PATHOGEN SAFETY DATA SHEETS: INFECTIOUS SUBSTANCES – MYCOBACTERIUM SPP.

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SECTION I - INFECTIOUS AGENT

NAME: *Mycobacterium* spp. - excluding *M. tuberculosis,* and members of the *Mycobacterium tuberculosis* complex (*M. bovis, M. africanum, M. pinnipedii, M. microti, M. caprae, "Mycobacterium canettii")*

SYNONYM OR CROSS REFERENCE: Atypical mycobacteria, non-tuberculous mycobacteria (NTM), mycobacteria other than tubercle bacilli (MOTT) Footnote1-Footnote3. There are well over 100 species of Mycobacteria but most common species include: *M. avium* Complex (MAC)*, M. kansasii*, *M. haemophilum*, *M. xenopi, M. malmoense, M. asiaticum, M. simiae, M. szulgai*, *M. marinum, M. ulcerans, M. genavense* (slow growers)*; M. fortuitum*, *M. chelonae*, *M. abscessus* (rapid growers) Footnote4.
CHARACTERISTICS: The *Mycobacterium* genus belongs to the family Mycobacteriaceae and consists of many species, some of which are pathogenic to humans Footnote3. They are aerobic, non-spore forming, non-motile, slightly curved or straight rods (0.2 to 0.6 µm by 1.0 to 10 µm) which may branch. They can grow on simple substrates such as amino acids and glycerol Footnote3. Different species have different temperatures of growth with a range of <30-45 °C Footnote3. They can either grow slowly (require 7 days for growth) or rapidly (requiring less than 7 days for growth) when subcultured on Löwenstein-Jensen media Footnote3. They belong to two groups: slow growers (further divided into photochromogens, scotochromogens, nonphotochromogens), and rapid growers Footnote4, Footnote5.

SECTION II - HAZARD IDENTIFICATION

PATHOGENICITY/TOXICITY: Non-tuberculous mycobacteria (NTM) infections occur mainly in immunosuppressed individuals, although immunocompetent patients can also be affected Footnote4, Footnote6. Non tuberculous mycobacteria cause many different diseases in humans:
Pulmonary disease: Pulmonary diseases are caused mainly by *M. kansasii*, MAC, and rarely by *M. malmoense, M. xenopi, M. asiaticum*, *M. simiae* and *M. szulgai* Footnote1.

Pulmonary disease may show different clinical patterns: tuberculosis like infiltrates, nodular bronchiectasis, solitary nodules, and diffuse infiltrates [Footnote3], [Footnote6].
Lymphadenitis: caused mainly by MAC, *M. scrofulaceum*, *M. haemophilum*, *M. fortuitum, M. kansasii* [Footnote1].
Cutaneous and soft tissue infections (skin ulcers): Cutaneous or skin infections may be associated with *M. marinum*, *M. ulcerans*, *M. fortuitum*, and *M. chelonei* [Footnote1]. *M. marinum* can cause cutaneous infection on exposure of broken skin to contaminated freshwater fish tanks [Footnote7]. The disease is characterized by a formation of a single papulonodular lesion confined to one extremity, which with time may become ulcerative [Footnote7]. *M. ulcerans* causes cutaneous skin ulcers which may vary from a localized nodule to widespread ulcerative or non-ulcerative disease including osteomyelitis [Footnote3].
Other infections associated with NTM include enteritis, musculoskeletal disease, bursitis, CNS disease, corneal infections, and otitis media [Footnote3], [Footnote4]. Disseminated infection and bacteremia may also occur [Footnote6]. Disseminated infection occurs mainly in immunosuppresed individuals, and may involve liver, spleen, bone marrow [Footnote6].
Patients with disseminated infection present with nonspecific symptoms such as fever, malaise, weight loss, anorexia, abdominal pain and night sweats [Footnote6].
EPIDEMIOLOGY: Worldwide. Altered local or systemic immunity (such as HIV infection) is the greatest risk factor for acquiring NTM infections [Footnote2]. In British Columbia, Canada from 1996-2006, incidence of all isolated NTM ranged from 3.4-9.1/100,000, *M. avium* Complex (MAC) accounted for 2.6–6.7 and non-MACaccounted for < 0.7 of the total sample (including both NTM and *M. tuberculosis* isolates) [Footnote8]. A similar study conducted in 2000-2003 in New York city, USA, reported the estimated incidence of NTM positive cultures (without HIV infection) and diseases (caused due to NTM infection) to be 17.7, 2.7, and 2.0 per 100,000 persons, respectively [Footnote9]. A 2008 study reported that isolation prevalence of all NTM species in Ontario, Canada, increased from 9.1/100 000 in 1997 to 14.1/100 000 by 2003 [Footnote10].
HOST RANGE: Humans, domestic and wild animals [Footnote3].
INFECTIOUS DOSE: Unknown.

MODE OF TRANSMISSION: Nosocomial, direct contact with a contaminated environment [Footnote3].
INCUBATION PERIOD: Infection with *M. marinum* has an incubation period of about 2-3 weeks [Footnote11].
COMMUNICABILITY: No evidence of person-to-person transmission of the infection.

SECTION III - DISSEMINATION

RESERVOIR: Ubiquitous in nature - soil, water, humans, domestic, and wild animals [Footnote3].
ZOONOSIS: Yes for some species: *M. marinum* from pet fish, *M. avium* complex from swine, and from other domestic and wild animals [Footnote3], [Footnote7].
VECTOR: None.

SECTION IV – STABILITY AND VIABILITY

DRUG SUSCEPTIBILITY/RESISTANCE: Combinational drug therapy is used as different species are susceptible and resistant to different drugs Footnote6. Drug susceptibility tests are performed on isolated organisms to guide proper therapy Footnote6. *M. kansasii* is susceptible to first line tuberculosis drugs (rifampin, isoniazid, pyrazinamide and ethambutol).
DRUG RESISTANCE: *M. marinum* is resistant to pyrazinamide Footnote11, and MAC organisms, unlike *M. kansasii*, are resistant to first line tuberculosis drugs Footnote6.
SUSCEPTIBILITY TO DISINFECTANTS: Mycobacteria are more resistant to disinfectants than vegetative bacteria Footnote12, Footnote13. Atypical mycobacteria are generally susceptible to sodium hydroxide, chlorine dioxide, ethylene oxide, 0.35% peracetic acid, and orthophthalaldehyde Footnote2, Footnote13–Footnote15. 70% ethanol can be used for surface disinfection Footnote13. Some atypical mycobacteria such as *M. marinum*, *M. smegmatis*, and *M. fortuitum* are highly susceptible to 2% alkaline glutaraldehyde, whereas others such as *M. gordonae*, *M. avium* complex, *M. xenopi*, *M. chelonae* are resistant to it Footnote13, Footnote16, Footnote17.
PHYSICAL INACTIVATION: Mycobacteria are easily inactivated by heat (> 65 °C for at least 30 min) and by UV light but not by freezing or desiccation Footnote3.
SURVIVAL OUTSIDE HOST: Mycobacteria are able to survive for weeks to months on inanimate objects if protected from sunlight Footnote3. NTM species are widely distributed in nature and have been found in natural water, tap water, soil, water used in showers and surgical solutions Footnote2.

SECTION V - FIRST AID / MEDICAL

SURVEILLANCE: Monitor for symptoms. Diagnosis of NTM infection can be done via culture of clinical specimens and identification using phenotypic characteristics (growth rate, colony pigmentation and biochemical tests); histopathological examination to demonstrate the presence of granuloma in aspirates or biopsies; serotyping methods; isoenzyme and protein electropherogram based methods; and PCR, DNA fingerprinting and identification using gene probes Footnote 2.

Note: All diagnostic methods are not necessarily available in all countries.

FIRST AID/TREATMENT: A combination of several antibiotics over long periods of time is recommended for treatment of NTM infections Footnote6. The most important antibiotics used in antimycobacterial therapy include: rifampin, isoniazid, ethambutol, macrolides (clarithromycin, azithromycin), quinolones (ciprofloxacin, moxifloxacin, gatifloxacin), aminoglycosides (streptomycin, amikacin) and linezolid Footnote6. Surgery may be useful in removing debridement in soft tissue diseases caused by NTM species, and in managing cervical lymphadenitis Footnote2, Footnote6. Surgery can also be used along with antibiotic therapy to reduce the bacterial load and to cure life threatening symptoms such as hemoptysis Footnote6.

IMMUNIZATION: None.

PROPHYLAXIS: The public health service of USA has recommended the use of rifabutin for preventing and delaying the onset of bacteremia caused by *M. avium* complex infection in HIV infected patients Footnote2, Footnote18.

SECTION VI - LABORATORY HAZARD

LABORATORY-ACQUIRED INFECTIONS: 40 cases of non pulmonary tuberculosis due to laboratory or autopsy room accidents have been reported. These infections may have been caused by *Mycobacterium* spp. other than *M. tuberculosis/bovis* Footnote1. A case has been described of an infection in a male research laboratory worker who accidentally inoculated his thumb with a viable suspension of *M. marinum* Footnote19.
SOURCE/SPECIMENS: NTM can be isolated from sputa, exudates from lesions, tissues, environmental samples (soil, water), and from wounds Footnote1. MAC has also been isolated from blood, and stool specimens of infected individuals Footnote3.
PRIMARY HAZARDS: Direct contact of skin or mucous membranes with the infectious material, accidental parenteral inoculation of the bacteria, and ingestion of the bacteria Footnote1.
SPECIAL HAZARDS: Exposure to infectious aerosols generated during manipulation of broth cultures or tissue homogenates may cause pulmonary disease in laboratory personnel Footnote1.

SECTION VII - EXPOSURE CONTROLS / PERSONAL PROTECTION

RISK GROUP CLASSIFICATION: Risk group 2 Footnote20. Note that this risk group applies to *Mycobacterium* spp. excluding *M. tuberculosis*, and members of the*Mycobacterium tuberculosis* complex (*M. bovis, M. africanum, M. pinnipedii, M. microti, M. caprae, Mycobacterium canettii*) as a whole, and may not apply to every species within the genus.
CONTAINMENT REQUIREMENTS: Containment Level 2 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials, animals, or cultures. Note that these containment requirements apply to *Mycobacterium* spp. (excluding *M. tuberculosis, and members of the Mycobacterium tuberculosis* complex (*M. bovis, M. africanum, M. pinnipedii, M. microti, M. caprae, M. canettii*) as a whole, and may not apply to every species within the genus.

PROTECTIVE CLOTHING: Lab coat. Gloves when direct skin contact with infected materials or animals is unavoidable. Eye protection must be used where there is a known or potential risk of exposure to splashes Footnote21.
OTHER PRECAUTIONS: All procedures that may produce aerosols, or involve high concentrations or large volumes should be conducted in a biological safety cabinet (BSC). The use of needles, syringes, and other sharp objects should be strictly limited.

Additional precautions should be considered with work involving animals or large scale activities Footnote21.

SECTION VIII - HANDLING AND STORAGE

SPILLS: Allow aerosols to settle and, wearing protective clothing, gently cover spill with paper towels and apply an appropriate disinfectant, starting at the perimeter and working towards the centre. Allow sufficient contact time before clean up Footnote21.
DISPOSAL: Decontaminate all wastes that contain or have come in contact with the infectious organism before disposing by autoclave, chemical disinfection, gamma irradiation, or incineration.

STORAGE: The infectious agent should be stored in leak-proof containers that are appropriately labelled.

SECTION IX - REGULATORY AND OTHER INFORMATION

REGULATORY INFORMATION: The import, transport, and use of pathogens in Canada is regulated under many regulatory bodies, including the Public Health Agency of Canada, Health Canada, Canadian Food Inspection Agency, Environment Canada, and Transport Canada. Users are responsible for ensuring they are compliant with all relevant acts, regulations, guidelines, and standards.

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PREPARED BY: Pathogen Regulation Directorate, Public Health Agency of Canada

Although the information, opinions and recommendations contained in this Pathogen Safety Data sheet are compiled from sources believed to be reliable, we accept no responsibility for the accuracy, sufficiency, or reliability or for any loss or injury resulting from the use of the information. Newly discovered hazards are frequent and this information may not be completely up to date.

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