Are our homes microbiologically safe for our pets?

We tend to think of domestic pets as potential sources of human infection, but **Charles Penn** asks if the animals are just as much at risk of disease from living with us.

Humans and their dog and cat companion animals have been closely associated for millennia, as the evidence for domestication of these species clearly shows. But how has the cost and benefit of this association worked out, not only for humans, but for the animals too? Microbiologically, we intuitively think of the animals with their irrational behaviour and sometimes outrageous habits of personal hygiene, as a potential hazard for the humans in their shared living environment. Sources of microbial hazards that can contaminate or enter the home through animal care and activity are many and varied. They include:

- the animal itself – excreta and other external secretions, respiratory and salivary (licking and washing the fur and skin, coprophagy and licking of perianal regions may significantly contaminate saliva)
- associated biota – internal parasites; associated arthropods such as fleas, and free-living insects like flies that may be attracted to the animal itself or to uncovered food
- the animal's food – often this is poorly controlled and may include table scraps or uneaten items which may or may not be fresh, spoiled food that has been stored too long to be attractive for human consumption, raw meat trimmings from food preparation, deliberately raw meat that may be thought 'more natural' for the animal, and dried 'chews' of, for example, unsterilized animal material carrying pathogens
- the external environment – muddy paws, perhaps from agricultural land with a liberal mix of faecal material from farm animals can quickly contaminate floors, furniture and surfaces
- contact with prey – for example, birds and rodents which may carry a wide range of pathogens potentially harmful to humans

Human infection from pets

Not surprisingly then, there is some level of public awareness (albeit not universally accepted!) of the risk of human infection in the home from companion animal sources. We are discouraged from allowing pets onto our soft furnishings and bedding, and especially onto surfaces where food is prepared. Indeed, there have been numerous studies investigating the role of pets as a possible source of infections in humans. Gastrointestinal infections are an obvious example, where household pets have been considered as possible sources of *Salmonella*, *Campylobacter* and pathogenic *Escherichia coli*, among others.

Less well known is that cold-blooded animal pets like snakes and turtles can carry pathogens, notably *Salmonellae*

◀ *Digital Vision / Jupiter Images*

of various kinds. One of the most bizarre mishaps has been a multi-state outbreak in the USA of *Salmonella enterica* Typhimurium arising from contaminated frozen vacuum-packed rodents supplied as feed for pet snakes! The reptiles, although not affected themselves by their carriage of the food poisoning pathogen, passed on the infection to their human handlers.

Are pets really a serious source of pathogens for people?

The underlying assumption in the great majority of these studies has been that the animal is the source of human infection, and if the same pathogen is found in both hosts the animal almost automatically gets the blame for passing it on to the human! But is this rational? Is it not possible that pet animals might equally be infected with pathogens emanating from ourselves, or acquired as a result of our uninformed practices in 'caring' for our pets?

Taking a step back, several issues have to be explored before these questions can be answered. Are healthy dogs and cats routinely carriers and sources of the zoonotic pathogens we fear? Or do they get sick as we do when infected, and perhaps cease to carry or shed these organisms when they recover? Can these pathogens be transiently excreted by pets after exposure to food or environmental or other sources?

The scientific literature on these topics is surprisingly sparse, and like any investigation of complex and variable phenomena in populations, different studies can give different answers and may be difficult to reconcile. Most authors agree that diarrhoeal disease in these animals attributable to organisms like *Salmonella* or *Campylobacter* is rare. This may be because they rarely have these organisms in their digestive tracts, or because they are generally not susceptible to disease when these organisms are present. First then, how commonly are these key pathogens present in cats and dogs? A simplistic generalization from the literature is that yes, a substantial number of pathogens can indeed be isolated from some cats and dogs when large numbers of animals are tested. However, this doesn't mean they are universally present, or that these pet animals represent an unacceptable hazard in the home.

A search of recent scientific literature suggests that at least in some circumstances, the presence of *Salmonella*, for example in dogs, is nowadays quite rare in a domestic setting. One large-scale study involved sampling faecal specimens every 2 months for a year. In dogs fed raw poultry meat, which is commonly contaminated with *Salmonella*, the isolation rate for the bacteria increased about eightfold, yet remained low at less than one isolation per dog per year of sampling.

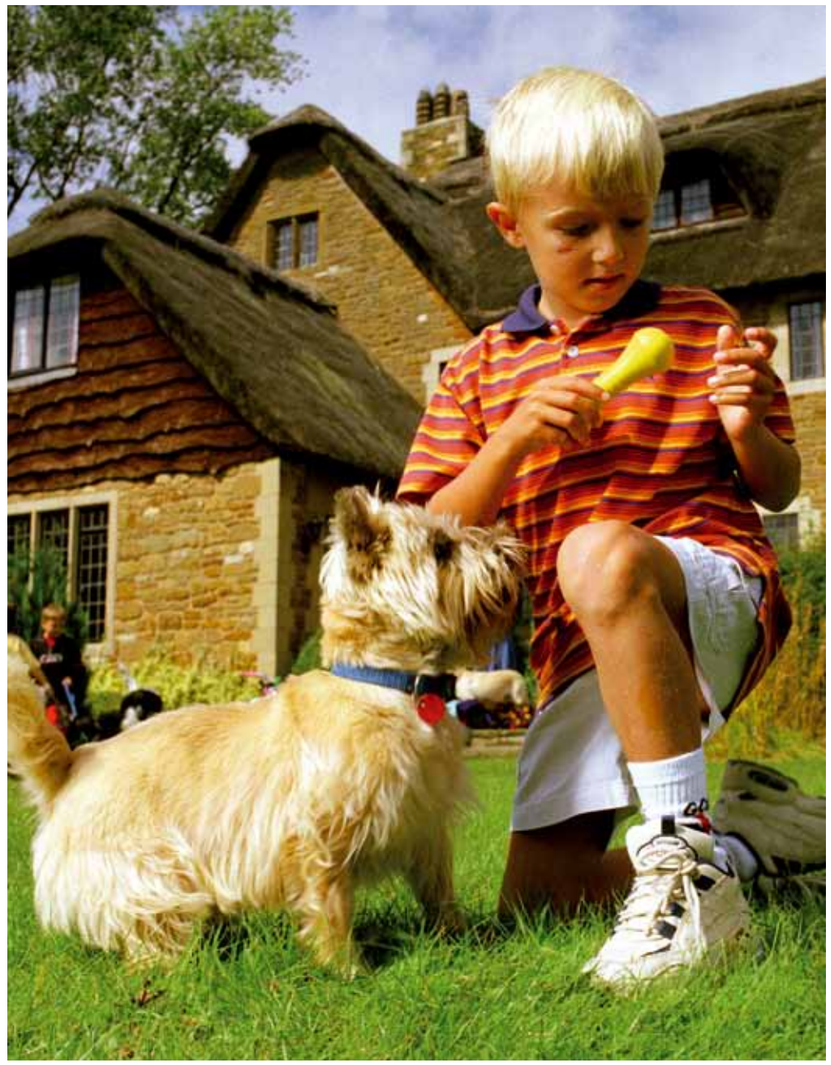
In soon-to-be published studies undertaken by Jenny Jennings at the WALTHAM Centre for Pet Nutrition in Leicestershire, faecal samples from substantial numbers of cats and dogs kept under semi-domestic conditions were tested for the presence of *Campylobacter jejuni*, the most frequent cause of bacterial diarrhoeal disease in the UK. Somewhat unexpectedly, this pathogenic species was rarely isolated, although a moderate number of animals did harbour the less pathogenic species *Campylobacter upsaliensis*, which is rarely associated with human disease.

The biter bitten?

A tentative conclusion then is that carriage of the more serious bacterial pathogens associated with intestinal disease in humans is uncommon in companion animals. Is there any evidence that these animals do acquire infections from their human hosts? Several studies do suggest that this is likely. While the available evidence suggests that intestinal carriage or on occasion intestinal disease in these animals is more likely to result from injudicious feeding than from direct human contact, the same conclusions cannot necessarily be drawn about, for example, respiratory infections. A recently described case of *Mycobacterium bovis* infection in both humans and a dog in the same household was highly suggestive of transmission from human to animal. So perhaps it is not unreasonable to keep an open mind about the direction of transmission of pathogens between humans and pet animals!

The key to future research

It is perhaps appropriate to end this article with a few words about an impending technical revolution in molecular biology which will open up new dimensions in knowledge of host-associated microbiota, particularly of the gastrointestinal tract. Until very recently, a comprehensive understanding of the complex microbial communities present in the nose, mouth, digestive tract, urogenital tract and body surfaces has been impossible, due to the immense technical difficulty of culturing, identifying and quantifying the micro-organisms present. Over the past couple of years, however, it has become possible to detect molecular 'signatures' from the DNA sequences of all the hundreds of species present, without the need to culture them individually. Furthermore, they can be quantified, over a range of abundances of many orders of magnitude, by simply counting the number of times a particular sequence is found when millions of sequence 'reads' are determined from samples of DNA derived and amplified from, for example, samples of faeces or dental plaque. This is made possible by the application of 'next generation' DNA sequencing technologies like pyrosequencing. As a result we can expect over the next few years to make huge leaps forward in dissecting the intricacies of not only pathogen detection and carriage, but the entire microbial ecosystem of host-associated microbiota.



▲ A pet female grey-banded kingsnake (*Lampropeltis alterna*). *Paul Hoskisson*

► Animals may pass infections on to us, but do we also pass our infections on to them? *WALTHAM Centre for Pet Nutrition*

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Further reading

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