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Contacts of smear positive pulmonary tuberculosis in the Northern Territory, 2014-2017

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Abstract

Contact investigation and management is a recommended public health measure for the control of tuberculosis (TB). Once identified, contacts should be assessed for latent TB infection (LTBI) after active TB is excluded and if infected offered preventive treatment where appropriate. Between 2014-2017, there were 35 cases of smear positive pulmonary TB in the Northern Territory (NT), with a median of 14 contacts per active TB case. The number of contacts identified ranged from 1 to 110 individuals requiring assessment. This article describes recent contact tracing activity in the NT and also provides a brief overview of recommended procedures for contact tracing as detailed in the "Guidelines for the Control of Tuberculosis in the Northern Territory."

Key words: tuberculosis; contact tracing.

Introduction

Tuberculosis (TB) is an infectious disease caused by *Mycobacterium tuberculosis* (MTB) and occasionally other bacteria of the MTB complex (*M. bovis, M. africanum and M. microti*).[1] Transmission occurs when infectious aerosol droplets are inhaled by close contacts when a person with active pulmonary or laryngeal TB coughs, spits, laughs or speaks.[2] Transmission is relatively inefficient compared to some other notifiable diseases such as measles and influenza but depends on the infectivity of the case of active TB, the amount of time spent in contact with susceptible individuals and the characteristics of the environment in which the contact occurs. For example, crowding in poorly ventilated spaces facilitates transmission.[3]

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In adults, following inhalation of a sufficient number of MTB bacilli, the host response usually triggers an immune reaction that contains the TB infection before it progresses to active TB. The MTB bacilli may live for many years in a dormant state, known as latent TB infection (LTBI). Following MTB exposure in some people, particularly young children and those immunocompromised, the TB infection overcomes the initial immune response and progresses directly to active TB.[4] In approximately 10% of people, LTBI will 'reactivate' to active TB with the risk of reactivation highest in the first 2 years after initial exposure.[4] Therefore, recent contacts of pulmonary TB are at greatest risk of reactivation.

The most important measures for the public health control of TB in the progress towards elimination are:

- early diagnosis and treatment of active TB cases to prevent the transmission of infection

and

- the identification of people at highest risk of LTBI through epidemiological investigation and contact tracing, using Mantoux (tuberculin skin) testing or interferon-gamma release assay (IGRA).

Once identified through a positive Mantoux test or IGRA and active TB has been ruled out, people with LTBI may be given treatment that prevents progression to active TB, thereby halting the cycle of transmission.[5]

The purpose of this article is to describe the current procedure for TB contact tracing and management in the Northern Territory (NT) and present summary data for contact tracing efforts in the NT for the period 2014-2017.

Methods

This was a small retrospective analysis of contact tracing data collected by registered nurses at the Centre for Disease Control (CDC) for the period 2014-2017. The analysis was conducted on the request of another jurisdiction to inform the development of their local contact tracing guidelines. The years 2014-2017 were chosen to reflect recent practice of the NT CDC TB Unit. Data were obtained from the 'Nurse Case Manager's List,' a spreadsheet updated on a regular basis by TB clinical nurse specialists and nurse coordinators at CDC. Nurses enter the number of contacts per active TB case into the spreadsheet. For cases with missing contact data, additional information was derived directly from Community Care Information System (CCIS), the electronic medical record system used by NT TB clinics. Data were collected for smear positive PTB cases only as these cases are the most infectious and are the priority for contact screening.[5] Data were de-identified prior to analysis. Descriptive statistics were performed using STATA software (StataCorp, College Station, TX, USA). Medians and interquartile ranges (IQR) were calculated as the data were not normally distributed. Ranges were also presented to display the minimum and maximum number of contacts per case, designed to illustrate the differing workloads surrounding each case.

Results

For the 4 year period from 1 January 2014 to 31 December 2017 there were 35 smear positive PTB cases notified in the NT resulting in 835 case contacts to be followed up. The median number of contacts per case is shown in Table 1. The median number of cases for the entire period was 14 (IQR 6, 36) contacts per case. The highest median number of contacts per case was recorded in 2016 as 38 contacts. Over the 4 years the number of people named as close contacts varied from 1 in 2017 to 110 in 2016.

Discussion

For every case of PTB, the immediate public health priorities are to commence anti-tuberculous therapy, determine the infectivity of the case and implement infection control measures to reduce transmission of TB. Subsequently, a series of procedures are commenced by CDC TB Unit staff, one of which is contact tracing.

As demonstrated by this analysis of contact tracing data, there has been substantial variation in the number of contacts identified per smear positive PTB case over the past 4 years in the NT. This reflects a huge range in workload, from 1 contact requiring follow up for 1 TB case in 2017, to 110 contacts requiring follow up for a single TB case in 2016.

Table 1. Summary table of contact tracing activity for smear positive PTB, Northern Territory, 2014-2017 (n=35)

Year of notification	Smear positive cases (n)	Median contacts per case (n)	Interquartile range (IQR)	Range	Total contacts for year (n)
2014	7	14	8, 31	5-50	140
2015	11	21	7, 36	4-90	303
2016	7	38	3, 45	2-110	251
2017	10	7.5	4, 11	1-76	141
Total	35	14	6, 36	1-110	835

The information provided here is limited but the analysis is useful in identifying other areas that could be analysed to assess current contact tracing areas of success or areas needing improvement. The CCIS system is currently limited in the data that can be extracted, but additional useful information would be the time taken to completely identify and follow up contacts and the number of contacts offered, accepting and completing treatment. The TB Unit is currently exploring more efficient ways of reporting these data.

Presented below is a summary of procedures for contact tracing investigation in the NT. Further information is available in the *Guidelines for the Control of Tuberculosis in the Northern Territory, 2016* (herein referred to as the TB Guidelines).[4]

Contact tracing in the NT

Every new case of TB was acquired through contact with a person with infectious TB at some point in their life. The risk of TB infection (LTBI) in close contacts of an infectious PTB case can be as high as 25-50%.[4] As the risk of progression to disease is highest in the first 2 years after infection and active disease can develop within only a few months of initial contact, the early identification of contacts is the key priority for TB control programs.[4]

Once a case of infectious TB is identified contact tracing should commence promptly. The overarching aim of contact tracing is to ensure that all those who will benefit from treatment of active TB or LTBI are identified and managed as soon as possible.[4] Contact tracing in the NT uses a coordinated approach involving CDC TB staff working in partnership with hospitals and primary care providers. An effective contact investigation requires careful coordination, time and effort. The process involves the evaluation of those contacts at highest risk of infection and/ or disease and then extending the investigation to those with lower risk until the contacts evaluated have a rate of infection that is no higher than the background rate for the community. This may range from assessment of household contacts only to mass screening of communities in some cases.[4]

The steps of a contact tracing investigation (see TB Guidelines pages 73-77 for further details) are:[4]

1. Categorise the infectivity of the index case (initial active TB case)
   - High
     - sputum smear positive for acid fast bacilli (AFB)
   - Medium
     - sputum smear negative with either culture or PCR positive
     - bronchial washing/induced sputum either smear positive or smear negative with culture or PCR positive
   - Low
     - clinical PTB without laboratory confirmation
   - Negligible
     - extra-pulmonary cases with no evidence of PTB. PTB must be assessed by sputum and CXR for all extra-pulmonary cases.
2. Collate the list of contacts from the index case including names, age, addresses and

phone numbers and categorise the contacts according to their level of risk as high, medium or low risk. Consider locations including homes, work, school and places of leisure. Environmental factors to be considered when determining the likelihood of TB infection include the size of enclosed spaces, adequacy of ventilation, crowding and exposure to UV light, which kills MTB.

- High risk contacts are those with frequent, prolonged and close contact within 3 months prior to diagnosis of index case and includes all contacts with immunosuppression and children aged <5 years. These 2 categories are at the greatest risk of acquiring the infection when exposed and progressing to disease.
- Medium risk contacts are those with frequent but less intense contact e.g. friends and work colleagues.
- Low risk contacts are other contacts with less frequent and less intense exposure. Details for low risk contacts may not be immediately necessary unless there is evidence of transmission in the high and medium risk groups.

All high risk contacts of PTB cases should be assessed first. Depending on the results of the high risk screen, consider examination of medium risk and then low risk contacts.[4] Education should be provided to the family, close contacts and, in situations such as when a person from a remote Aboriginal community is diagnosed with PTB, for the community and primary health service staff.

Rapid contact tracing is essential when the TB case is assessed as highly infectious (e.g. productive cough, cavitatory disease on CXR and sputum smear is positive).[5] High risk contacts should be screened within 7 days of diagnosis of the index case. High risk contacts of medium/low infectivity should be screened within 2 weeks of diagnosis.[4]

Management of contacts

In consultation with the TB case and/or their carer, potential contacts are identified. Each contact should have a clinical review. If disease is suspected then appropriate sputum (or other specimens) should be collected, a chest X-ray done and respiratory control measures implemented as patient management is considered. If disease is ruled out or the contact is well and not known to have had a past positive Mantoux test, a Mantoux test should be offered. In those people with a positive Mantoux result, a chest x-ray is also required. In the majority of situations (i.e. healthy young adults) a Mantoux result of ≥10mm in diameter represents LTBI.[4] A lower cut-off (i.e. ≥5mm) is used for young children and immunocompromised people, who have a higher likelihood of progression to active disease.[6] Note that contacts of a person with highly infectious PTB who are children <5 years or severely immunosuppressed may be offered preventive treatment even if the Mantoux test is negative.[4]

It usually takes 2 to 8 weeks for a person infected with MTB to develop an immune response that can be detected by the Mantoux test or IGRA.[4] In those contacts that initially test negative, the Mantoux test is repeated at least 8 weeks following the last contact with the active TB case.[5]

When the Mantoux test is positive at either the initial or subsequent screening and active disease is excluded, preventive treatment for LTBI will generally be offered.[4] The usual course of preventive therapy for adults is isoniazid 5mg/kg daily for 9 months, given with pyridoxine (Vitamin B6) 25mg daily to prevent the potential side effect of peripheral neuropathy. People treated for LTBI are followed monthly by TB nursing staff to assist and monitor adherence to therapy, assess any side effects and arrange for liver function testing if indicated. Further information of treatment of LTBI, including for children, is available in Chapter 7 of the TB Guidelines.[4]

At the end of treatment, recent contacts will have a repeat chest x-ray and medical review prior to discharge from the service.[4] In the few situations where isoniazid therapy or the alternative medication rifampicin are not suitable, contacts are placed on a monitoring program with regular chest x-ray and medical reviews to ensure the person does not develop any new symptoms or signs of active TB, usually over a 2.5 year period (when the risk of reactivation is highest).[4] This monitoring

contributes to TB control efforts by facilitating the early identification of active TB, early initiation of anti-tuberculous therapy and reduction in transmission.

Community screening

As specified in the TB Guidelines, community screening is indicated when a secondary active TB case is detected in a routine contact tracing investigation or when 2 or more cases of active TB are diagnosed within 1 year in a community. Community screening should not replace focussed contact tracing efforts.[4]

The mobility and size of the community may make it challenging to screen every resident with Mantoux testing, therefore prioritisation is important. Like contact tracing, the priority is to identify active TB disease, followed by identification of individuals at high risk of developing disease if they have LTBI.[4] There are 2 methods of community screening described in the TB Guidelines and the method chosen depends of the characteristics of the community and available resources within the local health service. Further information is available in Chapter 9 of the TB Guidelines.[4]

Conclusion

The number of contacts identified per smear positive PTB case in the NT varies substantially. This represents a huge range in the workload required in response to each case of active TB by TB Unit and primary health care staff through initial contact tracing efforts and the subsequent follow up of contacts with LTBI. Active TB cases classified as having high infectivity take priority for contact tracing and those contacts identified as being at highest risk for progression to active disease take priority for follow up. TB Guidelines are available for contact tracing and management decisions and should be utilised to progress towards elimination and control of TB in the NT.

Acknowledgements

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Territory working towards a TB-free world
World TB Day 24 March 2018

TB Unit, Centre for Disease Control, Darwin

The Northern Territory (NT) Centre for Disease Control (CDC) continues to play an important role in the global campaign to END Tuberculosis (TB).

Despite significant progress over recent decades with a 40% drop in TB deaths worldwide, TB continues to be the biggest infectious killer worldwide, claiming over 1.8 million deaths annually. The emergence of multidrug-resistant TB (MDR-TB) poses a major threat and could risk gains made in the fight against TB.

CDC Director and Head of TB Control Services in the NT Dr Vicki Krause said, "While TB rates in Australia are very low by international standards with 1200 to 1300 cases notified per year, there were 10.4 million TB cases globally last year. We need to educate people about TB and work regionally and globally to reduce the disease in high burden areas."

The theme of the 2018 *World Tuberculosis Day* (March 24),* "**Wanted: Leaders for a TB-free world,"** focused on leadership responsibilities and commitments to raise awareness of the impact of the disease and efforts to end the global TB epidemic.

TB is caused by a bacterium, *Mycobacterium tuberculosis* and can affect almost any organ in the body, but most commonly involves the lungs. TB spreads when people who have active untreated TB germs in their lungs or throat cough or sneeze and infect people close by. The people most at risk of being infected are those in direct and prolonged contact with cases of active TB. Those most at risk of developing TB once infected are those who have existing conditions that impair their immune system such as diabetes, kidney disease, cancer and the very young and very old.

"It is important to remember that TB can develop many years after someone has been in contact with an active case of the disease," said Dr Krause.

The NT notifies 20 to 30 cases per year with the highest risk groups for TB being those born overseas (60% of cases) and Aboriginal people (30%).

"TB is both a curable and preventable disease. It is important that disease is detected early and effectively treated and that contacts of those with disease are followed up and recommended for preventive treatment where appropriate," Dr Krause added.

"CDC's commitment to global TB control includes effective screening, contact tracing, preventive treatment for latent tuberculosis infection, directly-observed treatment (DOT) for active cases and high standard laboratory work for disease identification and antibiotic resistance testing."

TB can cause a variety of symptoms and signs including unexplained fevers, prolonged cough for more than 2 weeks, shortness of breath, weight loss, fatigue and night sweats.

If concerned, people are advised to seek medical attention early so appropriate diagnostic testing can be undertaken and treatment started early.

Further information on TB can be obtained from the CDC on 8922 8044, your local doctor and community health centers.

A fact sheet with more information on TB is available at:
https://nt.gov.au/wellbeing/health-conditions-treatments/bacterial/tuberculosis-tb

A fact sheet with more information on latent TB is available at:
http://digitallibrary.health.nt.gov.au/prodjspui/bitstream/10137/995/1/Latent%20tuberculosis%20infection.pdf

* The date marks the day in 1882 when Dr. Robert Koch announced that he had discovered the bacterium that causes TB, which opened the way towards diagnosing and curing this disease.

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NORTHERN TERRITORY GOVERNMENT

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Latent tuberculosis infection (LTBI)

To understand latent tuberculosis infection (LTBI) you need to know about tuberculosis.

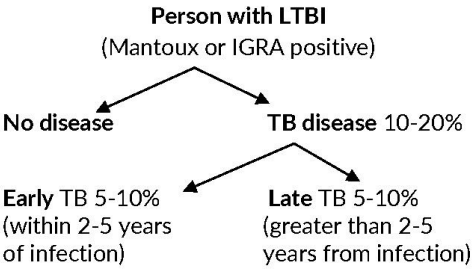
What is tuberculosis (TB)?

TB is an infectious disease caused by the TB germ *Mycobacterium tuberculosis*. It is a curable disease and is also preventable. TB usually affects the lungs but can affect any part of the body. TB is spread when people who have active untreated TB in their lungs or throat, cough, sneeze or speak and send the TB germs into the air. People in contact with those with active untreated TB are at risk of breathing the germs into their lungs and becoming infected. When infected, some people will progress to active TB disease within months but most people develop latent TB infection (LTBI) with the potential for progression to active disease at a later date. Therefore 2 conditions exist for *M. tuberculosis* germs, TB disease and latent TB infection (LTBI).

What is latent TB infection (LTBI)?

Latent TB infection (LTBI) is what happens to most people who breathe in TB germs. The germs enter the body, the body walls the TB germs off and the germs stay in the body in a 'sleeping' or inactive state. This is known as latent TB infection (LTBI). Persons with LTBI do not feel sick and do not have any symptoms. They are infected with *M. tuberculosis*, but do not have TB disease. Persons with LTBI are not infectious and cannot spread TB infection to others.

Overall, without preventive treatment, 10-20% of people with LTBI will develop active TB disease at some time in their lives. About half of those who develop TB disease do so within the first 2 years of being infected. However TB disease can occur even after many years, usually when the body defenses are weakened. This may be due to aging, developing a serious illness (including diabetes, kidney disease and cancer), drug or heavy alcohol use, certain immunosuppressive medications or HIV infection.



Important facts about LTBI

Treating LTBI kills the inactive TB germs preventing development of active TB later in life.

A person with LTBI:

- Has a positive Mantoux test (tuberculin skin test) or IGRA (blood test) result
- Has a chest x-ray showing no active disease and has negative sputum tests
- Has TB germs hidden in his/her body that are alive, but inactive or 'latent'
- Does not feel sick
- Cannot spread TB bacteria to others
- Can be treated to prevent TB developing in the future.

How is LTBI treated?

Medications prescribed by TB specialists can reduce the risk of progressing from LTBI to active TB disease by up to 92%. Which medication is used depends on an individual's health and circumstances. The current preferred treatment is isoniazid.

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Isoniazid (INH)

The course of isoniazid (INH) is given for 9 months. INH can occasionally cause drug-induced hepatitis (liver inflammation) so a liver function blood test will be done before starting treatment. INH is not recommended for people with liver disease or for those who consume alcohol regularly and heavily. **It is very important that a person avoid/minimise drinking alcohol while taking INH as alcohol increases the risk of serious liver damage.**

Rifampicin

A 4 month course of rifampicin is sometimes prescribed for patients who are unable to take INH. This treatment needs to be given under direct supervision, usually by a health care worker. Patients taking rifampicin should note that a pink-orange discolouration of bodily fluids (e.g. urine, sweat, tears) is expected. Contact lenses and clothes may be permanently stained. Rifampicin also makes all forms of oral contraception and implants (implanon) less effective, so women of child bearing age should discuss other contraception choices with their doctor.

Drug	Duration
Isoniazid*	9 months
Rifampicin	*4 months*

* A vitamin B6 supplement (pyridoxine) is also given with isoniazid

Medication side effects

Treatment for LTBI has been taken by millions of people around the world and is generally safe and well tolerated. However, as with any medicine, the tablets sometimes cause side effects. The doctor, health worker or nurse should be told immediately if any unexplained illness develops or if any of the following symptoms occur:

- Upset stomach
- Loss of appetite
- Nausea
- Vomiting
- Skin rash/itch
- Yellowish skin or eyes
- Dark urine (coca cola coloured)
- Tingling or numbness in the hands or feet
- Fever lasting 3 days or more.

Close follow up

Some patients may be unable to take any of the LTBI medications and need to be followed up closely by the TB clinic. These patients will have a review by a doctor and chest x-rays at 6, 18 and 30 months after their first appointment.

Further information

For further information contact the TB Clinic in your region

Alice Springs	8951 7548
Darwin	8922 8804
Katherine	8973 9049
Nhulunbuy	8987 0282
Tennant Creek	8962 4259

Or www.nt.gov.au/health/cdc

Pilot study – Is video microscopy effective in diagnosis of crusted scabies?

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In March 2016, crusted scabies was made a notifiable disease in the Northern Territory (NT) under the Notifiable Diseases Act. A confirmed case of crusted scabies requires laboratory evidence and clinical evidence. Laboratory evidence is the detection of scabies mites or eggs by microscopy of a skin scraping. Clinical evidence is visible skin abnormalities consistent with crusted scabies and verified by an infectious disease (IFD) physician or dermatologist (verification can be by clinical photography).[1]

Background

One Disease staff have audited NT Primary Care Information Systems (PCIS) looking at all patients with a recorded diagnosis of crusted scabies. The purpose of the clinical audit was to determine how many of the patients diagnosed with crusted scabies fulfil the Centre for Disease Control (CDC) case definition.

The findings of the audit revealed more education is needed around detection, diagnosis and long-term management of crusted scabies.

Concurrently health service staff have expressed concerns with timeliness of diagnosis of crusted scabies in regional and remote settings. One of the issues for detection of mites is that not all regional laboratories are no longer able to perform basic microscopy due to accreditation requirements (personal communication Robert Baird). The other confounding issue is the NT only has IFD and dermatology teams in Darwin and Alice Springs. This means that often diagnosis and time to treatment is delayed due to waiting for confirmation of presence of mites and the ability to get the patient reviewed by IFD and/or dermatology.

Aim

The purpose of this pilot study HREC 2017-2937 is to compare in the setting of suspected or confirmed crusted scabies detection of scabies mites and eggs using a low cost video microscope performed in conditions similar to primary health care settings against current detection of scabies mites and eggs using the standard laboratory microscopy of skin scrapings.

Method

The pilot study aims to recruit 20 patients over a 6 month period and will be conducted at Royal Darwin Hospital. Patients with suspected and/or confirmed crusted scabies will be identified by IFD or CDC staff and referred to study investigators (who will obtain informed consent from participants to be part of the pilot study. Patients providing consent will have images taken within 24 hours of scabies treatment being commenced using a low cost video microscope with 200 x (500 x digital) magnification (Figure 1) by trained investigators (IFD doctors and Registered Nurses). The 24 hour limit and documented training is to ensure reliability of method and validity of results. All video microscopy images will be de-identified and assigned a study number before being sent to a dermatologist for review. Each participant's images will then be compared to the participant's laboratory skin scraping results.

Figure 1. Example of low cost video microscope

Outcomes

The results of this pilot study will inform a future larger and more definitive community based study to improve diagnosis of scabies both with and without crusted scabies in primary health care settings. A recent study reported 95% sensitivity and specificity for in vivo identification of burrows and scabies mites using low cost video microscopy.[2] If similar sensitivity levels are identified from this pilot, One Disease will work with primary health care providers to provide low cost video microscopes to regional

primary health centres and train staff in the operation of the equipment and image uploading procedures. Changes could be made to the NT case definition allowing scabies mite identification via skin scraping or via video microscopy.

Lead investigator: Dev Tilakaratne. Other investigators: Bart Currie, Keith Forrest, Christian James, Megan Scolyer, Irene O'Meara, Hannah Woerle, Michelle Dowden

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An outbreak of toxin-mediated gastroenteritis following Christmas parties at a hotel in Alice Springs, December 2017

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Abstract

An outbreak of gastroenteritis occurred among people who attended Christmas parties hosted at Hotel X on 2 December 2017. We conducted a retrospective cohort study by telephone using a structured questionnaire that recorded symptoms and exposures to items on the buffet menu. Environmental Health Officers investigated the premises. A case was defined as anyone who experienced diarrhoea after attending a Christmas party at Hotel X on 2 December 2017. We contacted 114 (63%) of the 181 people who ate at Hotel X that night. Of the 114 people able to be contacted, at least 62 were ill (attack rate 54%). The most commonly reported symptoms were diarrhoea (100%, 62/62) and abdominal pain (56/62). The median incubation period was 13 hours (range 4–63 hours) and the median duration of symptoms was 2 days (range 1–5 days) which suggests a toxin mediated illness, most likely due to Clostridium perfringens. Of the 4 people who sought medical attention 1 was hospitalised. Illness was significantly associated with consuming chicken chasseur (aOR 48.5, 95% CI 7.6-311, p<0.001). The epidemiological and environmental health investigations suggest that temperature abuse of chicken meat prior to cooking is likely to have caused the outbreak.

Key words: Foodborne disease; Clostridium perfringens; outbreak investigation; cohort study; Northern Territory.

Background

Foodborne illness is caused by the presence of organisms and toxins in food and can result in symptoms such as diarrhoea, nausea, vomiting, fever, abdominal pain and even death. Foodborne illnesses can be caused by bacteria, parasites, viruses, or by toxins produced by bacteria or algae.[1] It is estimated that 80% of foodborne illness in Australia is due to unknown causes.[2]

Bacterial toxins typically produce symptoms of relatively short duration and as a result many outbreaks go unreported.[3] It is estimated that there are 16,500 episodes (Credible Interval 2,600–53,400) of foodborne illness each year in Australia attributable to the enterotoxin produced by *Clostridium perfringens* alone.[2] This is characterised by diarrhoea and abdominal pain usually in the absence of fever or vomiting.[1] The incubation period is usually 6-24 hours and the duration of symptoms is typically around 1-2 days.[4]

C. perfringens is a gram positive, anaerobic, spore forming bacillus[4] that is found in the gastrointestinal tracts of healthy humans,[1] animals (including cattle, fish, pigs and poultry), foods originating from these animals and in soil where spores can remain for years.[1,4] Foodborne outbreaks of Type A *C. perfringens* are almost always associated with the consumption of cooked foods.[5] *C. perfringens* spores survive normal cooking temperatures[1] while the cooking

kills off any other competing bacteria which may be present.[5] The optimal temperature for *C. perfringens* growth is 43°C-45°C which means that spores that survive cooking can germinate and multiply while cooked dishes cool.[6] For sickness to occur, a large number of vegetative *C. perfringens* cells ($>10^6/g$)[3] need to be ingested. Once ingested, the cells sporulate in the intestine and begin to secrete the enterotoxin which causes illness.[1,3]

Outbreaks of foodborne illness due to *C. perfringens* are not uncommon. Between 2001 and 2013, there were 81 reported outbreaks of foodborne illness in Australia due to *C. perfringens* which accounted for 76% of all bacterial toxin-mediated outbreaks during this period.[7]

On Monday 4 December 2017, staff at the Northern Territory (NT) Centre for Disease Control (CDC) received reports of an outbreak of gastroenteritis following a Christmas party that was held at Hotel X in Alice Springs on Saturday 2 December 2017. Environmental Health (EH) in Alice Springs contacted the hotel and was informed that a second Christmas party group also reported cases of gastroenteritis following their party at Hotel X on the same night. An outbreak investigation was initiated to identify the cause of illness and to implement appropriate public health prevention measures. This paper describes the outbreak investigation.

Methods

Environmental health investigation

An environmental health officer (EHO) from the NT Department of Health conducted an inspection at the hotel on 5 December 2017 to assess its compliance with the *NT Food Act*.[8] The EHO inspected food preparation and storage areas, collected information about food preparation, storage and procurement procedures, undertook temperature monitoring of food storage equipment, inspected temperature monitoring records for foods served on 2 December and collected information on staff and guest illness and guest complaints. The EHO also conducted a trace-back investigation to determine the manufacturers, distributers and transporters of food served at the functions. No food was acquired for microbiological testing. Guest lists of functions on 2 December were obtained.

Epidemiological investigation

We performed a retrospective cohort study via telephone using a structured questionnaire developed from the banquet menu that was served to the 2 affected groups. A list of attendees was obtained for both groups. Exposures and details of symptoms and health seeking behaviour were recorded. A case was defined as anyone who ate at a Christmas function at Hotel X on 2 December 2017 and experienced diarrhoea afterwards. Data were collected and entered into Microsoft Excel 2010 (Microsoft, USA) and analysed using StataIC® 13.1 (StataCorp, USA). Binary outcomes were reported as numbers and proportions, and compared using the chi-squared test, or Fisher's exact test when cell counts were less than 5. Age was the only non-categorical variable reported and was non-normally distributed, so medians were compared using the Wilcoxon rank sum test. To determine the risk of becoming unwell in exposed and unexposed groups, we conducted univariate analysis and calculated relative risks (RR). We conducted multivariate analysis using logistic regression to calculate an adjusted odds ratio (aOR) and 95% CI. Our model included those exposures which had an elevated RR and $p < 0.05$ after univariate analysis as well as sex and the party attended. All results were considered significant at the 5% level.

Laboratory investigation

Stools were requested from people who declared they were still experiencing diarrhoea at the time they were contacted. Stools were tested by polymerase chain reaction (PCR) for *Entamoeba histolytica*, *Giardia*, *Dientamoeba*, *Cryptosporidium*, *Blastocystis*, *Yersinia enterocolitica*, *Campylobacter*, *Shigella*, *Salmonella*, *Aeromonas*, norovirus, rotavirus and adenovirus.

Results

Epidemiological investigation

We were able to contact 114 of the 181 (63%) people who attended the Christmas parties; 87/152 (57%) from party A, 26/28 (93%) from party B and 1 staff member who was not unwell.

In total there were 62 people who met the case definition (attack rate 54%) (Table 1). Three cases sought medical care from a doctor and 1 case was hospitalised.

Table 1. Characteristics and symptoms of cases who attended Christmas parties at Hotel X on 2 December 2017 (n=62)

Characteristics	n	%
Gender		
Female	41	66
Male	21	34
Symptoms		
Diarrhoea	62	100
Abdominal pain	56	92
Nausea	39	64
Lethargy	39	63
Headache	28	47
Fever	22	36
Vomiting	13	21
Bloody diarrhoea	1	2

The median incubation period was 13 hours (range 4–63 hours) and the median duration of symptoms was 2 days (range 1–5 days). The epidemic curve was typical of a point source foodborne outbreak (Figure 1). The age and sex distribution of those who were ill was not significantly different from those who were not.

Three cases submitted stool samples, all of which tested negative by PCR for common enteric pathogens including rotavirus, norovirus and adenovirus. Stools were not tested for *Clostridium perfringens* enterotoxin (CPE) because of the delay in collection (cases' symptoms had resolved by the time they were contacted) and the inability to test locally.

We measured exposure against 53 menu items and Table 2 shows those that had an elevated RR and P <0.05 after univariate analysis.

Chicken chasseur was shown to be significantly associated with illness (RR 5.4, 95% CI 2.7-10.8, p <0.01) after univariate analysis. There were a number of other items from the buffet menu with lower, but still elevated RRs and p <0.05.

Figure 1. Epidemiological curve of cases by onset day after attending Christmas parties at Hotel X on 2 December 2017 (n=62)

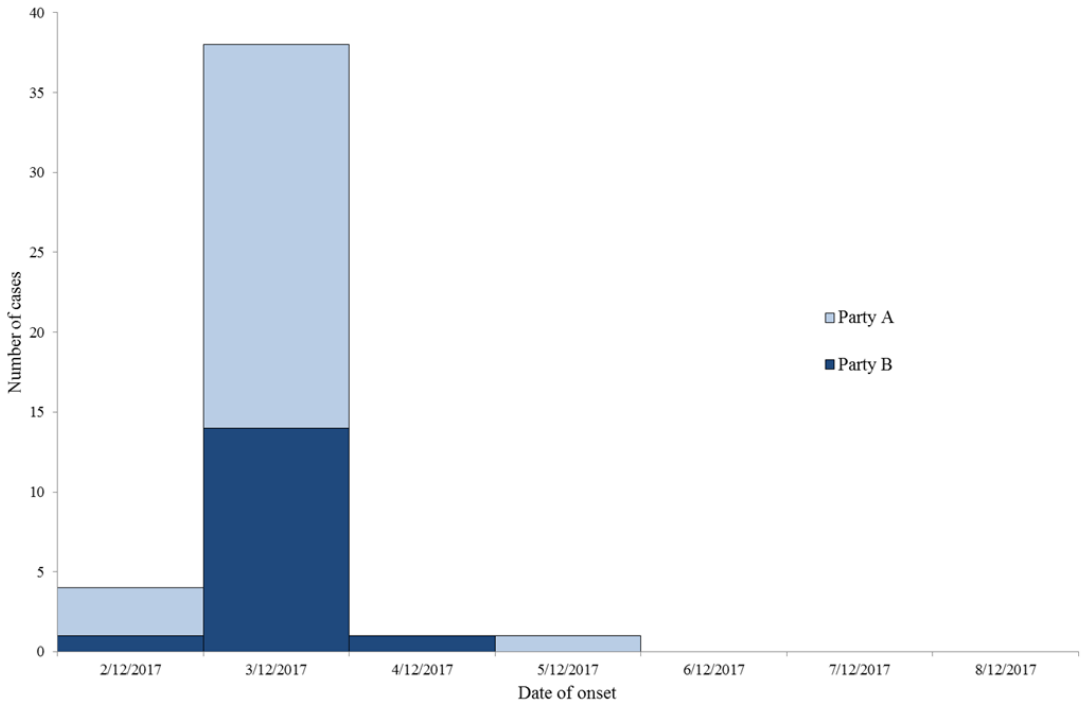

Table 2. Menu items with elevated RRs after univariable analysis for those that attended Christmas parties at Hotel X on 2 December 2017

Food Eaten	Exposed			Unexposed					
	Cases	Total	AR*%	Cases	Total	AR*%	RR†	95% CI‡	p value
Chicken Chasseur	50	62	81%	7	47	15%	5.4	2.7-10.8	<0.0001
Turkey	41	62	66%	19	50	38%	1.7	1.2-2.6	0.0030
Potato salad	34	50	68%	26	61	43%	1.6	1.1-2.3	0.0076
Rice pilaf	41	66	62%	19	47	40%	1.5	1.0-2.3	0.0227
Seared beef and mushroom ragout	36	51	71%	22	56	39%	1.8	1.2-2.6	0.0012
Chocolate mousse	25	38	66%	35	76	46%	1.4	1.0-2.0	0.0466
Plum pudding	30	43	70%	29	70	41%	1.7	1.2-2.4	0.0034

*AR = Attack Rate
† RR = Relative risk
‡ CI = Confidence Interval

Table 3. Results of multivariable analysis for those that attended Christmas parties at Hotel X on 2 December 2017

Exposure	aOR*	95% CI†	p value
Chicken Chasseur	48.5	7.6-311	<0.001
Party	6.1	1.1-32.1	0.034
Turkey	2.5	0.7-9.6	0.179
Plum pudding	2.1	0.5-8.5	0.318
Potato salad	1.6	0.5-5.3	0.455
Seared beef and mushroom ragout	1.3	0.4-4.5	0.691
Chocolate mousse	0.9	0.2-3.6	0.837
Gender	0.7	0.2-2.4	0.548
Rice pilaf	0.4	0.1-2.2	0.297

* aOR = Adjusted odds ratio
† CI = Confidence interval

Multivariate analysis of the exposures in Table 2 as well as gender and party attended resulted in chicken chasseur (aOR 48.5, 95% CI 7.6-311, p <0.001) and attending party B (aOR 6.1, 95% CI 1.1-32.1, p=0.034) being significantly associated with illness (Table 3).

Environmental Health investigation

Hotel X held 4 Christmas functions on 2 December 2017 and 2 of these functions reported illness. The 2 affected functions ate from the same buffet menu whereas the other 2 functions ate from different menus and did not report illness. There were no reports of illness or complaints received from guests who had eaten from room service or at their *a la carte* restaurant on 2 December. There were no reports of staff with diarrhoea prior to or following the outbreak.

The inspection observed that all cool room and refrigerator temperatures in the kitchen were satisfactory, the structural condition and equipment in food production areas were suitable, staff training was adequate and that the processes for preparing food were safe in accordance with the *NT Food Act*.[8] The hotel kept excellent temperature logs and food served on 2 December was verified to be maintained at appropriate temperatures when stored, cooked and served. The chicken chasseur was cooked to above 89°C. There was no food remaining from the functions for testing.

Traceback investigation revealed that chicken meat used in the chicken chasseur was pre-cut and transported by refrigerated truck from Adelaide. The transport company was unable to provide the temperature records for the chicken meat for its journey from Adelaide to Alice Springs as the data logger of the vehicle malfunctioned prior to the collection of the products from the distributor. This malfunction was not identified until the data were requested as part of the outbreak investigation. The distributor of the chicken meat in Adelaide recorded its temperature to be 1.9°C at the time of pick up by the transport company which is <5°C and acceptable in accordance with the Australia New Zealand Food Standards Code.[9]

The hotel received the chicken meat and recorded its temperature to be 1.9°C on receipt which is typically 22 hours after leaving Adelaide. The transport company advised that the vehicle passed performance tests after the journey but was unable to verify temperature control compliance during the journey.

The chicken meat was further traced from the distributor to a manufacturer in Adelaide. The Department of Primary Industries and Regions SA (PIRSA) investigated the chicken manufacturer which was unable to provide records of where the chicken was originally sourced. The chicken manufacturer also did not retain a sample of their product for further analysis. PIRSA did not however take any action against the manufacturer for their inability to trace the origins of the product as per the Food Standards Code.[10] The transport company, while unable to provide appropriate temperature control records, was able to demonstrate attempted compliance.

Discussion

The incubation period, median duration, range of symptoms and negative laboratory findings were consistent with a point source foodborne outbreak due to *C. perfringens*. Epidemiological investigation indicated that the consumption of chicken chasseur was the likely cause of the outbreak. It had a high attack rate, and a statistically significant association with illness was observed after both univariate and multivariate analysis.

It is recognised that *C. perfringens* is found in poultry[1,4] and in Australia the food categories most often implicated in confirmed *C. perfringens* outbreaks have been solid masses of food (eg. lasagne), liquid or semi-solid mixtures of food or roasted meat, poultry or fish.[7] The chicken chasseur at Hotel X consisted of pre-cut chicken pieces, mushrooms and a gravy-like sauce made from powder.

It is likely that *C. perfringens* was present in the pre-cut chicken meat prior to its arrival at Hotel X and cooking the meat did not kill spores that were present. There was little opportunity for *C. perfringens* growth while the chicken meat was at the hotel as staff were able to provide EHOs with comprehensive temperature control records during both storage, cooking and service. Growth of *C. perfringens* may have occurred during transport of the chicken meat from Adelaide to Alice Springs, as temperature control compliance for the chicken could not be verified during transport. We cannot discount the possibility that temperature abuse of the chicken meat occurred prior to its arrival at the manufacturer, as it was not able to provide any details of where the meat was sourced or temperature compliance prior to its receipt.

Although no stool samples were tested for CPE, the symptoms and incubation periods reported were consistent with those caused by *C. perfringens* infection.[1,4] Stools were not tested for CPE because cases' symptoms had largely resolved by the time they were contacted. The CPE toxin is rapidly eliminated from the gut due to profuse diarrhoea such that specimens >48hrs post onset are unsuitable.[11] The failure to detect bacterial or viral pathogens in stool samples further support a toxin mediated aetiology. This outbreak did not result in multiple presentations to the local hospital emergency department nor did cases provide samples prior to being requested as part of our investigation. The outbreak would not have been detected except that it was reported by a member of the public and was consistent with outbreaks of toxin mediated illness that are short in duration and mild in severity.[1]

A major limitation was that no food samples were available for testing. Food was ordered in on the Thursday prior to the weekend functions and used in its entirety before being either consumed or discarded.

We minimised measurement bias by using a standard questionnaire based on the Christmas party buffet menu that was served at Hotel X, including individual food items in each dish when possible. Selection bias was minimised by obtaining guest lists from the 2 implicated parties. We were able to contact 93% of guests from party B but only 57% from party A. In addition to the chicken chasseur, multivariable analysis also delivered an elevated aOR for those guests who attended party B (aOR 6.1, 95% CI 1.1-32.1, p=0.034). This may be a genuine association and represent a more highly

contaminated dish served to that party, or it may be bias due to the higher response rate from guests of party B.

Outbreaks of toxin-mediated illness can be avoided by maintaining safe temperatures throughout the manufacture, transport, storage, processing and service of food.[10] This outbreak investigation was hampered because of an inability to trace the chicken meat beyond the manufacturer to the supplier. In the event of an outbreak, it is important to be able to trace food products through all stages of production, processing and distribution in order to identify problems quickly and minimise potential risks to the public.[12]

Conclusion

We conclude that an outbreak of gastroenteritis affecting attendees at Christmas parties at Hotel X was likely due to consumption of contaminated chicken. The aetiology was most likely due to a toxin, probably CPE. Foodborne illness can be prevented by the safe manufacture, production, transport, storage, processing and service of food. It is important that food products can be traced through all stages of production, processing and distribution. This enables problems to be identified quickly in order to mitigate potential public health risks.

Acknowledgements

The authors acknowledge the staff at EH in Alice Springs as well as CDC staff who assisted by telephoning of patrons: Heather Cook, Jacqueline Arnold, Paula Wines, Renee Ragonesi, and Laura Francis.

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When a drain does not drain - mosquito breeding investigation in 2 Darwin suburbs in 2016

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Abstract

In May 2016, Culex sitiens mosquito numbers sharply increased in a routine adult mosquito CO_2 baited trap as part of the encephalitis virus surveillance in the northern Darwin suburb of Coconut Grove. A mosquito complaint was received from a resident in Nightcliff in July, with Cx. sitiens numbers also high in a mosquito trap subsequently set at the residence. To find the source of the high mosquito numbers, the Medical Entomology unit of the Department of Health (DoH) carried out larval mosquito surveys in May and found several blocked stormwater outfall drains, some of which were found to be breeding mosquitoes. The drains were treated for mosquito breeding, followed by maintenance works carried out by the City of Darwin (CoD) as part of the combined DoH and CoD mosquito engineering program. Subsequent mosquito surveillance results showed a dramatic decrease in mosquito numbers, highlighting the importance of the collaborative mosquito engineering program carried out in Darwin urban and the routine ground mosquito control program.

Key words: Mosquito engineering program; mosquito survey; mosquito control.

Background

The Medical Entomology (ME) unit of the Northern Territory (NT) Department of Health (DoH) has the responsibility to reduce the impact of biting insects on the health and well-being of NT residents. This is achieved through a number of ME programs, including the combined mosquito engineering program between the DoH and the City of Darwin (CoD), which was established in 1983 as a result of a Legislative Assembly order to 'rectify the mosquito problems in Darwin.' The program focuses on storm water drain maintenance and rectification in Darwin urban and filling of depressions to eliminate mosquito breeding.

In addition, weekly adult mosquito surveillance carried out by the ME unit, in the form of CO_2 baited traps as part of encephalitis virus surveillance are set at strategic points around Darwin. Information provided is used to investigate mosquito breeding and carry out mosquito larval control. Despite extensive mosquito control at times when salt marsh mosquito numbers are high, the DoH receives public complaints. There are also occasional complaints that are attributed to mosquito breeding caused by blocked stormwater drains or backyard breeding.

Between May and July 2016, numbers of the salt water mosquito, *Culex sitiens* increased dramatically in the adult mosquito trap set in Coconut Grove, with a public mosquito complaint received from a Nightcliff resident in early July 2016. ME launched an investigation to detect mosquito breeding and rectify the situation.

Mosquito breeding investigation and rectification

Cx. sitiens is a brackish coastal ground pool breeder, including tidal storm water drains. It bites humans, is a potential vector for Ross River virus and can occur in pest numbers within 2km of the breeding site.[1,2] Larvae of this species are frequently detected during larval surveys in Darwin including Coconut Grove.

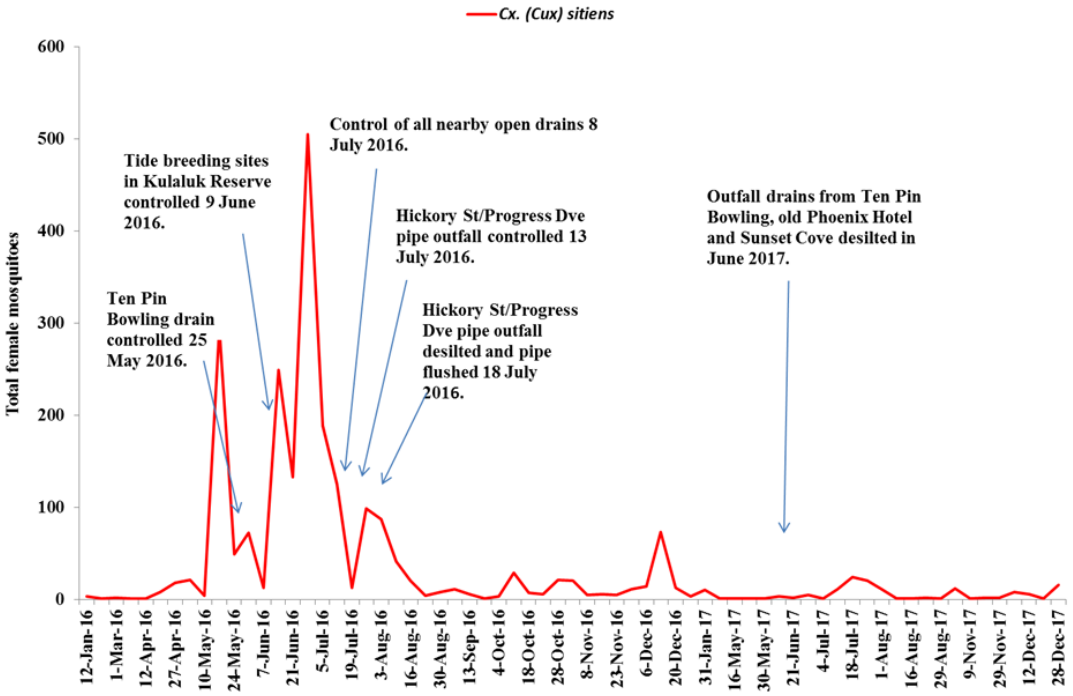
Weekly adult mosquito surveillance has been carried out in Coconut Grove since 1976, with a trap set at the end of Ostermann Street, providing long term data on mosquito abundance and species composition (Figure 1).

Between May and July 2016, *Cx. sitiens* numbers increased dramatically in Coconut Grove, with up to 500 specimens collected in the overnight trap (Figure 2).

As the general area was dry at the time, mosquito breeding was suspected in the stormwater drain, located behind Ten Pin Bowling, a known *Cx. sitiens* breeding site, receiving dry season low flows (Figure 3). High density mosquito breeding, but of a different

Figure 1. Location of problem open drains and adult mosquito trap sites

Figure 2. Coconut Grove weekly adult mosquito monitoring trap site. Total number of the adult female *Cx. sitiens* January 2016 to December 2017



species, was found on 25 May and controlled using a 30 day residual insecticide (Figures 1 and 2). Interestingly, *Cx. sitiens* numbers shortly decreased before another sharp increase in early and mid-June, despite mosquito control of all known tidal affected sites in the area, including the Kulaluk Reserve drains, following a 7.66m tide on 7 June (Figure 2).

Another high tide event in early July led to another comprehensive mosquito larval survey, with high density and minor *Cx. sitiens* breeding found in the Ten Pin Bowling and the Sunset Cove drain respectively (Figures 1, 3 and 4). The 2 drains, in addition to the old Phoenix Hotel open drain and all Kulaluk Reserve drains were re-treated with 30 day residual methoprene pellets on 8 July.

Figure 3. Ten Pin Bowling drain being treated for mosquito breeding

Figure 4. Sunset Cove drain blocked with vegetation

On 12 July, DoH received a public complaint from a resident in Hakea Street, Nightcliff, who mentioned high mosquito pest problems had been occurring for the last 3 to 4 weeks, coinciding with the sharp increase of *Cx. sitiens* in the Coconut Grove trap in June. To investigate, an adult mosquito trap was set at the residence on 12 July, with 30 *Cx. sitiens* collected, accounting for 81% of the total catch. The number of *Cx. sitiens* was relatively high, considering the trap was set well away from any major tidal breeding sites.

Following the complaint, the stormwater outlet drain from Progress Drive opposite Hickory Street was surveyed for mosquito breeding on the 13 July (Figure 1). The drain was found blocked by shifting beach sand causing the pipe at the outlet to be partially submerged in water, with water also ponding in the upstream pipe system (Figure 5). The sources of water in this drain were high tides and dry season urban water runoff. Low density larval breeding was

Figure 5. Progress Drive pipe outfall opposite Hickory Street, ponding water

detected, and although the larvae collected were not *Cx. sitiens*, the drain appeared to be an ideal breeding site for this species, especially with organic nutrients present (leaf litter, lawn clippings), which were evident in the upstream side entry pits. Although no larvae were found in the side entry pits, the outlet drain section and pits up to 100m from the outfall were treated with methoprene 30 day pellets as a precautionary measure.

To eliminate future mosquito breeding, the drain was desilted by CoD under the mosquito engineering program on 18 July to remove all sediment and debris, with the pipe also flushed by CoD the following day. While this operation ensured free flow in this particular drain, the Ten Pin Bowling, Sunset Cove and the old Phoenix Hotel drains were placed on a regular insecticide treatment program until maintenance works could be carried out by CoD in June 2017 using an excavator for sediment and vegetation removal.

Due to the flat topography, with a fall of about 0.1% in the drains, some minor pooling remained in the upper reaches of the open drains, allowing localised *Cx. sitiens* breeding (Figure 6). Thus, further minor works are required in 2018 to drain the remaining pools and remove any new sediment accumulation and debris.

Since the comprehensive insecticide treatment of all mosquito breeding sites and the rectification of the Hickory Street/Progress Drive drain, *Cx. sitiens* numbers have remained at relatively low levels in the Coconut Grove trap (Figure 2).

Figure 6. Old Phoenix Hotel drain de-silted, with minor shallow ponding

Discussion

This investigation highlighted several important aspects for a successful mosquito control program. Firstly, routine adult mosquito surveillance is crucial, as it identifies the fluctuation in mosquito abundance. In this case, the change in *Cx*. *sitiens* numbers in the weekly set trap indicated increased mosquito breeding within about 2km of the trap site, and triggered larval mosquito surveys to identify the source. The Coconut Grove trap was located 440m from the nearest breeding site (Sunset Cove drain) and 500m from the most productive breeding site (Ten Pin Bowling drain), indicating that *Cx. sitiens* was dispersing in appreciable numbers at least 500m from localised breeding sites. The address of the resident issuing the complaint was about 300m from the Hickory Street outfall drain, and 500m from the Ten Pin Bowling drain and was therefore within the flight range of this mosquito from localised productive breeding sites.

The investigation further shows the importance of routine larval surveillance for all known breeding sites, regardless of their history, as nutrient input into open stormwater drains as a result of urban runoff or rotting organic matter can quickly turn a relatively small site into a productive mosquito breeding site. In addition, and most likely in this case, storm water drains over time can become productive breeding sites due to silt deposition and vegetation growth blocking the drains and subsequently preventing water from free draining.

However, it needs to be highlighted that source reduction should always be the preferred option for mosquito control, as it eliminates breeding sites and the requirement for continuous mosquito control. Although mosquito numbers decreased following the insecticide treatment of all known mosquito breeding sites in the Coconut Grove area in early July, the fact that numbers further decreased and remained low after all drains were desilted highlights the importance of mosquito breeding prevention. The long-standing mosquito engineering program in Darwin, which is part of an integrated mosquito control program, is therefore a critical component in preventing urban mosquito breeding.

Finally, this scenario showed the importance of responding to public complaints, particularly from long term residents, as they can assist in identifying the extent of mosquito problems by reporting unusual mosquito activity.

Acknowledgements

We would like to thank CoD for their civil works management and co-funding of the combined DoH and CoD Mosquito Engineering Program, Gwalwa Daraniki Association for their ongoing support and access to their land, the resident of the adjacent unit complex who assisted in informing other residents of the engineering works being carried out, as well as all other nearby residents who may have been affected by noise. We would also like to thank the Nightcliff resident who alerted ME to the pest mosquito problem in the area.

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An audit of influenza vaccination rates in patients aged between 3 and 70 years old with recently diagnosed rheumatic heart disease. Are patients receiving care in line with the national guidelines?

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Abstract

Rheumatic heart disease (RHD) is a serious complication of acute rheumatic fever (ARF). Individuals with moderate to severe RHD are at increased risk of complications from influenza and vaccination is recommended by the national guideline. This audit reviews whether a new diagnosis of RHD is triggering an assessment of vaccination status and provision of influenza vaccination.

Key words: Rheumatic heart disease; immunisation; influenza; Northern Territory.

Background

Rheumatic heart disease (RHD) is a severe complication of acute rheumatic fever (ARF). ARF and RHD are still very common in Aboriginal people living in central and northern Australia.[1] The prevalence rate of RHD for Aboriginal Australians is 2.2% in the Northern Territory (NT).[2]

There is increased morbidity and mortality associated with influenza infections in patients with chronic cardiac disease such as RHD.[3] The influenza vaccine is recommended for patients with severe (Priority 1) and moderate (Priority 2) RHD.[1]

Influenza vaccines should be administered yearly. However, it is important to note that children under 9 years of age who have never received the vaccine and persons with certain immunocompromising conditions (i.e. recent haematopoietic stem cell transplant or solid organ transplant) are recommended to receive 2 vaccine doses at least 28 days apart.[3] Following this the vaccine is administered yearly.

The aim of this audit was to identify the influenza vaccination status in patients with recently diagnosed RHD in the NT in order to inform education sessions undertaken by the NT RHD Control Program staff with other health care providers.

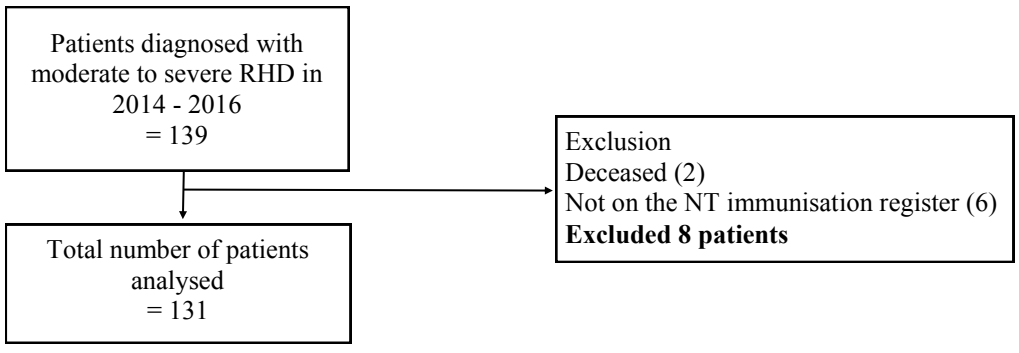
Methods

Ethics approval was obtained through the Human Research Ethics Committee of the NT Department of Health and Menzies School of Health Research.

Patients with a RHD diagnosis were identified from the NT RHD Register. Any patient diagnosed with RHD in 2014-2016 was included and patients who had died within 12 months of diagnosis or who did not have any record on the NT Immunisation Register were excluded (Figure 1).

The data obtained from the NT RHD register included date of birth, sex, Aboriginal status, date of RHD diagnosis, and RHD severity status at the time of diagnosis. The patient record

Figure 1. Inclusion and Exclusion criteria



number was manually matched to data from the NT Immunisation Register. Once the information was obtained (such as dates and number of doses of influenza vaccine since RHD diagnosis) the patients were de-identified.

A patient was considered to have received appropriate and timely vaccination cover following RHD diagnosis if they met the criteria outlined in Table 1. Data was extracted for analysis in October 2017.

Table 1. Criteria to be met to be considered appropriately vaccinated against influenza

Influenza vaccine administered within 12 months of RHD diagnosis *and*
If less than 9 years old, received a second dose of influenza vaccine at least 28 days later in the same year (if it was their first ever dose).

Influenza vaccination coverage for this cohort was compared with the influenza vaccination coverage for the general NT Aboriginal population for 2016.

Results

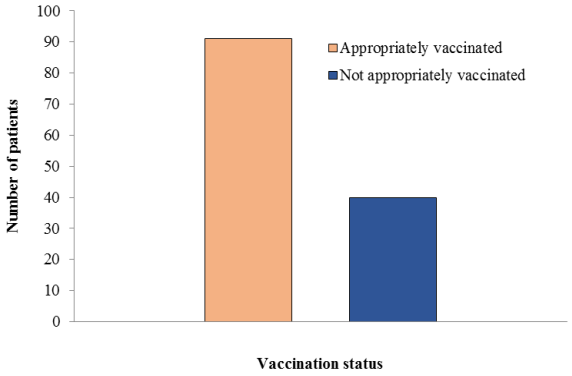
131 patients (71 % female) met the criteria for analysis with a median age of 22 years (range 3-70) and 128 (97.7%) patients were Aboriginal.

Influenza vaccination

91 of 131 (69%) patients received appropriate influenza vaccination within 12 months of their RHD diagnosis (Figure 2) (68% for males and 70% for females).

Children under 15 years old had the lowest coverage of influenza vaccination at 56% (25/45) within 12 months of RHD diagnosis (Table 2).

Figure 2. Influenza vaccination within 12 months of RHD diagnosis



There were 17 children under the age of 9 years who were diagnosed with RHD. 16 of these children required 2 doses of influenza vaccine at least 28 days apart. Only 6 of these children received both doses. One child had received the 2 dose course prior to RHD diagnosis but had not received further yearly vaccines post-diagnosis. Therefore only 35% (6/17) children under the age of 9 years were appropriately vaccinated for influenza within 12 months of RHD diagnosis.

Patients who were diagnosed with RHD in 2015 had the best coverage of influenza vaccine (76%) within 12 months of diagnosis (Figure 3). The poorest coverage was in 2016 at 52%.

Discussion

The results show that patients with moderate to severe RHD are 69% appropriately vaccinated against influenza in the period immediately following diagnosis.

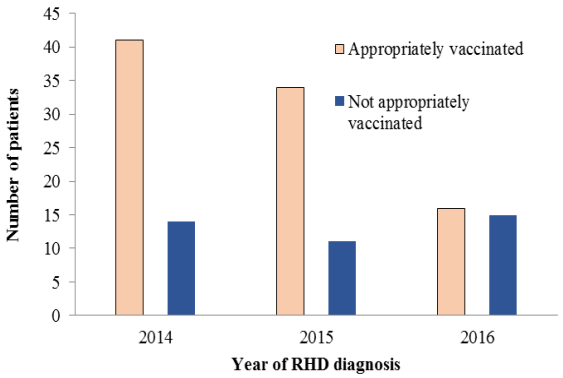
The influenza vaccine is given yearly. Influenza vaccination rate fell between 2015 (76%) to 2016 (52%). Additionally, children under 15

Table 2. Appropriate influenza vaccination by age group

Age group	No.	Number considered appropriately vaccinated for influenza (%)	% coverage in the general NT Aboriginal population in 2016
<5 years	5	3 (60%)	59%
5 to <15 years	40	22 (55%)	10%*
15 years or older	86	66 (77%)	49%
Total	131	91 (69%)	

*NB The influenza vaccine is not on the National Immunisation Program for 5 to <15 years old unless they have a chronic medical condition.

Figure 3. Influenza vaccination within 12 months of RHD diagnosis by year



years of age had lower influenza vaccination coverage (56%) compared to those 15 years and older (77%). Possible reasons for this could be a lack of awareness of the vaccine recommendations or difficulty in administering the vaccine due to patient factors. Children under 9 years should receive 2 influenza vaccine doses, at least 28 days apart the first time they receive the vaccine.[3] There were 17 children under 9 years of age in this audit and only 6 (35%) of them received the appropriate influenza doses within 12 months of diagnosis.

When influenza vaccine coverage was compared against the general NT Aboriginal population it appeared that the diagnosis of RHD did prompt the treating healthcare worker to administer the vaccine. This was markedly apparent in the 5 to under 15 year old patients with RHD where 55% received the influenza vaccine within 12 months of diagnosis compared with a coverage rate of 10% in the general NT Aboriginal population in this age group. Influenza vaccine is recommended for everyone over 6 months however there is no government funded influenza vaccine for Aboriginal Australians between 5 years and under 15 years old unless there is a chronic medical condition, such as RHD. Universally promoted and funded vaccines rather than targeted vaccines for higher risk groups usually reach higher coverage in the targeted groups.

The accuracy of this audit may have been affected by a lack of reporting of vaccinations to the NT Immunisation Register. In addition, there were 6 patients who were excluded from the analysis as they were not registered on the NT Immunisation Register and thus their vaccination status was unknown. An additional limitation is the small number of patients in some categories which limits the generalisation of the results beyond this study group.

The results of this audit indicate it would be worthwhile to increase the emphasis during education sessions with primary health clinicians and hospital staff regarding influenza vaccine for patients with moderate or severe RHD.

Conclusion

Overall, 69% of patients received influenza vaccination within 12 months of diagnosis of RHD. Of those with RHD, children under the age of 15 years had the lowest rate of vaccination against influenza (56%).

Acknowledgements

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New influenza vaccine for people aged 65 years and over in 2018

Ros Webby, Centre for Disease Control, Darwin

In 2018, the eligible groups for influenza vaccine on the National Immunisation Program are:

- Aboriginal children aged 6 months to less than 5 years and Aboriginal people aged 15 years and over
- People aged 6 months and over with chronic medical conditions
- Pregnant women (every pregnancy-any trimester)
- All people aged 65 years and over

All others aged 6 months and over who want to be protected from influenza infection can purchase vaccine via a private prescription from a general practitioner.

New influenza vaccine for people aged 65 years and over

In 2018, the Federal Government has announced that new vaccines for people aged 65 years and over will be available to improve protection against influenza in this age group. In 2017, 1100 people in Australia died from influenza with 90% of those deaths in people aged 65 years or over.[1] In a younger, healthier population the current influenza vaccine has better vaccine effectiveness (i.e. a measure of how well the influenza vaccine protects against influenza illness), compared to some older adults, especially the frail elderly, who may not produce a protective immune response after influenza vaccination.[2]

Two different methods have been used to improve the immune response to influenza vaccine in people aged 65 years and over. The first method is to provide a higher dose of antigen in the vaccine to produce a better immune response, and therefore, better protection against influenza.[3]

The other method is the addition of an adjuvant to the vaccine which will stimulate the immune response to vaccination.

While there is no preference for use between the 2 new trivalent vaccines, the NT funded program will be using the influenza vaccine with an adjuvant in 2018. This vaccine brand is Fluad®. These new vaccines are trivalent and are recommended over quadrivalent vaccines for adults aged 65 years and over. People in this age group are more likely to have severe disease from influenza A, especially H3N2, and the increase of the added adjuvant or increased antigen to produce a better immune response is likely to offset any decrease in protection against the second B strain.

The new vaccines for people over 65 years have been reported to have a higher local injection site reaction with approximately 10% more reactions compared to standard influenza vaccines. There is no increase in severe adverse events associated with these new vaccines.

These new vaccines will be available on the National Immunisation Program for people aged 65 years and over in 2018. Further information about this new vaccine will be sent to immunisation providers as it becomes available.

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Territory influenza in 2017; worst since 2009

Peter Markey, Ros Webby and Heather Cook
Centre for Disease Control, Darwin

Abstract

The Centre for Disease Control (CDC) Surveillance Section analysed the laboratory-confirmed influenza notification data from the Northern Territory (NT) Notifiable Diseases System together with influenza-like illness (ILI) data from the NT hospital Emergency Departments and the Primary Care Information System and compared the 2017 data with the previous 5 years (2012-16). There were 2-2.5 times more flu circulating in 2017 compared with the previous 5 years (2012-16). This led to more hospital admissions and more deaths. However, admission rate per case of laboratory-confirmed flu, the case fatality rate and length of hospital stay were no worse than previous years. The severity of the 2017 season affected the Aboriginal population more than the non-Aboriginal, apart from Aboriginal children under 5, who fared better than their non-Aboriginal counterparts, relative to the previous 5 years. The vaccine effectiveness in Aboriginal children 6 months to 4 years was 58% using the screening method.

Introduction

The 2017 influenza season was considered to be the severest since the 2009 H1N1pandemic.[1] It was characterised by very high rates of H3N2 laboratory-confirmed flu cases mainly affecting the elderly, high rates of mortality and low vaccine effectiveness.[2] As a warning for the Northern Hemisphere, Australian authorities publicised the severity of the season in Australia[2] to the extent that the disease was branded in some parts of the Northern Hemisphere as the "Aussie Flu".[3] This article summarises the flu season in the Northern Territory (NT) and makes comparisons with previous seasons. It also reports on the coverage of influenza vaccine in the community.

Methods

Influenza surveillance in the NT is now multi-facetted with no less than 8 systems, 4 local and 4 national, used to monitor trends and assess the intensity of flu activity. Most systems rely on syndromic data, which can lack specificity, so the most appropriate data for assessing the season is laboratory-confirmed notifications. The NT CDC applies extra efforts to ensure core data fields for laboratory-confirmed cases are complete (vaccine information, died status, hospitalised, length of stay). In addition we collect pregnancy status.

The notifiable disease data were downloaded from the NT Notifiable Diseases System and analysed using STATA, with the graphs being developed in Excel. Analysis was done by age group, Indigenous status and region and comparisons were made with the 5 year mean. Age groups were analysed using both 5 year groups and groups based on vaccination program (ie < 6months, 6 months-4 years, 5-14 years, 15-49 years, 50-64 years and 65 years and over). Hospitalisations, length of stay and mortality were also compared. Length of hospital stay, where data were complete, was log transformed and the groups compared using the Student's t-test.

Vaccine coverage estimates were derived for Aboriginal children between 6 months and 4 years and vaccine effectiveness estimates calculated based on the screening method. This method was not used in other population groups because of the uncertainty about coverage estimates and the inability to account for confounding (particularly relating to comorbidities).

Syndromic systems are used to monitor trends in influenza-like illness (ILI) and indicate the arrival of the season, but are less useful in comparing one year to another. Their advantage is that they are less susceptible to bias due to the variation of testing rates in the community which influences the laboratory-confirmed notifications. The NT monitors ILI using data from 4 sources; public hospital Emergency Departments, the Primary Care Information System (PCIS), the national Australian Sentinel Practice Research Network (ASPREN) and the national Flutracking project. Nationally, data from call centres is also used to monitor ILI.

Year-on-year comparisons are difficult due to the large proportion of ILI cases which are not influenza, that is, 'background' cases. While the number of these background non-flu cases may vary from year to year, it can be estimated by examining the baseline weekly count or the counts of ILI when laboratory-confirmed flu notifications are at a minimum. The weekly counts can then be adjusted by this baseline and summed to give the estimate of true flu cases for that year. This was trialled using data from both the ED and the PCIS-based systems. For the PCIS system the only comparison data was for 2016 and some assumptions were required to allow for missing data.

Results

There were 1544 cases of laboratory-confirmed influenza notified in 2017, which was 2.38 times more than the 5 year mean (648), 2.09 times more than 2016 (739) and the second highest recorded after 2009 (2079, Figure 1). In the Top End there were 2 seasonal epidemics, peaking in February and August with the February season larger (Figure 2). The number of cases in

Figure 1. Laboratory-confirmed influenza cases notified in NT by year and hospitalisation; 2009-17

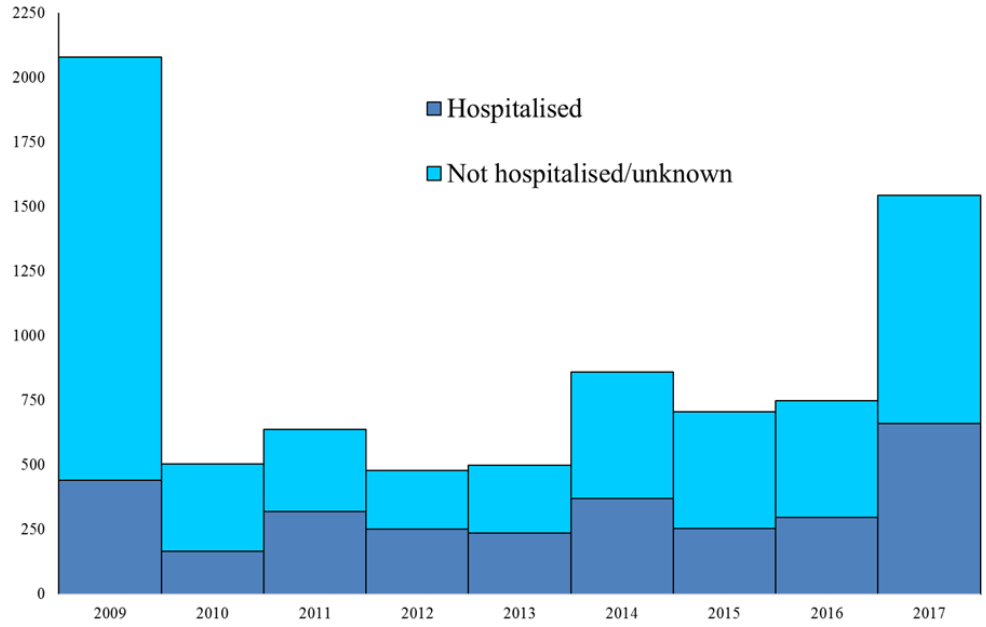
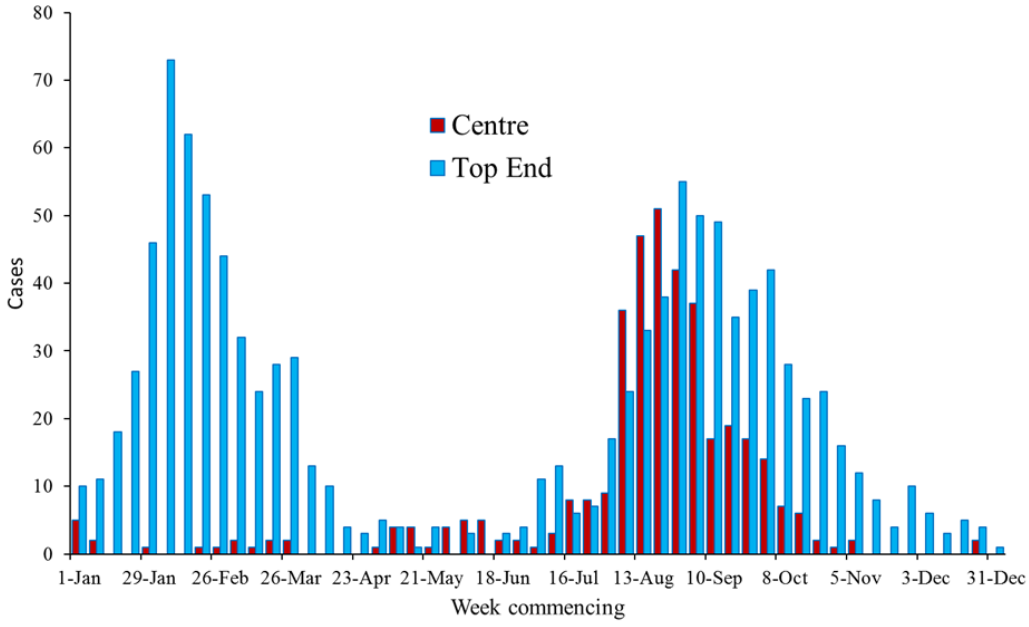


Figure 2. Laboratory-confirmed influenza cases by week commencing; Top End and Centre, 2017



Central Australia (Barkly and Alice Springs regions) was 373 which was 2.42 times the 5 year mean and larger than the bumper flu season experienced in 2014 (299 cases). The ratio of the district-specific rates of notifications compared with the 5 year mean varied from 3.7 in the Barkly to 1.8 in Darwin rural (Top End). Overall, however, Top End rates were similar to those of the Centre.

Five year age-specific rates compared to the rates in previous years are illustrated in Figure 3. Aboriginal rates were higher in all age groups but most marked in those aged 40 years and over. In Figure 4 analysis of age-groups based on vaccination policy revealed that the rate ratios between the 2017 rates and the 2012-16 combined rates were higher in the Aboriginal population apart from those under 5 years of age. That is, the severity of the 2017 season affected the Aboriginal population more than the non-Aboriginal, apart from those under 5 years.

Figure 3. Age-specific rates of laboratory-confirmed influenza by Indigenous status; 2017

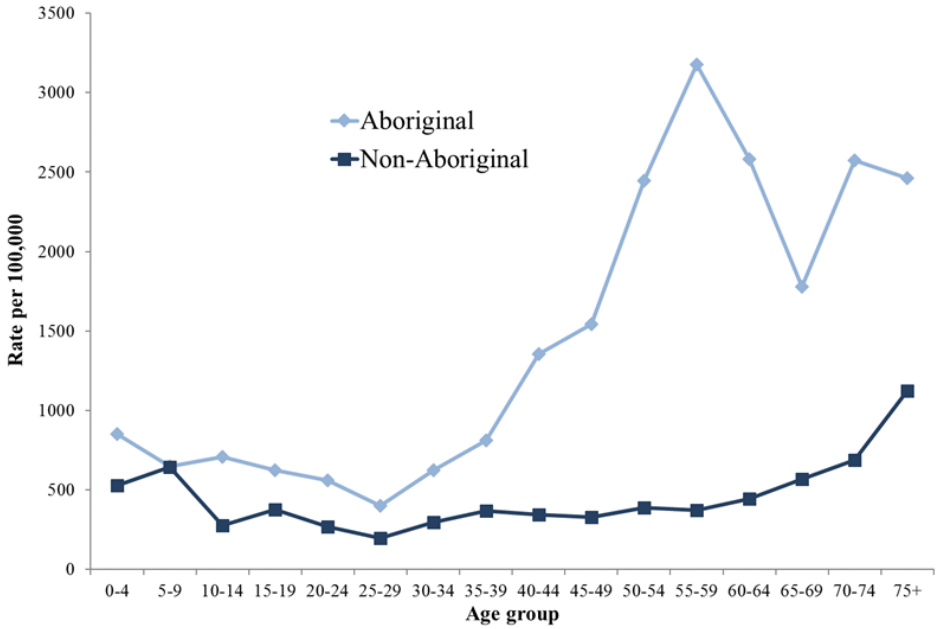
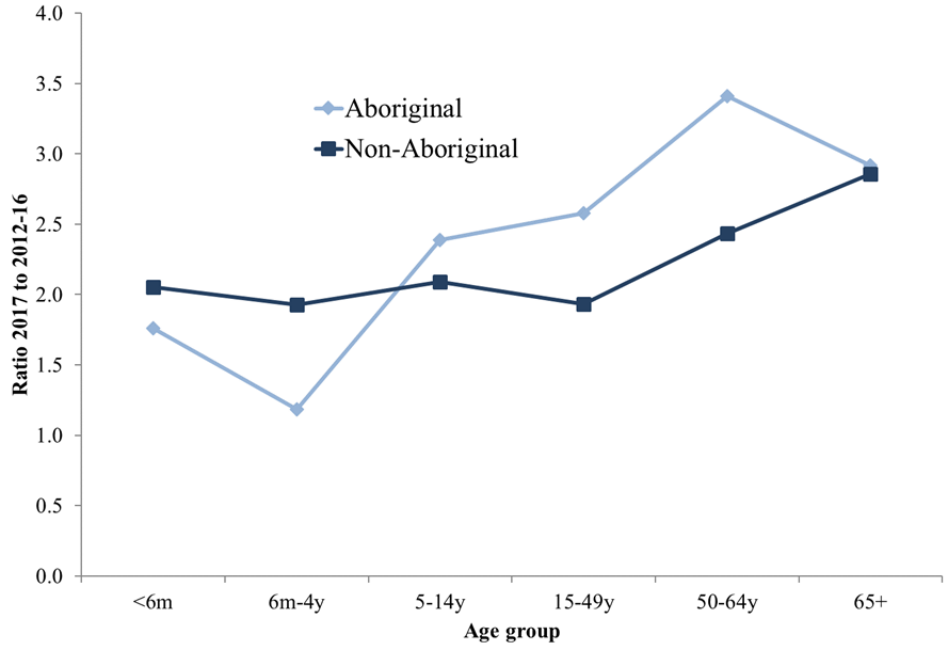


Figure 4. Age-specific ratios of the 2017 rate of laboratory-confirmed influenza compared to the 2012-16 rate; by Indigenous status and using age groups based on vaccination policy



In fact, the incidence of flu in Aboriginal children aged 6 months to 4 years in 2017 was not significantly higher than that of 2012-16 (Ratio 1.18; 95% CI, 0.87-1.60; p=0.27) as distinct from the non-Aboriginal group of the same age which had almost twice the 5 year rate (Ratio 1.93; 95%CI, 1.42-2.62; $p<10^{-4}$).

In 2017, 14.9% of women of child-bearing age with flu were pregnant. This was higher than the 5 year figure of 13.6% but not significantly so (Risk Ratio 1.1; CI 0.79-1.54; p=0.57). Pregnancy remained a significant risk factor for flu (Odds Ratio 3.5; CI 2.46-4.90; $p<10^{-4}$).

There were 661 cases of laboratory-confirmed flu admitted to hospital in 2017, 2.4 times the 5 year mean and 1.7 times that of the pandemic year 2009 (381, Figure 1). Interestingly, the proportion of laboratory-confirmed cases who were hospitalised was not significantly higher in 2017 compared to the previous 5 years (42.8% vs 42.1%; Risk ratio 1.02; CI 0.92-1.11; p=0.75). Aboriginal patients with laboratory-confirmed flu were slightly less likely to be admitted in 2017 than in previous years (51.7% vs 53.7%; RR 0.96; CI 0.85-1.09;p=0.53), while non-Aboriginal patients were slightly more likely to be admitted (35.9% vs 33.2%; RR 1.08; CI 0.93-1.25; p=0.29) but these differences were not statistically significant. The median length of stay was the same in 2017 as for the years 2012-16 (3 days). However the mean length of stay was slightly but significantly shorter in 2017 compared with 2012-16 (geometric means 3.26 vs 3.67 days; ratio 0.89; p=0.005).

There were 9 deaths among the notified cases in 2017. This is the highest annual number on record, higher than the number in the 2009 pandemic and represents a significantly higher population mortality rate than the previous 5 years (3.67 vs 1.32 per 100000; RR 2.77; 95% CI, 1.08-6.67; p=0.01). However, the case fatality rate of 5.8 per 1,000 laboratory-confirmed cases was not statistically significantly higher than the rate (4.9 per 1,000) among notified cases over the previous 5 years (16 deaths; Rate Ratio 1.18; CI 0.46-2.84, p=0.68).

Overall, 67.5% of cases were type A with 91% of those with known subtype being H3N2 (61% of total). Among the B cases, 92% (22/24) of those with known strain type were the Phuket strain (Yamagata lineage). Aboriginal people were slightly more likely to get type A flu than non-Aboriginal (73% vs 63%; $p<10^{-4}$).

Among Aboriginal cases aged 6 months to under 5 years, 52% were immunised. The coverage rate in the Aboriginal age-group was estimated at 72%, and the vaccine effectiveness (VE) as 57.7% (95%CI, 23.8-76.2%) based on the screening method. This compares to a VE of 44.6% in 2015 and 49.2% in 2016. The combined VE for the 3 years was 51.3% (95% CI, 28.7-66.6%). In that age-group in 2017, 77% were estimated to have A/H3N2, 23% had B and there were none with A/H1N1, while over the 3 years 2015-17, 49% were estimated to have had A/H3N2 and 47% B.

Analysis of the Emergency Department ILI weekly counts for several years revealed an approximate baseline of 150 cases per week. After adjusting for this, there were 5,190 cases of ILI in 2017 which was 2.26 times the 2012-16 annual mean. Looking at the PCIS data the background rate appeared to be about 140 per week and following adjustment the 2017 annual count was 4,706 or 1.86 that of 2016.

Discussion

Nationally, the 2017 influenza season was said to be the worst since the 2009 pandemic.[1] There was also agreement at the national level, that the increase was due to higher rates of flu transmission, mainly of H3N2, rather than a worsening virulence of any particular strain, or the introduction of a new strain.[1]

Analysis of the NT data for 2017 supports this view. Interestingly, when comparing 2017 to the previous 5 year data (2012-16), there was a consistent ratio of between 2.2 and 2.8 in the number of cases (laboratory-confirmed, ILI, hospital admissions, deaths) but there was no significant increase in the outcomes as a proportion of lab-confirmed cases (admission rate, case fatality, length of stay). This suggests that the increase was due to greater transmission and there was no evidence of an increase in virulence.

One explanation for the increased numbers of laboratory-confirmed cases is that there was

more testing being done. In 2017 there was a recruitment drive by ASPREN to encourage more GPs to partake in sentinel surveillance for ILI, and GPs were offered access to point-of-care testing. All tests done at point-of-care were then to be sent off for laboratory confirmation. This would no doubt have increased testing numbers (to which CDC does not have access), but given the small numbers of practices involved it would be unlikely to explain the increase. Likewise, the ILI numbers, not susceptible to bias due to testing, went up by a similar proportion to the laboratory-confirmed cases.

If there was higher transmission in 2017, it might have been related to the vaccine, which has in recent years shown only moderate effectiveness, particularly against H3N2 infection.[4] Estimates of vaccine effectiveness in 2017 against H3N2 influenza have revealed very low levels and almost no effect in the elderly.[4] This fits with the pattern of illness seen in the Territory where the rate ratio (2017 against the 5 year mean) in the elderly, who are usually affected more by H3N2 infection, was higher than younger age groups in both the Aboriginal and non-Aboriginal populations (Figure 4).

Interestingly, while the Aboriginal population overall was affected more than the non-Aboriginal population by the increased transmission in 2017, the younger Aboriginal age-groups were not as affected as their non-Aboriginal counterparts (Figure 3). This applied both to those aged less than 6 months, who may have been protected by higher rates of maternal uptake of flu vaccine in Aboriginal pregnant women, and to those aged 6 months to 4 years, the group which is offered free vaccine as part of the NT immunisation program. The finding that the Aboriginal cohort aged 6 months to 4 years did not fare significantly worse than the 5 year mean as distinct to the non-Aboriginal cohort is consistent with our findings of moderate benefit of the vaccine in this group, most of whom were thought to have H3N2.

Unfortunately this effect was not seen in the older age-groups; Aboriginal people aged 50-64 years receive funded vaccine and are likely to have a higher coverage rate than their non-Aboriginal counterparts, but were still more affected by the season (Figure 4), even though they had a smaller proportion of H3N2 cases (65.4%).

Summary

In 2017 the NT had the worst flu year since the 2009 pandemic. There was a flu season in the Top End during the Wet season and another season NT-wide in August. Altogether there were about 2-2.5 times more cases than the 5 year average, the morbidity per case was not worse than expected. The increased numbers may have been due to the poor vaccine effectiveness, however there is some evidence that the vaccine was effective in Aboriginal children under 5 years of age. Collection of more complete flu data has allowed us to develop useful comparisons and make assessments of local vaccine effectiveness.

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Meningococcal W update, March 31 2018

Priya Janagaraj and Ros Webby, Centre for Disease Control, Darwin

- There have been no further cases of invasive serogroup W meningococcal (MenW) disease in the Northern Territory (NT) since December 2017.
- Since March 2017, there have been 31 cases of invasive MenW and 3 cases of MenW conjunctivitis* in the outbreak area. The outbreak area is described as the Alice Springs, Barkly and Katherine regions of the NT and bordering interstate communities.
- All 34 cases of invasive MenW disease and MenW conjunctivitis have occurred in Aboriginal people from the Alice Springs, Barkly or Katherine regions or from border communities outside the NT with 32/34 (94%) cases below the age of 15 years.
- The isolates of MenW in the outbreak have shown high rates of penicillin intermediate resistance with minimum inhibitory concentration (MIC) between 250 to 640 micrograms There have been no MenW case fatalities in the NT.
- The MenW outbreak has been declared over as of 28 March 2018 in the NT.

The figure below shows the epidemiological curve of invasive MenW disease by region of residence in the NT in 2017.

A targeted vaccination program commenced in October 2017 and included all children aged 1-19 years in Alice Springs, Barkly and Katherine regions. From January 2018, the vaccination program was expanded to include all children in the Darwin Rural and East Arnhem regions as well as residents of boarding schools and residential facilities in Darwin.

Summary of Meningococcal ACWY vaccine coverage - Alice Springs, Barkly, Katherine

According to the NT Immunisation Register, as of 21 March 2018, an estimated 17 869 doses of MenACWY vaccine have been administered since February 2017 to people aged 1-19 years in Alice Springs Urban, Alice Remote, Tennant Creek, Barkly, Katherine Urban and Katherine Remote, East Arnhem regions and Darwin Rural regions since February 2017.

*Public health responses were initiated for meningococcal conjunctivitis cases as there is a risk of developing invasive meningococcal disease in 17% of patients.

Figure. Epidemiological curve of Meningococcal W outbreak in the Northern Territory by district of region of residence in 2017

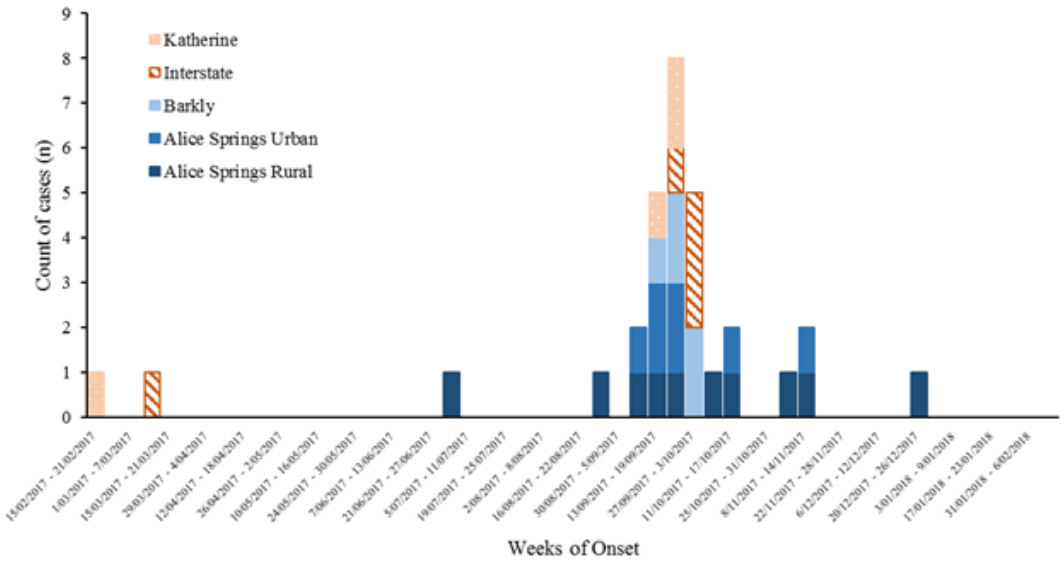

Table 1. Meningococcal ACWY vaccine number given and percentage coverage by Age Group and Aboriginal status**

Age Group	Aboriginal population			Non-Aboriginal population		
	Number of vaccines given (n)	Eligible population (n)	Coverage (%)	Number of vaccines given (n)	Eligible population (n)	Coverage (%)
1-4 years	2640	2880	92%	1203	1934	62%
5-9 years	2950	3494	84%	945	1969	48%
10-14 years	2667	3182	84%	902	1845	49%
15-19 years	1898	2949	64%	675	1849	37%
TOTAL	10155	12505	81%	3725	7597	49%

**Alice Springs, Barkly, Katherine regions

Explanation of the denominator used for coverage (this has been updated since previous reports):
For coverage reporting, regional level population data has been sourced from Health Gains. 'Northern Territory Resident Population Estimates by Age, Sex, Indigenous Status and Health Districts (1971-2016)', prepared by Health Gains Planning, file updated on 27 February 2017, using ABS Estimated Resident Population.

- Of these 10155 vaccines (81% of the estimated eligible population) were administered to Aboriginal people aged 1-19 years in Alice Springs, Barkly and Katherine regions.
- An additional 3725 (49% of the estimated eligible population) vaccines were administered to non-Aboriginal people aged 1-19 years in Alice Springs, Barkly and Katherine regions.

Ongoing programs

Meningococcal ACWY vaccine has replaced the MenC vaccine and been available on the NT childhood immunisation schedule since 1 December 2017 for all children at 12 months of age. The Federal Health Minister has announced that MenACWY vaccine will be added to the National Immunisation Program from mid-year 2018.

From January 2018, MenACWY vaccine has been available for all 1-19 year olds in East Arnhem and Darwin Rural regions as well as boarding students and residential facilities in urban Darwin.

Health care providers should continue to be vigilant for the classical and atypical presentations of meningococcal disease (see Box).

Box. Presentations of meningococcal disease

- Usual presentations of meningococcal disease sepsis or meningitis include fevers, headache, neck stiffness, dislike of bright lights (photophobia), vomiting, purpuric rash, cold limbs, and joint pains.
- Babies and very young children may experience irritability, have difficulty waking, non-blanching petechial rash, bulging fontanelle, rapid or laboured breathing, refusal to walk/ limping, diarrhoea, a high pitched cry or decrease oral intake.
- Atypical presentations such as epiglottitis, septic arthritis, conjunctivitis or pneumonia that present alone (~20%) or in combination with usual findings have been a feature of MenW disease.

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NT syphilis outbreak…. No downfall yet!

Manoji Gunathilake, Matthew O'Dwyer, Helen Goodwin, Peter Nihil and Vicki Krause
Centre for Disease Control, Darwin

A total of 739 cases of infectious syphilis have been reported in the Northern Territory (NT) by 28 March 2018, that can be attributed to an outbreak declared in mid-2014 among Aboriginal people living largely in remote and rural areas. The incident notification rate is very high in the NT compared to other jurisdictions. (Figure 1).

The outbreak first started in Alice Springs, reaching the Barkly, Katherine, East Arnhem and Darwin regions over the next 3 years; now the whole NT is considered an outbreak region (Figure 2).

About 73% (n=535) of outbreak cases were reported in young people aged less than 29 years.

Of the 739 cases, 402 (54%) were females diagnosed with infectious syphilis. Out of those

Figure 1. Infectious syphilis notification rate, per 100 000 population, 2014 -2017, by year and jurisdiction

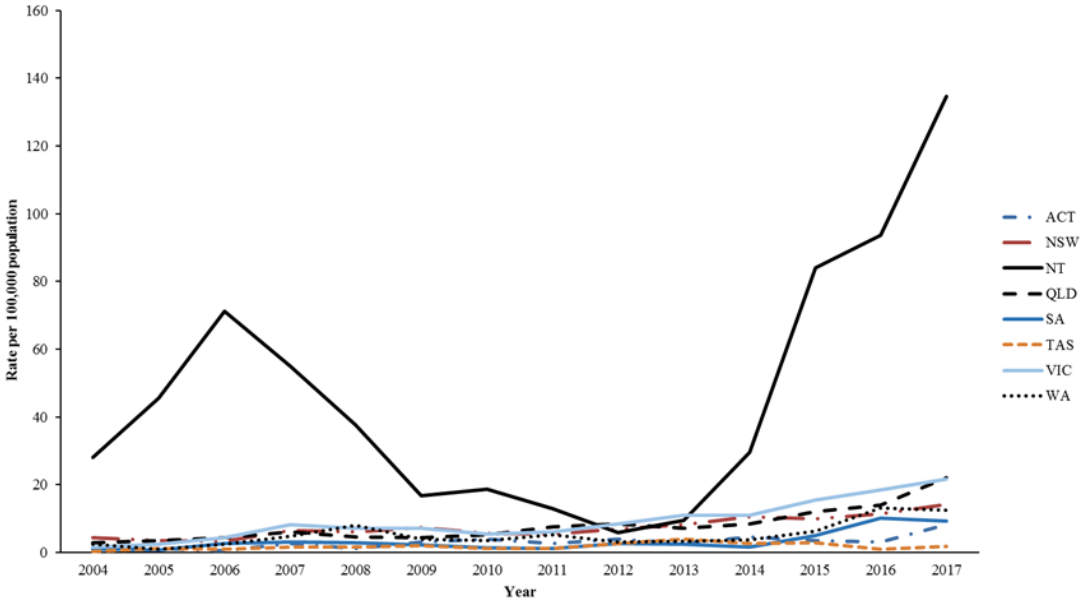
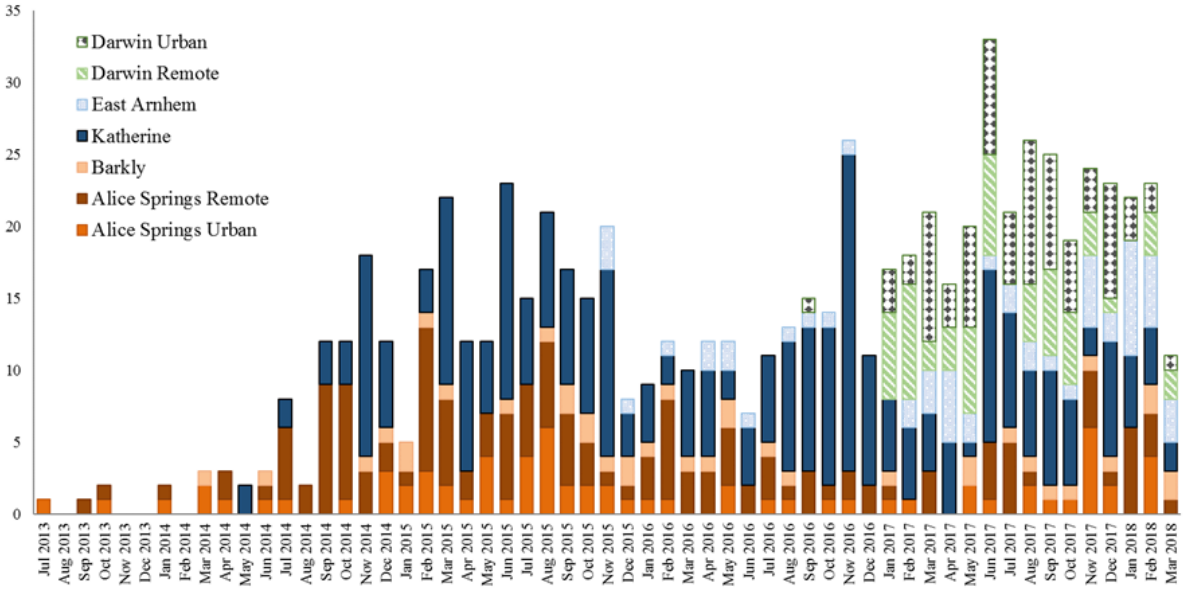


Figure 2. Northern Territory syphilis outbreak cases by region month and year



females at least 45 were treated for infectious syphilis while they were pregnant.

The resurgence of congenital syphilis is a dreadful consequence of the outbreak. There have been 2 cases of confirmed congenital syphilis reported in NT, one each in 2014 and 2017. One of the babies was very symptomatic requiring intensive care, the other was asymptomatic at birth.

Testing for syphilis has increased over the years in outbreak regions as shown in Figure 3 due to vigilant actions of healthcare staff, however there is more to be done.

Prevention and control of infectious syphilis requires initiatives for early diagnosis and treatment of patients as well as sexual contacts of syphilis.

The Sexual Health and Blood Borne Virus Unit (SHBBVU) of the Centre for Disease Control (CDC) introduced rapid point of care testing (POCT) for syphilis in 2014, in order to diagnose syphilis quickly in areas with higher number of cases during outreach testing initiatives. Remote health staff have been trained to carry out POCTs by SHBBVU teams who continue to support the remote primary health care workforce. POCTs are routinely available at some primary health care clinics. At least 3 500 syphilis POCTs were carried out and community positivity rates varied between 3 and 10%.

Provision of treatment to contacts of those with newly acquired syphilis is crucial in controlling the outbreak and it is the most challenging task. Healthcare staff make every attempt to provide urgent treatment to contacts of infectious syphilis. On line contact tracing web sites such as:

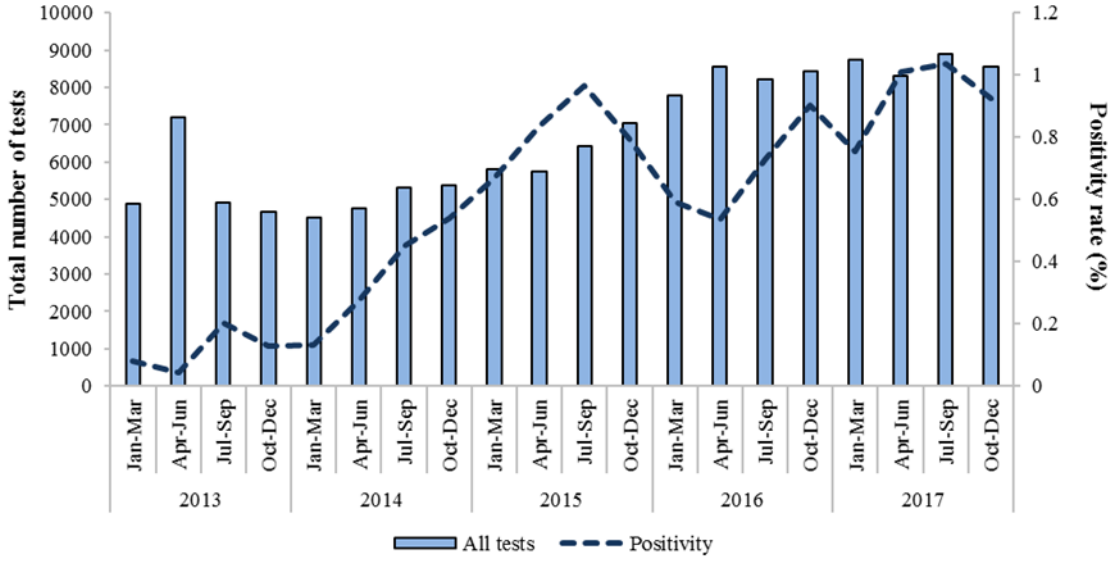
- 'Better to know' (http://www.bettertoknow.org.au) and
- 'Let them know' (http://www.letthemknow.org.au)

are very helpful for patients with syphilis to inform their contacts quickly and anonymously through short text messages (sms).

In pregnant women with untreated early syphilis, 70-100% of infants will be infected and up to one-third of cases will be still-births.[1,2] Infants with congenital syphilis might have multiple health problems with long term sequelae such as developmental delays, hearing, visual and bone abnormalities.

So early detection of pregnancy and frequent testing during pregnancy need to be a priority. Communities and mothers-to-be need to understand the importance of identifying pregnancy early and also the need to identify and treat infections such as syphilis should they be present during pregnancy so the babies will not be at risk of congenital syphilis.

Figure 3. Total number of syphilis tests (Westerns Diagnostic Pathology) and positivity rate (using NTNDS notifications), 2013-2017



All high risk pregnant women should be tested 5 times:

- at the booking visit
- at 28 weeks
- at 36 weeks
- at the time delivery and
- 6 weeks' post-partum

to ensure babies and mothers are free of syphilis. Surveillance by the SHBBVU indicates that about 80% of antenatal women residing in remote communities in the NT are being tested for syphilis at each of these visits.

Syphilis also increases the risk of acquisition and transmission of HIV.[3] It is vital to ensure that all patients with syphilis are being tested for HIV.

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A comparative lens on sexual health: Lessons from syphilis outbreaks in Australia and Canada

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Abstract

Background

A comparative analysis of sexually transmitted infection (STI) outbreaks in the Northern Territory (NT), Australia, and in Alberta (AB), Canada was undertaken, focusing on syphilis.

Methods

Epidemiological data, available literature, and personal communications with sexual health services team members in both regions were reviewed.

Results

It was found that the demographics of syphilis incidence differed significantly in each region. In the NT, rates are highest among heterosexual Aboriginal people <30 years of age, males only slightly more than females. In AB, rates are highest among young and middle-aged adults, males, men who have sex with men, and in urban areas. Both regions have faced challenges in expanding public sexual health awareness and sustaining investment in resources to improve testing and treatment during STI outbreaks. The NT engaged Aboriginal community members in sexual health promotion and outreach, including targeted use of mobile phone technology. In AB, resources have been channeled to the establishment of dedicated staff for contact and case follow-up and treatment, and financial incentives for testing have been piloted.

Conclusion

The STI outbreak demographics differ in each region. The exact drivers of transmission are unclear in both regions, with differing factors suggested. However, each region may gain from STI outreach strategies used in the other's region.

Background

The province of Alberta (AB) in Canada and the Northern Territory (NT) of Australia are regions of developed countries that face similar public health challenges. Specifically, both have a geographically dispersed population, with concentrations in urban areas, while those living in remote communities suffer from disparities in health care access and outcomes. Aboriginal groups in both regions may suffer from significant ongoing impacts because of historic colonization, affecting health determinants and leading to inequities in socioeconomic status.

Syphilis is an STI which, if not promptly and properly diagnosed and treated, can result in significant long-term health consequences. These include congenital syphilis resulting from perinatal transmission, which can lead to significant morbidity, still births and neonatal mortality. In AB, infectious syphilis rates in 2015 and 2016 have more than doubled since 2014. Six cases of congenital syphilis have been reported in AB in 2017.[1] In the NT, infectious syphilis rates have nearly doubled since 2014, constituting an ongoing outbreak of high public health concern with 2 cases of congenital syphilis since the outbreak started.

This study focuses on infectious syphilis, comparing the epidemiology and demographics of the outbreaks, and the public health responses. While acknowledging confounding factors in international comparisons such as differing health systems, population characteristics, beliefs and values, valuable insights may be gained by looking across borders. The goal is to identify any parallels or contrasts that may inform health services and policy approaches in either region.

Methods

Process

A comparative analysis of routinely collected notification data was done through collaboration with the Centre for Disease Control (CDC) Darwin Sexual Health and Blood Borne Virus Unit (SHBBVU) and Alberta Health Services' STI Services department. These data were supplemented by a review of academic and grey literature on sexual health trends and outreach approaches. Publications and reports were identified and information collected through personal communications with sexual health team members in both regions.

Terminology

References to 'syphilis' in this report should be taken to mean reported infectious syphilis cases. Slight differences in case definitions exist across regions, and may limit the validity of the comparison.

In AB, the data include primary, secondary, and early latent syphilis cases (disease acquired in the past year). Late latent syphilis cases are defined as syphilis acquired more than year ago, and are not included in the AB data.[2] In the NT, reported cases of infectious syphilis include those of <2 years duration.[3] Thus, cases of syphilis acquired between 1and 2 years ago are included in NT data, but are not included for AB, meaning reporting rates may be slightly lower in AB.

In this study, the following definitions are used:

An Aboriginal person is defined in Canada as someone who self-identifies as one of the 3 groups with constitutional recognition: First Nations (status or non-status), Métis, and Inuit peoples. In Australia, an Aboriginal person includes anyone who self-identifies as a member of Aboriginal and/or Torres Strait Islander groups.

Men who have sex with men (MSM) includes gay, bisexuals, and others who self-identify as male and engage in any form of sexual activities with men.

Results

Unless otherwise noted, NT data are from the NT CDC SHBBVU and AB data from the online Interactive Health Data Application.

Overall

Both AB and the NT have seen spikes in infectious syphilis rates since 2014, however the sex, age and regional distributions of the syphilis outbreaks differ. The current syphilis outbreak in AB started in the MSM non-Indigenous population (as compared to primarily heterosexual cases in previous outbreaks in AB in the mid-2000s and 1980s), whereas in the NT it has been largely heterosexual. While rates in AB are still higher in males, the proportion of female cases has increased, to 13% in 2016; in contrast, the sex ratio has been roughly even in the NT. In AB, the outbreak is largely urban, where in the NT it was largely rural till the end of 2016.

Figures 1 and 2 demonstrate the rate increases since 2014 in both regions, the gender disparity (male>female) in AB compared to the NT, and the higher overall rates in the NT (>100 per 100 000 population in the NT, just under 10 in AB in 2016). Figures 3 and 4 demonstrate a much younger age distribution in the NT, compared to the overall middle-aged distribution of syphilis incidence in AB. Figure 3 further shows that males are more highly affected across age groups in AB, whereas Figure 4 shows that young females (age 15-19) and older males are more affected in the NT.

Figure 1. Alberta syphilis incidence 2000-2016

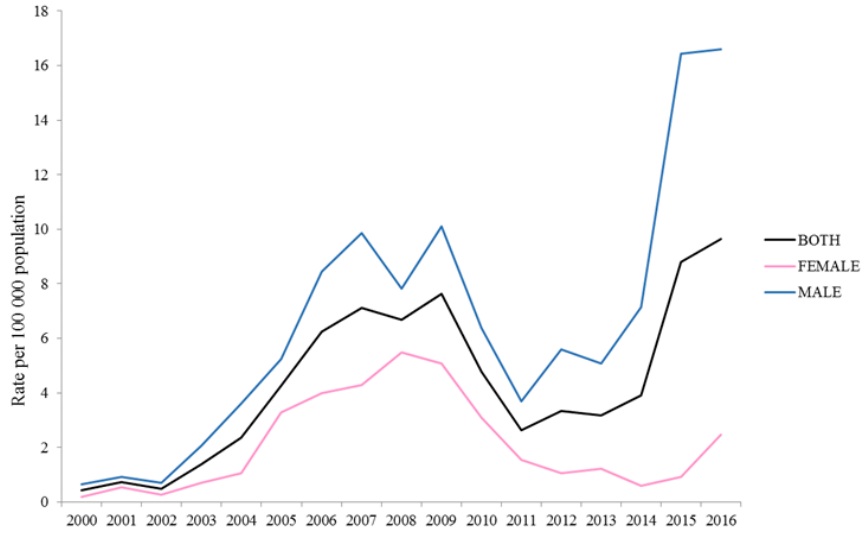

Figure 2. Northern Territory syphilis incidence 2000-2016

Figure 3. Alberta syphilis incidence by age and sex

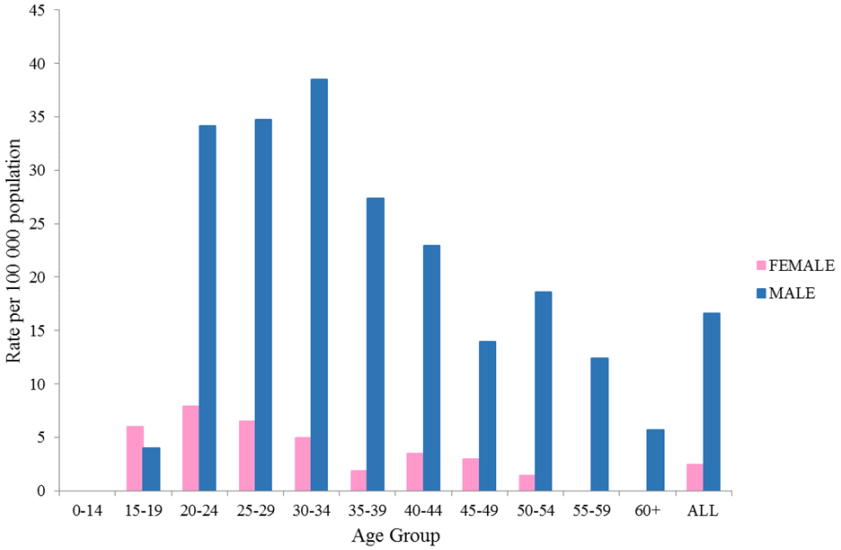

Figure 4. Northern Territory syphilis incidence by age and sex

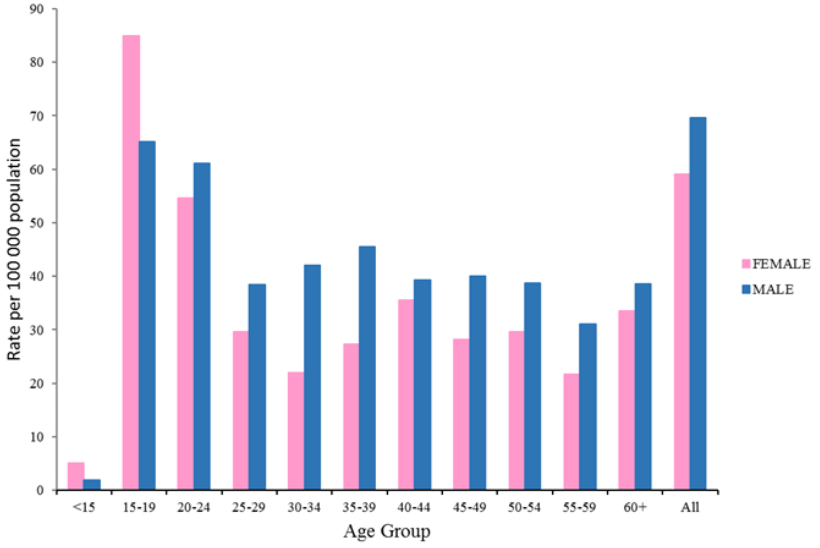

Table 1. Comparison of the epidemiology of syphilis outbreaks in AB and the NT

	Overall incidence 2000-2016	Absolute # of cases, 2016 (# in 2013)	Sex distribution	Age distribution	Regional distribution	High-risk groups*
AB	Increase from near-zero to 9.6 / 100 000	410 (127)	M > F	Older (highest 20-34)	Urban > rural	MSM, Caucasian
NT	Increase from near-zero to 115.6 / 100 000	283 (116)	M ~ F	Younger (highest 15-19)	Rural >> urban	Heterosexual, Aboriginal

*Note: Rates by ethnicity are not currently available for AB, and MSM rates are not currently available for the NT. Thus the groups at risk are indicated based on the limited available evidence and experience of sexual health services teams.

At-risk groups

In the NT, the syphilis outbreak since 2013 has disproportionately affected young Aboriginal people. In AB in 2009, 27% of infectious syphilis cases were Aboriginal (while Aboriginal peoples represent 6-7% of the AB population),[4] but current STI rates by ethnicity in AB are not available. Nonetheless the demographics of the current outbreak suggests higher syphilis rates in Caucasian and MSM populations (personal communication Jennifer Gratrix, Epidemiologist Alberta Health Services, June 2017). In the NT, the demographics of the recent syphilis outbreak suggest that cases notified have been primarily heterosexual (personal communication Dr Matthew Thalanany and Matthew O'Dwyer, Sexual Health and Blood Borne Virus Unit, Centre for Disease Control, NT, June 2017).

Discussion

Study limitations

Due to data gaps, it was not possible to compare similar data in 2 significant respects:

Firstly, the differences in case definitions may contribute to differences in reported rates of infectious syphilis. This may have increased the relative incidence in the NT as compared to AB.

Secondly, there were no current data available on rates by ethnicity, including Aboriginal status, in AB, or on sexual practices in the NT, including MSM.

Outbreak analysis

As both outbreaks are ongoing, no research evidence yet exists as to underlying transmission patterns, but the practical experience of sexual health teams is informative.

In AB, it is unclear what factors have driven the recent increase in STI rates, but given outbreak demographics, changing sexual practices and attitudes may contribute, along with the increasing availability of online dating apps and platforms for anonymous casual sexual encounters. Furthermore, the province experienced a severe economic downturn with the drop in global oil prices in 2014. The resulting impact on vulnerable

populations, including increased unemployment, unstable housing, and substance use, may have driven increases in high-risk sexual practices and reduced access to health care – however, evidence to support this hypothesis is lacking. Stigma and lack of awareness has also limited resources for adequate testing and treatment (personal communication Dr Petra Smyczek and Jennifer Gratrix, Alberta Health Services, June and October 2017. Discussion with Alberta Health Services STI Services Management Team, October 2017).

In the NT, the syphilis outbreak spread to the Territory after starting in Queensland in 2013, which coincided with a period of defunding sexual health services in the region. The demographics in the NT suggest possible underlying factors: a lack of health education and sexual health awareness, limited access to primary health care and follow-up, cultural stigma or taboos around discussing safe sexual practices. In contrast to AB, where most cases are urban, the NT response depends largely on remote health clinics facing additional challenges: high staff turnover, competing demands for staff time, cultural and linguistic barriers, and tracking transient cases between communities. Similar to AB, a lack of resources for testing and treatment hampers outbreak control (personal communication Mark Russell, Remote Sexual Health Program Manager, CDC, Alice Springs, June 2017).[5,6]

Public health responses

Both regions have shown commitment to a coordinated multi-faceted approach to health promotion, but have suffered a lack of sustained resources to maintain success long-term. Examples include the adolescent sexual education program in the NT which showed positive initial outcomes but ran out of government funding in 2015[7] or the successful but short province-wide STI awareness campaigns in AB in 2013 and 2011.[8,9]

In the NT, health promotion campaigns have been crafted with deliberate cultural relevance and Aboriginal community member engagement. These include the slogan 'Love and Respect Safely', posters and educational materials designed by Aboriginal health practitioners and outreach through Divas Chat, a popular social networking mobile app used by Aboriginal youth (personal communication, Jan Holt, Health Promotion Officer, Sexual Health and Blood Borne Virus Unit, CDC Darwin, June 2017). Alberta Health Services is engaging with Aboriginal community members in a 5 year STI strategy project. This project could be informed by the NT's practical and culturally relevant approach, including integration with existing technology used by at-risk groups.

In the NT, remote sexual health teams support clinic staff to implement routine, systematic testing and treatment for STIs in remote Aboriginal communities (personal communication Mark Russell).[10] Given the challenge of remote access to care, this approach of offering primary clinic staff training, follow-up, and support from sexual health outreach managers, may be utilised in AB for more remote centres, such as the north zone.

In AB, the ongoing challenge of outreach to at-risk populations in urban areas (e.g. those affected by substance use, homelessness) has been addressed by placing staff directly at inner city agencies.[11] Furthermore, a pilot intervention during AB's last outbreak added a financial incentive to syphilis testing at community organisations serving vulnerable populations, and case finding rates exceeded conventional rates, including a higher case finding rate among female sex workers.[12] The AB government recently extended funding to community organisations that support vulnerable populations, including Aboriginal women, to raise awareness and facilitate access to culturally relevant STI services.[1]

AB has also created dedicated staff positions to address the STI outbreak. These include partner notification nurses, who assertively engage in contact tracing. Initial anecdotal reports show the positivity rate has been quite high, as targeted individuals have been named as a contact to an STI. AB has also introduced new administrative staff to investigate positive lab results, additional STI clinic nurses in major centres, and a dedicated prenatal syphilis nurse to coordinate follow-up of mothers and infants at risk of congenital syphilis (personal correspondence Jennifer Gratrix).[1]

Conclusion

A comparison of syphilis outbreaks in AB and the NT shows that epidemiological characteristics differ, and in both regions the extent of underlying drivers of transmission remain

unclear. Consistent data delineating the demographics of syphilis incidence, including ethnicity and other social characteristics, are lacking. The challenges of sexual health outreach share similar characteristics across regions, including societal stigma, under-awareness of STI risks and a lack of sustained resources for sexual health education, syphilis testing and treatment.

A review of best practices across borders, adapting strategies to local situations, can inform the public health response to STI outbreaks. The NT's culturally engaged and informed health promotion approach could inform the current development of an Aboriginal STI strategy in AB. In the NT, remote sexual health teams exist to train and support remote primary clinic staff in STI services. This may inform AB's approach to rural centres, where dedicated sexual health staffing may be impractical. In larger centres in AB, dedicated central staff for contact tracing and case follow-up have been introduced to manage the outbreak. In the past, financial incentives for testing have also been piloted as a way to improve case finding and follow-up in AB. Such approaches may assist the response to the ongoing syphilis outbreak, provided the financial resources were made available.

Acknowledgments

Thanks goes to the CDC NT SHBBVU staff, particularly: Dr. Manoji Gunathilake, for assisting with final edits; Peter Nihill, Kelly Hosking, Mark Russell, and Jan Holt, for their discussions and insights into sexual health outreach in the NT.

Thanks also to Dr. Pasqualina Coffey and Dr. Peter Markey of the CDC Darwin Surveillance Unit for their feedback, support and guidance.

Thanks to Dr. Petra Smyczek and Jennifer Gratrix of Alberta Health Services for providing key information on sexual health data and outreach in Alberta, and facilitating fruitful discussion with the AHS STI services management team.

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Abstracts from peer reviewed published articles related to the Northern Territory

Evaluation of a cocooning program on infant pertussis infection in the Northern Territory

Overton K, Webby R, Markey P, Krause V

J Pediatr Infect Dis, https://doi.org/10.1055/s-0037-1616859

Since 2008, the Northern Territory (NT) Guidelines recommended delivering dTpa vaccine to postnatal women and all other household and close infant contacts. We aim to determine whether this pertussis cocooning strategy reduced infections in young infants in the NT. Infants < 12 months of age notified with pertussis and born at times when the cocooning strategy was in place (2009–2014) were compared with infants born pre-intervention (2002–2007). The proportion of cases of pertussis occurring in infants < 12 months of age was significantly higher in the pre-intervention period (6.7%) compared with the cocooning period (3.3%, p = 0.0067).

Multidrug-resistant tuberculosis in Australia, 1998–2012

Francis J, Manchikanti P, Blyth C, Denholm J, Lowbridge C, Coulter C, Donnan E, Stapledon R, Krause V, Waring J.

Int J Tuberc Lung Dis 22(3):294–299 Q 2018 http://dx.doi.org/10.5588/ijtld.17.0412

Objective: To describe the epidemiology and outcomes of multidrug-resistant tuberculosis (MDR-TB) diagnosed in Australia between 1998 and 2012.

Design: A retrospective review was undertaken involving all patients with laboratory -confirmed MDR-TB notified in Australia between 1998 and 2012 inclusive. Demographic, clinical and laboratory features are described. Clinical outcomes were defined according to World Health Organization definitions of treatment success (cure and treatment completion), treatment failure, death, loss to follow-up (including transfer out), or not evaluated at treatment completion.

Results: A total of 244 cases of MDR-TB were diagnosed in Australia during the study period, representing 1.4% of all TB cases notified. The majority were born outside Australia, including one third in Papua New Guinea. Of those with treatment outcome data available, treatment success was demonstrated in 81%. Treatment success was positively associated with use of a second-line injectable agent. Those born in Papua New Guinea were less likely to achieve treatment success.

Conclusion: MDR-TB is uncommon in Australia. The large number of cases born in Papua New Guinea, and the poorer outcomes in this cohort, represent challenges with cross-border management of MDR-TB in the Torres Strait. Australia has an ongoing role in the prevention and management of MDR-TB locally and in the region.

Prevention of perinatal hepatitis B virus transmission: are we following guidelines?

Markey P, White H, Matthews A, Strebor C, Krause V

Communicable Diseases Intelligence 41(3) 2017 E195-198

It is recommended that infants born to women with hepatitis B infection should have serological review following completion of a 4 dose vaccination schedule. A review was undertaken on 102 neonates who received hepatitis B immunoglobulin to ascertain the proportion that were fully immunised and then followed up. Of the 66 infants for whom data were available, 65 (98.5%) had appropriately received 4 doses of hepatitis B vaccine in infancy and a further child had received 3 doses. Only 19/66 (29%; 95%CI: 18-41%) infants had documented follow-up serology results, 1 of whom was infected and 1 of whom was immune through clearance of infection. All children who had no serology documented were traced and offered testing in primary care. Our results demonstrate that although adherence to the vaccination schedule in this group of infants was good, mechanisms for ensuring that infants receive serology testing need to be strengthened.

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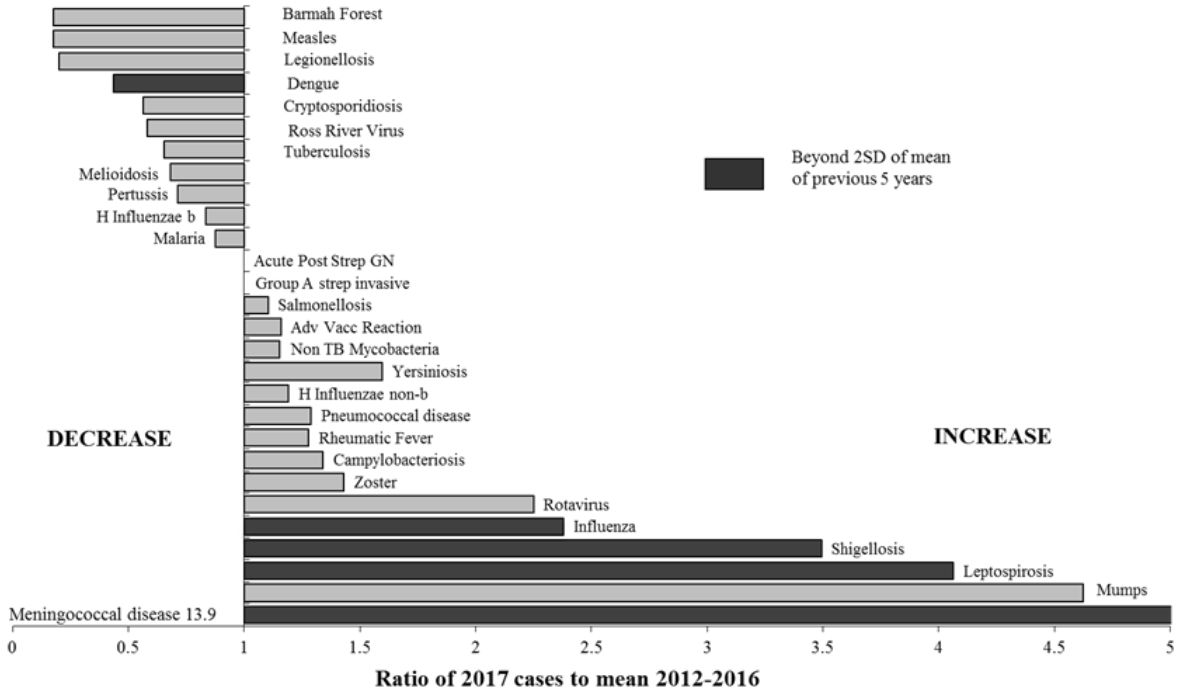
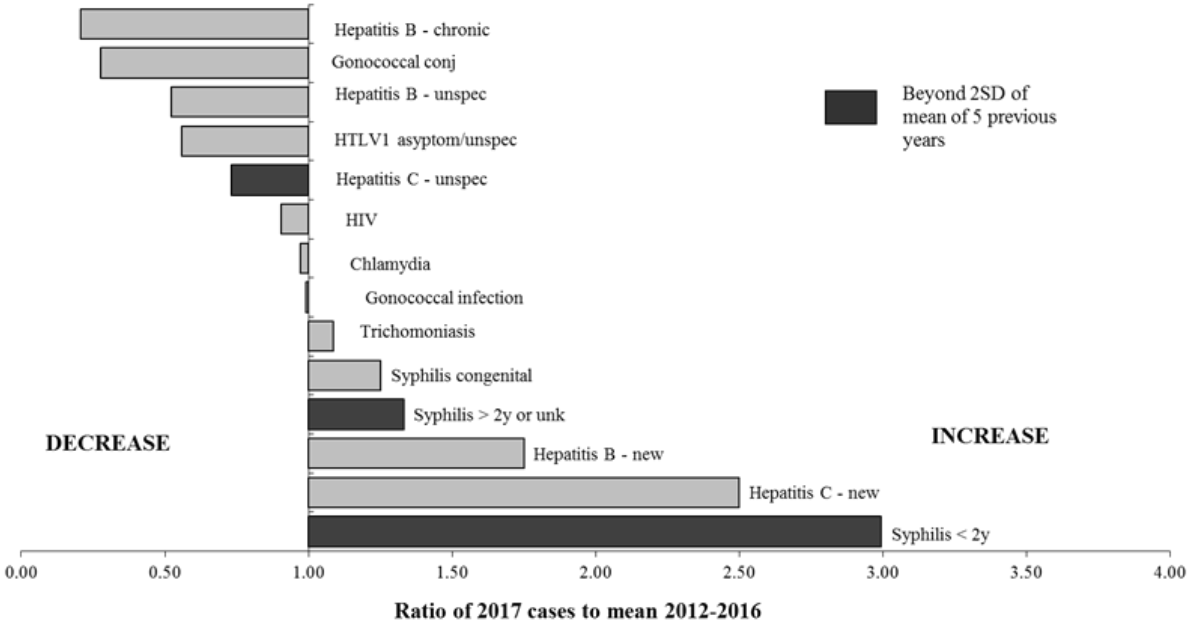
NT NOTIFICATIONS OF DISEASES BY ONSET DATE & DISTRICTS
1 January — 31 December 2016 and 2017

	Alice Springs		Barkly		Darwin		East Arnhem		Katherine		NT	
	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017	2016	2017
Acute post strep glomerulonephritis	14	15	3	0	8	15	10	6	8	12	43	48
Adverse vaccine reaction	7	11	5	3	31	39	2	2	5	4	50	59
Amoebiasis	0	1	0	0	3	1	0	0	0	0	3	2
Arbovirus not otherwise specified	0	0	0	0	1	0	0	0	0	0	1	0
Barmah Forest	0	2	0	1	11	16	2	1	0	0	13	20
Campylobacteriosis	93	66	10	10	296	249	17	18	45	64	461	407
Chickenpox	12	16	1	2	104	49	6	4	8	9	131	80
Chikungunya	0	0	0	0	2	0	0	0	0	0	2	0
Chlamydia	836	865	75	108	1323	1332	196	186	277	289	2707	2780
Chlamydial conjunctivitis	1	1	0	0	9	5	0	0	5	0	15	6
Ciguatera	0	0	0	0	0	0	1	0	0	0	1	0
Crusted scabies	2	4	0	0	15	23	10	18	4	6	31	51
Cryptosporidiosis	60	23	10	4	182	43	10	10	24	14	286	94
Dengue	13	2	0	2	90	30	0	0	0	0	103	34
Food/water borne disease	0	0	0	0	24	1	0	0	0	0	24	1
Gastro - related cases	8	2	0	0	2	1	0	0	0	0	10	3
Gonococcal conjunctivitis	1	0	0	0	2	0	0	0	1	1	4	1
Gonococcal infection	869	875	87	166	397	407	152	122	300	274	1805	1844
Gonococcal neonatal ophthalmia	0	0	0	0	0	1	0	0	0	0	0	1
Group A strep invasive	23	24	11	6	32	26	5	3	11	7	82	66
Hepatitis B - chronic	0	0	0	1	9	11	6	1	0	0	15	13
Hepatitis B - new	0	2	0	0	1	3	0	0	1	1	2	6
Hepatitis B - unspecified	6	13	0	0	88	79	7	3	3	5	104	100
Hepatitis C - new	1	1	0	0	2	6	0	0	0	0	3	7
Hepatitis C - unspecified	34	27	4	1	173	123	3	0	9	12	223	163
Hepatitis D	0	0	0	0	2	0	0	0	0	0	2	0
Hepatitis E	1	0	0	0	0	0	0	0	0	0	1	0
H Influenzae b	0	0	0	0	0	1	0	0	1	0	1	1
H Influenzae non-b	5	4	0	1	3	2	1	0	1	3	10	10
HIV	1	4	1	0	34	19	0	0	0	0	36	23
HTLV1 asymptomatic/unspecified	12	13	0	0	4	1	0	0	3	7	19	21
HTLV1 TSP	1	0	0	0	0	0	0	0	0	0	1	0
Influenza	131	344	6	61	509	763	34	167	68	209	748	1544
Lead - elevated	0	1	0	0	3	10	0	101	0	2	3	114
Legionellosis	0	0	0	0	0	1	0	0	0	0	0	1
Leprosy	0	0	0	0	0	0	1	0	0	0	1	0
Leptospirosis	0	0	0	0	1	8	0	0	0	5	1	13
LGV	0	0	0	0	1	0	0	0	0	0	1	0
Malaria	2	2	0	0	14	11	1	0	0	1	17	14
Measles	0	0	0	0	0	2	0	0	0	0	0	2
Melioidosis	0	0	2	0	41	34	8	5	7	4	58	43
Meningococcal infection	1	26	0	5	1	4	1	0	0	4	3	39
Mumps	34	68	60	17	9	20	7	1	28	42	138	148
Non TB Mycobacteria	1	0	0	0	9	9	0	0	0	0	10	9
Pertussis	13	11	2	1	201	84	6	9	4	7	226	112
Pneumococcal disease	25	40	2	7	21	20	2	4	2	7	52	78
Q Fever	2	0	0	0	1	0	0	0	0	0	3	0
Rheumatic Fever	53	66	5	1	51	46	33	28	15	22	157	163
Ross River Virus	8	17	1	4	169	123	11	17	18	18	207	179
Rotavirus	36	139	3	15	8	110	1	29	2	57	50	350
Salmonellosis	67	71	19	20	520	372	27	33	71	74	704	570
Shigellosis	58	205	11	46	72	74	37	32	22	115	200	472
STEC/VTEC	1	0	0	1	1	1	0	0	0	0	2	2
Strongyloidiasis disseminated	1	0	0	0	0	0	0	0	0	0	1	0
Syphilis < 2years duration	53	52	1	6	73	170	11	24	92	75	230	327
Syphilis > 2years duration or unknown	13	21	1	1	35	57	8	4	3	16	60	99
Syphilis congenital	0	0	0	0	0	0	0	0	0	1	0	1
Trichomoniasis	947	1054	154	215	1335	1211	663	511	623	596	3722	3587
Tuberculosis	5	3	1	1	13	15	3	0	2	4	24	23
Typhoid	0	0	0	0	1	1	0	0	0	0	1	1
Typhus	0	1	0	0	2	1	0	0	0	0	2	2
Varicella - unspecified	2	0	0	0	3	2	0	0	0	0	5	2
Vibrio food poisoning	0	0	0	0	0	1	0	0	0	0	0	1
Vibrio invasive	0	0	0	0	3	0	0	1	0	0	3	1
Yersiniosis	3	3	0	0	15	7	0	1	1	0	19	11
Zoster	62	55	4	11	286	308	20	18	18	33	390	425
Sum:	**3518**	**4150**	**479**	**717**	**6246**	**5948**	**1302**	**1359**	**1682**	**2000**	**13227**	**14174**

Ratio of the number of notifications in 2017 to the 5 year mean (2012-16): Selected diseases



Ratio of the number of notifications in 2017to the 5 year mean (2012-16): Sexually transmitted diseases



Comments on notifications

Shigellosis

There has been a continuing outbreak of shigellosis in remote Northern Territory (NT) communities since May 2017 associated with the introduction of a new *Shigella* subtype (*S. flexneri* 2b). In 2017 there were 472 cases which is about 3.5 times the 5 year mean of 135. An increase in case numbers has also been detected in Western Australis and South Australia. An outbreak response has been undertaken.

Meningococcal disease

There were 26 cases of invasive meningococcal W (MenW) in Alice Springs, Barkly and Katherine in 2017. There were 5 further cases of invasive meningococcal disease in nearby interstate communities. Additionally there were 2 cases of MenW conjunctivitis that were not notified but required a public health response, together with 3 sporadic cases of meningococcal B and 3 of meningococcal Y disease. The 39 total meningococcal disease cases which included the conjunctivitis cases and bordering community cases was almost 14 times the 5 year mean of just under 3 cases. The last case of MenW prior to 2017 was notified in 2010.

Influenza

There were 1544 cases of influenza notified in 2017, 2.3 times the 5 year mean of 659 and the highest number of notifications since the pandemic of 2009. See article in this edition for details on pages 24-28.

Leptospirosis

There were 13 cases of leptospirosis notified in 2017, just over 4 times the 5 year mean of 3.2 per year. Most of these were due to a cluster at 2 particular cattle stations during the movement of a herd of cattle which had likely acquired it from pigs. It was associated with monsoonal rainfall patterns and minor flooding.

Dengue

Dengue case numbers were down in 2017. Only 34 were notified compared with a 5 year mean of 78. There was a new national case definition released on 1 January 2017 and this may have led to some cases being rejected which may have qualified under the old definition. The major countries of acquisition were Indonesia (13) and East Timor (12).

Syphilis

Syphilis case numbers continue to be well above the expected number even now several years into the well-documented outbreak. There were 3 times the expected number of cases of infectious syphilis in 2017 (327 vs the 5 year mean of 109). The number of syphilis cases of greater than 2 years or unknown duration was slightly above expected (99 vs 75). Syphilis of greater than 2 years or unknown duration were also up with 100 cases notified compared with the 75 cases expected.

Hepatitis C unspecified

There were 165 cases of unspecified C notified in 2017 which was 27% less than the expected 226 based on the 5 year mean. This might be due to a combination of improved access to the needle and syringe program and better access to the recently available curative treatment. There were 5 newly acquired cases notified in 2017.

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NT malaria notifications October—December 2017

Elizabeth Stephenson, CDC Darwin

There were no cases of malaria notified in the 4th quarter of 2017.

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Immunisation coverage for children aged 12-<15 months at 31 December 2017

SA3 Name	Number of Individuals in SA3	%DTP	%Polio	%HIB	%Hep B	%Pneumo	% Fully vaccinated
Darwin City	118	93.22	93.22	93.22	94.07	94.92	93.22
Darwin Suburbs	216	92.13	92.13	92.13	93.06	91.67	91.20
Litchfield	53	96.23	96.23	96.23	98.11	96.23	96.23
Palmerston	195	96.41	96.41	96.41	95.90	96.41	95.90
Alice Springs	93	92.47	92.47	92.47	91.40	93.55	91.40
Barkly	10	90.00	90.00	90.00	100.00	90.00	90.00
Daly - Tiwi - West Arnhem	33	96.97	96.97	96.97	96.97	96.97	96.97
East Arnhem	39	94.87	94.87	94.87	94.87	94.87	94.87
Katherine	67	94.03	94.03	94.03	100.00	94.03	94.03
Not mapped†	89	92.13	92.13	92.13	95.51	91.01	91.01
Non Aboriginal (NT)	634	94.50	94.50	94.50	94.50	94.60	94.00
Aboriginal (NT)	283	92.60	92.60	92.60	96.10	92.60	91.90
NT	917	93.90	93.90	93.90	95.00	94.00	93.30
Australia	78643	94.80	94.80	94.60	94.80	94.40	94.10

Immunisation coverage for children aged 24-<27 months at 31 December 2017

SA3 Name	Number of Individuals in SA3	%DTP	%Polio	%HIB	%Hep B	%MMR	%MenC	%Varicella	% Fully vaccinated
Darwin Suburbs	215	93.02	97.67	96.74	97.67	93.02	97.21	93.02	91.63
Litchfield	63	92.06	92.06	92.06	93.65	92.06	93.65	90.48	87.30
Palmerston	192	94.27	97.40	96.35	97.40	93.75	96.35	94.27	92.19
Alice Springs	79	89.87	93.67	91.14	93.67	91.14	92.41	87.34	84.81
Barkly	14	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Daly - Tiwi - West Arnhem	27	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
East Arnhem	32	90.63	96.88	96.88	96.88	90.63	96.88	90.63	90.63
Katherine	65	89.23	96.92	92.31	96.92	89.23	95.38	90.77	84.62
Not mapped†	76	89.47	98.68	98.68	98.68	93.42	96.05	90.79	85.53
Non Aboriginal (NT)	605	93.40	96.90	95.00	97.00	93.60	95.90	93.20	90.90
Aboriginal (NT)	258	89.90	97.30	96.90	97.30	90.70	96.50	89.50	87.20
NT	863	92.40	97.00	95.60	97.10	92.70	96.10	92.10	89.80
Australia	79442	93.10	96.50	95.30	96.40	93.50	95.50	92.70	90.60

† Not mapped: Individual could not be mapped to a specific location. For example a PO Box cannot be mapped to a geographical area

Immunisation coverage for children aged 60-<63 months at 31 December 2017

SA3 Name	Number of Individuals in SA3	%DTP	%Polio	% Fully vaccinated
Darwin City	109	90.83	90.83	90.83
Darwin Suburbs	215	95.81	95.81	95.35
Litchfield	54	100.00	100.00	100.00
Palmerston	161	96.89	96.89	96.89
Alice Springs	80	86.25	88.75	86.25
Barkly	17	76.47	76.47	76.47
Daly - Tiwi - West Arnhem	27	92.59	92.59	92.59
East Arnhem	48	89.58	87.50	87.50
Katherine	73	97.26	97.26	97.26
Not mapped†	81	91.36	91.36	91.36
Non Aboriginal (NT)	571	94.20	94.60	94.00
Aboriginal (NT)	295	92.50	92.20	92.20
NT	866	93.60	93.80	93.40
Australia	82464	94.60	94.60	94.50

† Not mapped: Individual could not be mapped to a specific location. For example a PO Box cannot be mapped to a geographical area

Immunisation coverage at 31 December 2017

Holly Carmichael, CDC, Darwin

Background information to interpret coverage

Commencing with this issue of the Bulletin, immunisation coverage will be reported by Australian Bureau of Statistics (ABS) Statistical Area Level 3 (SA3) rather than postcode. SA3s are ABS standardised geographical areas to which children have been assigned based on their Medicare address as recorded on the Australian Immunisation Register (AIR). The region 'Not Mapped' captures the children whose residency could not be mapped to a specific location within the Northern Territory (NT), this includes PO Box addresses. Maps of these geographic area boundaries can be found at http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/B0AC271BC8160338CA257801000E0692/$File/1270055001_asgs_2011_nt_maps.pdf

The cohort of children assessed at 12 to <15 months of age on 31 December 2017 were born between 1 July 2016 and 30 September 2016 inclusive. To be considered fully vaccinated, these children must have received 3 valid doses of vaccines containing diphtheria, tetanus, pertussis, and poliomyelitis antigens, either 2 or 3 doses of PRP-OMP Hib or 3 doses of another Hib vaccine, 3 doses of hepatitis B vaccine and 3 doses of pneumococcal vaccine. All vaccinations must have been administered by 12 months of age.

The cohort of children assessed at 24 to <27 months of age on 31 December 2017 were born between 1 July 2015 and 30 September 2015 inclusive. To be considered fully vaccinated, these children must have received meningococcal C vaccination (given at the 12month schedule point), and a second dose of measles, mumps, rubella (MMR) and the first dose of the varicella vaccination (given in combination as MMRV at the 18 months schedule point). All vaccinations must have been administered by 24 months of age.

The cohort of children assessed at 60 to <63 months of age on 31 December 2017 were born between 1 July 2012 and 30 September 2012 inclusive. To be considered fully vaccinated, these children must have received 4 or 5 valid doses of vaccines containing diphtheria, tetanus, pertussis antigens, 4 doses of poliomyelitis

vaccine and 2 valid doses of MMR vaccine. All vaccinations must have been administered by 60 months (5 years) of age.

Interpretation and comment

Immunisation coverage rates for NT children by SA3 and Aboriginal status, as estimated by the AIR, are shown on pages 43-44. Coverage for all Australian children is also provided.

Children in the NT were less likely to be fully immunised in all cohorts in comparison to Australia wide coverage rates; 12 <15 months (NT 93.3%, National 94.1%), 24 to <27 month (NT 89.80%, National 90.60%) and 60 to <63 (NT 93.4%, National 94.5%) to be fully immunised.

Aboriginal children were less likely to be fully immunised than non-Aboriginal children in all cohorts; 12 to <15 month (Aboriginal 91.9%, non-Aboriginal 94%), 24 to <27 month (Aboriginal 87.2%, non-Aboriginal 90.9%) and 60 to <63 month (Aboriginal 92.20%, non-Aboriginal, 94%).

Coverage by SA3 in the Table shows variation between high and low coverage areas. East Arnhem had the lowest coverage for Aboriginal children in the 60<63 moth cohort. The highest coverage area for Aboriginal children was in Alice Springs for the 12-<15 month cohort as well as the Daly-Tiwi-West Arnhem region. The lowest coverage area for non-Aboriginal children was in Alice Springs for the 60<63 month cohort. The area that had the highest coverage for non-Aboriginal children was Katherine in the 12<15 month cohort and Litchfield, Katherine and East Arnhem in the 60<63 month cohort.

Centre for Disease Control (CDC) are currently reviewing the reasons for the lower coverage in both Aboriginal and non-Aboriginal children. CDC is working with the Australian Immunisation Register to review data quality and processing of vaccine recording, and reviewing other strategies to improve childhood immunisation coverage. Further information about the Australian Childhood Immunisation Register coverage may be found at: http://ncirs.edu.au/immunisation/coverage/index.php

Table. Variation between high and low coverage

	Aboriginal		Non-Aboriginal	
Age Group	**Lowest SA3**	**Highest SA3**	**Lowest SA3**	**Highest SA3**
12<15 months	85.29% Darwin Suburbs	100% Alice Springs	92.31% Darwin Suburbs	100% Katherine
24<27 months	78.95% Katherine	100% Daly-Tiwi-West Arnhem	82.89% Alice Springs	92.59% Katherine and Palmerston
60<63 months	77.78% East Arnhem	97.14% Darwin Suburbs	81.63% Alice Springs	100% Litchfield, Katherine and East Arnhem

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Disease Control staff updates January-March 2018

Top End

The Senior Administrative Officer at CDC, **Roberta Smith** retired in March 2018. Roberta worked at CDC initially as an Administrative Officer at Clinic 34 Darwin and then as a personal assistant to the Director, Vicki Krause. Roberta will be greatly missed.

Gladys Ngugi has joined the Rheumatic Heart Disease team as a Public Health Nurse. Gladys has a background in emergency nursing and has worked in Central Australia, Western Australia and in the United States in this field. More recently, Gladys worked in the general paediatric ward at Royal Darwin Hospital.

Judy Creighton, Manager Katherine CDC and Public Health Nurse, retired in February 2018. Judy is now living in Queensland with plans to buy a boat and spend time sailing.

Welcome to the new Medical Officers who commenced at CDC Darwin in January 2018. **Jennifer Becker, Hitti Bakshi, Haiyun Li** and **Olivia Rygororicz** are working at CDC on a 6 month rotation as General Practice Registrars. **Swe Tun and Sankalpa Gurung** completed their 6 month rotation in early January 2018. **Tasnim Hasan** an Infectious Diseases Registrar has replaced **Greta Lindenmayer,** Medical Registrar, on a 6 month placement at CDC.

Katelin Gallagher has started as an Administration Officer at Medical Entomology. Katelin has previously worked in the Department of Infrastructure.

Rose John started as the Manager Clinic 34 Darwin in February 2018. Rose previously worked in South Australia. **Kelly Carleton** commenced in March 2018 as the Clinical Nurse Specialist (CNS) Clinic 34 Darwin. Kelly previously worked at Menzies. **Liam Nancarrow** commenced at the end of January as a CNS in the Remote Sexual Health Team Top End on a short term contract. He previously worked in Primary Health Care. **Autumn Goodall** resigned after many years with CDC from her role as CNS Clinic 34 Darwin. Farewell to **Matthew O'Dwyer**, SHBBV Surveillance Officer, who has moved to Brisbane. **Shellee Williams** is acting in this role. Shellee completed her Masters of Applied Epidemiology at CDC in 2005 and has recently been working at Menzies.

Public Health Nurse and A/Manager Gove CDC **Kathy Shield** has commenced long service leave after over 30 years of working in the NT Government. **Joanne Smith** resigned as the Administrative Officer at Gove CDC with **Sharon Georgonicas** commencing in the role.

Central Australia

Kira Dick started in the role of Receptionist in a full time capacity in February 2018, replacing **Sheree Greenwood**. Kira has previously completed an Administrative Stream Indigenous Apprenticeship with NT Police and is currently studying criminal law via distance education.

Rebecca Curr returned from leave in February 2018 and is currently working as a CNS Sexual Health in Clinic 34. The CNS Sexual Health position became vacant following the resignation of **Mark Rowe** who relocated to England in January 2018. In January, **Mark Russell**, Clinical Nurse Manager Remote Sexual Health Program transferred to Primary Health Care and is replaced by **Helen Goodwin**. **Sarah Wyatt** transferred permanently to the Paediatric Ward in Alice Springs Hospital. **Helen Rudolph** is filling in for Helen Goodwin as the CNS Sexual Health.

In January 2018, Aboriginal Health Practitioner **Daniel Williams** commenced a temporary transfer to the Central Australian Health Service in Tennant Creek for 1 year .

Karen Hawkins joined CDC in January on a 3 month contract as a CNS Immunisation to help with the roll out of the meningococcal ACWY vaccination program. **Rahni Armstrong** CNS Immunisation returned to her nursing role in the Alice Springs Hospital in March. **Jacqueline Arnold** who was acting as CNS Immunisation while Rebecca Curr was on leave, has left CDC and is working at the Purple House in Alice Springs.

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