

POLLUTANTS AND HEALTH RISKS ASSOCIATED WITH CONCENTRATED ANIMAL FEEDING OPERATIONS

Pollutant/Threat	Problems Associated with Pollutant or Health Threat
Ammonia (NH ₃)	<p>Ammonia gas presents numerous health risks to humans and the environment. Hog waste also causes elevated ammonium levels when it reaches groundwater and surface waters.</p> <ul style="list-style-type: none"> • Ammonia may absorb dust particles that may then be carried into the lungs • Ammonia gas is released into the air when hog waste is sprayed onto fields. 70-80% of the nitrogen in hog lagoons enters the environment as airborne ammonia gas. The ammonia then falls to earth as rain that triggers algal blooms. • At sufficiently high levels, ammonium causes injury or death to fish and other aquatic life • Once the ammonia is changed from a liquid to gaseous state, it can be redeposited onto the land and water as far away as 300 miles. • Exposure levels <ul style="list-style-type: none"> ○ Maximum allowable concentrations of 50 ppm under OSHA regulations ○ Becomes a throat irritant at 400 ppm ○ Eye irritant at 700 ppm ○ Causes coughing and frothing at 1,700 ppm ○ An exposure of 3,000 ppm for 30 minutes causes asphyxiation ○ An exposure of 5,000 ppm for 40 minutes causes death • Although ammonia can cause eye irritation or even death at high levels, ammonia emissions associated with lagoon systems may not be at levels as toxic as other gases
Antibiotic Resistant Organisms	<p>Antibiotics are added to livestock feed and water to promote growth and prevent disease in crowded conditions. Microorganisms are so numerous and adept to exchanging genetic makeup that some escape the effects of the antibiotics. Over time, these hardy strains come to predominate in the population and the antibiotics are no longer effective. Antibiotic use in factory farm operations raises concerns because many antibiotics can no longer effectively battle infectious diseases because bacteria are resistant to them. Scientists and medical professionals are most concerned about factory farms using antibiotics similar to those used in human medicine</p> <ul style="list-style-type: none"> • The Union of Concerned Scientists estimated that livestock producers in the US use 24.6 million pounds of antimicrobials each year for nontherapeutic purposes, compared to just 3 million pounds used by humans to treat diseases • Concerned about the health risks of this practice, the American Medical Association (AMA) passed a resolution in June 2001 stating, the “AMA is opposed to the use of antimicrobials at nontherapeutic levels in agriculture or as pesticides or growth promoters and urges that non-therapeutic use in animals of antimicrobials (that are also used in humans) should be terminated or phased out.”

	<ul style="list-style-type: none"> • According to EPA’s National Research Exposure Laboratory, “in some cases as much as 80% of antibiotics administered orally pass through the animal unchanged into bacteria-rich waste lagoons and is then spread on croplands as fertilizer leaving antibiotics available for entry into groundwater and runoff into surface waters carrying both the drugs and resistant bacteria or genetic material to other bacteria in soils and waterways.” • Antibiotics commonly used in humans or closely related to those used in humans include: <ul style="list-style-type: none"> ○ Penicillins ○ Tetracyclines ○ Macrolides (including but not limited to erythromycin and tylosin) ○ Lincomycin ○ Bacitracin ○ Virginiamycin ○ Aminoglycosides ○ Sulfonamides • Also concern about the nontherapeutic use of Fluoroquinolones because these are used in a “last ditch” effort to treat humans. These include such drugs as Cypro.
Campylobacter	<p>Bacteria that is passed to humans from animals in food products. Bacteria can also infect humans through contaminated drinking water caused by runoff or leaching from animal waste application areas.</p> <ul style="list-style-type: none"> • This Bacteria is the cause of the most common form of food-borne illness • There are 16 species and 6 subspecies of Campylobacter, the most common of which are: <i>C. jejuni</i>, <i>C. coli</i>, <i>C. laridis</i> and <i>C. upsaliensis</i> • Health problems associated with a Campylobacter infection include: diarrhea (frequently with blood in the feces), abdominal pain, fever, headache, nausea and/or vomiting. <ul style="list-style-type: none"> ○ The symptoms typically last three to six days. ○ The onset of symptoms typically occurs two to five days after infection, but can range from one to ten days. • Fatalities are rare, but when they occur it is usually in infants and children, elderly, or those suffering from another serious disease such as AIDS. • Complications from infection include: bacteremia, hepatitis, pancreatitis, and abortion. Post-infection complications include: reactive arthritis and neurological disorders such as Guillain-Barre syndrome. • 18% of all Campylobacter infections requiring treatment by a physician are resistant to a Fluoroquinolone antibiotic, the treatment of choice for food poisoning
Carbon Dioxide (CO ₂)	<p>Organic matter in manure is converted to carbon dioxide during the decomposition process in waste lagoons. Carbon dioxide usually settles at the bottom of a pit.</p> <ul style="list-style-type: none"> • Carbon dioxide is not highly toxic, but it contributes to oxygen deficiency or asphyxiation • Health problems associated with high levels of carbon dioxide include respiratory problems, eye irritation and headaches

	<ul style="list-style-type: none"> • Exposure levels <ul style="list-style-type: none"> ○ Maximum allowable concentration is 5,000 ppm ○ Increased breathing occurs at 30,000 ppm ○ Drowsiness and headache occurs at 40,000 ppm ○ Heavy, asphyxiating breathing occurs at 60,000 ppm ○ Can be fatal after 30 minutes of exposure at 300,000 ppm • Carbon dioxide is also a greenhouse gas that contributes to global climate change
Cryptosporidium	<p>Cryptosporidium parvum is a microscopic parasite. The parasite produces cysts that are very resistant to harsh environmental conditions. When ingested, the parasites germinate, reproduce and cause illness. After feeding, the parasites form new cysts, which are then passed in the feces.</p> <ul style="list-style-type: none"> • Cryptosporidiosis is one of the most common causes of waterborne disease (drinking and recreational) in humans in the US • Infection occurs because of contact with the bacteria, which can be found in soil, food, water or surfaces that have been contaminated with the feces from infected humans or animals <ul style="list-style-type: none"> ○ Crypto is not spread by contact with blood ○ Crypto can be spread by putting in your mouth or accidentally swallowing something that has come in contact with the stool of an infected animal or person ○ Swallowing recreational water that is contaminated can spread Crypto. This is particularly concerning because Crypto is chlorine resistant and can live for days in pools. ○ Eating uncooked meat contaminated with Crypto can cause infection • Poses a problem to manure and wastewater processing because it is resistant to most treatment protocols, such as chlorine disinfection. • In healthy persons, Cryptosporidiosis lasts for a few days and causes diarrhea, vomiting, stomach cramps and fever. Symptoms generally occur two to ten days after being infected. • Particularly likely to affect infants, the elderly or persons with compromised immune systems (such as cancer or AIDS patients)
Erysipeloid (most likely occupationally related)	<p>A bacterium that results from handling infected animals or food products. The bacterium enters the skin through scratches or pricks. In the skin, the organism is capable of producing certain enzymes that help it dissect its way through the tissue. The bacteria may also spread in the body by way of the vascular system to the joints, heart, brain, central nervous system and lungs. This disease is more likely to occur among farmers and meat processors/packers.</p> <ul style="list-style-type: none"> • Symptoms include red, dark swollen lesions, which often appear on the hands. Symptoms may also include: fever, fatigue, chills, weight loss, joint pain, coughing, and headaches • Can result in death if the infected person is not treated
Escherichia coli (E. coli)	<p>E. coli is a bacteria that is passed to humans from animals in food products OR from human contact with infected animal or its manure. This bacteria can also infect humans through contaminated drinking water caused by runoff or leaching from animal waste application areas.</p>

	<ul style="list-style-type: none"> • Symptoms start about 7 days after infection <ul style="list-style-type: none"> ○ The first sign of E. coli is sudden and severe abdominal cramps ○ After a few hours, a person will start having watery diarrhea. Diarrhea causes the loss of fluids and electrolytes, resulting in dehydration. This will last for about one day. ○ The watery diarrhea will then change to bright red, bloody stool. The bacteria causes sores in the intestines, that result in bloody stool. Bloody diarrhea lasts for two to five days, with as many as ten bowel movements a day. ○ Symptoms may also include fever, nausea and/or vomiting • The most common complication from E. coli infection is hemolytic uremic syndrome. This may result in low red blood cell counts, low platelet counts, and kidney damage. Hemolytic uremic syndrome usually begins five to ten days after diarrhea starts. Hospitalization is required to treat this condition. • Particularly likely to affect infants, the elderly or persons with compromised immune systems (such as cancer or AIDS patients)
Giardia	<p>Giardiasis is caused by the parasite giardia. The parasite is passed to humans from contact with an infected animal's manure or an infected person's stool. The parasite can also infect humans through contaminated drinking water caused by runoff or leaching from animal waste application areas.</p> <ul style="list-style-type: none"> • The parasites produce cysts that are very resistant to harsh environmental conditions. When ingested, the parasites germinate, reproduce and cause illness. After feeding, the parasites form new cysts, which are then passed in the feces. • Infection occurs by: <ul style="list-style-type: none"> ○ Direct hand to mouth transfer from the stool of an infected person or animal ○ Swallowing water that has been contaminated with stool that contains giardia ○ Swimming in untreated and contaminated water • Symptoms include: diarrhea, bloating, nausea, abdominal cramps, fatigue and weight loss. Vomiting, chills, headache and fever may also occur. <ul style="list-style-type: none"> ○ Diarrhea may last for days or weeks. However, this symptom may not be constant. ○ Symptoms usually start 5 to 25 days after exposure. Some infected people never experience symptoms. • Healthy people are generally not treated for symptoms. The symptoms stop after about one month • Anti-parasitic drugs are used for immunocompromised people in whom the disease could develop into a persistent state
Hepatitis E (HEV)	<p>Hepatitis E is a virus that can be passed from pigs to humans. HEV is transmitted by the fecal to oral route. Waterborne transmission is one method that HEV is spread. Waterborne epidemics have occurred in Asia and North and East Africa. The spread of HEV can also occur through person to person contact and food-borne transmission. To date no US outbreaks have occurred.</p> <ul style="list-style-type: none"> • Hepatitis E is clinically indistinguishable from Hepatitis A • Symptoms include: fatigue, anorexia, abdominal pain, joint pain and fever. Symptoms usually occur two to four

	<p>weeks after exposure.</p> <ul style="list-style-type: none"> • Pregnant women seem to be most at risk, suffering a fatality rate near 20% • The risks of HEV represents to people on hog farms, or the risk that it may be transmitted to their families or to other members of the community, is unknown
Hydrogen sulfide (HS)	<p>Hydrogen sulfide is a colorless gas that smells like rotten eggs. This highly toxic gas usually settles at the bottom of a manure storage pit or lagoon</p> <ul style="list-style-type: none"> • Hydrogen sulfide is one of the most threatening air emissions from feedlots and CAFOs • Hydrogen sulfide can cause eye, nose and throat irritation; diarrhea; hoarseness; sore throat; coughing; chest tightness; nasal congestion; heart palpitations; shortness of breath; stress; mood alterations; sudden fatigue; headaches; nausea; sudden loss of consciousness; comas; and seizures. Hydrogen sulfide affects all organs, but particularly affects the nervous system. • Exposure levels <ul style="list-style-type: none"> ○ Maximum allowable concentration is 10 ppm ○ One hour of exposure at concentrations of 50-100 ppm will cause sub-acute poisoning symptoms such as eye irritation and nasal irritation ○ Concentrations at 200 ppm for 60 minutes till produce symptoms such as headaches and dizziness ○ Exposure at 500 ppm for 30 minutes can cause nausea, vomiting and insomnia ○ Concentrations at 600 ppm can be fatal in 30 minutes ○ Concentrations of 1,000 ppm can be fatal in only 2-3 minutes • Exposure at levels of 100 ppm is especially dangerous because you can not smell it at this level. Additionally, exposure changes above this level are undetectable by scent. • Occupational exposure limits are set at 10 ppm. Between 10 ppm and 50 ppm, exposure without a respirator is allowed, but only once and for less than 10 minutes. When the concentration is higher than 50 ppm, a respirator is required by OSHA regulations. • Even when exposure is at low levels, the health impacts can be irreversible • Hydrogen sulfide is explosive at concentrations ranging from 4.3% to 46% by volume • When hydrogen sulfide is released as a gas, it may form sulfur dioxide and sulfuric acid in the atmosphere. Sulfur dioxide can be further broken down and is a major contributor to acid rain.
Influenza	<p>The same virus does not cause swine influenza (SIV) and human influenza. However, the epithelial cells of pigs seem to have receptors for both human and avian influenza. This supports the idea that pigs may be the mixing vessel where human pathogens develop.</p> <ul style="list-style-type: none"> • Major health risk appears to be from use of antibiotics to prevent influenza in pigs • See antibiotic resistant organisms above for full discussion
Leptospirosis	<p>Leptospirosis is caused by exposure to the bacteria <i>Leptospira interrogans</i>. This infection typically results from contacting pig urine. Leptospirosis may also be transmitted by inhalation or ingestion. The disease is not known to spread from person to person.</p>

	<ul style="list-style-type: none"> • The contact with <i>Leptospira interrogans</i> generally comes from contact with water that has been contaminated by animal urine <ul style="list-style-type: none"> ○ Farmers and workers face the risk of occupational exposure ○ Exposure may result from recreational contact with infected waters • Symptoms include: an abrupt onset of fever, rigors, muscle pain and headaches <ul style="list-style-type: none"> ○ Symptoms may also include dry cough, nausea, vomiting and diarrhea ○ Less common symptoms include joint aches, bone pain, sore throat and abdominal pain ○ Symptoms usually appear in 2 to 26 days, but appear in an average of 10 days • Complications may include kidney damage, meningitis, liver failure, and respiratory distress. Death may result in rare cases. • May result in abortions in pregnant women • The incidence of <i>Leptospirosis</i> is low in the Continental US. Hawaii has the most reported cases.
Listeria	<p><i>Listeria monocytogenes</i> is a disease causing bacteria that is food-borne and causes the illness listeriosis. <i>Listeria</i> may also be transmitted by agricultural runoff into water supplies.</p> <ul style="list-style-type: none"> • <i>Listeria</i> is capable of surviving at the temperature range we use for refrigeration. Thus, <i>Listeria</i> may be transmitted in ready-to-eat foods that have been kept properly refrigerated. <i>Listeria</i> is also capable of living in the intestines of humans and animals for long periods of time without causing infection. • Symptoms include: fever, muscle aches, nausea, and diarrhea <ul style="list-style-type: none"> ○ If infection has spread to the nervous system, symptoms include: headache, stiff neck, loss of balance, confusion and convulsions ○ Symptoms generally appear one to eight weeks after contaminations, averaging about one month • Pregnant women (and their unborn children) and immunocompromised persons are most at risk for <i>Listeria</i> <ul style="list-style-type: none"> ○ In pregnant women, <i>Listeria</i> most often infects the fetus, leading to spontaneous abortion, stillbirths, or sepsis in infancy ○ For immunocompromised individuals, the <i>Listeria</i> invades and grows best in the central nervous system, causing meningitis and/or encephalitis (brain infection)
Methane (CH ₄)	<p>Methane is generated during the decomposition of animal waste in an anaerobic environment. How manure is managed is the most important factor affecting the release of methane from animal waste. Liquid waste management systems encourage anaerobic conditions, and thus also encourage the release of methane. However, solid waste management produces little or no methane. Higher temperatures and moist climatic conditions also promote methane generation.</p> <ul style="list-style-type: none"> • Methane is toxic at high levels <ul style="list-style-type: none"> ○ Typically such levels are not found surrounding open-air lagoons ○ However, such levels may be found at the top of unventilated areas such as closed manure pits • Exposure is difficult to discover because methane is colorless, odorless and tasteless • Exposure levels <ul style="list-style-type: none"> ○ The maximum allowable concentration is 1,000 ppm

	<ul style="list-style-type: none"> ○ At 500,000 ppm exposure can cause headaches ● In high temperatures, the methane in the air can be highly combustible and thus extremely dangerous <ul style="list-style-type: none"> ○ Methane is highly flammable and explosive at concentrations of 5-15% by volume ● Methane is a potent greenhouse gas that contributes to global climate change. Methane in the atmosphere has a significantly higher impact on global climate change because it is estimated to be 21 times more effective at trapping heat in the atmosphere than carbon dioxide ● EPA estimates that emissions from manure management were about 6% of the US methane emissions in 1999, and 20% of the methane emissions were from agriculture. <ul style="list-style-type: none"> ○ Methane emissions from manure management activities increased 53% from 1990 to 1998 and EPA attributes the increase in methane emissions to the growing number of large hog and dairy operations and their use of liquid manure systems ○ EPA claims that liquid manure systems produce conditions that result in large quantities of methane emissions
Nitrates	<p>Manure contains nitrogen, which changes to nitrates in the soil. Nitrates are extremely soluble in water and can move easily through soil into drinking water supplies. Because nitrates move with the flow of groundwater, the contamination can move great distances from its source. US EPA and PA DEP have established a drinking-water standard for public water systems of 10 mg/L (10 ppm) of nitrogen-nitrate or less. The water should not contain more than 45 mg/L (45 ppm) of nitrate. It is recommended that private wells also meet these limits.</p> <ul style="list-style-type: none"> ● The greatest health risk associated with nitrate-tainted water is methemoglobinemia, or blue baby syndrome. This condition occurs when hemoglobin, the oxygen carrying component of blood, is converted by nitrate to methemoglobin, which fails to carry oxygen efficiently through the body. This results in vital tissues, including the brain, to receive less oxygen than needed. <ul style="list-style-type: none"> ○ Severe methemoglobinemia can result in brain damage, and even death. ○ Young infants, especially those under six years, are highly vulnerable. ● Ingestion of drinking water with very high levels of nitrate (greater than 1,000 mg/L) can lead to acute nitrate poisoning ● Nitrate ingestion is also believed to contribute to the development of some cancers ● Nitrate ingestion is also believed to cause adverse reproductive outcomes. The Centers for Disease Control has linked high nitrate levels in well water near feedlots to spontaneous abortions in humans
Pfiesteria	<ul style="list-style-type: none"> ● Pfiesteria piscicida dinoflagellate (a single-celled organism) normally exists in non-toxic forms, feeding on algae and bacteria in the water and in sediments of tidal rivers and estuaries ● Nutrient loadings to surface waters (specifically of nitrogen and phosphorus) contribute to outbreaks of Pfiesteria by stimulating the growth of algae on which Pfiesteria feeds ● Pfiesteria piscicida dinoflagellate is highly toxic in the presence of fish <ul style="list-style-type: none"> ○ Scientists believe that Pfiesteria becomes toxic to fish, triggered by fish secretions or excrement ○ Some Pfiesteria cells stun fish, making them lethargic

	<ul style="list-style-type: none"> ○ Other Pfiesteria toxins break down the fish skin tissue, causing open bleeding sores or lesions. The lesions usually are not fatal to fish ○ Pfiesteria is NOT an infectious agent like some bacteria. Thus, the fish are not killed by an infection of Pfiesteria, but rather by the toxins it releases or the secondary infections that attack the fish once the lesions have developed ● Toxic outbreaks of Pfiesteria are typically only a few hours long; however, Pfiesteria related fish lesions or fish kills may last for days or weeks once fish are weakened by the toxins ● Humans with environmental exposure to waterways in which Pfiesteria toxins are present are at risk of developing a reversible clinical syndrome characterized by difficulties with learning and higher cognitive function ● The risk of illness is directly related to degree of exposure, with the most prominent symptoms and signs occurring among people with chronic daily exposure to affected waterways.
Phosphorous (P)	<p>Excess Phosphorous can enter the groundwater and surface water instead of binding to the soil. Soils overloaded with phosphorous generate significant amounts of soluble phosphorous that can be readily transported by surface water runoff even with minimal soil erosion.</p> <ul style="list-style-type: none"> ● Phosphorous may come from a variety of sources, such as <ul style="list-style-type: none"> ○ Fertilizer added to crops to promote growth and disease resistance ○ Feed of the animals to improve animal performance ○ By-product in animal waste, which is often applied to agricultural fields <ul style="list-style-type: none"> ▪ Consideration must be given to the amount of land available to absorb the Phosphorous ▪ Avoiding excess build-up of Phosphorous in soils can prevent erosion and runoff ● Phosphorous overloading exacerbates eutrophication in surface water (acceleration of algae and plant growth in water; the plants take oxygen out of water, causing a dead zone where aquatic life cannot live) <ul style="list-style-type: none"> ○ Depletion of dissolved oxygen promotes conditions that convert many dissolved compounds to potentially toxic forms (such as nitrates to ammonia, sulfate to hydrogen sulfide, carbon dioxide to methane) that may harm wildlife and livestock ○ Increased cost and difficulty in purifying drinking water ○ Replaces high quality edible fish with coarse, rapid-growing fish and algae ○ Increases sedimentation and impairs navigational and recreational uses: lake depths are reduced, enhanced vegetation growth blocks navigable waterways ○ Decaying algae produces surface scum and undesirable odors (hydrogen sulfide and methane) ○ Populations of insect pests such as mosquitoes are increased ● Polluted runoff reduces the food supply and makes red tides occur more often and last longer ● Agricultural runoff can be reduced by targeted fertilizer and manure applications, installing buffers and wetlands to filter runoff, and tillage practices that reduce erosion
Salmonella	Salmonella is a bacteria that is passed from pigs to humans by consuming contaminated pork products. Contacting an

	<p>infected animal or its manure can also spread salmonella. Contact with animal manure may arise from animal waste contaminating a water source. Person-to-person transmission is also possible if good personal hygiene is not followed.</p> <ul style="list-style-type: none"> • Symptoms include: a sudden onset of diarrhea, fever and abdominal cramps <ul style="list-style-type: none"> ○ A person may also experience nausea and vomiting initially ○ The diarrhea often includes mucous and is occasionally bloody ○ Symptoms usually begin in 6 hours to 10 days, but usually occur between 6 and 48 hours • Infants, the elderly, immune suppressed persons and persons with sickle cell anemia are most susceptible to disease <ul style="list-style-type: none"> ○ These people often suffer the most severe symptoms ○ Organisms in these individuals are most likely to gain access to the blood stream and possibly persist in sites of the body distant from the intestines • Complications from salmonella infection include: <ul style="list-style-type: none"> ○ Reiter's syndrome, or reactive arthritis, where a person develops pain in their joints, irritation of the eyes, and discomfort on urination. Reiter's syndrome may last for months or years and may lead to chronic arthritis ○ Salmonella septicemia (invasion of the blood stream) has become associated with subsequent infection of virtually every organ system ○ In persons with arteriosclerosis/atherosclerosis of the aorta, salmonella may grow there ○ Persons with sickle cell disease or its variants tend to get infection in the bone (osteomyelitis) or joints (septic arthritis) ○ Salmonella infection may exist in the gallbladder for months or years in rare cases ○ Fatalities occur in less than 1% of salmonella cases. These are usually in the very young, the very old, or the immunocompromised.
<p>Volatile Organic Compounds</p>	<p>Volatile organic compounds (VOCs) are substances containing carbon and different proportions of other elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulfur, or nitrogen</p> <ul style="list-style-type: none"> • These compounds are often found in pesticides, herbicides, and other chemicals <ul style="list-style-type: none"> ○ Agricultural runoff can carry these chemicals to the water supplies • These contaminants may be found in the water supplies <ul style="list-style-type: none"> ○ VOCs are virtually undetectable in drinking water ○ Children are more at risk for exposure to VOCs because they drink more water per pound of body weight than adults • These substances easily become vapors or gases at low temperatures • Symptoms of exposure include: eye irritation, nose and throat discomfort, headaches, allergic skin reaction, labored breathing, nausea, fatigue, and dizziness • Health risks associated with VOCs <ul style="list-style-type: none"> ○ Can cause health problems such as: cancer, kidney damage, liver damage, brain damage, nervous system

	<p>damage, reproductive system damage, and immune system damage</p> <ul style="list-style-type: none"> ○ Some VOCs are endocrine imposters that mimic hormones and trigger biological reactions that damage the brain, immune system and reproductive system
<p>Yersinia</p>	<p>Eating contaminated food products can pass the yersinia bacteria. The bacteria can also infect humans through contaminated drinking water caused by runoff or leaching from animal waste application areas. The bacteria can be passed to humans from contact with an infected animal's manure or an infected person's stool. Rarely, the bacteria is passed through contaminated blood during a transfusion.</p> <ul style="list-style-type: none"> • The most common form of yersinia bacteria in the US is Yersinia enterocolitica • Young children are most often infected with yersinia <ul style="list-style-type: none"> ○ Common symptoms in children include: fever, abdominal pain and diarrhea which is often bloody ○ Symptoms usually occur four to seven days after infection ○ Symptoms usually last one to three weeks or longer • In older children and adults symptoms include: right-sided abdominal pain and fever, which may be confused with appendicitis • Complications include: skin rash, joint pain, or spread of the bacteria in the bloodstream