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Editor's note:

Paving the way for the coming new year this edition of *The NT Disease Control Bulletin* offers the 2024 revisions to the Darwin Melioidosis Treatment Guideline on pages 3 to 12. The Guideline has developed over the years following, and largely informed by, the Darwin Prospective Melioidosis Study that started in 1989. This revision further refines the dosing and duration of antibiotics used to treat melioidosis and provides a new graded introduction of therapy with trimethoprim + sulfamethoxazole. Additionally new comprehensive guidance around monitoring and managing adverse effects from trimethoprim + sulfamethoxazole is given.

Also at this time of year it is important to be aware of the dangers of box jellyfish (*Chironex fleckei*) in the coastal waters of the NT. The official 'stinger season' in the NT is from 1 October to 1 June but stings have been reported in all months of the year. The Box Jellyfish NT Health Fact sheet on pages 23 and 24 gives you the why, whats, when and hows about this potentially deadly sea creature. It also emphasizes that children are at particularly high risk of severe, life-threatening envenoming because of their smaller body mass so avoiding stings is a high priority.

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Contents

The 2024 revised Darwin Melioidosis Treatment Guideline

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Abstract

The Darwin Prospective Melioidosis Study commenced in October 1989. Guidelines for the diagnosis and management of melioidosis have evolved over the decades, informed by local studies and experience and randomised controlled trials of antibiotic therapy from Thailand. The 2015 Darwin Melioidosis Treatment Guideline introduced comprehensive direction for the durations of the initial intensive intravenous phase of therapy and the subsequent oral eradication phase, based on specific clinical parameters. These were refined further for the 2020 Darwin Melioidosis Treatment Guideline. In recent years there has been increasing recognition and concern regarding adverse effects arising during the required prolonged use of trimethoprim+sulfamethoxazole for melioidosis therapy. The 2024 revision of the Darwin Melioidosis Treatment Guideline further refines the dosing and duration of antibiotics and presents a new graded introduction of therapy with trimethoprim+sulfamethoxazole. The 2024 Guideline also provides new comprehensive guidance on monitoring for and management of adverse effects from trimethoprim+sulfamethoxazole.

Epidemiology

Melioidosis is the clinical illness resulting from infection with the soil and water bacterium *Burkholderia pseudomallei*[1]. Each case of melioidosis results from a single infecting exposure event, but asymptomatic infection appears far more common than melioidosis. Disease occurs in humans and many animals and mostly follows percutaneous inoculation, although inhalation of aerosolized bacteria is probable during severe weather events such as tropical storms and cyclones. Aspiration has also been documented with near drowning, and ingestion of unchlorinated water supplies contaminated with *B. pseudomallei* probably accounts for the higher rates of melioidosis seen in children in South and Southeast Asia than in Australia[2]. Rare instances of ingestion have occurred from mastitis-associated infected breast milk[3]. Zoonotic transmission is exceedingly rare, as are person-to-person transmission and laboratory-acquired infection.

The known endemic distribution of *B. pseudomallei* has expanded beyond the traditional melioidosis-endemic regions of Southeast Asia and northern Australia. Melioidosis is now recognised widely across Asia, including Sri Lanka, India, Bangladesh, China and Taiwan, in some Indian Ocean and Pacific nations, Madagascar and Africa, South and Central America, the Caribbean and most recently the southern USA [4]. *B. pseudomallei* evolved in the environment of Australia. The historical spread globally and links with movement of humans, animals and plants over millennia and in recent centuries and decades require further elucidation, as does the distinction of this international dispersal from the unmasking of unrecognised endemicity seen in recent years as laboratory diagnostic capacity improves globally [4].

The first reported case of melioidosis in the Northern Territory was in 1960[5]. Since October 1989 all cases of melioidosis have been prospectively followed in the Top End. Over the 30 years from October 1st 1989 until September 30th 2019, there were 1148 culture-confirmed cases, with 133 deaths (12%) in the Darwin Prospective Melioidosis Study (DPMS). [6] With heavy rains in the wet seasons from 2009-2012

case numbers rose dramatically; 91 cases (11 fatal) in 2009-2010; 64 cases (9 fatal) in 2010-2011; and 97 cases (10 fatal) in 2011-2012. In addition, following very heavy rains early in 2011 an unprecedented 6 cases occurred in central Australia, which were considered acquired in central Australia rather than in the Top End. Previously, cases of melioidosis in central Australia were mostly in people who acquired infection in the Top End. *B. pseudomallei* has been recovered from various environmental locations in central Australia.

With a much drier year in 2012-2013 there was a decrease in melioidosis in the Top End with 36 cases (2 fatal), but cases rose again to 64 in 2013-2014 (5 fatal) and 70 in 2014-2015 (3 fatal). Numbers then dropped again with the dry years and in 2018-2019 there were 42 cases (1 fatal), in 2019-2020 45 cases (1 fatal) and in 2020-2021 30 cases (3 fatal). With the return of more rain in the last 2-3 years, linked to consecutive La Nina weather cycles, the case numbers in 2021-2022 rose to 74 (7 fatal), then 87 (6 fatal) in 2022-2023. With the return of El Nino and drier conditions, case numbers may well decrease in 2023-2024.

80% of cases in the Top End occur during the wet season (November 1st – April 30th).

Pathogenesis

Serological surveys support that most infections are asymptomatic, with rates of seropositivity by indirect haemagglutination assay (IHA) of over 50% in parts of northeast Thailand [7]. In contrast, in the Top End of the Northern Territory, IHA seropositivity (titre greater than 1:20) in long term Darwin residents is less than 5% but in remote communities in Arnhem Land it can be as high as 20% (unpublished data).

The clinical presentations of melioidosis and outcomes are thought to be determined by a combination of mode of infection, infecting dose of bacteria, putative *B. pseudomallei* strain differences in virulence and, most importantly host risk factors for disease.

Diabetes is the most important risk factor for melioidosis, followed by **hazardous alcohol use, chronic kidney disease, and chronic lung disease**[8,9]**.** Over recent years in Darwin it has become clear that **immunosuppressive therapy**, most notably high dose corticosteroids, is an important risk factor. **Malignancy** has been considered a risk factor, but teasing out the role of specific chemotherapy regimens requires further studies, as does the risk of individual and classes of biological therapies such as monoclonal antibodies. Cardiac failure is also a likely independent risk factor for melioidosis.

Although animal studies support there being differential virulence between strains of *B. pseudomallei*, the specific virulence factors responsible for clinical disease and severe infection remain surprisingly poorly elucidated [9,10].

The vast majority of melioidosis cases are from infection during the current or recent wet season, with an incubation period of 1-21 days (median, 4 days) in those presenting with **acute melioidosis** (88% of all cases). A more chronic course following infection (**chronic melioidosis**, defined as symptoms being present for longer than 2 months) occurs in 9% of all cases[11]. Chronic melioidosis usually presents as respiratory symptoms and radiology findings that can mimic tuberculosis, or a chronic non-healing skin sore. **Latent infection with subsequent activation** is well recognised in melioidosis, with periods of latency described for up to several decades[12], but in the DPMS this is considered very uncommon and accounts for under 3% of all cases.

Clinical features

Around half of melioidosis cases present with pneumonia, which can be part of a fatal sepsis, a less severe unilateral infection indistinguishable from other community-acquired pneumonias or a chronic illness mimicking tuberculosis[13,14]. Other

presentations range from skin lesions without systemic illness[15], to overwhelming sepsis with abscesses disseminated in multiple internal organs[11]. Genitourinary disease with prostatic abscesses is especially common in the Top End[16]. Bone, joint, mycotic arterial aneurysms and neurological infections are all well documented[17]. Blood cultures are positive in over 50% of all patients.

Diagnosis

The likelihood of diagnosing melioidosis is maximized if the diagnosis is considered in at-risk subjects and appropriate clinical samples from a variety of sites are sent to the microbiology laboratory for microscopy and culture.

Culture is the mainstay of diagnosis. Diagnosis of melioidosis (i.e. active disease) is not made based on a positive serology (IHA) result, although melioidosis serology should be ordered if melioidosis is suspected. Serologic testing alone is not a reliable method of diagnosis and culture confirmation should always be vigorously sought in patients with suspected melioidosis.

All patients with suspected melioidosis should have the following samples, if available, taken for culture:

- Blood cultures
- Sputum
- Urine
- Swab of an ulcer or skin lesion; placed into Ashdown's selective medium (purple bottle) to enhance recovery of the organism
- Abscess fluid or pus
- Throat swab; placed into Ashdown's selective medium
- Rectal swab; placed into Ashdown's selective medium

Chest X-ray should be performed in all suspected cases. In any confirmed melioidosis case (i.e. culture positive), contrast CT or ultrasound of abdomen and pelvis is required to detect any internal abscesses, irrespective of clinical presentation. In children and females who are not significantly systemically unwell, ultrasound is preferable to minimise radiation exposure. CT is the best imaging to detect prostatic abscesses.

All confirmed cases of melioidosis and any suspected cases without confirmation despite appropriate diagnostic work up (as above) should be referred to the **RDH Infectious Diseases team or ASH Infectious Diseases team.** Melioidosis is a laboratory-notifiable disease in the NT.

Treatment

All cases of melioidosis in the Top End are managed and followed up by the RDH Infectious Diseases team.

For **initial intensive therapy**, use (see Table 2 below for dosing in renal impairment):

1. ceftazidime (wards) 2 g (child: 50 mg/kg up to 2 g) IV, 6-hourly for at least 14 days

OR

1. meropenem (ICU) 1 g (child: 25 mg/kg up to 1 g) IV, 8-hourly for at least 14 days

For adults with septic shock requiring intensive care support and with augmented renal clearance, use meropenem 2g IV, 8-hourly. Administer the 2g dose over 3 hours to improve attainment of PK/PD targets. Consider swapping to standard dose meropenem when the patient's critical illness resolves and the susceptibility results show that the isolate does not have a high minimum inhibitory concentration (MIC).

At RDH we generally restrict use of meropenem for treating patients with melioidosis who are in ICU and for initial empirical CareFlight and ED therapy of patients with critical sepsis who are considered likely to need ICU therapy on admission. Patients being treated for melioidosis on the general hospital wards and those discharged from ICU are generally treated with ceftazidime.

Regular monitoring of urea and electrolytes, creatinine, LFTs, FBE including eosinophil count and CRP are required and adjust dosing if renal impairment develops (see Table 2 for dosing in renal impairment).

It is policy in RDH ICU for all patients in ICU/HDU with melioidosis septic shock to be considered for granulocyte colony-stimulating factor (G-CSF) - filgrastim 300 microgram IV daily, unless contraindicated, beginning as soon as the Microbiology Laboratory flags a probable *B. pseudomallei* infection[18]. The main contraindication to commencing G-CSF is an acute coronary event; abnormal liver function is not considered a contraindication for giving G-CSF in patients with melioidosis. G-CSF is continued for 10 days or for the duration of ICU/HDU stay depending on clinical response, unless a contraindication develops such as total blood white cell count more than 50,000 $X10^6$/L.

In critically ill ventilated patients who are deteriorating despite appropriate antibiotics, use of extracorporeal membrane oxygenation (ECMO) has been lifesaving for two patients managed in the RDH ICU; for both, this necessitated aeromedical transfer to the Alfred Hospital in Melbourne.

For **neurological melioidosis** meropenem is the initial IV therapy and the meropenem dose is doubled to 2 g (child: 40 mg/kg up to 2 g) IV, 8-hourly. The dose should be administered over 3 hours to improve attainment of PK/PD targets. There is also a theoretical reduction in the risk of neurotoxicity compared to standard more rapid infusions of 2g (which result in high peak concentrations). Double-dose meropenem is also sometimes used in long bone **melioidosis osteomyelitis** when there is presumptive high bacterial burden of infection.

For **neurological melioidosis, osteomyelitis and septic arthritis, genitourinary infection including prostatic abscesses, and skin and soft tissue infections**, add trimethoprim+sulfamethoxazole from commencement of therapy in the eradication doses as below. This does not alter the subsequent duration of the eradication therapy as in Table 1.

Prolonged IV therapy (4 to 8 weeks or longer) is necessary for **complicated pneumonia, deep-seated infection including prostatic abscesses, neurological melioidosis, osteomyelitis and septic arthritis**[19,20].

See Table 1 below for duration of initial intensive IV therapy, which has evolved from modifications of the 2015 and 2020 Darwin Melioidosis Treatment Guidelines[19,20].

24-hour ceftazidime 6g infusers have been used for melioidosis in RDH Hospital in the Home (HITH) since the mid-1990s. Patients receiving ceftazidime via 24-hour infusion are encouraged to remain inside in air conditioning at 25° Celsius or less as much as possible, to mitigate the theoretical patient exposure to pyridine as ceftazidime degrades in heat. For patients that are unable to remain inside in air conditioning for prolonged periods of time, the Infectious Diseases team may elect for infuser changes every 12 hours (same total daily dose, using 2 x 24-hour ceftazidime 6g infusers which are changed every 12 hours).

Eradication therapy is required after the initial intensive therapy. The doses used in Darwin were previously changed to be consistent with those used in Thailand[21]. Use:

trimethoprim+sulfamethoxazole child 6+30 mg/kg up to 240+1200 mg; adult 40-60kg, 240+1200 mg; more than 60kg, 320+1600 mg orally, 12-hourly for at least a further 3 months

PLUS

folic acid 5 mg (child: 0.1 mg/kg up to 5 mg) orally, daily for at least a further 3 months

See Table 1 for duration of eradication therapy after initial IV intensive therapy.

See Table 2 for antibiotic dosing adjustment for those with renal impairment.

Patients on trimethoprim+sulfamethoxazole prolonged oral therapy require monitoring for adverse effects, as some of these are serious. See Table 3 for trimethoprim+sulfamethoxazole adverse effects and monitoring parameters. Minimum one monthly blood tests and medical reviews are required.

Because of the high rates of trimethoprim+sulfamethoxazole adverse effects seen with the Darwin melioidosis regimen[22], commencing in the 2023-2024 melioidosis season we are using a **graded introduction of trimethoprim+sulfamethoxazole**, with the limited literature supporting that this may decrease the overall rate of trimethoprim+sulfamethoxazole adverse effects[23]. The graded introduction will vary by patient weight and renal function and will generally be used for all melioidosis patients, including those requiring ICU therapy, with the exception of those with neurological melioidosis, where full dose trimethoprim+sulfamethoxazole will be commenced immediately. This means that for those with melioidosis pneumonia and bacteremia without a focus, where trimethoprim+sulfamethoxazole has not been part of the initial intensive therapy, it will now need to be commenced during the intensive phase so that the full trimethoprim+sulfamethoxazole dose has been reached by completion of the intravenous therapy. The graded dose will take 1-2 weeks to reach full dose, depending on circumstances.

For those over 60kg with normal renal function, the new recommendation is a graded trimethoprim+sulfamethoxazole dose over 8 days; 40/200mg (half a SS tablet) BD for 2 days, 80/400mg (1 SS tablet) BD for 2 days, 160/800mg (1DS tablet) BD for 2 days, 240/1200mg (1.5 DS tablets) BD for 2 days, then full dose 320/1600mg (2DS tablets) BD to commence the defined period of eradication therapy (see Table 1). For those 60kg or under and for those with impaired renal function, the Infectious Diseases team will determine the graded dosing schedule. Note, more rapid introduction of trimethoprim+sulfamethoxazole may be considered for unwell patients with deep seated infection.

All patients who undergo intensive therapy and eradication therapy for melioidosis require counselling regarding monitoring for adverse effects of medication. Consumer factsheets, including the Trimethoprim Sulfamethoxazole Factsheet should be given as educational aids, and interpreters and Aboriginal health care practitioners are to be used where necessary.

Prophylaxis for melioidosis with trimethoprim+sulfamethoxazole is recommended in selected circumstances (such as dialysis patients during the wet season and selected immunosuppression scenarios). See Table 2 footnote for dosing.

Virtually all primary clinical isolates of *B. pseudomallei* have the same standard antimicrobial susceptibility profile. The standard therapy used in these guidelines reflects this. Acquired resistance to each of the antimicrobials used has been documented but is very uncommon. Nevertheless, antimicrobial susceptibility testing is routinely performed on all *B. pseudomallei* isolates should recrudescent disease occur while the patient is on therapy, or should the patient be admitted with recurrent melioidosis (relapse or new infection as determined by bacterial genotyping) after therapy has been completed. Acquired resistance has occurred in the context of high bacterial burden and requirement for prolonged therapy, such as seen sometimes with bronchiectasis and cystic fibrosis and with extensive melioidosis osteomyelitis or multiple and/or large internal splenic abscesses.

Table 1.The 2024 Darwin Melioidosis Treatment Duration Guideline

Antibiotic Duration-Determining Focus	Minimum intensive phase duration (weeks)[a]	Eradication phase duration (months)[e]
Skin abscess	2	3
Bacteraemia with no focus	2	3
Pneumonia		
- Unilobar pneumonia without lymphadenopathy[b] or ICU admission and with negative blood cultures	2	3
- Multilobar pneumonia without lymphadenopathy[b] or ICU admission and with negative blood cultures; - or unilobar pneumonia without lymphadenopathy[b] or ICU admission but with positive blood cultures	3	3
- Pneumonia with either lymphadenopathy[b] or ICU admission; or multilobar pneumonia with positive blood cultures	4	3
Deep-seated collection and septic arthritis[c]	4[d]	3
Osteomyelitis	6[d]	6
Central nervous system infection and arterial infections (e.g. mycotic aneurysms)	8[d]	6[f]

a. Use clinical judgement to guide prolongation of intensive phase if improvement is slow or if blood cultures remain positive at 7 days.
b. Defined as enlargement of any hilar or mediastinal lymph node to greater than 10mm diameter.
c. Defined as abscess anywhere other than skin, lungs, bone, CNS or vasculature.
d. Intensive phase duration is timed from date of most recent drainage of collection (eg prostatic abscess) or tissue resection, where culture of the drainage specimen or resected material grew *B. pseudomallei* or where no specimen was sent for culture; clock is not reset if drainage specimen is culture-negative.
e. Except in CNS melioidosis, trimethoprim+sulfamethoxazole is introduced as a graded dosing (see text). Cessation of intravenous therapy and commencement of the timed eradication phase is set only once the full planned dose of trimethoprim+sulfamethoxazole is reached.
f. Life-long suppressive antibiotic therapy may be required following vascular prosthetic surgery.

Table 2. Darwin Melioidosis Adult Treatment Dosing in Renal Impairment

	Dose adjustment by eGFR/CrCl (ml/min) [a]			Dose adjustment for dialysis [b]		
	31-50	15-30	less than 15	HD	CAPD	CRRT
Ceftazidime	Up to 60kg 1 g q8h Over 60kg 2 g q8h	Up to 60kg 1g q12h Over 60kg 2g q12h	Up to 60kg 1 g q24h Over 60kg 2 g q24h	as for eGFR less than 15, dose q24h with dose given after dialysis on dialysis days	as for eGFR less than 15 (if intravenous route inconvenient, administer intraperitoneally with dwell time of longer than 6 hr and 25% extra dose)	2g q8h
Meropenem	1 g q12h	1 g q12h	1 g q24h	as for eGFR less than 15, dose q24h with dose given after dialysis on dialysis days	as for eGFR less than 15	1 g q8h
TMP+SMX [cde]	Up to 60kg 240+1200 mg q12h Over 60kg 320+1600 mg q12h	Up to 60kg 120+600 mg q12h Over 60kg 160+800 mg q12h	Up to 60kg 120+600 mg q12h Over 60kg 160+800 mg q12h	as for eGFR less than 15	as for eGFR less than 15	as for eGFR 15-30

a. eGFR : estimated Glomerular Filtration Rate. CrCl : Creatinine clearance is calculated by Cockroft-Gault method [140-age (years) x ideal body weight) x 0.85 (female) /0.814 x serum creatinine (micromol/L) x 72)].
For obese patients, consider using adjusted body weight for calculation—contact AMS pharmacist or Infectious Diseases.

b. HD- haemodialysis; CAPD- chronic ambulatory peritoneal dialysis; CRRT- continuous renal replacement therapy.

c. TMP+SMX: trimethoprim+sulfamethoxazole. Folic acid 5mg daily is added for the duration of therapy.

d. **For prophylaxis**, use TMP+SMX at around one quarter of the total daily treatment dose;
if over 60kg this is:
For eGFR/CrCl over 30mL/min, use double strength (DS) (160+800 mg) 1 tablet daily
For eGFR/CrCl 15-30mL/min, use single strength (SS) (80+400 mg) 1 tablet daily OR DS (160+800 mg) 1 tablet 3 times a week.
ForeGFR/ CrCl less than 15mL/min (non-dialysis) – use SS (80+400 mg) 1 tablet 3 times a week
For dialysis patients, use DS (160+800 mg) 1 tablet 3 times a week post dialysis.

e. Except in CNS melioidosis, trimethoprim+sulfamethoxazole is usually introduced as graded dosing (see text). Cessation of intravenous therapy and commencement of the timed eradication phase is set only once the full planned dose of trimethoprim+sulfamethoxazole is reached.

Table 3: Trimethoprim-Sulfamethoxazole (TMP+SMX) Adverse Effects* and Monitoring Parameters

Predominant TMP+SMX Adverse Effects	Incidence according to AMH[a] (%)	Incidence in Tropical Northern Territory[b] (%)	Monitoring Parameters Comments	When to Consider Cessation or Change of TMP+SMX Oral Therapy[d]
Acute Kidney Injury (AKI)	Unknown	10.8	UECs. A rise of > 20% in creatinine is considered to be AKI	Renal adjustments as per Table 2. Change of antibiotic considered if AKI significant.
Rash	>1	7	Physical assessment [e] and encourage patient reporting	Consider cessation and change of antibiotic. In cases of mild rash with no other features of Severe Cutaneous Adverse Drug Reaction (SCAR)[e], graduated desensitisation may be considered (consult ID and pharmacy).
Bone Marrow Suppression	>1	6.4	WBCs, platelets, Hb[c] Platelets < 150 x 10^9/L Neutrophils < 1 x 10^9/L Haemoglobin < 100 g/L Ensure folic acid supplementation	Consider change of antibiotic. Mild cases use clinical judgement to dose reduce.
Nausea and/or Vomiting	>1	3.4	UECs, patient reporting	Excessive nausea and vomiting will reduce the absorption and effectiveness. Consider change of antibiotic or dose reduce.
Stevens-Johnson Syndrome (SJS), a type of SCAR [e]	Unknown	Unknown	Flu-like symptoms followed by a painful blistering and desquamating rash[e] of skin and mucous membranes	Must cease antibiotic.
Drug rash with Eosinophilia and Systemic Symptoms (DRESS), a type of SCAR [e]	Unknown	1	Physical assessment for fever, lymphadenopathy, facial oedema, rash[e]. Blood markers such as atypical lymphocytes, eosinophils, LFTs, UECs	Must cease antibiotic.
Liver Function Derangement	<0.1	1	LFTs Severe liver injury markers: ≥5x upper limit of normal (ULN) ALT or AST, or ≥3x ULN for ALT with ≥2x ULN for bilirubin or ≥2x ULN for ALP	Consider dose reduction or change of antibiotic. TMP+SMX is contraindicated in marked hepatic dysfunction.
Eosinophilia without DRESS	0.1-1.0	0.5	WBCs Eosinophilia >0.7 x 10^9/L	Consider change of antibiotic. Mild cases use clinical judgement to dose reduce.
Headache	0.1-1.0	0.5	Encourage patient reporting	Consider change of antibiotic if persistent.
Hyperkalaemia	>1	0.5	UECs	Consider dose reduction or antibiotic change.

* The discharge summary of a patient discharged on prolonged TMP+SMX should direct clinicians to be aware of and to monitor patients for the above potential side effects.

a. From the Australian Medicines Handbook Adverse Effects[24]. To indicate the broad discrepancies between national and local prevalence.

b. A retrospective cohort study reviewed side effects from oral eradication therapy in patients presenting with first episode culture-confirmed melioidosis in the tropical north of Australia's Northern Territory between October 2012 and January 2017[22].

c. The trimethoprim component may cause megaloblastic changes (e.g., macrocytic anaemia, thrombocytopenia, leukopenia) by reducing folate available for haematopoiesis.

d. Initial oral eradication therapy with trimethoprim-sulfamethoxazole may cause adverse effects that necessitate a dose reduction or change. Changes to a patient's eradication therapy requires an Infectious Disease Specialist review and approval.

e. Early Severe Cutaneous Adverse Drug Reaction (SCAR) erythema and inflammation can be difficult to appreciate in pigmented skin and requires careful assessment.

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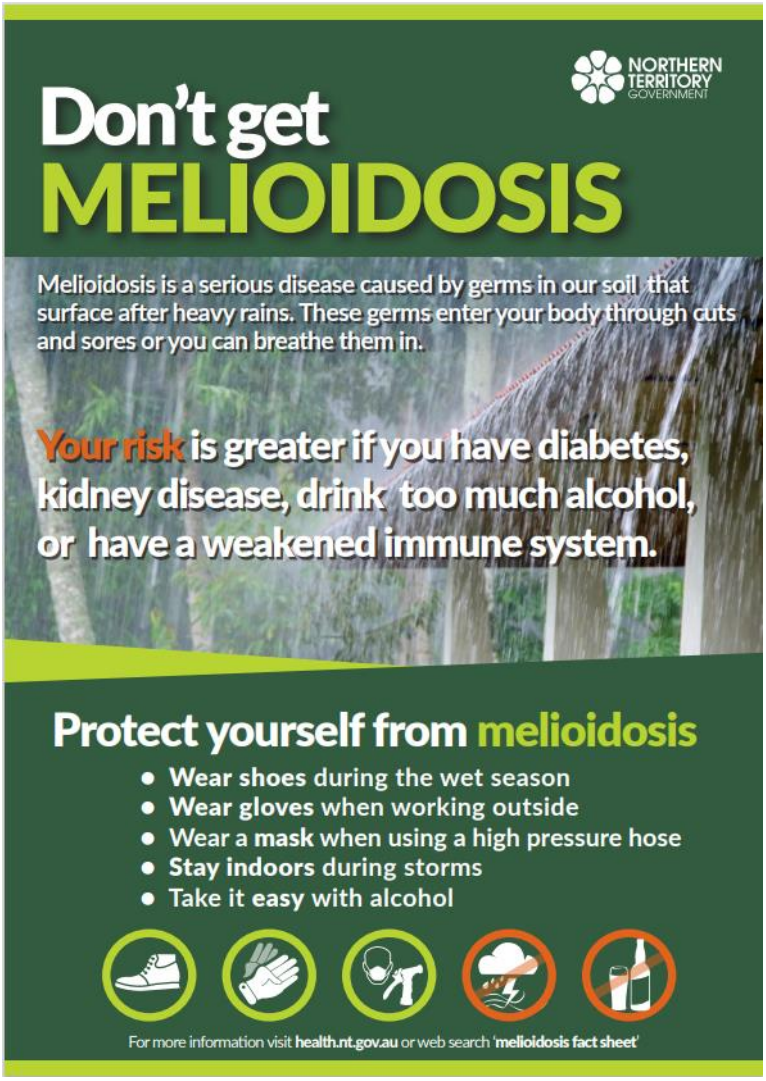


NT Health Fact sheet

Melioidosis

What is melioidosis?

Melioidosis is a serious disease caused by bacteria called *Burkholderia pseudomallei*, which live in tropical soils and water. Heavy rainfall brings them up into surface water and soil, where they can be picked up by the wind and spread in the air.

Melioidosis requires urgent medical attention as it can be fatal if not treated with the right antibiotics.

How do I catch melioidosis?

Melioidosis bacteria can infect a person through penetrating injuries, skin cuts and sores exposed to soil and water, breathing in dust or droplets (especially during storms or spray from high-pressure hoses), and rarely by drinking unchlorinated water that contains the bacteria.

It can also infect some domestic and farm animals and animals in zoos.

Melioidosis does not usually spread from one person to another or from animals to humans.

Where does melioidosis usually occur?

Melioidosis occurs in tropical areas worldwide, particularly in Southeast Asia and northern Australia. In the Northern Territory, it typically occurs in the tropical Top End but has occurred as far south as Tennant Creek. Melioidosis mostly occurs in the wet season (October to April), but cases also occur in the dry season.

What are the symptoms of melioidosis?

Most people have their first symptoms of melioidosis 1-21 days after being infected with the bacteria. Symptom onset can be sudden or gradual, but most cases present suddenly and may be very unwell. Melioidosis can affect almost any part of the body, and symptoms depend on the site of infection. Often it starts as a chest infection (pneumonia) with shortness of breath, productive cough, and fever.

Other people can present with fever, headache, confusion, difficulty passing urine, joint pain and swelling and/or bone pain, or needing Intensive Care due to severe, life-threatening infection.

In around 10% of melioidosis cases, the illness is chronic, with 2 or more months of symptoms. These cases may present as a chest infection with intermittent fever, cough, and weight loss or as a skin infection with a non-healing ulcer.

Rarely (under 5% of all cases) people can get sick with melioidosis many years after their initial infection. In these cases, the bacteria have been carried by the person in a hibernating state and then become active, usually due to a weakening of the person's immune system.

Who is at risk?

People with the following conditions are most at risk of melioidosis:

- Diabetes mellitus
- Heavy alcohol consumption (more than 20 standard drinks a week, or binge drinking)
- Kidney disease
- Lung disease
- Cancer
- Transplant recipients
- Treatment with immunosuppressive therapy, including steroids

Up to 20% of cases occur in healthy people without any of the above risk factors, but who have been exposed to the bacteria in soil or water, usually through skin exposure.

Healthy children are much less likely to get melioidosis than adults. However, children with chronic diseases or a weakened immune system can become sick with melioidosis.

What is the treatment for melioidosis?

All people with melioidosis should be admitted to hospital to start their treatment with the correct antibiotics and to be investigated for the extent of infection.

Treatment starts using antibiotics infused into the veins for at least 2 weeks (sometimes for more than 4 weeks), followed by tablet antibiotics for at least 3 months to ensure cure and prevent relapse.

How can I prevent melioidosis?

There is no way to eradicate melioidosis from tropical soils and there is no vaccine against melioidosis. People who have previously had melioidosis can get infected again.

Key ways that people can avoid catching melioidosis in tropical areas include:

	• Wear waterproof shoes or boots to protect your feet when you walk or work in wet soil, around pooled water, or muddy conditions – including for gardening or excavations • *Open footwear, such as sandals, is NOT good protection*
	• Wear rubber gloves when handling soil, particularly during the wet season, and wash hands straight after with disinfected water • Wash cuts and wounds on any skin area promptly and thoroughly, then keep them covered with clean dressings
	• Wear a mask that covers the mouth and nose to avoid breathing in the melioidosis bacteria when using high pressure hoses around soil • Use pumping equipment to control water when working in excavations
	• People with risk factors should stay indoors during storms with heavy wind and rain, because the germ gets blown into the air • Healthy children are at very low risk and can have the usual safe play activities outdoors as undertaken in non-melioidosis locations
	• People with risk factors for melioidosis should ensure bore water is disinfected before domestic use for drinking and showering: access to town water supply, disinfect water, or use a combination of rain water and bottled/boiled water • Cut back on alcohol – to improve your health all round!

For more information call your nearest Centre for Disease Control.

Location	Phone
Darwin (Top End Region)	(08) 8922 8044 1800 008 002
Katherine (Big Rivers Region)	(08) 8973 9049
Tennant Creek (Central Australia Region)	(08) 8962 4259
Alice Springs (Central Australia Region)	(08) 8951 7540
Nhulunbuy (East Arnhem Region)	(08) 8987 0357

COVID-19 Epidemiological Situation Report – 27 October 2023

CDC NT COVID-19

Situation report – no. 376

Coronavirus (COVID-19)

Report date: 27 October 2023

Reporting period: 13 – 26 October 2023

Table 1: Summary of COVID-19 cases in the past 3 fortnights

	13 – 26 Oct	29 Sep – 12 Oct	15 – 28 Sep	Total
Cases notified in this reporting period	238	163	196	108,989^
Case classification				
Confirmed	115	78	112	25,383
Probable	123	85	84	83,606
Age group (years)				
<5	16	11	9	5,483
5<12	11	4	6	9,572
12<20	8	2	6	10,205
20<40	70	49	69	42,029
40<60	81	61	60	28,914
≥60	52	36	46	12,784
Not recorded	0	0	0	2
Aboriginal status				
Aboriginal and/or Torres Strait Islander	59	43	46	27,297
Neither Aboriginal nor Torres Strait Islander	179	120	150	81,498
Unknown/not stated	0	0	0	194
Deaths	0	2	0	111
Region*				
Barkly	5	0	4	2,298
Big Rivers	10	3	5	6,492
Central Australia	21	18	25	16,529
East Arnhem	9	18	21	4,341
Top End	183	109	129	73,129
Interstate	10	15	11	5,700
Overseas	0	0	1	136
Cruise Ship	0	0	0	339
Not recorded	0	0	0	25

*Resident location or place of infection, if unknown or infected on cruise ships.

^Total cases may vary each day due to the addition of historic cases or deletion of duplicates.

COVID-19 cases

There were 238 cases notified in the past fortnight. This was a 46% increase in cases compared to the previous fortnight. There were no COVID-19 deaths for reporting this fortnight. The 14-day mean was 17 cases per day on 26 October 2023 compared to 12 cases per day on 12 October 2023.

Of the cases notified this fortnight, 75% were non-Aboriginal and 25% were Aboriginal.

CDC NT COVID-19 & influenza situation report

Figure 1: Epidemiological curve of COVID-19 notifications by classification and notification date, diagnosed in the Northern Territory (NT) since 1 December 2021 (inset graph display trends from 1 January 2023)

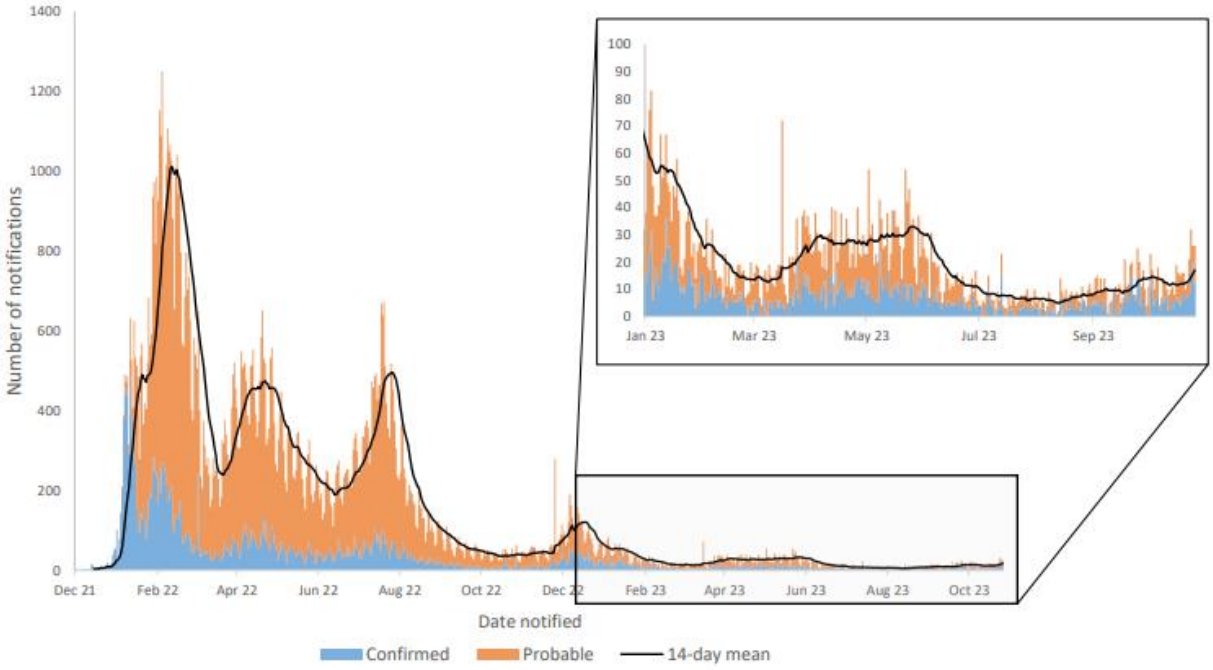


Table 2: COVID-19 deaths by Aboriginal status, sex and age groups

	Non-Aboriginal		Aboriginal		
	Female	Male	Female	Male	**Total**
<10	0	0	0	1	**1**
10<20	0	0	0	1	**1**
20<30	0	0	0	0	**0**
30<40	0	0	2	2	**4**
40<50	0	0	4	0	**4**
50<60	2	3	4	7	**16**
60<70	3	8	9	9	**29**
70<80	3	10	7	4	**24**
≥80	10	14	7	1	**32**
Total	**18**	**35**	**33**	**25**	**111**

Hospitalisation

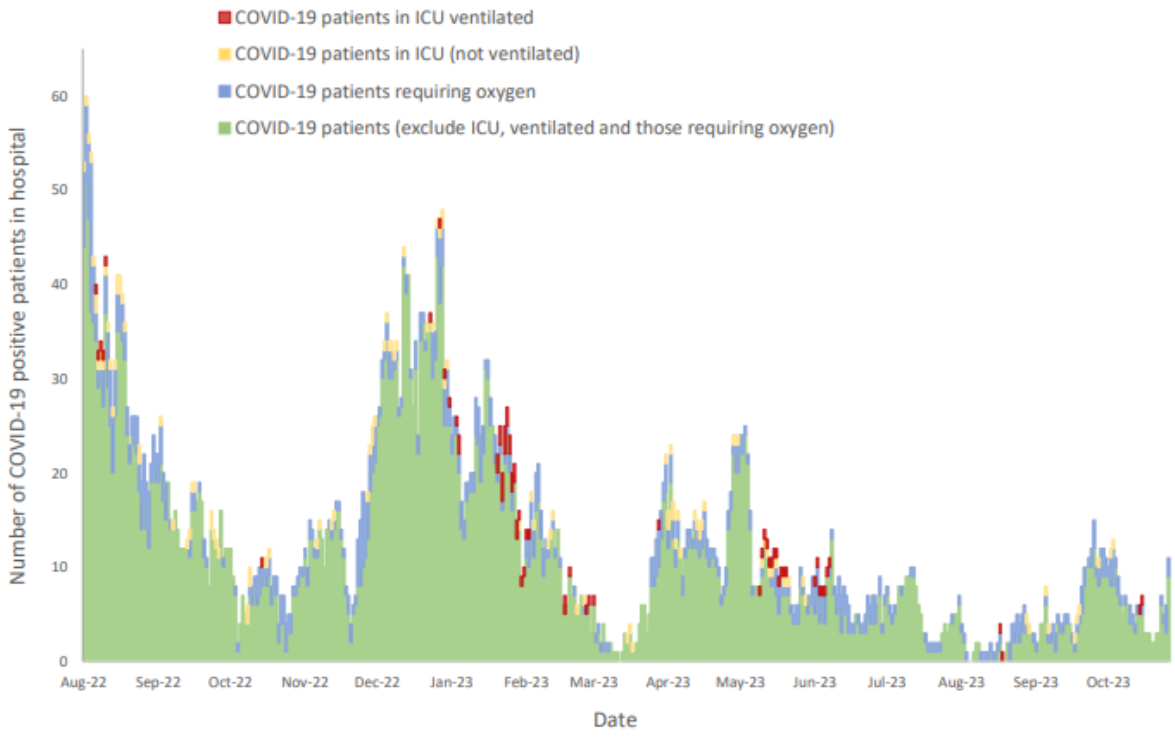
There were 11 patients in hospital with COVID-19 on 26 October 2023. Over the past fortnight, there have been 14 new hospital admissions with COVID-19.

Table 3: Current COVID-19 hospitalisations as of 26 October 2023

Hospital	General ward	ICU	Requiring O_2	Total
Alice Springs Hospital	0	0	0	0
Gove District Hospital	0	0	0	0
Katherine District Hospital	0	0	0	0
Royal Darwin Hospital*	9	0	2	11
Tennant Creek Hospital	0	0	0	0
Total	**9**	**0**	**2**	**11**

* Includes Palmerston Regional Hospital

Figure 2: COVID-19 hospital patient numbers since 1 August 2022



COVID-19 Epidemiological Situation Report – 24 Nov 2023

NORTHERN TERRITORY GOVERNMENT

Centre for Disease Control

NT HEALTH

COVID-19 surveillance update

Reporting period: 27 October to 23 November 2023

Summary

There were 496 confirmed cases (PCR positive) of COVID-19 notified in the 4 week reporting period (27 October 2023 to 23 November 2023); 2.6 times more cases compared to the previous 4 week reporting period (194 cases). There have been 2,707 confirmed cases (PCR positive) of COVID-19 notified this year.

Please note, probable cases (RAT positive) of COVID-19 are no longer notified or included in this surveillance report.

Table 1: Confirmed cases (PCR positive) of COVID-19 notified in the 4 week reporting period and year-to-date

	4 week reporting period		Year-to-date	
Cases notified	496		2,707	
Aboriginal status	**Cases**	**Proportion**	**Cases**	**Proportion**
Aboriginal	186	38%	877	32%
Non-Aboriginal	304	61%	1,747	65%
Unknown	6	1%	83	3%
Age group	**Cases**	**Proportion**	**Cases**	**Proportion**
0-9	61	12%	306	11%
10-19	20	4%	124	5%
20-59	287	58%	1,604	59%
60-69	48	10%	301	11%
≥70	80	16%	372	14%

Health district	Cases	Rate per 100,000 population	Cases
Alice Springs Rural	16	1,603	147
Alice Springs Urban	29	1,326	339
Barkly	11	2,221	45
Darwin Rural	36	2,956	165
Darwin Urban	317	2,603	1,526
East Arnhem	34	2,759	163
Interstate	11		166
Katherine	40	2,495	129
Overseas	2		27
Unknown			

Table 2: COVID-19 hospitalisations^* in the reporting period, previous 4 week period and year-to-date

Reporting period	Previous 4 week period	Ratio	Year-to-date
94	16	5.9	347

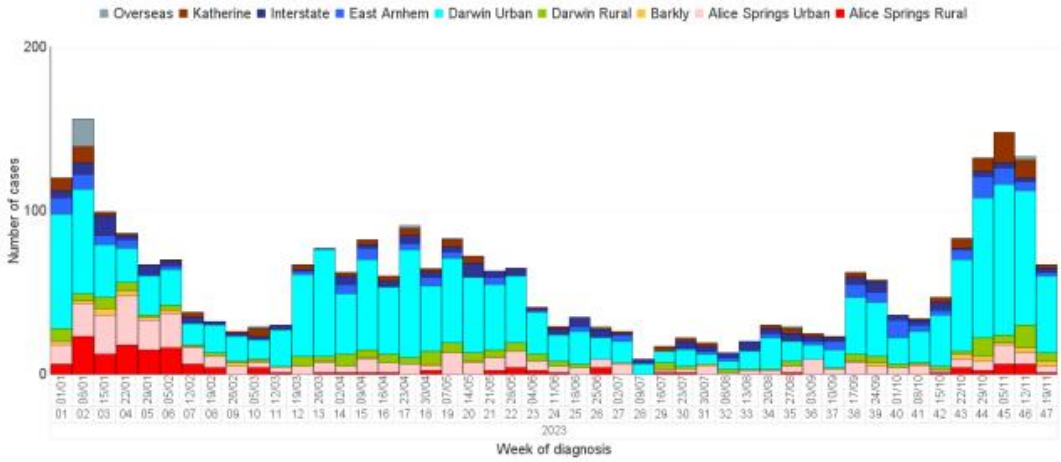
^ Hospitalisation status is recorded as at the time of notification entry.

Table 3: COVID-19 deaths* in the reporting period, previous 4 week period and year-to-date

Reporting period	Previous 4 week period	Ratio	Year-to-date
3	0	3.0	24

* COVID-19 hospitalisations and deaths include only confirmed cases (PCR positive)

Figure 1: Confirmed cases (PCR positive) of COVID-19 by health district and week of diagnosis, since 1 January 2023



Health alerts issued October to December 2023

The following public health alerts were issued by Centre for Disease Control (CDC) between October and December 2023. Below are excerpts from the health alerts, noting these alerts may no longer be active at the time of publishing this issue. Current and previous health alerts can be viewed at the NT Health website.

Syphilis

The Northern Territory syphilis outbreak is ongoing, with 2,064 outbreak cases notified from 1 July 2013 to 26 October 2023. A case of congenital syphilis was notified in Central Australia in August 2023.

Clinicians are urged to:

- repeat syphilis serology in all pregnant women after the initial serology during pregnancy.
- test all pregnant women in outbreak areas for syphilis at the first visit (including request for test), 28 weeks, 36 weeks, delivery and 6 weeks post- partum.
- test all other pregnant women for syphilis at the first visit, 28 weeks and 36 weeks or at time of any preterm birth

Read the full alert issued 31 October 2023.

COVID-19

Increased cases of COVID-19 were seen across the Top End of the NT, with 160 confirmed cases between 21 October and 3 November 2023. This was more than twice the number seen in the previous 2 weeks. Recent outbreaks across various institutions were reported, as well as an increase in hospitalisations. NT COVID-19 vaccinations remain low, with an estimated 43% of Territorians aged over 75 years having received a COVID-19 vaccination in 2023. Practitioners are encouraged to consider anti-viral treatment for all eligible COVID-19 patients.

Read the full alert issued 8 November 2023.

Penicillinase-producing *Neisseria gonorrhoeae* and changes to treatment recommendations

Changes to treatment recommendations were issued 23 October 2023. Read the full alert here, or view on the next page.

Seasonal alert - Box Jellyfish

With the start of 'stinger season' CDC issued its seasonal alert to the public for box jellyfish. The venomous major box jellyfish *Chironex fleckeri* is more active in the water from October to the end of May. Some species of box jellyfish can cause Irukandji syndrome, which presents as a diverse range of symptoms, starting mild and progressing to severe limb, abdominal and back pain.

Read the full alert issued 1 October 2023 and find more information on box jellyfish on pages 23-24 and Irukandji syndrome at the NT Health website.

Penicillinase-producing *Neisseria gonorrhoeae* and changes to treatment recommendations

Issued: 23 October 2023
Issued to: Health staff, NT wide

Penicillinase-producing Neisseria gonorrhoeae (PPNG): changes treatment recommendations for gonorrhoea NT wide

Summary

- Rates of penicillin-resistant gonorrhoea in the NT outside of Darwin have historically been low
- Since January 2023, 34 cases of PPNG have been detected in the Northern Territory (NT), mostly in Central Australia
- All uncomplicated gonococcal infections across the NT should now be treated with ceftriaxone based treatments (see below) to prevent further spread

Change to 1st line treatment of all uncomplicated gonorrhoea in the NT

All cases of **suspected** or **confirmed** uncomplicated genital and anorectal gonorrhoea should be treated with:

- **Ceftriaxone 500mg in 1.8mL 1% lignocaine IM single dose AND**
- **Azithromycin 1g oral single dose**

Ensure **complete STI testing** has been done including serology for HIV and syphilis.
Retest three months after treatment as risk of reinfection is high.

Amoxicillin/probenecid/azithromycin combinations (ZAP packs) are no longer considered effective 1st line treatment of gonorrhoea in the NT.

Contact tracing for PPNG cases

Urgent contact tracing is needed. Sexual contacts in the previous 2 months should:

- Have a **full STI screen** (consider including a swab or urine for culture) AND
- Be **treated** on the same day **with ceftriaxone and azithromycin** as above

PPNG

- When *Neisseria gonorrhoeae* produces the enzyme called penicillinase it is no longer susceptible to penicillin treatment (ZAP packs) and is called PPNG.

Centre for Disease Control
Public Health Division
(08) 8922 8044 or 1800 008 002
CDCSurveillance.DARWIN@nt.gov.au

Testing for PPNG

- Since September 2023 Western Diagnostic Pathology has joined Territory Pathology in routinely testing all positive gonorrhoea specimens for PPNG
- You will notice a PPNG PCR result in all positive gonorrhoea results from these labs

Contact & advice

- Clinic 34 is the NT's specialist sexual health service and their staff can provide further clinical advice if needed. Contact through clinic34.ths@nt.gov.au or via your local CDC unit.

CDC Darwin	Ph 8922 8044	Fax 8922 8310	cdcsurveilliance.darwin@nt.gov.au
CDC Alice Springs	Ph 8951 7540 0436 667 809	Fax 8951 7900	cdc.alicesprings@nt.gov.au
CDC Katherine	Ph 8973 9049	Fax 8973 9048	cdc.katherine@nt.gov.au
CDC Tennant Creek	Ph 8962 4259	Fax 8962 4420	cdc.barkly@nt.gov.au
CDC Nhulunbuy	Ph 8987 0357	Fax 8987 0500	cdcgove.doh@nt.gov.au

Scan below for more on Public Health Alerts

Issued by: Director, Centre for Disease Control, Public Health Division, NT Health

Centre for Disease Control
Public Health Division
(08) 8922 8044 or 1800 008 002
CDCSurveillance.DARWIN@nt.gov.au

NT Health Fact sheet

Box Jellyfish (Chironex fleckeri)

Why is the box jellyfish so dangerous?

'Chironex fleckeri', also known as the major box jellyfish has the most rapidly acting venom known to science and is capable of killing a person in under 5 minutes.

What does the box jellyfish look like?

The bell of the jellyfish is a rounded box shape with the bottom missing, with 4 fleshy appendages, 1 at each corner, from which tentacles trail.

The jellyfish is difficult to see in the water because the bell is colourless, and although the outermost tentacles are sometimes purple near their base the others are white or dull yellow.

Visible baby box jellyfish have bodies 2-5cm in diameter, while the larger mature specimens can often be 20cm across or even larger. An adult jellyfish may have 40 or more tentacles, each of which may be 2 metres or more in length.

When and where are they found?

The official 'stinger' season for the Northern Territory is from 1 October until 1 June. However stings have been recorded in all months of the year.

Chironex fleckeri inhabit the shallow waters of the northern Australian coast, and are more numerous after local rain and in calm seas, especially near river and creek outlets and around boat ramps.

What happens if you are stung?

The tentacles contain millions of 'nematocysts' which store venom. A sting occurs when the tentacles contact the bare skin causing these nematocysts to very quickly (within 3 milliseconds) release their harpoon like thread, which injects venom into the skin.

A massive dose of venom can cause heart beat irregularities and even lead to cardiac arrest and death within 5 minutes of being stung.

Children are at greater risk of a severe, life threatening reaction because of their smaller body mass. There have been 14 deaths in Top End since 1975 – all have been children.

What other symptoms occur when stung by a box jellyfish?

There is immediate severe pain at the site of the sting. Within minutes white welts appear where the tentacles contacted the skin, followed by red whip-like lines which may later blister. Subsequent skin death can occur and lead to permanent scarring.

NT HEALTH – EDOC2022/382180
1 November 2021

NORTHERN TERRITORY GOVERNMENT

In up to 60% of cases an itchy bumpy rash can occur 1-2 weeks later at the site of the sting. This 'delayed reaction' can be intensely itchy. The rash usually resolves within 10 days although it may occasionally persist for weeks. The itching may be relieved by antihistamines and steroid cream if the skin is not broken.

How can I prevent a box jellyfish sting?

The best prevention is to stay out of the water where there may be jellyfish especially during the 'stinger season'.

If entering the water wear protective clothing. Any clothing, even if very thin, will provide protection as long as there are no gaps or exposed skin. The more skin that is covered, the greater the protection. Special stinger suits are available for those undertaking coastal water activities.

What is the initial treatment if stung?

Immediate first aid is vital and cardiopulmonary resuscitation (CPR) may be needed.

- remove the person from the water
- call for help (dial 000 or get a surf life saver or life guard if available to help you)
- assess the patient and commence CPR as necessary
- pour vinegar if available on the area of the sting to stop further discharge from nematocysts – do not wash with fresh water
- if vinegar is unavailable, pick off any remnants of the tentacles (the skin of the pads of the fingers and palm is thicker so any stinging will usually be minor)
- seek urgent medical assistance with rapid transport to hospital. Treatment with antivenom may be required in severe stings.

Ice or hot packs may be applied for local pain relief for less severe stings, but do not use hot packs in severe stings.

Contact

For more information contact the Centre for Disease Control in your region.

Location	Phone
Darwin (Top End Region)	(08) 8922 8044 1800 008 002
Katherine (Big Rivers Region)	(08) 8973 9049
Tennant Creek (Central Australia Region)	(08) 8962 4259
Alice Springs (Central Australia Region)	(08) 8951 7540
Nhulunbuy (East Arnhem Region)	(08) 8987 0357

Northern Territory disease notifications by onset date and district – 1 July to 30 September (2023 vs. 2022)

	Alice Springs		Barkly		Darwin		East Arnhem		Katherine		N T	
	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022
Acute Post Strep GN	3	7	2	3	5	7	0	2	2	2	12	21
Adv Vacc Reaction	1	4	1	0	0	10	0	0	1	1	3	15
Barmah Forest	0	0	0	0	0	1	0	0	0	0	0	1
Campylobacteriosis	12	8	3	3	66	63	3	1	4	12	88	87
Chickenpox	1	2	0	0	15	10	0	1	8	1	24	14
Chlamydia	225	220	32	25	382	341	60	31	102	81	801	698
Chlamydial conj	0	0	0	0	0	2	0	0	0	2	0	4
CJD	1	0	0	0	0	0	0	0	0	0	1	0
Coronavirus - pandemic potential	67	543	3	53	246	2341	32	97	11	133	359	3167
Crusted scabies	2	2	2	2	9	13	2	5	3	3	18	25
Cryptosporidiosis	1	0	2	0	27	3	0	0	0	2	30	5
Dengue	2	1	0	0	3	5	0	0	0	0	5	6
Diphtheria	0	0	0	0	1	0	0	0	0	0	1	0
Gastro - related cases	0	0	0	0	0	1	0	0	0	0	0	1
Gonococcal conj	0	0	1	0	1	1	0	0	0	0	2	1
Gonococcal infection	246	280	33	52	216	174	44	17	87	79	626	602
Gonococcal neon ophth	0	0	1	0	0	0	0	0	0	0	1	0
Group A strep invasive	5	11	3	2	17	16	0	3	7	6	32	38
Hepatitis A	0	0	0	0	0	1	0	0	0	0	0	1
Hepatitis B - chronic	0	3	0	0	0	3	0	0	0	0	0	6
Hepatitis B - new	0	0	0	0	1	0	0	0	1	0	2	0
Hepatitis B - unspec	3	2	0	0	16	6	0	0	1	1	20	9
Hepatitis C - unspec	8	3	1	0	17	19	2	0	0	2	28	24
H Influenzae b	0	0	1	0	1	0	0	0	0	0	2	0
H Influenzae non-b	2	1	0	0	1	0	1	0	1	0	5	1
HIV	0	0	0	0	3	3	0	0	0	1	3	4
HTLV1 adult TCL	0	0	0	0	1	0	0	0	0	0	1	0
HTLV1 asyptom/unspec	10	17	1	1	2	0	0	0	2	1	15	19
Influenza	157	25	34	4	159	109	8	21	19	43	377	202
Lead - elevated	1	0	1	0	35	99	1	1	4	2	42	102
Leptospirosis	0	0	0	0	1	0	0	0	0	0	1	0
Malaria	0	0	0	0	2	0	0	0	0	0	2	0
Melioidosis	0	0	0	0	3	5	0	1	0	0	3	6
Meningococcal infection	0	0	0	0	1	1	0	0	0	0	1	1
Non TB Mycobacteria	0	1	0	0	6	1	0	0	0	0	6	2
Pertussis	0	0	0	0	0	1	0	0	0	0	0	1
Pneumococcal disease	12	10	8	2	12	13	0	0	0	2	32	27
Q Fever	0	1	0	0	1	0	0	0	0	0	1	1
Rheumatic Fever	22	27	5	3	9	5	3	6	7	7	46	48
Rheumatic heart disease	4	7	0	2	4	10	2	3	4	3	14	25

	Alice Springs		Barkly		Darwin		East Arnhem		Katherine		N T	
	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022
Ross River Virus	0	2	1	2	14	9	1	1	3	1	19	15
Rotavirus	51	53	17	9	66	21	12	3	7	5	153	91
RSV infection	94	345	2	56	52	449	7	36	8	29	163	915
Salmonellosis	5	11	5	2	47	62	8	6	9	8	74	89
Shigellosis	8	4	6	0	17	11	5	5	5	7	41	27
STEC/VTEC	0	0	1	0	0	1	0	0	0	0	1	1
Syphilis < 2y	33	31	3	3	10	21	1	1	10	10	57	66
Syphilis > 2y or unk	7	3	0	0	2	5	3	0	2	2	14	10
Syphilis congenital	1	0	0	0	0	0	0	0	0	0	1	0
Trichomoniasis	204	241	42	48	311	275	104	89	134	83	795	736
Tuberculosis	0	0	0	0	7	6	0	0	2	1	9	7
Typhus	0	0	0	0	1	1	0	0	0	0	1	1
Varicella - unspec	10	2	0	0	12	30	4	1	2	1	28	34
Yersiniosis	3	0	0	0	7	4	0	0	0	0	10	4
Zoster	13	13	4	2	90	63	4	4	4	3	115	85
Sum:	**1,214**	**1,880**	**215**	**274**	**1,899**	**4,222**	**307**	**335**	**450**	**534**	**4085**	**7245**

Dengue notifications for July - September 2023

Number of cases	Origin of infection	NT Region notified
2	Timor-Leste	Alice Springs
1	Timor-Leste	Darwin
1	Philippines	Darwin
1	Thailand	Darwin

Malaria notifications for July - September 2023

Number of cases	Origin of infection	Agent	Chemoprophylaxis	NT Region
1	Solomon Islands	*P. vivax*	None	Darwin
1	Nigeria	*P. falciparum*	None	Darwin

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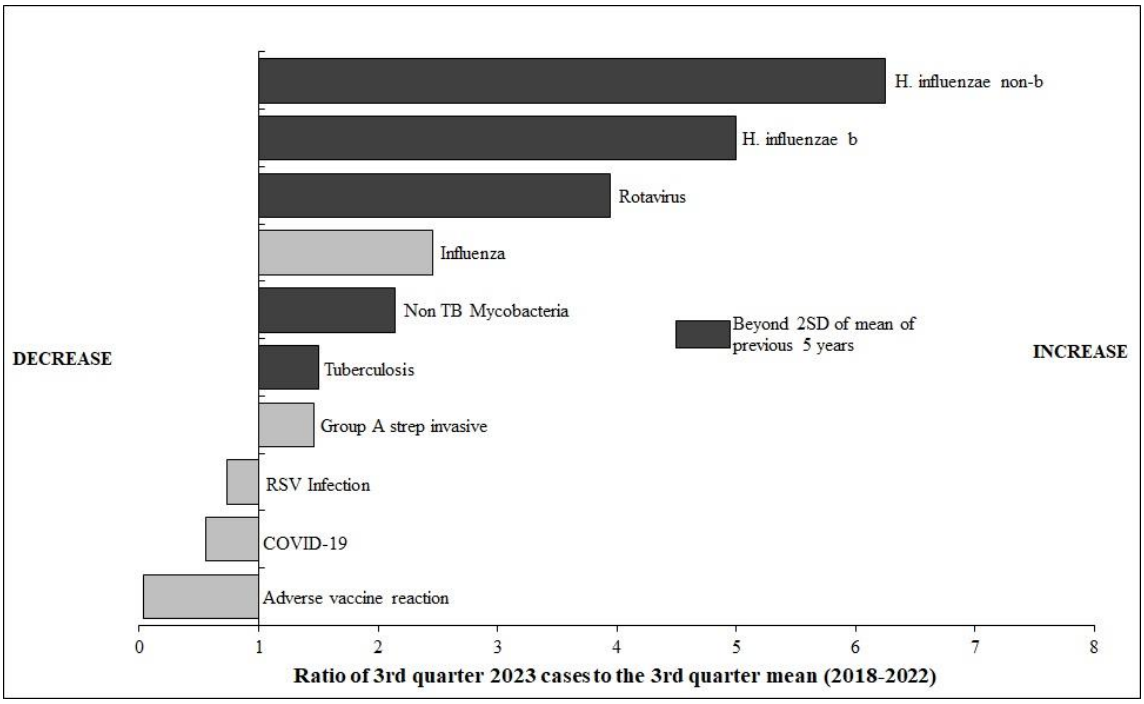
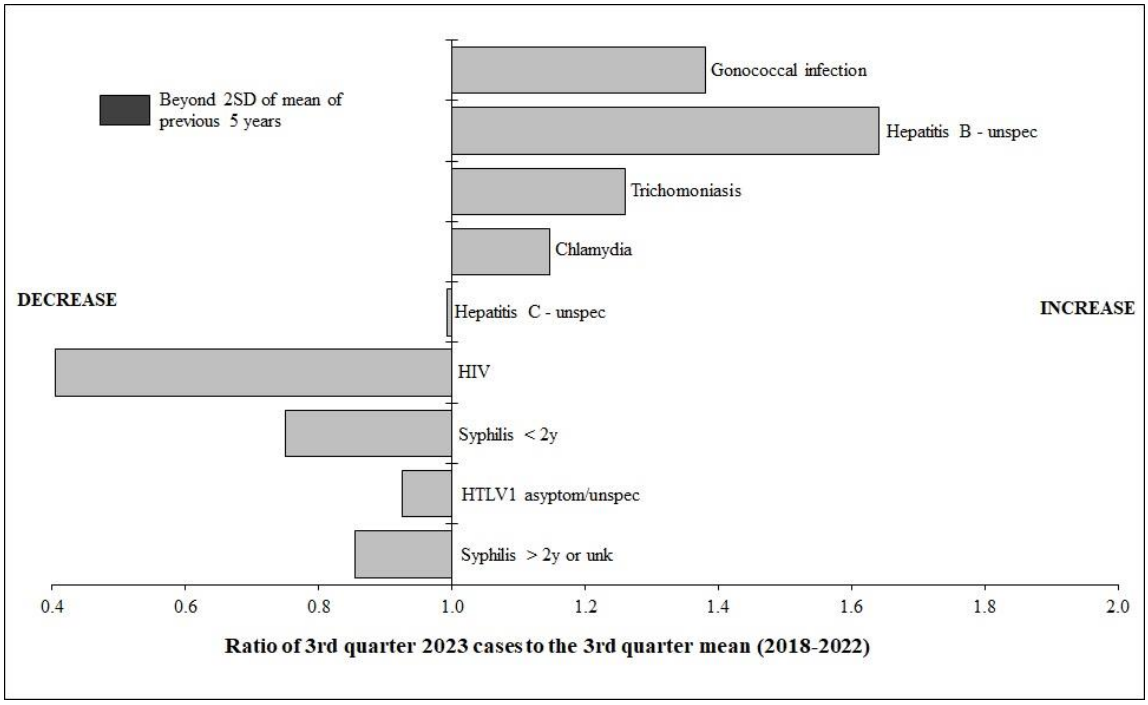
Graphs of selected diseases and STIs – 3rd quarter, 2023

Ratio of the number of notifications in 3rd quarter of 2023 to the 3rd quarter, 5 year mean (2018 – 2022): Selected diseases



Ratio of the number of notifications in 3rd quarter of 2023 to the 3rd quarter, 5 year mean (2018 – 2022): Sexually transmitted infections (STIs)



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Comments on selected disease notifications

Haemophilus influenzae (non-b)

There were 5 notifications of *Haemophilus influenzae* (non-b) in the 3rd quarter of 2023 compared to the 5 year 3rd quarter mean of 0.8 cases.

Haemophilus influenzae (type b)

There were 2 notifications of *Haemophilus influenzae* (type b) in the 3rd quarter of 2023 compared to the 5 year 3rd quarter mean of 0.2 cases. The last case notified in the 3rd quarter prior to 2023 was in the 3rd quarter of 2020. One case was a vaccinated child and the other was an unvaccinated adult.

Rotavirus

There were 153 cases of rotavirus notified in the 3rd quarter of 2023 compared to the 5 year 3rd quarter mean of 39 cases (3.9 times increase). Restrictions on travel and physical distancing in 2020 and 2021 due to the COVID-19 pandemic are likely to have lowered transmission during those years. The incidence of rotavirus in the 3rd quarter of 2023 was typical of the seasonal outbreaks seen before the pandemic and in 2022.

Non-tuberculosis Mycobacteria

There were 6 notifications of non-tuberculosis Mycobacteria in the 3rd quarter of 2023 compared to the 5 year 3rd quarter mean of 2.8 cases.

Tuberculosis

There were 9 notifications of tuberculosis in the 3rd quarter of 2023 compared to the 5 year 3rd quarter mean of 6 cases.

Immunisation coverage in the Northern Territory

Northern Territory immunisation data is accessible from the Australian Government website. The following link provides tables of the latest annualised quarterly report on childhood immunisation coverage from the Australian Government Department of Health and Aged Care, which combines the December, March, June and September quarters for NT and Australia.

The data show the proportion of children fully immunised at 1, 2 and 5 years of age according to the National Immunisation Program Schedule.

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Abstracts from peer reviewed published articles related to the Northern Territory

Clinical characteristics of hospitalised children with acute post-streptococcal glomerulonephritis in the Top End of Australia

Chong HY, Hung TY, Hohls A, Francis J and Chaturvedi S.

Journal of Paediatrics and Child Health. 2023;59: 735-742

https://doi.org/10.1111/jpc.16386

Aims: Despite the declining incidence of acute post-streptococcal glomerulonephritis (APSGN) in Australia, there is still a significant burden of disease amongst Aboriginal and Torres Strait Islander people in the Northern Territory. Childhood APSGN has been highlighted as a predictor of chronic kidney disease in this population. We aimed to describe clinical characteristics and outcomes of hospitalised children with APSGN in the Northern Territory.

Methods: Single-centre, retrospective cohort study of children (<18 years) with APSGN admitted to a tertiary hospital in the Top End of the Northern Territory between January 2012 and December 2017. Cases were confirmed using the Centre for Disease Control case definition guidelines. Data were extracted from the case notes and electronic medical records.

Results: There were 96 cases of APSGN with median age of 7.1 years (interquartile range (IQR) 6.7–11.4). Majority were Aboriginal and Torres

Strait Islander (90.6%) and from rural and remote areas (82.3%). Preceding skin infections were identified in 65.5% and sore throat in 27.1%.

Severe complications included hypertensive emergencies (37.4%), acute kidney injury (43.8%) and nephrotic-range proteinuria (57.7%). All children improved from their acute illness with supportive medical therapy; however, only 55 out of 96 (57.3%) children were followed up within 12 months of their acute illness.

Conclusions: APSGN disproportionately affects Aboriginal and Torres Strait Islander children and highlights the need for continued and improved public health response. There is room for significant improvement in the medium- and long-term follow-up of affected children.

Keywords: acute kidney injury; chronic kidney disease; glomerulonephritis; Northern Territory; public health; streptococcus

A cluster of leptospirosis cases associated with crocodile workers in the Northern Territory, Australia, 2022

Stark A, Nohrenberg M, Draper A, McMahon K, Hewitt T, Lomas K and Krause V.

Communicable Disease Intelligence 2023;v47:1-14

https://doi.org/10.33321/cdi.2023.47.70

Leptospirosis is a worldwide zoonotic waterborne disease endemic in tropical and subtropical climates. Outbreaks have been observed in the Northern Territory (NT) of Australia. We briefly described the epidemiology of leptospirosis in the NT between 2012 and 2022, and undertook an investigation of a cluster of three leptospirosis cases observed in crocodile workers between January and December 2022 in the Top End of the NT. A descriptive case series was conducted to

investigate the cluster; all three cases were male and non-Aboriginal with a median age of 46.5 years; none took chemoprophylaxis; only one of the three cases reported wearing appropriate protective attire; all reported receiving limited to no education about personal protective measures from their associated workplaces. Higher than average rainfall in both February and December 2022 likely contributed to the increased risk of infection in those months. Changing climate patterns are likely to result in more frequent periods of heavy rain, and risk of contracting leptospirosis in the NT may increase, particularly for those who work in wet and muddy conditions. Promoting the use of protective workplace clothing and equipment, the use of waterproof dressings for skin abrasions, regular hand hygiene, and the consideration of chemoprophylaxis in certain circumstances may prevent future cases.

Keywords: leptospirosis; Leptospira; crocodiles; rats; Northern Territory; rainfall; climate change

Data analysis of zoonoses notifications in Aboriginal and Torres Strait Islander populations in Australia 1996–2021: implications for One Health

Riley T, Lovett R, Cumming B, Meredith A, Anderson N, Thandrayen J.

Sec. Infectious Diseases: Epidemiology and Prevention. 2023;11:

https://doi.org/10.3389/fpubh.2023.1175835

Introduction: Zoonoses are a health concern for Aboriginal and Torres Strait Islander peoples in Australia that face elevated risk of disease related to the environment and animals.

Internationally, One Health is encouraged to effectively manage zoonoses by taking integrated approaches involving animal, human, and environmental health sectors to improve health outcomes. However, Australia's health systems manage zoonotic diseases in animals and people separately which does not support a One Health approach. For the effective management of zoonoses, a strong evidence base and database regarding the epidemiology of zoonotic pathogens is needed. However, we currently lack this evidence limiting our understanding of the impact of zoonoses on Aboriginal and Torres Strait Islander populations.

Methods: As a first step towards building the evidence base, we undertook a descriptive analysis of Aboriginal and Torres Strait Islander zoonotic notifications in Australia from 1996 to 2021. We presented notifications as annual notification rates per 100,000 population, and percentages of notifications by state, remoteness, sex, and age group.

Results: Salmonellosis and campylobacteriosis were the most notified zoonoses with the highest annual notification rates of 99.75 and 87.46 per 100,000 population, respectively. The north of Australia (Queensland, Northern Territory and Western Australia), remote and outer regional areas, and young children (0–4 years of age) had the highest percentages of notifications.

Discussion: To our knowledge, these findings are the first national presentation of the epidemiology of zoonoses within Aboriginal and Torres Strait Islander populations. A greater understanding of transmission, prevalence and impact of zoonoses on Aboriginal and Torres Strait Islander peoples (including animal and environmental health factors) is required to inform their effective management through a One Health approach.

Burkholderia pseudomallei and melioidosis.

M*eumann EM, Limmathurotsakul D, Dunachie SJ, Wiersinga WJ, Currie BJ*

Nat Rev Microbiol 2023;Oct 4th

https://doi.org/10.1038/s41579-023-00972-5

Burkholderia pseudomallei, the causative agent of melioidosis, is found in soil and water of tropical and subtropical regions globally. Modelled estimates of the global burden predict that melioidosis remains vastly under-reported, and a call has been made for it to be recognized as a neglected tropical disease by the World Health Organization. Severe weather events and environmental disturbance are associated with increased case numbers, and it is anticipated that, in some regions, cases will increase in association with climate change. Genomic epidemiological investigations have confirmed B. pseudomallei endemicity in newly recognized regions, including the southern United States. Melioidosis follows environmental exposure to B. pseudomallei and is associated with comorbidities that affect the immune response, such as diabetes, and with socioeconomic disadvantage. Several vaccine candidates are ready for phase I clinical trials. In this Review, we explore the global burden, epidemiology and pathophysiology of B. pseudomallei as well as current diagnostics, treatment recommendations and preventive measures, highlighting research needs and priorities.

A graphical overview of the histopathology of human melioidosis: a case series.

Savelkoel J, Tiemensma M, Birnie E, Wiersinga WJ, Currie BJ, Roelofs JJTH

Open Forum Infect Dis 2023;10(8);ofad367.

https://doi.org/10.1093/ofid/ofad367

Background

Melioidosis, caused by the Gram-negative bacterium Burkholderia pseudomallei, has a major global health impact and a wide range of different disease manifestations. Histopathological descriptions of melioidosis remain limited. Granulomatous inflammation with multinucleated giant cells are considered classic features. We aim to present a graphical overview of histopathological manifestations of melioidosis, serving as an aid in diagnosing this disease.

Methods

We performed a retrospective international multicenter laboratory-based analysis of formalin-fixed paraffin-embedded (FFPE) tissue from culture-confirmed melioidosis autopsy and biopsy cases. Available FFPE tissue was stained with hematoxylin and eosin and immunostainings including a monoclonal antibody targeting the capsular polysaccharide (CPS) of B pseudomallei. Tissue with site-specific cultures and/or positive CPS staining were included in the graphical histopathological overview.

Results

We identified tissue of 8 autopsy and 5 biopsy cases. Pneumonia and soft tissue abscesses were the leading foci of disease displaying mainly necrosis and suppuration. Infrequent disease manifestations included involvement of bone marrow and adrenal glands in an autopsy case and biopsied mediastinal tissue, the latter being the

only case in which we identified multinucleated giant cells. Using the CPS staining, we demonstrated granulomata as part of rare gastric tissue involvement.

Conclusions

We found fatal melioidosis to be a necrotizing and suppurative inflammation, usually without multinucleated giant cell formation. Gastric and mediastinal involvement points to ingestion and inhalation as possible routes of infection. The CPS staining proved beneficial as an aid to establish a histopathological diagnosis. Our graphical overview can be used by infectious diseases specialists, microbiologists, and pathologists.

The Expanding Global Footprint of *Burkholderia pseudomallei* and Melioidosis

Currie BJ, Meumann EM, Kaestli M

Am J Trop Med Hyg 2023;108:1081-1083

https://doi.org/10.4269/ajtmh.23-0223

Summary

This century there has been a dramatic expansion of the documented global footprint of *Burkholderia pseudomallei* and melioidosis. This predominantly reflects increased surveillance, with improved laboratory resources and methods for detecting *B. pseudomallei* in clinical specimens (most importantly blood cultures) and soil and water samples from environmental studies. Nevertheless, there are also indicators that *B. pseudomallei* and melioidosis are on the move into new locations and that melioidosis case numbers are increasing in some endemic regions.

Genomic databanks provide robust assessment of invasive mosquito movement pathways and cryptic establishment

Schmidt TL, Endersby-Harshman NM, Kurucz N, Pettit W, Krause VL, Ehlers G, Muzari MO, Currie BJ, Hoffmann AA

Biological Invasions 2023; 25, 3453–3469

https://link.springer.com/article/10.1007/s10530-023-03117-0

Biosecurity strategies that aim to restrict the spread of invasive pests can benefit from knowing where incursions have come from and whether cryptic establishment has taken place. This knowledge can be acquired with genomic databanks, by comparing genetic variation in incursion samples against reference samples. Here we use genomic databanks to characterise incursions of two mosquito species within Australia, and to observe how genomic tracing methods perform when databank samples have limited genetic differentiation and were collected tens of generations ago. We used a deep learning method to trace a 2021 invasion of *Aedes aegypti* in Tennant Creek, Northern Territory, to Townsville, Queensland, and to trace two years of *Ae. albopictus* incursions to two specific islands in the Torres Strait. Tracing had high precision despite 30–70 generations separating incursion and reference samples, and cross-validation of reference samples assigned them to the correct origin in 87% of cases. Similar precision was not achieved with PCAs, which performed particularly poorly for tracing when the invasion had been subject to strong drift effects. Targeted assays also provided additional information on the origin of the Tennant Creek *Ae. aegypti*, in this case by comparing Wolbachia infection data and mitochondrial DNA variation. Patterns of relatedness and inbreeding indicated that Tennant

Creek was likely invaded by one family of *Ae. aegypti*, while Torres Strait incursions were independent and indicated no cryptic establishment. Our results highlight the value of genomic databanks that remain informative over years and for a range of biological conditions.

Design and development of an internationally applicable educational video to increase community awareness in regions with high prevalence of melioidosis and diabetes

Maisrikrod SC, Currie M, Govan BL, Norton RE, Currie BJ, Ketheesan N, Mayo M

Am J Trop Med Hyg 2023;108:503-504

https://doi:10.4269/ajtmh.22-0024

Melioidosis is a neglected tropical disease that causes high morbidity and mortality. Public health awareness is essential for both prevention and early detection of the infection. This project aimed to develop an internationally applicable educational tool to increase community awareness in regions with high prevalence of diabetes and melioidosis. The animation was created with international collaboration. Sixty-four delegates from different cultural backgrounds participated in the survey to evaluate the animation. Feedback was positive, with 85% agreeing that they would use this video for public education and 82% agreeing that the video was culturally appropriate to them in the context of their region. The animation was refined after feedback. To supplement the 3-minute animation, a 13-minute film footage of interviews with clinicians, researchers and patients was also created. These materials have been made available online through the International Melioidosis Network and can be readily downloaded or subtitled in any language using publicly available software, demonstrating the utility of developing low-cost adaptable health education material targeted for widespread use internationally.

Epidemiology, management and outcomes of *Cryptococcus gattii* infections: a 22-year cohort

O'Hern JA, Koenen A, Janson S, Hajkowicz KM, Robertson IK, Kidd SE, Baird RW, Tong SYC, Davis JS, Carson P, Currie BJ, Ralph AP

PLoS NTD 2023;17(3):e0011162.

https://doi: 10.1371/journal.pntd.0011162

Background

Cryptococcus gattii is a globally endemic pathogen causing disease in apparently immune-competent hosts. We describe a 22-year cohort study from Australia's Northern Territory to evaluate trends in epidemiology and management, and outcome predictors.

Methods

A retrospective cohort study of all C. gattii infections at the northern Australian referral hospital 1996–2018 was conducted. Cases were defined as confirmed (culture-positive) or probable. Demographic, clinical and outcome data were extracted from medical records.

Results

45 individuals with C. gattii infection were included: 44 Aboriginal Australians; 35 with confirmed infection; none HIV positive out of 38 tested. Multifocal disease (pulmonary and central nervous system) occurred in 20/45 (44%). Nine people (20%) died within 12 months of diagnosis, five attributed directly to C. gattii. Significant residual disability was evident in 4/36 (11%) survivors. Predictors of mortality included: treatment before the year 2002 (4/11 versus

1/34); interruption to induction therapy (2/8 versus 3/37) and end-stage kidney disease (2/5 versus 3/40). Prolonged antifungal therapy was the standard approach in this cohort, with median treatment duration being 425 days (IQR 166–715). Ten individuals had adjunctive lung resection surgery for large pulmonary cryptococcomas (median diameter 6cm [range 2.2-10cm], versus 2.8cm [1.2-9cm] in those managed non-operatively). One died post-operatively, and 7 had thoracic surgical complications, but ultimately 9/10 (90%) treated surgically were cured compared with 10/15 (67%) who did not have lung surgery. Four patients were diagnosed with immune reconstitution inflammatory syndrome which was associated with age <40 years, brain cryptococcomas, high cerebrospinal fluid pressure, and serum cryptococcal antigen titre >1:512.

Conclusion

C. gattii infection remains a challenging condition but treatment outcomes have significantly improved over 2 decades, with eradication of infection the norm. Adjunctive surgery for the management of bulky pulmonary C. gattii infection appears to increase the likelihood of durable cure and likely reduces the required duration of antifungal therapy.

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