Dipping toes & other body parts in fish tanks

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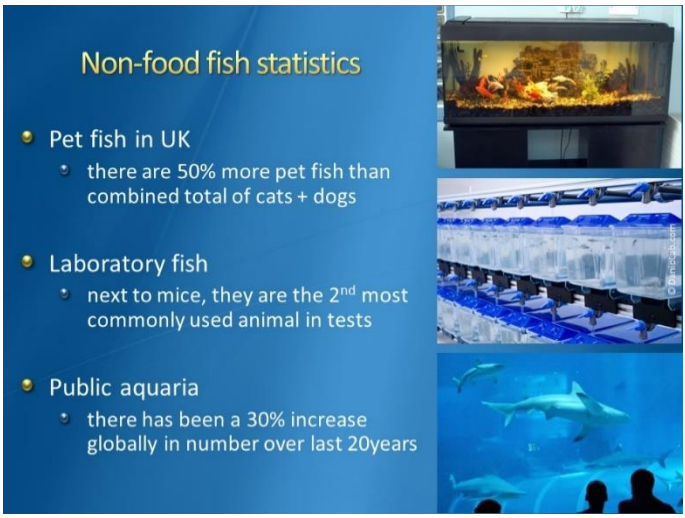
I appreciate that zoonotic diseases of pet fish must be pretty low down on your scale of human health concerns, but hopefully I will give you a brief insight into this important subject. Milorad asked me to sex up this subject but no matter what part of the body is affected, to me, skin lesions never look that sexy.

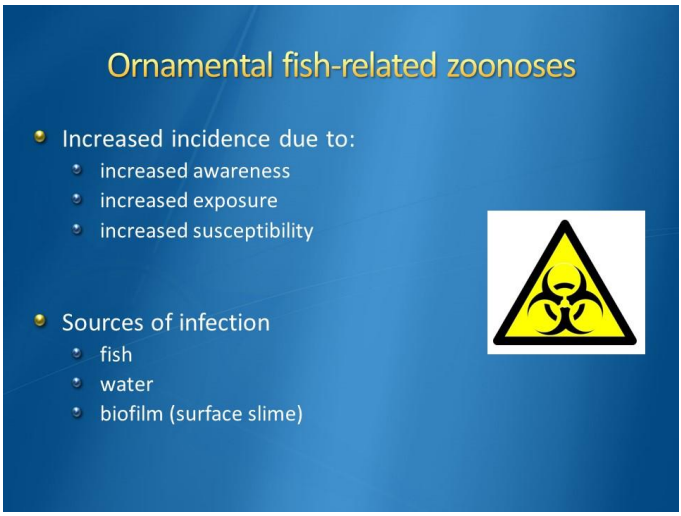
So, out of interest, how many of you keep fish as pets?

Well, at least some of you will know how popular fishkeeping has become in the UK with 1 in 10 homes now keeping pet fish. And more to the point, how much it can cost. You will also know that as cute as they appear, fish-bowls like this are not an ideal environment for any fish, often being over-stocked, over-fed, over-planted, and with no effective filtration system.



Here are a few simple statistics to help put things into perspective. It is estimated that there are well over 20million fish kept as pets in the UK, more than the total number of cats and dogs combined, which is estimated at 14million. Zebra fish are one of the most common fish used in research labs. They are used in a wide range of studies including human medicine,

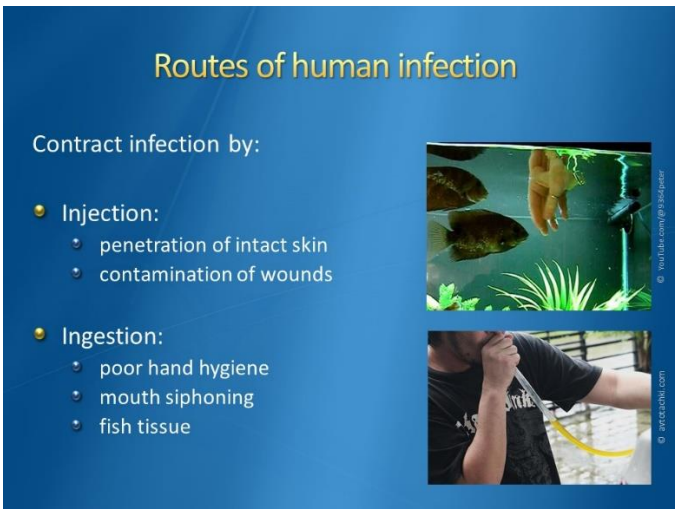
biological research, genetics and are increasingly used for toxicology tests. Public aquaria are now big business and one of the most popular tourist attractions. Sealife is the largest chain of public aquaria in the world, and their parent company, Merlin Entertainments is the second largest theme park company in the world, after Walt Disney Resorts.



Unfortunately, with this increasing popularity of keeping pet fish, there has been an increase in the incidence of zoonotic disease. There are no statutory requirements to record these events, which makes it difficult to get an accurate scale of the problem, but more cases are now being reported in the scientific literature. This is due to increased:

- awareness through the hobby press and internet forums, and use of better diagnostic tests
- exposure due to expansion of the hobby and research, which in part is due to better life-support equipment, and
- susceptibility of humans due to HIV infection, chemotherapy and compromised immune systems

Infections result from contact with fish themselves, contaminated water or biofilm, the slime inside the tank and filtration system.

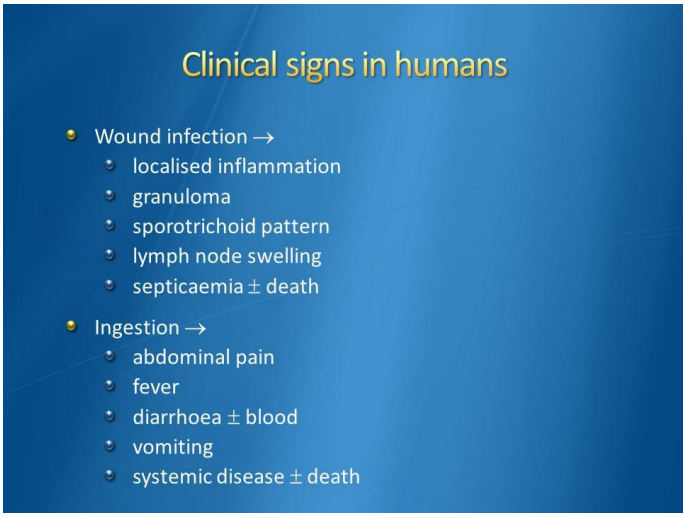


As with many zoonotic diseases, humans contract infection from fish in several ways, most of which is due to poor hygiene and complacent attitudes. The main routes are:

- Injection, where the owners injure their hands or arms on sharp items in the tank or even from spines on the fish, typically when they are

cleaning the tanks. Existing wounds that are not protected by gloves or waterproof dressings may also become infected by contamination.

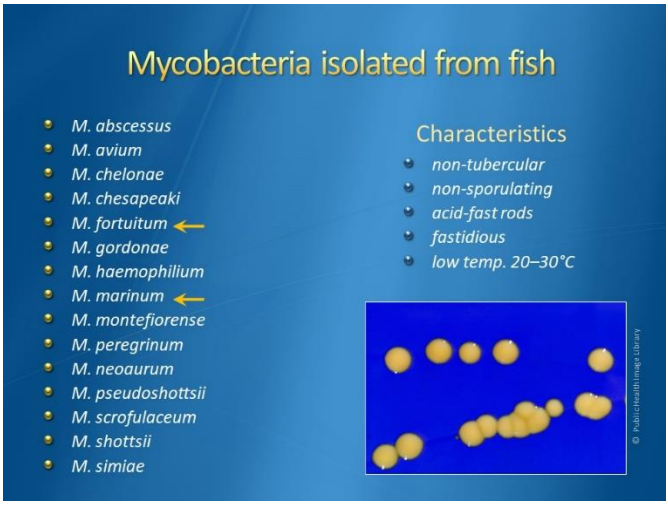
- Ingestion, where most infection is due to carelessness, as a result of failure to wash hands after handling fish, water or accessories. Due to the practicalities of changing water in large fish tanks, siphons are commonly used. These are often 'primed' by mouth, which involves sucking on a length of plastic tubing with one end submerged in the tank. Most hobbyists don't normally eat their own pets, so I won't be discussing zoonoses from sushi or shellfish, which is a completely different and much bigger subject altogether.



The most common clinical signs of wound infections can vary from mild localised inflammation to severe deep tissue reaction and swelling. In some cases, this infection can become extensive, and in extreme cases may result in septicaemia and death. As would be expected, the most common sign of illness following ingestion is varying degrees of gastro-enteric upset and this can also deteriorate so much so that the patient dies.

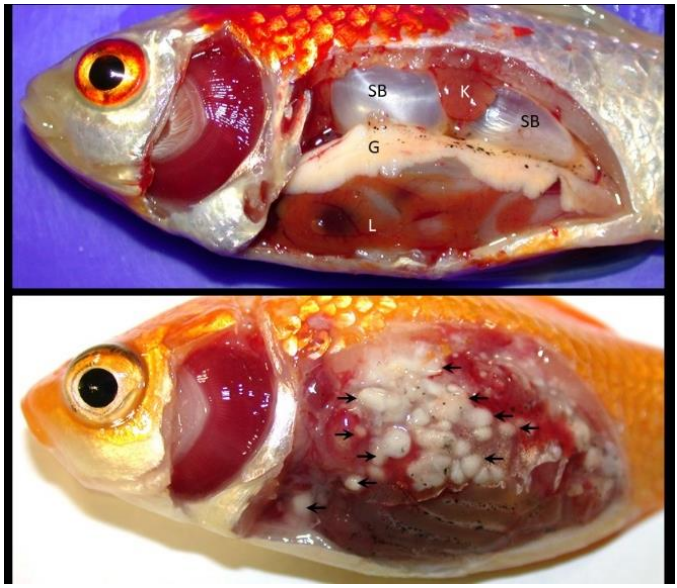
The usual zoonotic suspects include a variety of microorganisms. In reality, there are no known fish viruses and very few fungi or parasites that have any zoonotic potential. These are the most significant bacteria and of these, most zoonotic cases are due to mycobacteria and Aeromonad infections. However, not all these organisms cause disease in fish: some

are only contaminants, or the fish act as carriers. Despite this, the overall degree of risk is generally considered to be low. Not exciting news but of these, mycobacteria is perhaps the most interesting.

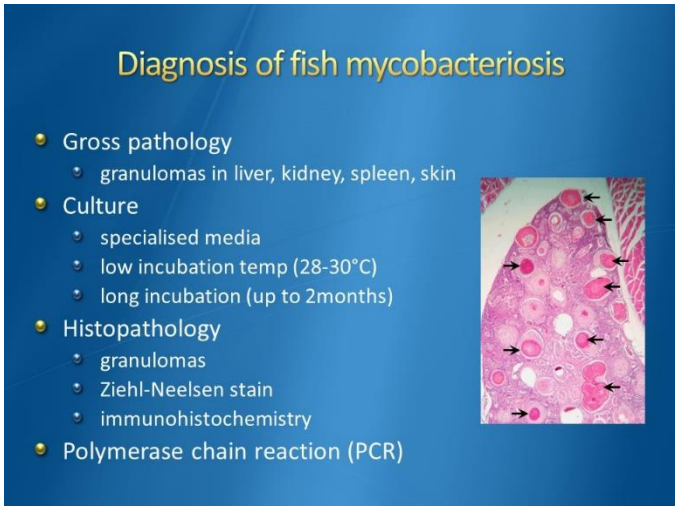


Of the 120 different species of mycobacteria, many are found in the aquatic environment. At present, there are at least 15 different species that have been isolated from fish. These bacteria can be found in the water and the fish, but their zoonotic potential is complex. Common features of aquatic mycobacteria are that they are non-tubercular, non-sporulating acid-fast rods that have fussy growth requirements in the host. For example, they are rarely found in pond fish in the UK because the temperature is too cold, but they are common in heated fish tanks. There are significant differences in virulence and pathogenicity between the species. Of all the mycobacteria on the list, *M marinum* and *M fortuitum* are the most common species associated with disease in humans.

This is one of the most common chronic diseases of fish kept in aquaria. Species commonly infected are small tropical freshwater fish such as tetras, bettas and danios: all popular species with hobbyists and research labs. It is also one of the two most common diseases in danio breeding colonies. There can be various clinical signs, but in most cases, these are non-specific, and the fish are usually found dead. In larger species such as goldfish, discharging skin ulcers may be seen in some cases, but the diagnosis is often made on internal post-mortem examination (PME).



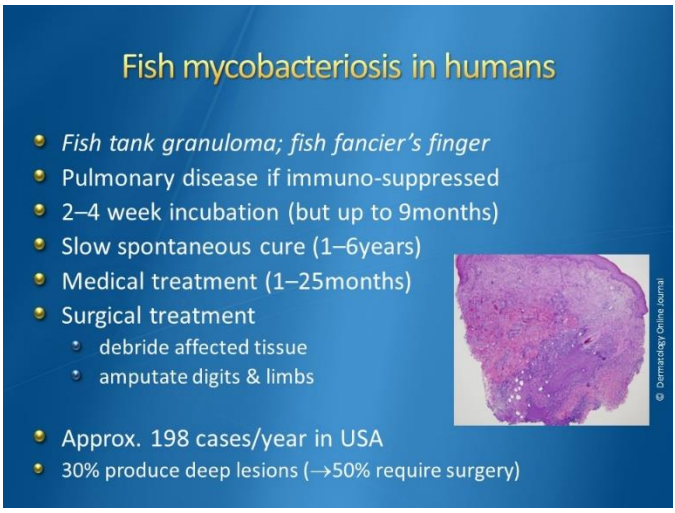
This top image shows the normal internal anatomy of a goldfish, the most common species that I see in general practice. The kidney (K) is situated between the two chambers of the swim bladder (SB), with the male gonad (G), liver (L) and bowel lying below. The goldfish in the lower image has extensive mycobacterial granulomas (arrowed). There were no external clinical lesions as is often the case, but it demonstrates the severity of internal pathology that is common in the chronic form of this disease. However, not every case has granulomas, and acute forms of disease may only have diffuse inflammatory changes with acid-fast bacteria throughout the tissues.



There is no non-lethal method for diagnosing this disease in live fish. As I have said, clinical signs are rarely specific unless skin ulcers are found with a characteristic creamy-white discharge. On PME, typical granulomas can be found in various organs but, in goldfish, these can be indistinguishable from those caused by amoeba. This slide shows the kidney of a cardinal tetra and demonstrates the extensive nature of the disease. The small size of the fish made it almost impossible to see the organ with the naked eye, let alone any gross pathology on PME.

Culture can be very slow, requiring specialised media and specific incubation temperatures (usually 30-32°C), and for up to 2 months with slow growing species such as *M marinum.* Histopath of lesions will identify

typical granulomas but, in some cases, serial sections of the same lesion may be required to find acid-fast bacteria with Ziehl-Neelsen stain. PCR is increasingly being used to identify some species of mycobacteria but is only available at specialised labs. This is important to help predict zoonotic risk and the likely response to treatment.

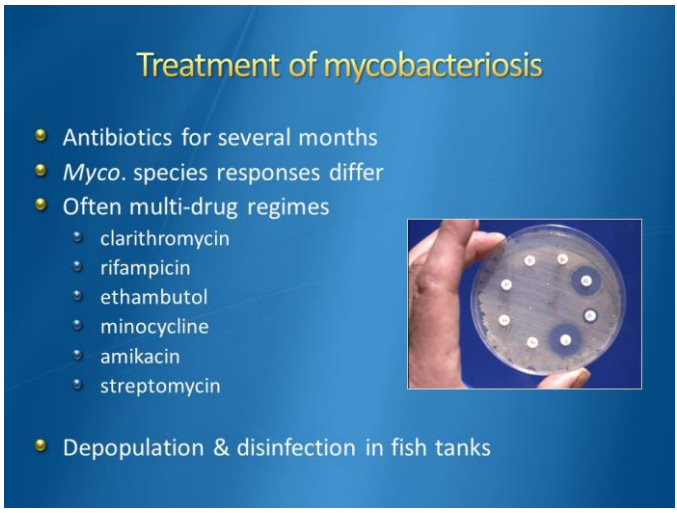


In humans, the infection is difficult to diagnose and requires prolonged treatment. The disease was first identified over 50 years ago and is often called *fish fancier's finger* because it commonly affects the hands or fingers, the body parts that are most commonly in contact with contaminated water and which have a slightly lower tissue temperature. In severe cases, and in patients with compromised immune systems due to HIV or chemotherapy, the disease often affects deeper tissues and can even spread to the lungs and prove fatal.

It is often a chronic disease that can last several years, and even with medical treatment it can take several months to respond. This image is typical of the diffuse histological appearance of human lesions. Few statistics have been found for human cases, but I came across this data from the US which shows that a significant percentage requires surgical intervention, which may include amputation.

Lesions vary in appearance and mild lesions may be misdiagnosed by GPs or heal spontaneously before being confirmed. Diagnosis is often made following referral to human dermatology specialist. One veterinary

colleague I know who contracted the disease even had to suggest the diagnosis to his GP. Some infections spread along the arm and multiple nodules develop a sporotrichoid pattern, which is more likely in patients who are immune-compromised. Some lesions may become deep and affect the joints or underlying bone.



There is no standard treatment protocol that is universally effective in humans, let alone fish. Several antibiotics are used in the treatment of human non-tubercular mycobacterial lesions, often in combination and are often required for many months. Different species of mycobacteria have a different response to drugs mainly because of the resilience of the organism. Bacterial resistance is also common and is another reason for failure to respond to treatment. However, resistance is also common in many other bacteria found in fish.

Some of these drugs have been used in fish but with limited success. Little is known about the pharmacokinetics of these drugs in fish and as a result, a slaughter and disinfection policy is the best option for controlling the disease. However, owners who are 'emotionally bonded' to their pet fish are unlikely to go along that route and are more likely to 'live with the infection' and accept the risks. Afterall, there's no guarantee that new replacement stock will not be similarly infected since there is no effective diagnostic screening test for live fish.

Mycobacteria remains a challenging problem that will not go away. People most at risk include:

- Hobbyists, particularly children with their bad hand hygiene and immature immune systems
- People working in fish retail and wholesale businesses in frequent contact with fish and water
- Laboratory technicians and researchers, and
- Staff working in public aquaria and visitors who are tempted by touch pools

However, the risk is substantially greater for those with compromised immune systems where disease is often more severe and occasionally systemic.

As mentioned earlier, there was this curious fashion for people to have their feet nibbled by these small toothless carp, *Garra rufa*, which are commonly called 'doctor fish'. It was a novelty that originated in the Middle East and was all the rage in 2011, when up to 100,000 of these fish were imported into the UK every week to satisfy this booming business.

These fish foot spas popped up in shopping centres and beauty salons everywhere but there were also a few high-class establishments in London that looked very impressive. For quite a long time, fish professionals sat on the fence undecided about whether this was a good or bad thing until it

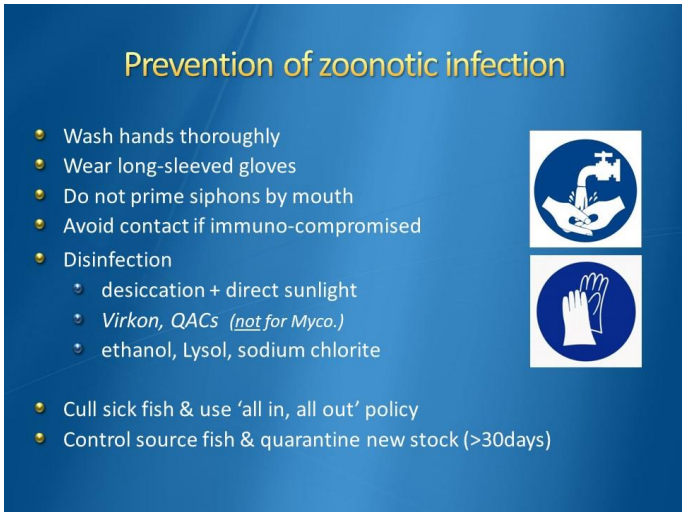
became obvious that there were several major human health risks and fish welfare issues.

Following concern from the public and local authority health officials, the Health Protection Agency established the Fish Spa Working Group to look closely at the industry and develop a set of guidelines to reduce human health risks to the workers and the public. This working group involved various health agencies and authorities, but it was only concerned about the human health risks, although they did acknowledge that fish welfare problems also existed.

Their detailed report looked at several zoonotic diseases in addition to environmental pathogens from the water and infections that could spread between humans. Many of these are the same as in pet fish tanks and some that may result from users sharing the tank or bleeding into the water. I felt it gave a fair and honest opinion on the risks and provides useful suggestions for the salons to minimise the risks to their staff and users. It concluded that the risk was '*likely to be very low but could not be completely excluded*'.

The day after the report was published, several newspapers summarised the lengthy detailed report. Some summaries were more alarmist than others and, true to form, *The Sun* newspaper was the most extreme. Interestingly, they were more concerned about diseases that users could contract from other users, when in fact there was probably a higher risk due to true zoonotic diseases from the fish. Sadly, these headlines were the beginning of the end for the industry, and within 6months fish spas had virtually disappeared in England.

Fish spas had previously been banned in several US states and other countries because they could not be sterilised adequately. Quite simply, it is impossible to keep an aquatic environment 'sterile' while still supporting fish life — fish, literally, swim in their own sewage. Several factors influence the efficacy of UV and many of the UV systems used in fish spas were not powerful enough to sterilise water. These units only have an effect on the water that is pumped through the filtration system: they have no effect on the microbes on the fish or biofilm in the tank. Consequently, the over-optimistic use of the word, '*sterilisation'* in some fish spa adverts, gave unrealistic and false reassurance to users.



So, what can be done to prevent zoonoses from fish? The simple, cheap measures are still the best.

- Improve hand hygiene
- Wear long gloves, such as calving or rectal gloves
- Avoid priming siphons by mouth
- People with compromised immune systems should take extra care if they want to keep fish
- Routine disinfection of equipment is a good policy, but for mycobacteria strong hazardous products are required since the organism is resistant to Virkon® and many other commonly used products
- Routine health care of fish (*ie*. removing diseased fish and investigate where appropriate)
- Good husbandry measures in retail/wholesale premises and research labs requires an '*all in, all out*' policy
- Vaccination of fish against mycobacteria is still a long way off.

Some of you with kids of a certain age will know that Sponge Bob Square Pants is an aquatic invertebrate that lives in a pineapple under the sea. He never mentions that any of his fish friends have mycobacterial infections which highlights that this disease is more of a problem resulting from conditions in captivity, than exists in the wild. Although zoonotic diseases from fish represent a low risk to human health, misdiagnosis may result in serious illness and these diseases should still be taken very seriously.

This paper is based on a presentation given at the Spring Conference of the Veterinary Public Health Association in Stratford-upon-Avon on 27 April 2013.

References and further reading

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