Pathogen Safety Data Sheets: Infectious Substances – Staphylococcus aureus

PATHOGEN SAFETY DATA SHEET - INFECTIOUS SUBSTANCES

SECTION I - INFECTIOUS AGENT

NAME: *Staphylococcus aureus*

SYNONYM OR CROSS REFERENCE: MRSA (methicillin-resistant *Staphylococcus aureus*), MSSA (methicillin-susceptive (or sensitive) *Staphylococcus aureus*), VISA (vancomycin-intermediate *Staphylococcus aureus*), hVISA (heteroresistant vancomycin-intermediate *Staphylococcus aureus*), VRSA (vancomycin-resistant *Staphylococcus aureus*), staph infection, staphylococcus infection, impetigo, toxic shock syndrome.

CHARACTERISTICS: *Staphylococcus aureus* are Gram-positive, catalase positive cocci belonging to the ***Staphylococcaceae*** family [1, 2]. They are approximately 0.5-1.5 µm in diameter, nonmotile, non-spore-forming, facultative anaerobes (with the exception of *S. aureus anaerobius*) that usually form in clusters. Many strains produce staphylococcal enterotoxins,

the superantigen toxic shock syndrome toxin (TSST-1), and exfoliative toxins. *Staphylococcus aureus* are part of human flora, and are primarily found in the nose and skin [3].

SECTION II - HAZARD IDENTIFICATION

PATHOGENICITY/TOXICITY: *Staphylococcus aureus* is an opportunistic pathogen that can cause a variety of self-limiting to life-threatening diseases in humans [2]. The bacteria are a leading cause of food poisoning, resulting from the consumption of food contaminated with enterotoxins [4]. Staphylococcal food intoxication involves rapid onset of nausea, vomiting, abdominal pain, cramps, and diarrhea [2, 4]. Symptoms usually resolve after 24 hours [4]. Animal bites can result in local infections, cellulitis, erythema, tenderness, mild fever, adenopathy, and lymphangitis (rarely) [5]. Scalded skin syndrome is caused by exfoliative toxins secreted on the epidermis and mostly affects neonates and young children [2]. Other skin conditions caused by Staphylococcal exfoliative toxins include blisters, skin loss, pimples, furuncles, impetigo, folliculitis, abscesses, poor temperature control, fluid loss, and secondary infection [2, 4, 6, 7]. *S. aureus* can also cause necrotizing fasciitis in immunocompromised individuals, although this is very rare [8]. Necrotizing fasciitis is life-threatening and causes severe morbidity.

Certain strains of *S. aureus* produce the superantigen TSST-1, which is responsible for 75% of toxic shock syndrome (TSS) cases [2]. The clinical presentation of TSS is severe and acute symptoms include high fever, vascular collapse, vomiting, diarrhea, myalgia, hypotension, erythematous rash, desquamation, and involvement of at least 3 organs [2, 9, 10]. Mortality is very high and death can occur within 2 hours [9]. Toxic shock syndrome is associated with vaginal colonization with toxin-producing *S. aureus* during menstruation, complications with staphylococcal infection at other sites, or

complications of surgical procedures [10]. Deep infections include endocarditis, peritonitis, necrotizing pneumonia, bacteremia, meningitis, osteomyelitis, septic arthritis, and infections of bones, joints and organs [2, 6, 7].

EPIDEMIOLOGY: Worldwide distribution. *Staphylococcus aureus* is one of the most common causes of skin, soft-tissue, and nosocomial infection [7]. Rates of infection in community settings are increasing [7, 11]. Residents of nursing homes are also at an increased risk of acquiring MRSA [12]. Around 20% of individuals are persistent carriers of *Staphylococcus aureus*, about 60% are intermittent carriers, and approximately 20% rarely carry it [3]. Children are more likely to be persistent carriers of the bacteria [3]. Young women are at a higher risk for toxic shock syndrome [10].

HOST RANGE: Humans, wild and domestic animals, including cows [13].

INFECTIOUS DOSE: At least 100,000 organisms in humans [14].

MODE OF TRANSMISSION: Ingestion of food containing enterotoxins [4]. Vertical transmission during vaginal delivery is uncommon [15]. Person-to-person transmission occurs through contact with a purulent lesion or with a carrier [3]. Unsanitary conditions and crowded community settings increase exposure to *S. aureus* [16]. Infection may be spread from person-to-person through health care workers or patients [3]. Nasal colonization can lead to auto-infection [17].

INCUBATION PERIOD: Onset of symptoms after consuming contaminated food is usually 30 minutes to 8 hours [4] . Colonies of S. aureus can be carried for an undetermined amount of time; some individuals may carry it chronically, and some may carry it intermittently [3] .

COMMUNICABILITY: Communicable period is as long as a purulent lesion is present or carrier state persists.

SECTION III - DISSEMINATION

RESERVOIR: *Staphylococcus aureus* is found in humans in the nose, groin, axillae, perineal area (males), mucous membranes, the mouth, mammary glands, hair, and the intestinal, genitourinary and upper respiratory tracts [2, 4, 18]. Many animals act as reservoirs, particularly cows with infected udders [13].

ZOONOSIS: Yes, through direct or indirect contact with an infected animal [5].

VECTORS: None.

SECTION IV - STABILITY AND VIABILITY

DRUG SUSCEPTIBILITY: Antibiotics such as cloxacillin and cephalexin are commonly used to treat staph infections [19]. Vancomycin which is administered intravenously is used to treat MRSA [20].

DRUG RESISTANCE: Many strains of Staphylococcus aureus have increasing resistance to multiple antibiotic classes [6]. Methicillin resistant strains are common causes of nosocomial infection [21]. Increasing resistance to vancomycin is being documented in many hospitals [6].

SUSCEPTIBILITY TO DISINFECTANTS: Susceptible to 70% ethanol, clorhexidine, 1% sodium hypochlorite, 2% glutaraldehyde, 0.25% benzalkonium chloride, and formaldehyde [12, 22, 23].

PHYSICAL INACTIVATION: *Staphylococcus aureus* can grow in a pH of 4.2 to 9.3 and in salt concentrations of up to 15% [4]. Enterotoxins are resistant to temperatures that would destroy the bacilli [4]. Sensitive to dry heat treatment of 160-170^{o}C for at least an hour, but not to moist heat treatment [24].

SURVIVAL OUTSIDE HOST: Survives on carcasses and organs (up to 42 days), floors (less than 7 days), glass (46 hours), sunlight (17 hours), UV (7 hours), meat products (60 days), coins (up to 7 days), skin (30 minutes to 38 days) (citation needed). Depending on colony size, *S. aureus* can survive on fabrics from days to months [25].

SECTION V – FIRST AID / MEDICAL

SURVEILLANCE: Monitor for symptoms. In outbreak settings, food poisoning can be diagnosed on clinical grounds with food cultured for *S. aureus* [2]. Toxic shock syndrome can be indicated with a clinical diagnosis and isolation of *S. aureus* strain, TSST-1, or enterotoxins B or C. This can be achieved using ELISA, reverse passive latex agglutination, or PCR. Scalded skin syndrome can be diagnosed clinically, with presence of Nikolsky's sign and identification of *S. aureus* retrieved from the infection site. Bacteremia and deep site infections are confirmed with direct microscopic examination of clinical specimen.

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

FIRST AID/TREATMENT: Treatment of abscesses usually does not need antibiotic therapy; appropriate drainage is usually sufficient [6] . Proper antibiotic therapy is required for more serious infections.

IMMUNIZATION: None [2].

PROPHYLAXIS: Elimination of nasal carriage by using topical mupirocin also eliminates hand carriage [3].

SECTION VI - LABORATORY HAZARDS

LABORATORY-ACQUIRED INFECTIONS: 29 reported cases as of 1973, with 1 death [26].

SOURCE/SPECIMENS: Infective stages may be present in CSF, joint aspirates, blood, abscesses, aerosols, faeces, and urine [2, 4, 6, 18].

PRIMARY HAZARDS: Trauma of cutaneous barrier, parenteral inoculation, direct implantation of medical devices (i.e. indwelling catheters and IVs), ingestion of infected material, and contact with aerosols [2, 4, 18].

SPECIAL HAZARDS: Contaminated request forms that have been wrapped around specimen containers [21]. Direct contact with open cuts and lesions of skin.

SECTION VII – EXPOSURE CONTROLS / PERSONAL PROTECTION

RISK GROUP CLASSIFICATION: Risk Group 2 [27].

CONTAINMENT REQUIREMENTS: Containment Level 2 facilities, equipment, and operational practices for work involving infectious or potentially infectious materials, animals, or cultures.

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 [28].

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 [28].

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.

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.

UPDATED: December 2011

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

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Date modified:

2012-04-30