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BACILLUS CEREUS

PATHOGEN SAFETY DATA SHEET - INFECTIOUS SUBSTANCES

SECTION I - INFECTIOUS AGENT

NAME: *Bacillus cereus*

SYNONYM OR CROSS REFERENCE: *Bacillus cereus* food-poisoning.

CHARACTERISTICS: 1.4 µm gram-positive rods, usually appear as pairs and short chains [1](#), [2](#). *B. cereus* are facultative anaerobes that are motile and able to form endospores, have colonial morphology of about 2-7 mm in diameter, and have a white granular texture [3](#). *B. cereus* grows above 10-20°C and below 35-45°C with an optimum temperature of about 37°C [1](#), [2](#). The bacteria are able to produce six types of toxins: five enterotoxins and an emetic toxin, which can be heat-stable or heat-labile depending on the strain [2](#), [4](#).

SECTION II - HAZARD IDENTIFICATION

PATHOGENICITY/TOXICITY: *B. cereus* causes self-limiting (24-48 hours) food-poisoning syndromes (a diarrheal type and an emetic type), opportunistic infections and is associated with clinical infections such as endophthalmitis and other ocular infections [2](#), [5-7](#). The diarrheal form of *B. cereus* food poisoning is characterized by abdominal cramps, profuse watery diarrhea, and rectal tenesmus, and, occasionally, fever and vomiting. The emetic form of *B. cereus* food poisoning is characterized by nausea, vomiting, and malaise, occasionally with diarrhea [2](#). *B. cereus* can cause wound infections, bacteremia, septicaemia, meningitis, pneumonia, central nervous system infections, endocarditis, pericarditis, respiratory infections, and peripheral infections [2](#), [7](#), [8](#). Infection in immunocompromised individuals can be life-threatening [5](#). *B. cereus* strains which harbour a plasmid bearing *B. anthracis*-like virulence factors can cause severe pneumonia in immunocompetent people [9](#).

EPIDEMIOLOGY: Worldwide [2](#). Diseases caused by *B. cereus* are commonly found in places where there is improper food handling. Between 1973-1985, *B. cereus* caused 17.8% of the total bacterial food poisonings in Finland, 11.5% in the Netherlands, 0.8% in Scotland, 0.7% in England and Wales, 2.2% in Canada, 0.7% in Japan, and 15.0% (between 1960-1968) in Hungary [10](#). As of 2008, 103 confirmed outbreak cases have been reported in the US [11](#). In Norway, *B. cereus* was the most common microbe isolated from foodborne illnesses in 1990 [10](#).

HOST RANGE: Animals and humans, specifically those who are immunocompromised, intravenous drug users, or neonates [1](#), [2](#), [7](#).

INFECTIOUS DOSE: In diarrheal illness, the toxin responsible is produced by organisms in the small intestine and infective dose is 10^4 - 10^9 cells per gram of food. The emetic toxin is preformed and indigested in food (about 10^5 - 10^8 cells per gram in order to produce sufficient toxin) [2](#).

MODE OF TRANSMISSION: The primary mode of transmission is via the ingestion of *B. cereus* contaminated food [1](#), [2](#): emetic type of food poisoning has been largely associated with the consumption of rice and pasta, while the diarrheal type is transmitted mostly by milk products, vegetables and meat. It forms spores and spreads easily [10](#). In hospitals, *B. cereus* can be

transmitted via contaminated linen [12](#).

INCUBATION PERIOD: The diarrheal form of *B. cereus* has an onset period of 8-16 h while the emetic form has an onset period of 1-6 h. Recovery is usually complete in 24 h [1](#), [2](#).

COMMUNICABILITY: Not transmitted from person-to-person.

SECTION III - DISSEMINATION

RESERVOIR: Animals, humans, stool, organisms in soil [10](#), straw, and foods associated with foodborne disease (rice, pasta, milk products, spices, vegetables and meat) [13](#).

ZOONOSIS: None.

VECTORS: None.

SECTION IV - STABILITY AND VIABILITY

DRUG SUSCEPTIBILITY/RESISTANCE: *B. cereus* is susceptible to imipenem and vancomycin, and most strains are sensitive to chloramphenicol, aminoglycosides, ciprofloxacin, erythromycin, and gentamicin [1](#), [2](#), [7](#), [14](#). Some strains were moderately sensitive to clindamycin and tetracycline [1](#). Clindamycin with gentamicin, given early, is the best treatment for ophthalmic infections from *B. cereus*.

DRUG RESISTANCE: *B. cereus* produce large amounts of β lactamase and are resistant to penicillin, ampicillin, cephalosporins, trimethoprim [1](#), [2](#), [7](#).

SUSCEPTIBILITY TO DISINFECTANTS: Glutaraldehyde is a chemical agent used to sterilize bacillus-contaminated material. Spores can be killed by 1% sodium hypochlorite, paracetic acid, activated hydrogen peroxide, chlorine dioxide [15](#), formaldehyde, iodine, acids, alkali [7](#), [16](#). These chemical agents should be highly concentrated and required greater time of contact to kill spores. Ozolidinones are also effective antibacterial agents for *B. cereus* [1](#).

PHYSICAL INACTIVATION: *B. cereus* can be inactivated by pulse electric field in 0.15 % NaCl solution [17](#). *B. cereus* spores can be resistant to heat and radiation, but heating at 100°C for 5 minutes results in cellular damage to the membranes and ribosomes [2](#), [18](#). Gamma irradiation at 2-5 kGy is required to inactivate *B. cereus* cells [19](#).

SURVIVAL OUTSIDE HOST: *B. cereus* survives in soil and on vegetation, and is generally heat-resistant and thus may survive thermal food processing with or without injury to cells [11](#), [20](#).

SECTION V – FIRST AID / MEDICAL

SURVEILLANCE: Monitor for symptoms. *B. cereus* strains can be isolated and grown in laboratory media at 37°C. Specimen isolated from contaminated human stool can be grown with tryptic soy broth with polymyxin [2](#). The organism can be isolated in *B. cereus* medium, i.e. in mannitol, egg yolk, polymyxin B agar (MEYP) or polymyxin B, egg yolk, mannitol, bromthymol blue agar (PEMBA). Immunological assays, polymerase chain reaction and biological tests, have been used to detect the enterotoxin activity of *B. cereus* [10](#). Isolation of greater than 10⁵ organisms/g from contaminated food can confirm *B. cereus* contamination [1](#).

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

FIRST AID/TREATMENT: Administer appropriate drug therapy with supportive treatment [6](#). Oral rehydration therapy is the treatment for acute food poisoning syndromes, and antibiotics are seldom required [21](#). Patients are given corticosteroids and antibiotics as a first line treatment for eye infections from *B. cereus* [22](#). Whenever gram-positive rods are discovered in the blood or the cerebrospinal fluid of an immunocompromised patient with clinical signs of infection, the empiric

antibiotic treatment should cover *B. cereus* (*B. cereus* is usually sensitive to clindamycin, aminoglycosides, vancomycin, chloramphenicol, and erythromycin) [1](#), [23](#).

IMMUNIZATION: None.

PROPHYLAXIS: In cases of an acute non-inflammatory infectious diarrhea, a pharmacologic prophylaxis with bismuth subsalicylate in a dose of two tablets four times daily with meals and at bedtime may be useful. Duration of use should not exceed 3 weeks [21](#).

SECTION VI - LABORATORY HAZARDS

LABORATORY ACQUIRED INFECTIONS: No reported cases.

SOURCES / SPECIMENS: Human stool [1](#), food specimens [10](#), soil [7](#), [10](#).

PRIMARY HAZARD: Ingestion of contaminated material. *B. cereus* produces toxins that can be present in food and soil [10](#).

SPECIAL HAZARD: None.

SECTION VII – EXPOSURE CONTROLS / PERSONAL PROTECTION

RISK GROUP CLASSIFICATION: Risk Group 2.

CONTAINMENT REQUIREMENTS: Containment Level 2 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials, animals, or cultures [24](#).

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 [24](#).

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 [24](#).

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 (1% sodium hypochlorite), starting at the perimeter and working towards the centre. Allow sufficient contact time before clean up.

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 [24](#).

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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