

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.

Agent	Cat	Disease	O	H	R/T	Z/H	Refs
Arsenic	C	Arsenic	✓ (P)		R		[1]
<i>Brucella abortus</i> <i>B. melitensis</i> <i>B. suis</i> <i>B. canis</i>	B	Brucellosis	✓	✓		Z	[2, 3]
<i>Campylobacter jejuni</i> <i>Campylobacter coli</i>	B	Campylobacteriosis Guillain-Barré syndrome	✓			Z	[4-9]
<i>Corynebacterium diphtheriae</i>	B	Diphtheria	✓	✓		H	[3, 10]
<i>Corynebacterium pseudotuberculosis</i>	B				R		[3]
<i>Coxiella burnetti</i>	B	Q-Fever		✓	R	Z	[1, 11]
<i>Cryptosporidium parvum</i> <i>Cryptosporidium andersoni</i>	P	Cryptosporidiosis	✓		R	Z	[12]
<i>Escherichia coli</i> 0157:H7 <i>E.coli</i> verotoxigenic	B	EHEC – enterohaemorrhagic <i>E.coli</i> 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]
<i>Ixodes persulcatus</i> <i>Ixodes ricinus</i>	P	Tickborne encephalitis			T	Z	[19-21]
<i>Listeria monocytogenes</i>	B	Listeriosis	✓			Z	[22-25]
<i>Lyssavirus</i> (Rhabdovirus family)	V	Rabies			T		[26-28]
<i>Mycobacterium bovis</i> <i>Mycobacterium tuberculosis</i>	B	Tuberculosis	✓	✓		Z	[1, 3, 23, 29]
Poliovirus types 1, 2, 3 (genus <i>Enterovirus</i>)	V	Poliomyelitis		✓	R	H	[1]
<i>Pseudomonas aeruginosa</i>	B	<i>Pseudomonas</i> enteritis	✓ (P)	✓	R		[1]
<i>Salmonella enterica</i> subsp. <i>enterica</i> serovar Typhi or <i>S. Typhi</i>	B	Typhoid Fever	✓			H	[1, 10, 30- 35]
<i>S. Paratyphi</i> A <i>S. Paratyphi</i> B	B	Paratyphoid Fever	✓		R	H	[10]
<i>Salmonella</i> spp.	B	Salmonellosis	✓			Z	[25, 30-37]
<i>Shigella dysenteriae</i> , <i>S.</i> <i>flexneri</i> , <i>S. sonnei</i>	B	Shigellosis	✓	✓		H	[38]

Agent	Cat	Disease	O	H	R/T	Z/H	Refs
<i>Staphylococcus aureus</i> – antibiotic resistant strains	B	MRSA			T*	H	
<i>Staphylococcus aureus</i> enterotoxins	B	Staphylococcal intoxication	✓	✓		H	[39]
<i>Streptobacillus moniliformis</i>	B	Haverhill fever (Rat-bite fever)	✓	✓	R	Z	[1, 3]
<i>Streptococci pyogenes</i> (Group A)	B	Scarlet Fever	✓	✓		H	[1, 10]
<i>Streptococci pyogenes</i> (Group A)	B	Septic Sore Throat	✓	✓		H	[1, 10]
<i>Toxoplasma gondii</i>	P	Toxoplasmosis			R	Z	[1, 23]
Tremetol	C	Milk Sickness		✓		Z	[1]
Unknown		Brainerd diarrhea syndrome			R		[40]
<i>Yersinia enterocolitica</i>	B	Yersiniosis	✓			Z	[3, 23, 41-43]

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

[http://en.wikipedia.org/wiki/Arsenic_poisoning]

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

Incubation: few hours

Duration: variable (few days to chronic)

Infections and - long-term physical/mental complaints

Complications: - 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 - no response to antibiotics
Complications: -
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 - suppurative (pus forming) infections of liver, spleen
Complications: - 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 - typhoid-like syndrome
Complications: - meningial syndrome
- febrile convulsions
- Guillan-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 - immunodeficient (especially HIV) prolonged, fulminant disease
Complications: - cholecystitis in biliary tract infections
- symptoms wax and wane (remit and relapse weeks to months)
Fatality Rate: can be significant in immunodeficient

Diphtheria (*Corynebacterium diphtheriae*)

- 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
- 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
- Infections and Complications: - Hemolytic uraemic syndrome (HUS), 8% of people progress to this syndrome
- Fatality Rate:

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
- Infections and Complications: - Untreated cases may result in the following:
- bacterial endocarditis
- pericarditis
- parotitis
- tenosynovitis
- focal abscesses of soft tissues or brain
- Fatality Rate: 7 to 10% in untreated cases

Hemolytic Uraemic Syndrome

[Ref http://en.wikipedia.org/wiki/Hemolytic-uremic_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 - hypertension

Complications: - cerebrovascular accidents

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, decarboxylase.

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 - prolonged, relapsing hepatitis for up to one year (15% of cases)

Complications: - chronic infection may occur

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 - meningoencephalitis &/or septicemia in new-borns and adults

Complications: - 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 - chronic Q-fever results in endocarditis, may present up to 2 yrs after initial infection
- Complications: - post Q-fever fatigue syndrome
- Fatality Rate: acute, untreated <1% to 2.4%

Septic Sore Throat (*Streptococci pyrogenes*)

- 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 - otitis media
- Complications: - peritonsillar abscess
 - acute glomerular 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 pyrogenes*)

- 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 - severe infections have high fever, nausea and vomiting
- Complications: - 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 - septicemia
Complications: - 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 - mild illness is gastroenteritis (see Salmonellosis)
Complications: - 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
- toxemia
- cramps
- tenesmus
Incubation: 12 to 96 hours, usually 1 to 3 days
Duration: 4 to 7 days
Infections and - convulsions in young children
Complications: - *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 - abrupt and violent onset of vomiting, may require hospitalization
Complications: -
Fatality Rate: rare

MRSA (Methicillin resistant *Staphylococcus aureus*)

Symptoms: - skin lesions
 - fever
 - malaise
 - headache
 - anorexia
Incubation: variable
Duration:
Infections and - pneumonia
Complications: - 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 - 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 diphasic milk fever or diphasic 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 enterocolitica*)

- 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)
 - septicemia
- Fatality Rate:

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