



# Mycobacterium bovis, paratuberculosis, and marinum infections in humans and animals

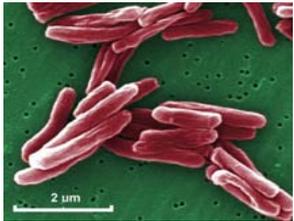
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## Introduction

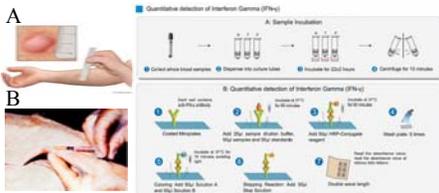
Bacteria of the genus *Mycobacterium*, slender acid-fast rods, affect species ranging from fish and elephants to cows and frogs.<sup>1</sup> A number of these, including *M. tuberculosis*, *M. bovis*, *M. marinum*, and *M. paratuberculosis*, are zoonotic pathogens.



**Figure 1.** Colorized Scanning EM of *M. tuberculosis*. Photo by Janice Haney Carr, provided by CDC/Dr. Ray Butler.

- *M. tuberculosis* and *M. bovis* primarily infect the lung, but may also cause tubercles with caseating (“cheese-like”) necrosis in lymph nodes and other viscera.<sup>2</sup>
- Other *Mycobacterium* (*M. avium* subspecies *paratuberculosis*) preferentially infect the gastrointestinal tract, and, *M. marinum* in humans, infects the skin.<sup>3,4</sup>
- Hosts are most susceptible to infection by *Mycobacterium* if immunocompromised.<sup>2,3,4</sup>
- This poster provides a brief overview of three *Mycobacterial* diseases in humans and animals.

## Diagnostic Tests



**Figure 2.** *Mycobacterium* testing: A, measurement of human TST result<sup>5</sup>, B, injection of tuberculin for a Caudal Fold Test injection in cattle (bovine analog of TST)<sup>6</sup> C, method of INF- $\gamma$  testing<sup>7</sup>

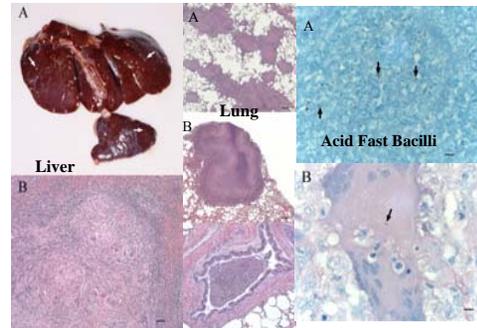
- TST (Tuberculosis skin tests) are rapidly being replaced with more sensitive assays such as those that detect *in vitro* *Mycobacteria* - specific INF- $\gamma$  release from lymphocytes.

## Mycobacterium bovis

*M. bovis* infected Rhesus macaques (*Macaca mulatta*) displayed more severe clinical signs (coughing) than *Cynomolgus* (*Macaca fascicularis*) macaques.<sup>2</sup>



**Figure 3.** Severe consolidation and hemorrhage were typical of the pulmonary lesions seen in rhesus macaques at necropsy. Prominent raised yellow/grey nodules (granulomata) were abundant in the right cranial lobes (arrow).<sup>2</sup>



**Figure 4.** Typical *M. bovis* lesions in macaques: **Liver:** A, “miliary” foci (white arrows), and B, associated histology. **Lung:** A, typical pulmonary granulomas, B, suppurative airway involvement (bronchopneumonia) in a rhesus. **Acid fast bacilli:** A, numerous organisms in rhesus’ lesions, B, rare organisms seen in cynomolgus macaques<sup>2</sup>.

### *M. bovis* in humans:

- Tuberculosis from *M. bovis* rare in the US, after eradication from cattle in the 1990s.<sup>8</sup>
- *M. bovis* infections are clinically indistinguishable from *M. tuberculosis* infections
- *M. bovis* patients twice as likely to die during treatment as *M. tuberculosis* patients.<sup>8</sup>
- Consuming contaminated dairy products may result in infection.<sup>8</sup>
- Infection is often observed in children and HIV-positive patients.<sup>8</sup>

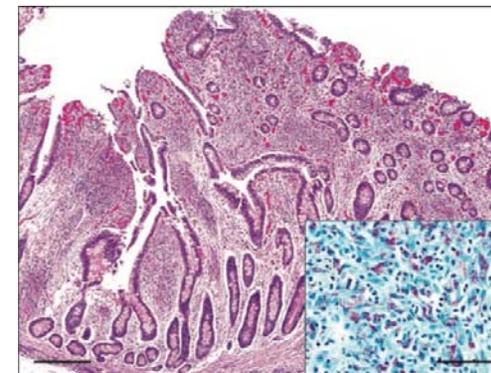
## Mycobacterium paratuberculosis

### *M. paratuberculosis* (Johne’s Disease) in cattle:

- Extreme enteritis results in inflammation of mucosa in the ileum (in advanced cases resembling transverse rugae) causing malabsorption and profuse, “projectile” diarrhea.<sup>1</sup>



**Figure 5.** Cow with Johne’s disease presents with emaciation, bottle jaw, and diarrhea.<sup>9</sup>



**Figure 6.** Microphotograph of ileum in a cow with *M. paratuberculosis*. Note villous blunting and expansion of lamina propria by macrophages. H&E stain; bar = 500  $\mu$ m. Inset- Acid-fast bacilli within macrophages. Ziehl-Neelsen stain; bar = 50  $\mu$ m.<sup>3</sup>

### *M. paratuberculosis* association with human Crohn’s Disease:

- Crohn’s Disease presents as chronic inflammation with and ulcerative colitis.<sup>10</sup>
- Crohn’s patients may be seropositive for *M. paratuberculosis*<sup>10</sup>
- Tissues samples from Crohn’s patients may contain *M. paratuberculosis*, rarely seen in normal controls.<sup>10</sup>

## Mycobacterium marinum

### *M. marinum* in leopard frogs:

- Immunocompetent leopard frogs (*Rana pipiens*) exhibit a chronic, granulomatous, non-lethal disease, with lesions in the liver and spleen.<sup>4</sup>



**Figure 7.** Small raised lesions from infection of *M. marinum* on the dorsum of the hand of a man who worked in a pet shop. His duties included cleaning fish tanks, which he did without wearing protective gloves. He was successfully treated with an antibiotic regimen.<sup>11</sup>

### *M. marinum* in humans:

- Infection acquired through direct bacterial contact with broken skin, often while attending to fish tanks or while fishing.<sup>11,12</sup>
- Manifests as cutaneous lesions on extremities due to low optimal growth temperature<sup>11,12</sup>
- Human infection is often called “swimming pool” or “fish tank” granuloma<sup>11,12</sup>

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