Dog Health and Zoonotic Diseases—A Review from a Northern Australian Perspective

By Bart Currie

Summary

There is continuing disparity in morbidity and mortality between Aboriginal people and other Australians. While differential mortality rates between Aboriginal and non-Aboriginal people are still highest for various infectious diseases, non-communicable diseases now cause more deaths overall in Aboriginals. Circulatory diseases, chronic respiratory conditions and trauma are the commonest causes of death. ‘Lifestyle’ diseases such as hypertension, coronary heart disease and diabetes figure prominently, together with alcohol-related illness, making mortality in the 20–40 years age group up to ten times that for other Australians and life expectancy 10–20 years lower.

There are many remote Aboriginal communities scattered across central and northern Australia. These communities have populations ranging from less than one hundred people up to a few thousand, not infrequently living in harsh conditions. Overcrowding is common, with sometimes 20 or more people sharing a house with poorly functioning water supplies and toilet facilities. Dogs can be present in large numbers, living a semi-domesticated existence around the houses, scrounging for food and defecating nearby. The relationship between the dogs and the people is complex, often being one of both companionship and cultural significance.

Since the mid-1980s there have been a range of dog programs introduced in some communities. The programs have involved various combinations of dog sterilisation, contraception, euthanasia and treatment of the dogs with anti-parasitic drugs. The programs have been funded from a range of government and non-government sources, with motivation being sometimes externally driven and sometimes coming from within the community. Implementation has often been ad hoc with programs not being sustained in some communities. In some earlier programs where dog population control was not adequately addressed, there was actually an increase in dog numbers. However, it is clear that with a well-funded, planned and sustained program the health of the dogs has substantially improved.

What remains unclear is whether the dog programs have had any significant impact on human health. Initial enthusiasm that the dog programs would improve human health, especially child health, still awaits valid supporting scientific evidence. Concerns have been raised that health resources may be directed away from child health programs towards dog health programs justified by the assumption that this will substantially benefit the health of Aboriginal children.

There are various bacteria, viruses, fungi and parasites that can be transmitted from dogs to humans. These are called zoonotic infections. The critical question for any community where dogs interact with humans is how much of the burden of infections and related malnutrition is attributable to dog-human interactions in comparison to human-human interactions and human interaction with the rest of the local environment.

The classical zoonoses from dogs to humans are hydatid disease (from a dog tapeworm), which causes cysts in the liver and elsewhere, and toxocariasis (from dog and cat roundworms), which causes parasite collections in the liver, behind the eye and elsewhere. Hydatid disease is not present in most of central and northern Australia and cases of toxocariasis are very rare. Less important but well recognised zoonoses from dogs are a dog heart and lung worm (Dirofilaria immitis), transmitted by mosquitos, which occasionally causes lung nodules in humans; and cutaneous larva migrans, a migrating itchy skin lesion caused by the dog and cat hookworms (especially Ancylostoma braziliense) as their larvae, which hatch out of dog faeces, unsuccessfully attempt to
penetrate from the inoculated human skin into the circulation of the unnatural (for them) human host.

The areas of recent interest for potential zoonotic transmissions from dogs to humans have been various gastrointestinal and skin infections. Transmission for gastrointestinal infections is usually faecal-oral spread via contamination of food, water, hands, utensils or through eating soil. Flies facilitate the transmission of certain bacteria. Some gastrointestinal parasites such as hookworms and Strongyloides are transmitted from faeces to soil to skin. Skin bacteria and scabies parasites are transmitted directly from skin to skin. For both diarrhoeal disease and skin disease extensive epidemiological studies show that the most important factors for transmission are household overcrowding, poor sanitation and inadequate water supplies. The international experience suggests that with the disadvantaged conditions in Australian Aboriginal communities the human-to-human transmission of infectious diseases will be very large. The undefined quantity is the additional burden of infections from dog to human transmission.

While for all the major human gastrointestinal pathogens the role of human-to-human spread and of infection from contaminated food products or water is well established, the role of potential zoonotic infections from dogs is only adequately documented for a few organisms such as Campylobacter and some Salmonella. However, even with Campylobacter and Salmonella, the proportion of transmission to humans from dogs is small. There has been considerable interest in whether the giardia parasites found in dog faeces are similar enough to those in humans to be transmitted zoonotically. Preliminary molecular genetic studies suggest that the cycles of transmission of giardia in dogs and humans may not actually overlap to an important degree, at least in the Aboriginal communities tested to date.

The major skin infections in Aboriginal communities are skin sores (streptococcal), tinea and scabies. For skin sores the common streptococcal bacteria for dogs and humans are different. The fungus responsible for nearly all the skin and nail tinea in Aboriginal communities is specific for humans, unlike some of the tinea fungi seen in southern Australian cities, which are zoonotic from cats and dogs. While host specificity is not absolute for the animal variants of the scabies mite, recent molecular genetic studies also suggest that the vast majority of cases of scabies in the current epidemic in Aboriginal communities are unrelated to cycles of transmission of the dog scabies mite.

Conclusions

There is a wealth of international information on the role of human-to-human transmission of infections causing diarrhoeal and skin diseases. While many Aboriginal communities have numerous and often unhealthy dogs living in close proximity to the people, the contribution these dogs make to the infections and related malnutrition of the community remains unclear. Financial constraints and competition for public health resources necessitate emphasis on child health programs such as community-based routine deworming, coordinated scabies programs and education initiatives. A focus on the unhealthy dogs should not be used to draw attention away from the fundamental issues of equity in health hardware such as adequate housing, water supply and sanitation. However, dog programs in addition to child health and health hardware programs may provide some benefits to humans as well as the obvious benefits to the dogs.

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BART CURRIE’S PRESENTATION OF HIS PAPER

I am going to provide a human health perspective on what we’ve been talking about so far, focusing on the issue of dog programs and zoonotic disease from dogs.
Indigenous Health, Funding and Dog Programs

First of all, some background about Indigenous health. The life expectancy for Indigenous Australians is 16 to 19 years less than that for other Australians, with an infant mortality two to four times higher. In the ages between 25 and 54 years, Aboriginals are five to eight times more likely to die in any one year because of various illnesses. There are heaps of children in communities where 40% under 15 years old, compared to only 21% in the non-Indigenous population. This is the shocking picture of Indigenous health in Australia in 2000.

One of the big myths about Indigenous health is that a lot of money is being spent on it. The Deeble study (AIHW, 1999) published in 1998 finally put to rest that idea. It has been hard to look at the figures before now because in Australia there are so many funding bodies, and where money comes from and who is responsible for it is very complex because of the nature of our Commonwealth (with states, territories, local government, etc.). Professor Deeble put in a lot of time and found that despite those health figures, the total spending for all Indigenous health issues was only 8% higher. So for every dollar spent on non-Indigenous health, only an extra 8 cents was spent on Indigenous health.

At a state, territory and local government level the spending is quite a bit more per capita. Where the problem lies is with Commonwealth spending through Medicare and the Pharmaceutical Benefits Scheme, which provide access to doctors and medications. For every $1 spent on non-Indigenous people in Australia on doctors and medications, only 63 cents is spent on Indigenous people.

Whenever we look at human health, this issue of horizontal equity in funding comes up time and time again. In a rich country like Australia we should be looking at the concept of equal access to equal care, appropriate to need. Obviously that has to be adjusted for demographic structure—where you have a lot of older people, you need resources for nursing homes; where you have a lot of younger people, you need resources for child health programs. And where you have a population with a lot more illness (such as the Indigenous population), you need more money so you can address the problems.

What expenditure is needed in relation to Indigenous health? A number of formulas have been proposed to redress the balance. Some people have said maybe twice as much. In central Australia, where the disparity is possibly greater than anywhere else, it has been suggested that four times as much should be spent per capita on Indigenous health as for non-Indigenous people.

Allocation of Funding

Of course, once you agree that we are a rich country and need to spend more money on Indigenous health, the most difficult question is how to spend the money in the most effective way.

This is where you might consider what role dog health programs have in relation to human health. There has been a lot of discussion on this in the literature recently. My thesis is that we need money, and lots of it, for human health programs, particularly in relation to infrastructure, health hardware and, most importantly, housing and education initiatives. Alongside that we certainly also need money for dog programs, and we need to see these as part of the bigger picture.

Understanding this bigger picture and its complexity exposes the danger of having unrealistic expectations about making a difference. In August 1996, a prominent Government Minister said regarding the 2000 Olympics, ‘I will defy anybody to say we have Third World conditions in any Aboriginal community in Australia.’ That’s a pretty embarrassing statement. They actually believed they were going to be able to turn around things that quickly. We have to have realistic expectations about initiatives to make incremental and sustainable change.
**Fragmentation of Services**

One of the problems we face here is the fragmentation of services. Who pays, who coordinates, and who implements these programs? This is a fundamental aspect of human health and must also be addressed in relation to dog programs and other vet issues. Are all these departments, people, etc. coordinating with each other? It’s the whole issue of functional service delivery.

Here I would like to pay tribute to what’s happened in the Kimberley, which Kathryn presented for us earlier. That program went from a research program to a functional program and ended up with control in the hands of the community itself. Most importantly, that program is now being driven by Indigenous Environmental Health Officers within the community, and I know we hope in the Northern Territory to be able to follow what’s happened there and have more Indigenous Environmental Health Officers working with their communities and running programs. And dog programs can certainly be an important part of that environmental health initiative.

Jack told us in his talk about how it is difficult in Queensland to run some of these programs for health workers (except in some parts of the Torres Strait) because in many instances health workers can’t even get a licence to give injections and other basic health things. In contrast, in the Northern Territory the registered health workers have the ability to do a number of health interventions.

**Zoonosis**

Now in my view the priority if you are going to improve health has to be the health of children and programs that are going to directly affect children. That raises the issue of dog health and zoonotic diseases.

There are many ways that zoonotic diseases can pass from dogs or other animals to humans—dog heartworm via mosquitoes, for example, or hookworms via dirt, or *Salmonella* via direct transmission. And there is no doubt that there are a lot of dogs in communities living in very close contact with the people, and also no doubt that the dogs are often unwell. Dog programs have often had a substantial effect on dog health and made the dogs a lot healthier.

Yet despite a fair bit of work over the years, the reality is that from the scientific information, there is not a lot of evidence that there is much zoonotic disease affecting people in Indigenous communities.

When looking at illnesses and malnutrition in people in remote communities, the question is what contribution to that illness is coming from zoonotic diseases. Is it really a major factor, or are zoonotic infections really not that relevant in comparison with other aspects of transmission of diseases (in particular transmission from human to human)?

Hydatid disease is the big zoonosis that people are concerned about at the global level. It is a classic zoonosis that causes cysts and is life-threatening. The dog is the primary host and the human is the secondary host. These cysts have been found in cattle in the Kimberley, in dingo’s as the primary host in Queensland, and in New South Wales around Canberra; but this disease is not an issue for remote Aboriginal communities. Hydatid disease is present in humans in southern Australia, and at one stage it was a major issue in Tasmania. But it is not a zoonosis we need to be concerned about in the Northern Territory.

Another classical zoonosis is *Toxocara*, a round worm that can lead to cysts behind the eye and in the liver and cause visceral larvae migrans. For *T. canis* the primary host is the dog, but we only get one case every two or three years in people from remote communities. So this other major life-threatening zoonosis is not of great relevance.
Next we can look at specifics in relation to particular bacteria, parasites, etc. It's important to be upfront here. For example, too often people talk about hookworm but fail to adequately differentiate between human and dog hookworms, particularly when they are educating Indigenous people about health issues.

**Skin bacteria**

The major bacteria driving a lot of problems in communities is **Group A Streptococcus**. This results in post streptococcal glomerulonephritis, which is associated with the high levels of chronic renal disease in communities; it is also the bacterium that causes rheumatic fever and heart disease. **Group A Streptococcus** does not occur on dogs; it is a human-only bacteria. **Group C and G Streptococci** do occur in dogs and can occasionally cause illness in humans. **Staphylococcus aureus** is present in both humans and dogs, but the most important thing is that the **Group A Streptococcus**, the major skin bacteria, has nothing to do with dogs. Necrotising fasciitis from Group A **Streptococcus**—the flesh-eating bug in the Northern Territory—is Group A **Streptococcus** for human but Group C or G for dogs. In other words, the dog equivalent is a different **Streptococcus** from the one that causes the flesh-eating bacterium in humans.

In communities, skin sores are driven by crowding, hot weather, lack of water, humidity and hygiene, with scabies being a big driver of skin sores which get Group A infection, skin fungi, insect bites. **Trichophyton rubrum** is almost always the fungus causing nail and skin disease, but it is human only and nothing to do with animals. The animal fungi that can cause loss of hair, such as **Microsporum canis**, are very rare in northern Australia. They are much more common in the south. Therefore in the north the important skin fungus is a human-only pathogen.

So neither fungi nor **Streptococcus** from animals is a major problem in remote Australian communities.

**Scabies**

The form of scabies that is an issue for us is called crusted or Norwegian scabies, where people are hyper-infested for reasons I won't go into. These people have a relatively high mortality because of secondary bacterial infection.

When Jack coordinated the conference back in Darwin in 1993 there was a lot of discussion around the issue of scabies in dogs and humans. The literature suggested that the scabies mites from dogs could jump onto a human but not actually replicate and mate, though they would cause a reaction. But that was the literature, and it was generally felt that although they are the same species (Sarcopes scabiei), there are actually sub-species as far as replication on hosts goes. So the human variety, the dog variety, the pig variety, etc. are different.

Now it seems that only two things have changed since that 1993 workshop. One is that Kathryn has been able to demonstrate the sustainability of a good dog health program in the Kimberley. The other has been work at a basic scientific level that has sought out the transmission of scabies. The argument I made in 1993 was that there is so much scabies around in remote communities from human-to-human transmission that the component of scabies related to dog scabies mites on humans is not very important at all. I’ll show you why the data is now supporting that.

The only way to do this was by molecular typing or genetic typing, the same method used in forensic science in relation to murder cases, sexual assault, etc. Basically you get a scabies mite and take out the DNA, then do tests on it to determine a unique genetic code for that particular mite. There has not been a lot of money in the funding organisations for scabies research because it hasn’t been an issue in countries with research money (only recently, with scabies becoming a much
bigger problem in the USA with HIV, have they finally started putting money into scabies research). So no one had done any genetic work on scabies before. Then National Health and Medical Research Council funding was made available for a program at the Menzies School in Darwin specifically to answer the question of dog scabies in Indigenous health.

That research took one person three years and is now complete. Starting from scratch, a molecular typing method was developed for scabies mites using three particular bits of genetic material available from any scabies mite. You take out the DNA and get a unique genetic fingerprint for that scabies mite, and the bottom line is you can analyse genetic relatedness between mites.

The study looked at over 400 human scabies mites and 200 dog scabies mites. We collaborated with people overseas: we had human mites sent from Panama, where there is a big problem in remote islands, and dog mites sent from the east coast of the United States. We gathered around 400 human scabies mites from remote communities in the Top End. What we found quite clearly is that the human mites from the Top End are much more closely related to human mites from Panama than they are to Top End dog mites, and similarly that Top End dog mites are much more closely related to the dog mites from America than to the human mites.

What this shows in the context of Northern Territory communities, where there is so much scabies at the moment, is that all the scabies circling around is going from human to human. And although occasionally you may get mites jumping onto people from dogs, they are just not important in relation to the enormous burden of scabies that is happening due to person-to-person transmission.

But what about the environmental transmission of scabies? In fact, there are very few circumstances where scabies is acquired from the environment. Work done on conscientious objectors during the Second World War in the United Kingdom showed that for scabies to be transmitted from person to person, you needed to have close individual contact. It was transmitted on the clothes or bedding—it didn’t come from the floor. (However, we do know that when people have crusted scabies there are many mites in their environment, and they could possibly be infectious to others beyond just touching them. Although people with crusted scabies are a minority, they are considered to be possible core transmitters in the community.)

This has important implications. Dogs may be shedding lots of mites, but in addition to the fact that those mites are not adapted to humans and will not replicate on them, the literature on human mites shows that this way of transmission is very inefficient.

So we know the transmission of scabies is occurring because of the closeness of people. When 20 or 30 people live in the same house with only two bedrooms and someone has scabies, it is much more likely that others will get it. Sure, there are a lot of dogs around and they are unhealthy. But in the context of overcrowded conditions, the predominant priority has to be stopping the cycle of person-to-person transmission.

The reason I am bringing this up is that the whole idea of dog health has sometimes been used by politicians in the past as an excuse to not put funding into human health. For example, one well-known politician said in the newspaper that if Aboriginal people sorted out their dogs, it would solve Aboriginal health. What that person was saying was that we don’t need to build more houses, we don’t need to fix broken taps and toilets, we don’t need to mount educational initiatives for the children. It’s their fault: it’s their dogs, it’s their failure to look after them or take responsibility for them. This is victim-blaming.

Resources must be put into scabies programs for humans. Where there have been dog programs without human programs, scabies has remained just as bad in the people. However, there have now been three or four successful programs where the focus has been only on treating the people, without specific dog programs, and these have been very successful.
It is critical for this information to be available to Indigenous people because it’s giving us a political message. What it is saying is that we need to focus on treating scabies in people. Often there isn’t the resources or will power from government to do this.

All the data are now supporting the burden of illness being very much the human-to-human transmission of *Sarcoptes scabiei var hominis*, the human scabies variant. Once coordinated scabies programs, which are planned in the Northern Territory in the next year or two, are durable, then there will be a very important role for dog programs. If the current epidemic of scabies in humans is brought under control, we will be left with a heap of scabies in dogs which will be a continuing problem.

**Discussion from Bart Currie’s talk**

**Debbie Osborne**  Do you see visceral larval migrans in urban children?

**Bart Currie**  There have been a few serology studies suggesting that maybe up to 10 or 15% percent of the population, Indigenous and non-Indigenous, are being exposed, but clinical disease is very rare. As I said, there is about one case diagnosed every 18 months to two years in the Northern Territory.

It’s a dramatic, severe illness, or it can be. It causes cysts at the back of the eye or cysts on the liver. It was only recognised as a disease of humans about 30 years ago, when doctors in America were removing the eyes of affected children, thinking it was a tumour of the eye, until someone looked under a microscope and saw things that looked foreign and said, ‘Oh no, these are parasites!’ They worked out then they didn’t need to remove the eyes; it was a zoonosis.

I don’t know why it’s not more common. The parasites are common in the animals and dogs here, but they are also quite common down south, as I understand it. So it is important in zoonosis terms, but it’s not a large component of health problems.

**Kevin de Witte**  The thing to remember with vet dog health programs is that the amount of funding it would take to run a program is probably or one or two per cent of the budget that would be spent on human health care. It's something to keep in mind if we are going to compare the two programs. And possibly for a small fee we could supply Ivomec to the people as well!

**Jan Hills**  (vet, Adelaide River)  I just wanted to comment that an aberrant heartworm has been found in the back of the human eye. My other comment was to ask whether you had considered kangaroos with *Strongyloides* infection?

**Bart Currie**  Rick is the expert on that; maybe he should comment.

**Rick Speare**  The species of *Strongyloides* in kangaroos is totally different to *Strongyloides stercoralis*. There is no chance of human infection.

**Bart Currie**  Rick, do you know anything about typing for *Strongyloides* with dogs? Have you been working on that?

**Rick Speare**  I haven’t been doing any work on it. The latest is there have been some molecular studies done on *Strongyloides* from dogs overseas and it's turned out to be specific—morphologically similar to *Strongyloides stercoralis*, but molecularly a different species.
Ro Mcfarlane  On the subject of *Toxoplasma*, which is obviously a cat parasite, what’s the zoonotic importance of *Toxoplasma* in the Northern Territory?

Bart Currie  Thanks for asking. We see a couple of nasty toxoplasmosis in eyes in both urban and remote/rural kids every year. As you know, it's more related to cats than dogs.

All I can say is that it's around and infects many, and an unfortunate few seem to get diseased. If pregnant woman are infected at a certain period of their pregnancy it can be very serious; otherwise it becomes an issue when you become immuno-compromised, particularly in relation to HIV. Toxoplasmosis is a really nasty infection.

Some interesting work, as I understand it, has just come out about toxoplasmosis. Everyone used to worry about sandpits, but the latest control case study from overseas suggests that this is not where most people picked up the disease. It's mainly from eating undercooked meat. I don’t know about people eating meat they have caught out bush, for instance—whether toxoplasmosis is in native animals. It has been found in kangaroos. Rick?

Rick Speare  That was a poorly reported study, actually.

Grey kangaroos and red kangaroos have an amazingly low level prevalence of toxoplasma in the meat, so they are not really a risk. Some of the wallabies on the coast have a high prevalence, but they don't usually get into the commercial system. I suppose potentially they could be used for food by community people. In most other native animals it's not a high prevalence at all.

Bart Currie  From a human health point of view, the focus is high on pregnant women, and advising people not to eat undercooked meat. They don’t have to worry about the kids playing in the sandpit.

So that would be an issue in remote areas. It could be a part of the Strong Women’s emphasis on pregnancy issues: make sure you are eating healthy food and it's well cooked.