

# PATHOGEN SAFETY DATA SHEETS: INFECTIOUS SUBSTANCES – PROTEUS SPP.

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## PATHOGEN SAFETY DATA SHEET - INFECTIOUS SUBSTANCES

### SECTION I - INFECTIOUS AGENT

**NAME:** *Proteus* spp. (human pathogens include *P. mirabilis*, *P. vulgaris*, *P. penneri*, and *P. hauseri*)

**SYNONYM OR CROSS REFERENCE:** Sometimes referred as members of the Proteaceae tribe [Footnote1](#). Former species of genus *Proteus* now homotypic synonyms with other species: *P. inconstans* with *Providencia alcalifaciens*, *P. morgani* with *Morganella morgani*, and *P. rettgeri* with *Providencia rettgeri* [Footnote2](#).

**CHARACTERISTICS:** *Proteus* spp. consist of Gram-negative, motile, aerobic rod-shaped bacilli belonging to the family Enterobacteriaceae [Footnote3](#) [Footnote4](#). Members of the Enterobacteriaceae family generally range from 0.3 to 1.0 mm in width and 0.6 to 6.0 mm in length [Footnote3](#). They are urease positive and form swarmer cells which allow for swarming motility on solid media. They are part of normal flora of human gastrointestinal tract.

### SECTION II - HAZARD IDENTIFICATION

**PATHOGENICITY/TOXICITY:** *Proteus* spp. are commonly associated with complicated urinary tract infections (UTIs) [Footnote1](#) [Footnote3](#) [Footnote5](#). They generally affect the upper urinary tract (common site of infection), causing infections such as urolithiasis (stone formation in kidney or bladder) [Footnote3](#) [Footnote4](#), cystitis [Footnote4](#), and acute pyelonephritis. Rare cases of bacteraemia, associated with UTIs, with *Proteus* spp. have also been reported [Footnote1](#). Other infections include septicaemia and wound infections. After attachment and colonization within the urinary tract, *Proteus* spp. release urease, which catalyzes the conversion of urea into ammonia and CO<sub>2</sub> [Footnote3](#) [Footnote5](#). This causes a decrease in the urine pH and may eventually lead to the formation of kidney or bladder stones. *P. mirabilis* causes the most infections among all *Proteus* spp.

**EPIDEMIOLOGY:** *Proteus* spp. infections occur worldwide and *Proteus* spp. are part of the human intestinal flora [Footnote1](#) [Footnote3](#) [Footnote5](#). They are also widespread in the environment, including animals, soil, and polluted water. They are important causative

agents in community-acquired and nosocomial UTIs; within Europe and North America, 4 to 6% of *Proteus* infections are community-acquired and 3 to 6% are nosocomial <sup>Footnote3</sup>. *Proteus* spp. are generally considered pathogenic for young individuals and opportunistic pathogens for the elderly <sup>Footnote4</sup>. The rate of infection is highest among the elderly, particularly those with indwelling catheters (long-term catheterization) or under frequent antibiotic therapy <sup>Footnote1</sup>, <sup>Footnote4</sup>, <sup>Footnote5</sup>. Other target groups include prepubescent males and females, with higher rate of infection reported among uncircumcised males <sup>Footnote4</sup>. Individuals with long-term catheterization or structural abnormalities of the urinary tract are more susceptible to infection with *Proteus* spp. <sup>Footnote1</sup>, <sup>Footnote4</sup>, <sup>Footnote5</sup>. Nosocomial outbreaks with antibiotic-resistant *Proteus* spp. have been reported <sup>Footnote4</sup>.

**HOST RANGE:** Humans <sup>Footnote3</sup>.

**INFECTIOUS DOSE:** Unknown.

**MODE OF TRANSMISSION:** *Proteus* spp. are part of the human intestinal flora <sup>Footnote1</sup>, <sup>Footnote3</sup>, <sup>Footnote5</sup> and can cause infection upon leaving this location. They may also be transmitted through contaminated catheters (particularly urinary catheters) <sup>Footnote1</sup>, <sup>Footnote4</sup>, <sup>Footnote5</sup> or by accidental parenteral inoculation. The specific mode of transmission, however, has not been identified.

**INCUBATION PERIOD:** Unknown.

**COMMUNICABILITY:** *Proteus* spp. are not known to be transmitted from person-to-person.

## SECTION III - DISSEMINATION

**RESERVOIR:** Humans <sup>Footnote1</sup>, <sup>Footnote3</sup>, <sup>Footnote4</sup>, animals, birds <sup>Footnote3</sup>, and fish. *Proteus* spp. are widespread within the environment, including soil, water, and sewerage <sup>Footnote1</sup>, <sup>Footnote4</sup>.

**ZOONOSIS:** None.

**VECTORS:** None.

## SECTION IV – STABILITY AND VIABILITY

**DRUG SUSCEPTIBILITY:** *Proteus* spp. are generally susceptible to broad-spectrum cephalosporins, aminoglycosides, and imipenem <sup>Footnote3</sup>. *P. mirabilis* is also susceptible to trimethoprim-sulfamethoxazole, ampicillin, amoxicillin, and piperacillin. *P. vulgaris* and *P. penneri* are also susceptible to cefoxitin, cefepime, and aztreonam. *P. mirabilis* is resistant to nitrofurantoin. Resistance to ciprofloxacin may develop with unrestricted use. *P. vulgaris* and *P. penneri* are resistant to piperacillin, amoxicillin, ampicillin, cefoperazone, cefuroxime, and ceftazidime. *P. penneri* is more resistant to penicillin than *P. vulgaris*. Resistance to  $\beta$ -lactamases among *Proteus* spp. is emerging <sup>Footnote4</sup>. Carbapenem resistance, including pan-resistant isolates, have been described in India <sup>Footnote6</sup>.

**SUSCEPTIBILITY TO DISINFECTANTS:** Gram-negative bacteria are generally susceptible to a number of disinfectants including phenolic compounds, hypochlorites (1% sodium hypochlorite), alcohols (70% ethanol), formaldehyde (18.5 g/L; 5% formalin in water), glutaraldehyde, and iodines (0.075 g/L) [Footnote7](#) .

**PHYSICAL INACTIVATION:** Bacteria are generally sensitive to moist heat (121 °C for at least 15 minutes) and dry heat (160 to 170 °C for at least 1 hour) [Footnote8](#) .

**SURVIVAL OUTSIDE HOST:** *Proteus* spp. survive only for a few days on inanimate surfaces; and only 1 to 2 days in the case of *P. vulgaris* [Footnote9](#) . They also survive well within the environment in soil, water, and sewage [Footnote3](#) .

## SECTION V - FIRST AID / MEDICAL

**SURVEILLANCE:** Monitor for symptoms. *Proteus* spp. can be diagnosed by isolation and differentiation with chromogenic media (i.e. by means of cultured organisms from urine and bloods samples) [Footnote3](#) .

**FIRST AID/TREATMENT:** Administer appropriate antibiotic therapy where necessary [Footnote3](#) . [Footnote4](#) . Other than that, treatment is mainly for symptoms.

**IMMUNIZATION:** None.

**PROPHYLAXIS:** None.

## SECTION VI - LABORATORY HAZARD

**LABORATORY-ACQUIRED INFECTIONS:** No cases of laboratory-acquired infection have reported to date.

**SOURCES/SPECIMENS:** Samples from urine tract, wounds, and blood samples [Footnote3](#) .

Specific sources identified include:

*P. mirabilis*: Urinary tract, blood, and cerebrospinal fluid.

*P. penneri*: Urinary tract, blood, wound, feces, eye.

*P. vulgaris*: Urinary and respiratory tract, wound, and stool.

**PRIMARY HAZARDS:** Use of contaminated catheters (particularly urinary catheters) in medical procedures [Footnote1](#) . [Footnote4](#) . [Footnote5](#) , and accidental parenteral inoculation and/or ingestion of contaminated material.

**SPECIAL HAZARDS:** None.

## SECTION VII - EXPOSURE CONTROLS / PERSONAL PROTECTION

**RISK GROUP CLASSIFICATION:** Risk Group 2 [Footnote10](#) . The risk group associated with “*Proteus* spp.” reflects the genus as a whole, but does not necessarily reflect the risk group classification of 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 [Footnote11](#). These containment requirements apply to the genus as a whole, and may not apply to each 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 to splashes [Footnote10](#).

**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 [Footnote10](#). Additional precautions should be considered with work involving animals or large scale activities.

## SECTION VIII - HANDLING AND STORAGE

**SPILLS:** Allow aerosols to settle. While wearing protective clothing, gently cover the spill with absorbent paper towel and apply appropriate disinfectant, starting at perimeter and working towards the centre. Allow sufficient contact time before clean up [Footnote11](#).

**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 [Footnote11](#).

**STORAGE:** The infectious agent should be stored in leak-proof containers that are appropriately labelled [Footnote11](#).

## 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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**Footnote 11**

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