## Raw Milk Contaminants and Pathogens

**Key:**
- O – known outbreaks (P-pasteurized milk only)
- H – historical importance
- R – rare disease occurrence
- T – theoretical disease transmission
- Z/H – zoonotic or human disease transmission

**List of agents known or theoretically possible in raw milk. Agents listed alphabetically.**

Category – B bacterial; C chemical; P parasites; V viral.

<table>
<thead>
<tr>
<th>Agent</th>
<th>Cat</th>
<th>Disease</th>
<th>O</th>
<th>H</th>
<th>R/T</th>
<th>Z/H</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>C</td>
<td>Arsenic</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>Z</td>
<td>[1]</td>
</tr>
</tbody>
</table>
| *Brucella abortus*  
*B. melitensis*  
*B. suis*  
*B. canis* | B | Brucellosis | ✓ | ✓ |   | Z   | [2, 3] |
| *Campylobacter jejuni*  
*Campylobacter coli* | B | Campylobacteriosis  
Guillain-Barré syndrome | ✓ | ✓ |   | Z   | [4-9] |
| *Corynebacterium diphtheriae* | B | Diptheria | ✓ | ✓ |   | H   | [3, 10] |
| *Corynebacterium pseudotuberculosis* | B |   |   |   |   | [3] |
| *Coxiella burnetii* | B | Q-Fever | ✓ | R | Z   | [1, 11] |
| *Cryptosporidium parvum*  
*Cryptosporidium andersoni* | P | Cryptosporidiosis | ✓ | R | Z   | [12] |
| *Escherichia coli* 0157:H7  
*E.coli* verotoxigenic | B | EHEC – enterohaemorrhagic E.coli  
HUS – haemolytic uremic syndrome | ✓ |   | ✓  | Z   | [13-18] |
| Hepatitis A | V | Jaundice (infectious hepatitis) | ✓ |   | R | H   | [1] |
| Histamine | C | Histamine intoxication | ✓ |   |   |   | [1] |
| Iron | C | Iron intoxication |   |   | R   |   | [1] |
| *Ixodes persulcatus*  
*Ixodes ricinis* | P | Tickborne encephalitis |   |   | T | Z   | [19-21] |
| *Listeria monocyctogenes* | B | Listeriosis | ✓ |   |   | Z   | [22-25] |
| *Lyssavirus* (Rhabdovirus family) | V | Rabies | ✓ |   | T   | Z   | [26-28] |
| *Mycobacterium bovis*  
*Mycobacterium tuberculosis* | B | Tuberculosis | ✓ | ✓ |   | Z   | [1, 3, 23, 29] |
| Poliovirus types 1, 2, 3  
(genus *Enterovirus*) | V | Poliomyelitis | ✓ | R | H   | [1] |
| *Pseudomonas aeruginosa* | B | Pseudomonas ententis | ✓ |   | R   | Z   | [1] |
| *Salmonella enterica*  
subsp. enterica serovar  
Typhi or S. Typhi | B | Typhoid Fever | ✓ |   |   | H   | [1, 10, 30-35] |
| *S. Paratyphi A*  
*S. Paratyphi B* | B | Paratyphoid Fever | ✓ | R | H   | [10] |
| *Salmonella* spp. | B | Salmonellosis | ✓ |   |   | Z   | [25, 30-37] |
| *Shigella dysenteriae*  
*S. flexneri*  
*S. sonnei* | B | Shigellosis | ✓ | ✓ |   | H   | [38] |

Prepared by Food Protection Services, BC Centre for Disease Control
### Diseases caused by Raw Milk

**References for this section are:**

i) Diagnosis and Management of Foodborne Illnesses: A Primer for Physicians and Other Health Care Professionals. Feb, 2004.

ii) [44]

iii) As noted.

### Arsenic, Iron


**Symptoms:**
- vomiting
- colic
- diarrhea
- lethargy
- hyperactivity
- chest pain
- headache
- stomach pains

**Incubation:** few hours

**Duration:** variable (few days to chronic)

**Infections and Complications:**
- long-term physical/mental complaints
- neurological damage
- kidney damage (eosinophilia)
- cardiovascular effects
- reproductive toxicity

**Fatality Rate:**

### Brainerd Diarrhea (unknown)

**Symptoms:**
- diarrhea, watery (acute onset)
- urgency

**Incubation:**

**Duration:** long – 2 to 36 months (median 16.5 months)
Infections and Complications: - no response to antibiotics
Fatality Rate:

**Brucellosis (Brucella spp.)**
Symptoms: - fever acute or insidious with continued intermittent or irregular fever of variable duration
- headache
- weakness
- profuse sweating
- chills
- arthralgia
- weight loss
- generalized aching
- depression
- bloody stools during acute phase
Incubation: 5 to 60 days
Duration: days, months up to a year
Infections and Complications:
- suppurative (pus forming) infections of liver, spleen
- chronic localized infections
- chronic joint pain in 20-60% of patients (osteoarticular complications, e.g., sacroiliitis)
- genitourinary in 2 to 20% (e.g., orchitis, epididymitis)
- endocarditis
Fatality Rate: <2%

**Campylobacteriosis (Campylobacter spp.)**
Symptoms: - diarrhea (frequently with bloody stools)
- abdominal pain
- malaise
- fever
- nausea
- vomiting
Incubation: 2 to 10 days
Duration: one week, occasional prolonged illness, relapses in adults
Infections and Complications:
- typhoid-like syndrome
- meningeal syndrome
- febrile convulsions
- Guillain-Barré syndrome
Fatality Rate:

**Cryptosporidiosis (Cryptosporidium spp.)**
Symptoms: - diarrhea, profuse and watery. In children anorexia & vomiting prior to diarrheal onset
- cramping abdominal pain
- general malaise
- fever
- anorexia
- nausea
- vomiting
Incubation: 1 to 12 days (average 7 days)
Duration: weeks to months for immunocompetent
Infections and Complications:
- immunodeficient (especially HIV) prolonged, fulminant disease
- cholecystitis in biliary tract infections
- symptoms wax and wane (remit and relapse weeks to months)
Fatality Rate: can be significant in immunodeficient
**Diptheria (Corynebacterium diptheriae)**

Symptoms: - moderate to severe sore throat (involves tonsils, larynx, nose, membranes)
- tender enlarged lymph nodes
- swelling and oedema of neck; airway obstruction

Incubation: 2 to 5 days
Duration: (?) ~2 weeks, communicable for up to 4 weeks
Infections and complications: - chronic nasal discharge
Complications: - myocarditis (from toxin) leading to heart block and progressive congestive failure in ~ 1 week
- lesions (excoriations)
- neuropathies (mimic Guillan-Barré)

Fatality Rate: 5 to 10% of noncutaneous diphtheria

**Enterohaemorrhagic E.coli Infections (E.coli 0157:H7)**

Symptoms: - diarrhea (severe, bloody to mild)
- abdominal pain
- vomiting
- absence of fever

Incubation: 1 to 10 days, median 3 to 4 days
Duration: 5 to 10 days, up to 3 weeks in children
Complications: - Hemolytic uraemic syndrome (HUS), 8% of people progress to this syndrome

**Guillain-Barré Syndrome**

[Ref: http://en.wikipedia.org/wiki/Guillain-Barr%C3%A9_syndrome]

Acute inflammatory demyelinating polyneuropathy: an autoimmune disease affecting the peripheral nervous system, usually triggered by an acute infectious process. Causes ascending paralysis, weakness in the legs spreading to upper limbs and the face along with complete loss of deep tendon reflexes.

**Haverhill Fever (Streptobacillus moniliformis)**

Symptoms: - chills
- fever
- headache
- muscle pain
- maculopapular rash on extremities
- swollen joints

Incubation: 3 to 10 days
Duration: relapses common
Complications: - bacterial endocarditis
- pericarditis
- parotitis
- tenosynovitis
- focal abscesses of soft tissues or brain

Fatality Rate: 7 to 10% in untreated cases
Hemolytic Uraemic Syndrome
A disease characterized by hemolytic anemia, acute renal failure (uremia) and a low platelet count (thrombocytopenia).

Histamine
Symptoms: - headache
- nausea
- vomiting
- facial flushing
- burning throat
- thirst
- swelling of lips
- urticaria
- sweating
- palpitations
- dizziness
- rash
Incubation: minutes to a few hours
Duration: 12 hours, symptoms resolve spontaneously
Infections and complications: - hypertension
Fatality Rate:
Note: Histamine is found in cheese, and is formed when histidine is decarboxylated to histamine. Many Enterobacteriaceae, enterococci, and Lactobacillus casei produce the enzyme, decarbocylase.

Jaundice (Infectious Hepatitis)
Symptoms: - fever
- malaise
- anorexia
- nausea
- abdominal discomfort
- jaundice
Incubation: 15 to 50 days (average 28 to 30 days)
Duration: mild (1 to 2 weeks), severe (several months)
Infections and complications: - prolonged, relapsing hepatitis for up to one year (15% of cases)
Fatality Rate: 0.1% to 0.3%; 1.8% in adults over 50.

Listeriosis (Listeria monocytogenes)
Symptoms: - fever
- intense headache
- nausea
- vomiting
Incubation: 3 to 70 days (median 3 weeks)
Duration: variable
Infections and complications: - meningoencephalitis &/or septicemia in new-borns and adults
- fever and abortion in pregnant women
- delirium, coma; occasionally collapse and shock
Fatality Rate: 30% in newborns and approaches 50% when onset occurs in the first 4 days. Higher in the elderly.
Milk Sickness (Tremetol)
Symptoms: - weakness
- prostration
- loss of appetite
- abdominal pain
- nausea
- vomiting
- muscular tremors
- coma

Incubation:
Duration:
Infections and -
Complications: -
Fatality Rate: frequent
Note: grazing animals eliminate trematol (a higher alcohol which is toxic to the liver) as a result of eating leaves and stems of white snakeroot (Eupatorium rugosum) or rayless goldenrod Aplopappus heterophyllus or Isocoma wrightii).

Poliomyelitis (Enterovirus)
Symptoms: - 'minor' in 10% of cases.
- fever
- malaise
- headache
- nausea
- vomiting
- 'major' illness, also includes following symptoms:
  - sever muscle pain
  - stiffness of muscle and back
  - flaccid paralysis (asymmetric)

Incubation: 7 to 14 days (range 3 to 35 days)
Duration: infectivity in stool is up to 3 weeks
Infections and - acute onset of flaccid paralysis occurs in 1% of cases
Complications: - aseptic meningitis occurs in 1% of cases
- paralysis present after 60 days likely to be permanent
- "postpolio syndrome", recurrence of paralysis years after infection
Fatality Rate:
Special note: This is a preventable disease through vaccination. At risk groups would be those refusing vaccination exposed to drinking raw milk that becomes contaminated by handling with persons with the infection (fecal transmission to milk).

Pseudomonas enteritis (Pseudomonas aeruginosa)
Symptoms: - vomiting
- diarrhea

Incubation:
Duration:
Infections and - all outbreaks involved infants
Complications: -
Fatality Rate:
**Q-fever (Coxiella burnetti)**

**Symptoms:**
- chills
- headache
- weakness
- malaise
- severe sweats

**Incubation:** 2 to 3 weeks

**Duration:**

**Infections and Complications:**
- chronic Q-fever results in endocarditis, may present up to 2 yrs after initial infection
- post Q-fever fatigue syndrome

**Fatality Rate:**
- acute, untreated <1% to 2.4%

**Septic Sore Throat (Streptococci pyogenes)**

**Symptoms:**
- fever (sudden onset)
- exudative tonsillitis or pharyngitis (sore throat)
- tender lymph nodes

**Incubation:** 1 to 3 days

**Duration:**
- untreated communicability is 10 to 21 days (can be treated with penicillin), but may be carried for several months

**Infections and Complications:**
- otitis media
- peritonsillar abscess
- acute glomular nephritis (onset 1 to 5 weeks, mean 10 days)
- acute rheumatic fever (onset mean 19 days)
- rheumatic heart (valvular) disease may occur days to weeks after infection
- Sydenham chorea may occur several months after infection

**Fatality Rate:**

**Scarlet Fever (Streptococci pyogenes)**

**Symptoms:**
- all symptoms associated with septic sore throat, plus;
- skin rash (from production of pyrogenic exotoxin)
- enanthem, strawberry tongue, exanthema
- fever rash not on face (typically), but there is flushing of cheeks and circumoral pallor

**Incubation:** 1 to 3 days

**Duration:**
- untreated communicability 10 to 21 days (can be treated with penicillin)

**Infections and Complications:**
- severe infections have high fever, nausea and vomiting
- desquamation of the skin at tips of fingers and toes

**Fatality Rate:**
- as high as 3%

**Salmonellosis (Salmonella spp.)**

**Symptoms:**
- acute enterocolitis
- headache
- fever
- abdominal pain
- diarrhea
- nausea
- vomiting
- dehydration (severe in children and the elderly)

**Incubation:** 6 to 72 hours, usually 12 to 26 hours

**Duration:** 4 to 7 days (sometimes weeks)
Salmonellosis (Salmonella spp.) – continued:
Infections and Complications:
- septicemia
- focal infection
- abscesses
- septic arthritis
- cholecystitis
- endocarditis
- meningitis
- pericarditis
- pneumonia
- pyoderma
- pyelonephritis
Fatality Rate: rare

Typhoid and Paratyphoid Fever (S. Typhi, S. Paratyphi)
Symptoms:
- fever
- headache
- malaise
- anorexia
- bradycardia
- splenomegaly
- cough
- rose spots on trunk
- constipation
Incubation: Typhoid: 3 to 60 days, usually 8-14 days; Paratyphoid: 1 to 10 days
Duration: 4 to 7 days
Infections and Complications:
- mild illness is gastroenteritis (see Salmonellosis)
- severe illness becomes systemic with potential for following symptoms;
  - non-sweating fevers, mental dullness, slight deafness, parotitis
  - peyer patches in ileum can ulcerate, intestinal hemorrhage in 1%
  - 15 to 20% may experience relapses
Fatality Rate: without antibiotics, 10 to 20%; with antibiotics <1%
Special Note: 2 to 5% become permanent carriers (exclude from food handling)

Shigellosis (Shigella spp.)
Symptoms:
- diarrhea (with blood and mucus)
- fever
- nausea
- toxaemia
- cramps
- tenesmus
Incubation: 12 to 96 hours, usually 1 to 3 days
Duration: 4 to 7 days
Infections and Complications:
- convulsions in young children
- S. dysenteriae type 1: toxic megacolon, intestinal perforation
- S. dysenteriae type 1HUS
- S. flexneri: reactive arthropathy (Reiter syndrome)
Fatality Rate: S. dysenteriae type 1 – up to 20%
**Staphylococcal intoxication (Staphylococcus aureus)**

Symptoms:  
- vomiting  
- nausea  
- cramps  
- prostration  
- diarrhea

Incubation: 30 minutes up to 8 hours (usually 2 to 4 hours)

Duration: 24 to 48 hours

Infections and complications:  
- abrupt and violent onset of vomiting, may require hospitalization

Fatality Rate: rare

**MRSA (Methicillin resistant Staphylococcus aureus)**

Symptoms:  
- skin lesions  
- fever  
- malaise  
- headache  
- anorexia

Incubation: variable

Duration:

Infections and complications:  
- pneumonia  
- lung abscess  
- osteomyelitis  
- sepsis  
- endocarditis  
- arthritis  
- meningitis  
- toxic shock syndrome

Fatality Rate:

**Tickborne encephalitis (Ixodes spp.)**

Symptoms:  
- focal epilepsy  
- flaccid paralysis  
- fever

Incubation: 7 to 14 days

Duration: 3 weeks

Infections and complications:  
- fever and meningoencephalitis follow 4 to 10 days after apparent recovery

Complications:  
- death and severe residua may occur

Fatality Rate: up to 10% with Powassan encephalitis (PE)

Note: Ticks (Ixodes spp.) carry flaviviruses that cause the infection. CEE or Central European tick-borne encephalitis is also known as diphagic milk fever or diphagic meningoencephalitis. Powassan virus is present in Canada. Tick biting season peaks in Canada from June to September.
**Toxoplasmosis** (*Toxoplasma gondii*)

**Symptoms:**
- swollen/enlarged lymph nodes
- fever
- lymphocytosis (increase in lymphocyte counts in blood)

**Incubation:** 5 to 23 days

**Duration:** months

**Infections and Complications:**
- immunodeficient (especially HIV) other symptoms;
  - maculopapular rash
  - generalized skeletal muscle involvement
  - cerebritis
  - chorioretinitis
  - pneumonia
  - myocarditis
  - cerebral toxoplasmosis
  - death
  - infection during early pregnancy causing fetal infection;
    - death of fetus
    - chorioretinitis
    - brain damage
    - hydrocephaly
    - microcephaly
    - fever
    - jaundice
    - rash
    - hepatosplenomegaly
    - xanthochromic CSF
    - convulsions at birth or afterwards

**Fatality Rate:**
- significant in immunodeficient individuals and early fetal infections

**Tuberculosis (bovine)** (*Mycobacterium bovis*)

**Symptoms:**
- lung lesions (pulmonary)
- lesions in other organs (extrapulmonary): lymph nodes, pleura, pericardium, joints etc.

**Incubation:** 2 to 10 weeks

**Duration:** years

**Infections and Complications:**
- 10% of those initially infected will develop active infection
  - HIV+ more at risk
  - drug resistance problematic

**Fatality Rate:**
- significant, 65% of those infected will die within 5 years (if untreated)

**Yersiniosis** (*Yersinia enterolitica*)

**Symptoms:**
- fever
- diarrhea
- abdominal pain (especially in children)
- acute mesenteric lymphadenitis (mimics appendicitis)

**Incubation:** 24 hrs to 7 days (usually <10 days)

**Duration:** 1 to 3 weeks

**Infections and Complications:**
- systemic infections
  - reactive arthritis
  - Reiter syndrome
  - erythema nodosum (red nodules on the skin – inflammation of subcutaneous fat)
  - septicaemia

**Fatality Rate:**
References: