How Is TB Transmitted?

To the Editor:

Unlike nontuberculous mycobacteria, *Mycobacterium tuberculosis* is not considered to be an environmental mycobacterium; rather, humans are considered to be the reservoir for *M tuberculosis*, with transmission occurring person-to-person via the respiratory route. In this issue of *CHEST* (see page 1094), Velayati et al¹ reported the surprising finding of viable *M tuberculosis* in 10% of water samples (and 1% of soil samples) in metropolitan Tehran.

One explanation for these results would be laboratory cross-contamination. Although there were no matching genotypes for isolates from human and environmental sources to suggest potential cross-contamination, information was not provided on the proportion of all *M tuberculosis* isolates handled by the laboratory during the study period that were genotyped. Notably, though, all positive water cultures were from sources other than tap water, making random cross-contamination less likely.

The authors did not find matching environmental and pulmonary isolates to suggest transmission between the environment and humans. However, this lack of correlation is difficult to interpret without information on the genotyping coverage among human cases. As animals can also become infected with *M tuberculosis*, another consideration would be that the source of environmental *M tuberculosis* could be nonhuman.² In this regard, data on the prevalence of *M tuberculosis* in domesticated and wild animals in the Tehran region would be helpful.

The authors posit that contamination of water sources with *M tuberculosis* may occur through expectoration. However, since both human stool and urine can harbor *M tuberculosis*, sewage contamination of water sources could potentially be another source.³

The possible connections between human TB and the environmental isolates are undiscovered—no environmental *M tuberculosis* isolates matched those from human pulmonary TB. One question is whether isolates from scrofula would have matched. An oral route of infection has been postulated as a source of TB in nodes draining the oropharynx.⁴ For example, human TB from *Mycobacterium bovis* acquired through ingestion of

contaminated dairy products is associated with cervical lymphadenitis.⁵

The finding of viable *M tuberculosis* in a broad survey of environmental sources, if confirmed in other settings, has several potentially important public health implications. The elegant studies that showed that *M tuberculosis* can be spread by aerosolized droplet nuclei did not exclude transmission through other routes. The findings of Velayati et al¹ suggest that a broader view of possible routes of TB transmission should be reconsidered. Furthermore, immunologic effects of oral exposure to environmental sources of *M tuberculosis*, whether associated with infection and disease, merit consideration.

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Response

To the Editor:

We appreciate Dr Click for providing a critique on our publication in *CHEST*.¹ We agree that our article introduces a new potential route of TB transmission that needs urgent consideration.

We performed all possible procedures to avoid laboratory cross-contamination in our study. We confirmed our findings by resampling from locations with positive mycobacterial results. In addition, finding no evidence of matching genotype between human and environmental isolates from the study locations makes the risk of contamination negligible. Consequently, we would confidently confirm our findings in this study.

Regarding the role of animals in this epidemiologic cycle, we addressed the potential role of animals in transmitting *Mycobacterium tuberculosis*, particularly multidrug-resistant TB, to humans elsewhere.² Given that Tehran is a rat-infested city, the role of the rats in contaminating the environment with *M tuberculosis* should be investigated. To our knowledge, the prevalence of *M tuberculosis* in animals has not been studied in Iran.

The contamination of water samples with sewage is very unlikely in Tehran for a couple of reasons. The water samples were mainly collected from channels that are designed to collect superficial water from streets after rains and have no connection to sewage. Besides, voiding in water channels is not culturally accepted in Iran, so the risk of direct contamination also is very unlikely. We still think that water source contamination could occur through expectoration.

Regarding TB lymphadenitis, we did not match environmental isolates with all isolates from TB lymphadenitis from Tehran. Considering we could not isolate any *M tuberculosis* from drinking water samples, and no one drinks channel water, at least in the study locations, the role of drinking *M tuberculosis* was not questioned for us. We agree this possible association should be investigated in other locations where the risk of drinking contaminated water is valid.

Finally, we agree with Dr Click that our understanding about TB transmission is evolving. In our previous studies,^{3,4} we showed *M tuberculosis* has a high biologic adaptation in response to difficult environmental

conditions, including exposure to antibiotics. This ability allows *M tuberculosis* to stay alive and infectious in soil and water for a significant duration of time; as we showed, it remains alive in wet soil for > 9 months.

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