



Table 3. Clinical manifestations, epidemiology and risk factors of pathogens and toxins penetrating or infecting broken skin

Type of pathogen or toxin producing organism	Clinical Manifestations	Epidemiology and risk factors
BACTERIA		
<i>V. vulnificus</i> and <i>V. parahaemolyticus</i>	Acute skin infection (can be very severe) Septicaemia (high mortality rate) (Morris, 2024; Morris 2024)	Global distribution – warmer months. Puncture wounds or injured skin/abrasions (recreational activities) can become infected in contaminated water (brackish and salt water); more common in those with liver disease, DM, CRF, RA, other IC conditions (Morris, 2024; Morris 2024)
<i>Aeromonas</i> spp	Acute skin infection – mild to severe Bacteraemia with possible infection in multiple sites (Morris, 2023)	Global distribution – warmer months. Aquatic injury in fresh, brackish or surface water (including post flood). More common in those with liver disease, haem malignancies (Morris, 2023).
<i>Plesiomonas</i> spp	Acute skin infection – cellulitis, abscesses. Bacteraemia, and other extraintestinal infections which can be severe; high mortality rate (Morris, 2023).	Global distribution in warmer months. Aquatic injury in fresh or brackish water. More common in those with liver disease, neonates, IS (Morris, 2023).



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<i>Mycobacterium marinum</i>	Indolent and prolonged skin infection however disseminated disease is possible (more likely in immunosuppressed) but rare (Mazumder, 2023; Hashish, 2018).	Global distribution in fresh, brackish and salt water; fish-hook punctures, preparing seafood including oysters (Mazumder, 2023; Hashish, 2018).
<i>Leptospira</i> spp	Acute febrile illness which can develop into severe pulmonary haemorrhage, jaundice. High mortality rate (Day 2024).	Most common South and SE Asia, Oceania, Caribbean, Latin America and sub-Saharan Africa Contact with animal urine-contaminated water (rat urine common but also dogs, pigs, cattle, sheep). Enters through cuts/abrasions, often during heavy rainfall and floods but can also be in ponds, lakes and rivers. Often misdiagnosed in pregnant persons; affects to foetus can be devastating (abortion or foetal death) (Day 2024).
<i>Burkholderia pseudomallei</i>	Acute and chronic febrile illness Single or multi-system infections Mimics many other infections. High mortality rate (Meumann, 2024; Wiersinga, 2018).	More common in SE Asia, South Asia (and Northern Australia) but increasingly recognised in China, South America and Africa (Meumann, 2024; Wiersinga, 2018). Ingestion (of contaminated water), inoculation of skin or infection of abrasions with contaminated water (and also inhalation of the bacterium). More common in diabetics, chronic respiratory, renal and liver disease, high alcohol intake (especially binge drinking), immunosuppressive therapy (e.g. steroids) (Meumann, 2024; Wiersinga, 2018).



PARASITES		
Schistosoma spp ○ <i>S. haematobium</i> ○ <i>S. mansoni</i>, ○ <i>S. japonicum</i> ○ <i>S. mekongi</i> ○ <i>S. malayensis</i> ○ <i>Schistosoma intercalatum</i> and <i>S. guineensis</i>	<u>Acute and chronic</u> effects (chronic more serious) Skin penetration of cercariae in fresh water leads to acute itch for all species. Some go onto have a hypersensitivity reaction. Chronic infection has indolent presentation. Affects GUT disease (<i>S. haem</i>) – haematuria, pyuria followed by fibrosis and calcification, strictures, reduced renal function and malignancy All other species present with GIT disease - chronic or intermittent abdominal pain, poor appetite, and diarrhea followed by bowel strictures, hepatosplenomegaly, portal hypertension, GI bleeds. Other systems can also be involved (Clerinx, 2024).	Sub-saharan Africa and Middle East, Sthn Arabian Peninsula Sub-Saharan Africa and western South America Africa, (mainly Brazil), and some of the South Caribbean islands. China, southern Philippines, Indonesia (Sulawesi) Thailand, Laos, Cambodia Peninsular Malaysia West and Central Africa - Congo, Gabon, and Cameroon (Clerinx, 2024).
<u>Helminths</u>		
Hookworm – human and animal (<i>Ancylostoma duodenale</i>, <i>Necator Americanus</i>, <i>Ancylostoma ceylanicum</i>, <i>Ancylostoma braziliensis</i> and <i>A. caninum</i> (<i>cutaneous larva migrans</i>))	Predominantly larval penetration of skin leaving a pruritic maculopapular eruption at the site. As larvae move through the body there may be symptoms e.g. through respiratory system (cough), GIT (nausea, vomiting, diarrhoea, epigastric pain). Chronic infection can lead to anaemia due to blood and iron loss (Weller, 2024).	Most common in sub-Saharan Africa, Asia, Latin America and Caribbean. At risk of infection when walking bare foot, particularly moist surfaces such as the beach, river side etc. Ingestion of raw vegetables contaminated by helminths also (Weller, 2024).



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<i>Strongyloides stercoralis</i>	Skin contact with contaminated soil predominantly. <u>Acute infection</u> reflects the path of larval migration - from the site of skin penetration (skin irritation/redness) - migration through bloodstream and lymphatics to lungs and alveoli (dry cough) - ascend tracheobronchial tree and swallowed and then establishes infection in small bowel (anorexia, abdominal pain, diarrhoea or constipation) (Weller, 2024). <u>Chronic infection</u> – symptoms mostly related to skin (pruritus, urticaria) and GIT (usually mild but can include peri-umbilical pain, diarrhoea, constipation, borborygmi). Respiratory symptoms rare. Can develop disseminated disease that can be fatal (Weller, 2024).	Endemic in tropical and subtropical regions – most common SE Asia, Africa, Western Pacific regions. Skin contact with contaminated soil, faecal-oral, fomites and sexual contacts. Risk factors for hyperinfection/disseminated disease include those on corticosteroids (includes short courses), TNF inhibitors, HTLV infection, AIDS, malignancy, hypogammaglobulinaemia, alcohol use, transplant recipients. Pregnant persons may also be at higher risk (Weller, 2024).
AQUATIC ANIMALS		
Jelly fish - various species	Immediate pain at site of contact with redness and intense burning, itching and throbbing. Pending type of jellyfish can get vomiting, abdominal and chest pain, sweating, agitation, tachycardia +/- cardiorespiratory arrest (Marcus, 2024; TG, 2020).	Found in Indo-Pacific, northern Australia, Hawaii (Spyres, 2020; Marcus, 2024). When jellyfish tentacles contact skin, they release nematocytes that inject toxins into skin. Some jellyfish highly toxic. Seasonal (tropical monsoon season) (Marcus, 2024).



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Other aquatic species e.g. coral, sea urchins, stingrays, spines of fish (catfish, stonefish), sea snakes	Acute pain and sometimes redness and swelling depending on aquatic animal. Some envenomations can result in severe pain (Isbister, 2023).	Distribution depends on the species
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