0.05	0.95			28

*CL = confidence limit

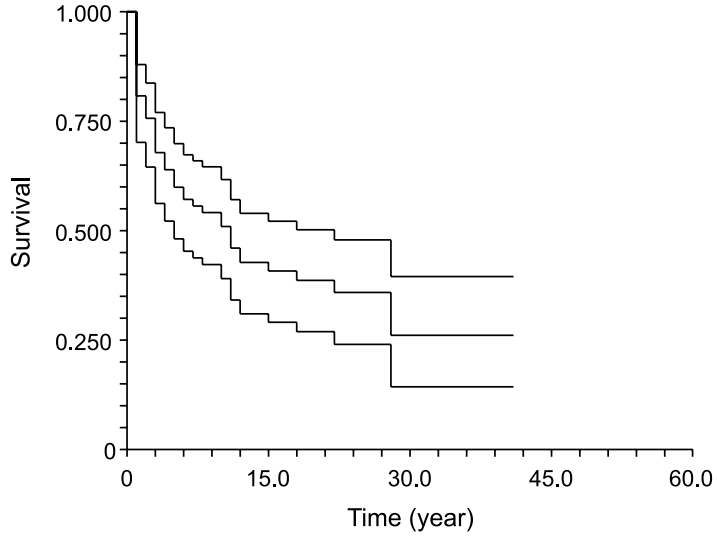

Fig. 2: **Kaplan-Meier survival plot for the time** (years) **between graduation and contracting a zoonotic disease.**

Table 7: **Location where each incident of zoonotic disease was contracted.**

Country/region	Frequency
Gauteng	42
Uncertain	10
KwaZulu-Natal	9
Mpumalanga	6
North West Province	6
Northern Province	5
Eastern Cape	3
Free State	3
Northern Cape	2
Western Cape	1
Mozambique	1
Nigeria	1
Ohio, USA	1
Swaziland	1
UK	1
Zimbabwe	1
Total	93

Table 8: **Mode of transmission of each disease incident.**

Mode of transmission	Number
Direct contact	58
Vector	24
Uncertain	7
Ingestion	4

does not take into account multiple or repeated infections.

Of the 88 veterinarians interviewed, 19 were female and 69 male. Twelve (63 %) females and forty-four (63.8 %) males contracted zoonoses. No difference could therefore be shown between male and female veterinarians in terms of the risk of contracting a zoonotic disease.

Table 7 shows where each incident of zoonotic disease was contracted. The majority of incidents occurred in Gauteng but this, in hindsight, may be due to the biased nature of the survey, which concentrated on veterinarians that probably worked predominantly in Gauteng while in practice.

Table 8 shows the mode of transmission of each disease incident. Included under direct transmission were diseases contracted while conducting necropsies. Direct contact was the most frequent mode of transmission.

DISCUSSION

The survey carried out at the Faculty of Veterinary Science, University of Pretoria, in 2001, showed that a high proportion of veterinarians (45–82 %) had contracted zoonotic diseases and that many of the zoonotic diseases contracted by veterinarians had not immediately been diagnosed by general practitioners and often had to be diagnosed with the assistance of the veterinarian. This highlights the fact that many zoonotic conditions are difficult to diagnose clinically and are probably frequently misdiagnosed or missed. For example, brucellosis, leptospirosis, tick-bite fever, Q-fever and Rift Valley fever can all present with similar clinical signs in man in the early stages. In areas where malaria is endemic, they can easily be misdiagnosed as malaria cases if no diagnostic confirmation tests are carried out.

A study of medical curricula in South Africa shows a deficiency of training at an undergraduate level in recognising zoonotic conditions. Another compounding factor is the inexperience of the junior doctors working unsupervised in many district hospitals in South Africa. Coupled to this are limited laboratory facilities and a lack of funds to carry out comprehensive diagnostic procedures (D A Cameron, Department of Family Medicine, University of Pretoria, pers. comm., 2002). It is thus conceivable that a large number of zoonotic conditions are currently misdiagnosed or go undiagnosed in South Africa.

The survey showed that veterinarians working with farm animals are at higher risk of contracting zoonotic diseases than those working with small animals. It also showed that direct contact is still the most prevalent means of contracting a zoonotic disease. Personal hygiene and protective clothing, therefore, are probably the most important ways of preventing transmission of zoonotic diseases.

The survey illustrated that the longer veterinarians have been in practice, the greater their chances are of contracting a zoonotic disease. It also showed that a veterinarian is more likely to contract a zoonotic disease early on in his/her time in practice. A similar trend is likely to manifest in the rural areas of South Africa.

South African demographic data show that 46.3 % of the population still lives in rural areas, and can be expected to regularly come into close contact with farm animals and their parasites[9]. In many cases, they share the same water sources and habitat, making transmission of diseases between animals and man very likely. Compounding this are the poor socioeconomic conditions under which many South Africans live. These result in malnutrition and poor sanitation within these communities, providing an ideal environment for the transmission and maintenance of infectious diseases.

In a recent study by the South African Medical Research Council it was etimated that 40 % of adult (15–49 years of age) deaths that occurred in 2000 in South Africa were due to HIV/AIDS[4]. Historically, it has been this component of society that has been at lowest risk of contracting zoonotic diseases because many zoonotic conditions only manifest in immunodeficient individuals, such as children and the very old. Conditions such as ringworm, Q-fever, tick-bite fever, cutaneous-anthrax, cat scratch disease and toxoplasmosis, to name but a few, that many adults would shrug off, as evidenced by the relatively few days sick leave taken by veterinarians in this study, take on a new meaning when individuals become immunocompromised. According to Grant and Olsen[6], animal-associated pathogens of concern to immunocompromised persons in the USA include *Toxoplasma, Cryptosporidium, Salmonella, Campylobacter, Giardia lamblia, Rhodococcus equi, Bartonella, Mycobacterium, Bordetella bronchiseptica, Chlamydia psittaci* and zoophilic dermatophytes. From the present survey it also became apparent that in South Africa this list is probably longer and the consequences

more life-threatening. Certainly, some of the conditions found in the survey, such as malaria, tick bite fever, brucellosis, Q-fever and Rift Valley fever, need to be included in a South African list.

While some work has been done on the role of zoonotic diseases in immuno-compromised persons, most, if not all, emanated from first world countries. Earlier studies concluded that the risk of zoonotic transmission to HIV patients was small and that the benefits of animal companionship outweigh the risks to HIV patients[5]. This perception appears to be changing and, more recently, Grant and Olsen[6] suggested that 'with the exception of *Bartonella henselae* and zoophilic dermatophytes, infections in humans are more commonly acquired from sources other than pets, and the infectious disease risk from owning pets is considered low. Nevertheless, HIV-infected persons may still be advised not to own pets'. While this may be so in developed countries, the WHO in one of its latest reports stated that 'Infectious diseases will remain the major causes of mortality in most developing countries, with HIV/AIDS and opportunistic infections (including zoonoses) being especially important'[13]. The high proportion of veterinarians in this survey that have contracted zoonotic diseases supports this statement.

Macpherson *et al.*[7] reported that 'The average prevalence of *Cryptosporidiosis parvum* in patients with HIV has been reported to be 27 % in developing countries and 12 % in industrialised countries. The life-threatening potential of *C. parvum* infections in immunocompromised and immunosuppressed individuals has greatly enhanced the importance of cryptosporidiosis as a global public health problem'. Referring to toxoplasmosis they go on to state that a risk group of special interest has emerged, that of 'non-immune HIV positive pregnant women'. Toxoplasmosis in HIV patients is reportedly of long-duration and may be followed by death. Recent studies have also shown that *T. gondii* is the most common cerebral opportunistic infection of patients with AIDS[3]. More than 90 % of the estimated 36 million people with HIV/AIDS live in developing countries[13]. In Africa, the role of veterinarians in controlling these diseases is thus becoming increasingly important. Coupled to this is the responsibility of veterinarians to keep abreast of new information on emerging zoonotic conditions and to keep the public educated as to their consequences.

Given that a diversity of zoonotic conditions have been reproted in South Africa, that a large segment of the population is immunocompromised and that they are likely to come into contact with animals on a regular basis under poor socioeconomic conditions, one can justifiably put forward the hypothesis that the incidence and severity of certain zoonotic conditions are likely to increase at a similar rate to that of the HIV/AIDS epidemic, thus compounding an already serious situation.

ACKNOWLEDGEMENTS

The author wishes to thank David Bradbury, a final-year student at the Faculty of Veterinary Science at the time of the survey, for assisting him in interviewing veterinarians, and David Cameron, a medical practitioner in the Department of Family Medicine, University of Pretoria, for providing insights into the AIDS situation in South Africa.

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