



CENTRE FOR DISEASE CONTROL
NORTHERN TERRITORY

THE NORTHERN TERRITORY DISEASE CONTROL BULLETIN



Vol. 18, No. 2, June 2011

ISSN 1440-883X

Norovirus outbreak in a school group travelling through Central Australia

Teem Wing Yip¹, Claire Hewitt¹ and Peter Markey²

¹CDC, Alice Springs, ²CDC, Darwin

Abstract

An outbreak of gastroenteritis occurred in May 2010 affecting 27 people in a group of 96 teenage students and 6 teachers who were travelling through Central Australia. Investigations showed that the outbreak was caused by norovirus, with an attack rate of 26.5%. The virus was most likely acquired from another travelling school group from the group's hometown. This article also gives a brief review of norovirus, including its history, its modes of transmission, as well as its societal impact.

Keywords: norovirus; school students; viral gastroenteritis; outbreak

Background

Gastroenteritis, especially diarrhoeal disease, presents a significant burden of disease worldwide. With over 2.5 billion cases of diarrhoea in the world each year, it is a leading cause of child morbidity and mortality, especially in developing countries.¹

In industrialised countries, the burden of disease is also significant. A recent report showed the United States of America (USA) has 9.4 million cases of illnesses caused by food-borne pathogens each year, of which 5.5 million cases (59%) were caused by norovirus.² In a report from Australia in 2005, with a population then of about 21 million, there were 4.6 million cases of gastroenteritis per year, with about 2.3 million due to viral infections.³

Norovirus is the most common cause of epidemic gastroenteritis in all age groups, accounting for over 90% of viral gastroenteritis and approximately 50% of all-cause outbreaks worldwide.⁴

A syndrome called 'winter vomiting disease' was first described in 1929,⁴ and in the 1940s and 1950s, there were multiple failed attempts at identifying the organism. In 1971, after an outbreak of gastroenteritis in Norwalk, Ohio, USA, a stool filtrate from a case was orally administered to volunteers, who then

Contents

Norovirus outbreak in a school group travelling through Central Australia.....	1
The NT Immunisation Register: towards whole-of-life vaccine records.....	7
Announcing 2 new notifiable diseases—invasive group A streptococcal infection and disseminated strongyloidiasis....	9
Strongyloidiasis fact sheet.....	11
Nit? Nit! - head lice control program.....	13
Busting the myths about trachoma.....	14
Melbourne Demons join fight against trachoma.....	15
Red flag tool for recognition of acute rheumatic fever.....	16
Mosquito borne diseases in the NT: a historical overview....	19
Another exotic mosquito interception at Frances Bay port, Darwin, January 2011.....	24
A year of mosquito monitoring at Robertson Barracks and the nearby Millner Swamp, NT.....	27
My mosquito run.....	35
NT notifications of diseases by onset date and districts.....	36
Graphs of selected diseases and STI's.....	37
Comments on notifications.....	38
Immunisation coverage 31 March 2011.....	40
Malaria notifications.....	41
Staff updates.....	41

Editor: Vicki Krause

Email: vicki.krause@nt.gov.au

Assistant Editors: Peter Markey
Chris Nagy
Heather Cook
Peter Whelan
Ros Webby
Steven Skov

Centre for Disease Control
PO Box 40596
Casuarina
Northern Territory 0811

Production Design: Justine Glover

Website: <http://www.nt.gov.au/health/cdc/cdc.shtml>

developed gastroenteritis. Their stool samples were examined by electron microscopy, revealing a new virus.⁵ The virus was named Norwalk virus, the prototype of the genus *Norovirus*.

Norovirus is 1 of 4 genera in the *Calciviridae* family, which include *Sapovirus*, *Lagovirus* and *Vesivirus*. With newer genetic techniques in the 1990s, noroviruses have been found to be genetically and antigenetically diverse, with 29 genetic clusters within 5 genogroups, of which 2 genogroups affect humans.⁴

A prospective cohort study of over 4800 people in the Netherlands followed over 6 months showed that 14-19% of gastroenteritis cases in children aged 17 years and below were associated with norovirus.⁶ Of the 99 cases of norovirus infection, 87% reported diarrhoea with 74% reporting vomiting. In addition, 51% experienced abdominal pain, 49% experienced nausea, and 32% experienced fever. Vomiting, nausea and fever primarily occurred on the first day of illness. Diarrhoea had a median duration of 4 days, with a maximum of 28 days. Norovirus was detected on the first day of illness in 78% of cases, with 10% of the cases having virus detectable from day 8 to day 22, but not detectable on day 1. Shedding of the virus occurred up to 22 days after the onset of illness in 26% of the cases.

Like many pathogens that cause gastroenteritis, norovirus is spread by the faecal-oral route and other modes of transmission. Evidence of airborne transmission of norovirus comes from a school outbreak in the United Kingdom where pupils who were in a classroom where vomiting occurred were significantly more likely to be ill than pupils in a classroom where no vomiting occurred.⁷ Transmission of the virus from contaminated surfaces has also been documented in an outbreak in a long-term care facility in the USA where norovirus with identical RNA sequences to the clinical isolates were found on toilet seats used by cases, a dining room table top, an elevator button, and a bed rail of a case's bed.⁸ A contaminated source of drinking water was identified in an outbreak involving 2 nearby hotels in South Korea where guests and staff were found to have the same norovirus strains as the water source supplying both the hotels.⁹ Norovirus can also be acquired from water

sources in other ways, for example 54% of children playing in a contaminated recreational fountain in the Netherlands developed gastroenteritis and the cases were found to have norovirus in their stools which were identical to the strain of norovirus found in the fountain.¹⁰ In other outbreak investigations¹¹ the mode of transmission has been found to be foodborne (5%-35%) or person-to-person (24%-85%), and in settings including schools, hospitals, residential care facilities, restaurants, private homes, holiday camps and military bases. Norovirus is a very common cause of outbreaks on cruise ships as reported on the *United States Centers for Disease Control and Prevention's* website that is dedicated to cruise ship gastroenteritis outbreaks.¹²

In Australia, between 2000 and 2008 there were between 19 and 772 norovirus outbreaks reported to OzFoodNet each year, with a total of over 86,000 people being affected. This is likely to be an underestimate, due to under-reporting. Person-to-person spread was likely in 75% of outbreaks, while 22% were of an unknown mode of transmission and only 2.7% were suspected or proven to be foodborne. The settings in which the outbreaks occurred were: 69% in aged care facilities, 19% in hospitals, 3% in childcare centres and 3% in other institutions.¹³

Oysters are frequently implicated in foodborne norovirus outbreaks because as they feed they accumulate the virus. In the first 3 months of 2010, there were 65 clusters of outbreaks involving 334 cases in 5 European countries that were attributed to oysters.¹⁴ The Northern Territory was involved in a multi-jurisdictional outbreak in 2003-2004 where norovirus in oyster meat was implicated.¹⁵

Noroviruses have the following characteristics that facilitate their spread during epidemics.⁴

- As few as 100 viral particles can cause infection.
- Viruses can be shed even if a person is asymptomatic, facilitating secondary spread.
- Viruses can survive freezing temperatures up to 60°C and exposure to up to 10 parts per million of chlorine.
- The strains are very diverse, so multiple antigenic types can cause repeat infections.
- Humans do not develop lasting immunity.

The objective of this paper is to report on the management and investigation of an outbreak of gastroenteritis that occurred in a school group of 96 teenage students and 6 teachers (102 in total) from New South Wales who were travelling through Central Australia by coach and camping in tents. Of this group 17 sought help for their symptoms at Yulara Clinic on 3 May 2010. Clinic staff reported the outbreak to the Centre for Disease Control (CDC) in Alice Springs on the same day. At the time, the group attributed their illness to swimming or drinking some 'black water' on the top of Uluru.

Methods

A case was defined as any staff member or student travelling with this school group who had vomiting or diarrhoea from 29 April 2010 to 5 May 2010. People who only had nausea or abdominal pain were not counted as cases.

Symptomatic group members were interviewed by CDC staff within 3 days of their symptoms. All cases were interviewed using a questionnaire based on the menus prepared over the previous 3 days and other possible environmental exposures including contact with the 'black water' on Uluru.

CDC staff had discussions with the teachers about the group's activities, including any

reports of illness prior to arrival in Central Australia and also contacts with people outside the group in the days prior to the onset.

Symptomatic cases were asked to provide stool samples for laboratory analysis.

The group had a rushed itinerary, so the time available for CDC staff to interview them while they were in Alice Springs was very limited and no contact was possible after they left Alice Springs. A cohort study was therefore not achievable.

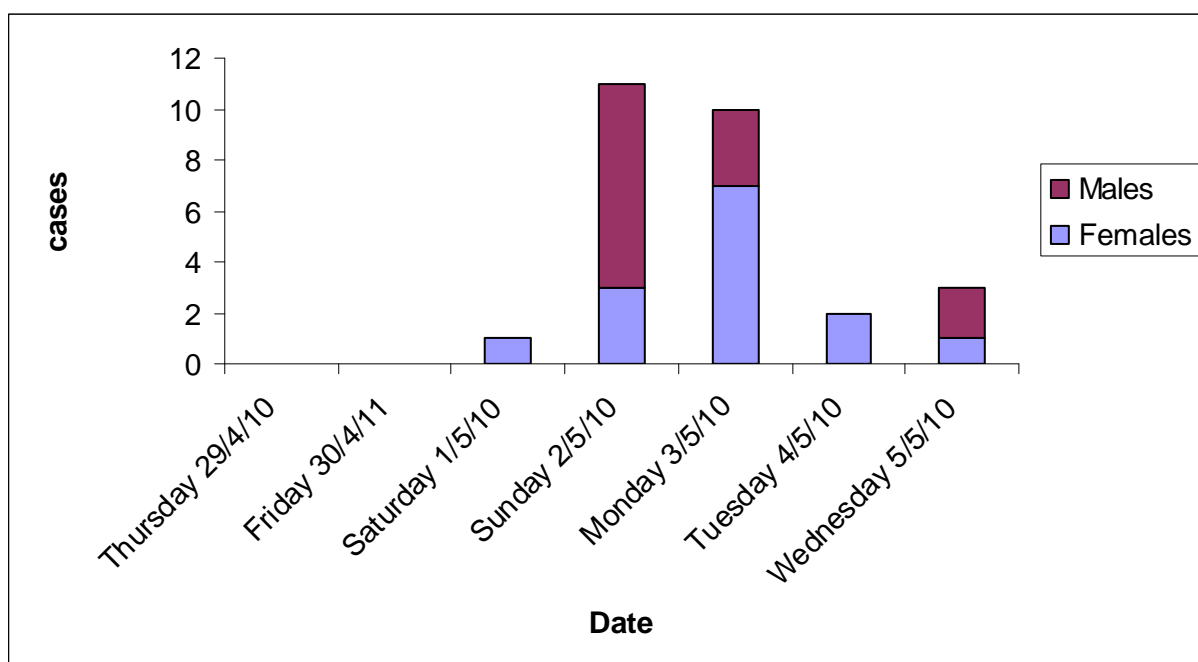
At the same time as the investigation, CDC staff advised the group leaders about the importance of hygiene measures, especially hand washing or the use of alcohol-based hand sanitising gels.

Results

Out of the 102 people in the group, CDC staff interviewed 33 symptomatic people over 2 days, 27 met the case definition, while the remaining 6 had symptoms such as abdominal pain and nausea, but no diarrhoea or vomiting. The attack rate was 26.5%.

Of the 27 cases, 13 reported diarrhoea (48%), while 23 reported vomiting (85%). There were 12 who became unwell on 1 May and 2 May, but their symptoms had resolved by the time they

Figure: Date of onset of vomiting or diarrhoea by sex



were interviewed on the evening of 3 May, indicating a short duration of illness.

The timing of the outbreak is illustrated in the Figure on the previous page.

The shape of the outbreak curve suggests a likely point-source, as most cases had onset on 2 and 3 May with significantly fewer cases in days on either side. Norovirus has an incubation period of 24 to 48 hours⁴ and with the mean onset being midnight Sunday, the most likely exposure for the group was on Saturday afternoon.

Of the 27 cases, 21 were interviewed and the findings are summarised in the Table.

The results do not suggest that exposure to the water on Uluru or eating the lunch foods was likely to be the source of the illness. Furthermore, because a cohort study was not able to be conducted, it is not known how many of the 102 members of the group had contact with the water on Uluru or ate the lunch foods but did not show any symptoms. However, it can be presumed that the majority ate the lunch foods but were not affected.

Discussion with the teachers revealed that the school group had come into contact with another school group from their hometown that was travelling on the same route, but just 1 day ahead, and many members of that group had gastroenteritis. The 2 school groups both had students of similar ages, and both groups camped at Yulara on Saturday 1 May. None of the other group had required medical attention and CDC had not been notified. A telephone call to the principal of the other school revealed that of the 75 people in that group 38 (50.7%) of

them had symptoms of gastroenteritis. The timeframe of the group's symptoms was not available.

There were 7 faecal specimens collected from the cases, 5 of which were positive for norovirus. No other pathogen was found; other pathogens tested for were *Salmonella*, *Shigella*, *Yersinia*, *Campylobacter*, *Aeromonas*, *Plesiomonas*, adenoviruses and rotavirus.

The group departed Alice Springs on 6 May and were no longer contactable. No further information was available regarding the incidence of symptoms after this date.

Discussion

There are several limitations of this outbreak investigation particularly with the constraints on data collection, such that assumptions have been made on incomplete information.

Firstly, a major constraint was the lack of opportunity to conduct interviews of suitable quantity and quality. Due to the group's rushed schedule while staying in Alice Springs, 2 CDC staff had less than 3 hours to interview the teachers for background information and then interview the cases on the evening of 3 May. A similarly tight time frame was available on the next day for further interviews. On 6 May, the school group had to continue their travels before CDC staff could conduct further interviews and they were not contactable after their departure from Alice Springs. These limitations did not permit a cohort study to be done to calculate the relative risks of exposures. If more opportunities were available for further interviews, it would have been ideal to find out which members of this school group had contact

Table: Interview findings

Exposure	Cases exposed	% of cases exposed
Drank / swam / washed face / washed hands with water on Uluru	12/21	57.1%
Chicken sandwich on Saturday 1 May	9/21	42.9%
Ham sandwich on Saturday 1 May	6/21	28.6%
Salmon sandwich in Saturday 1 May	2/21	9.5%
Tuna sandwich on Saturday 1 May	3/21	14.3%
Corned beef sandwich on Saturday 1 May	10/21	47.6%

with members of the other school group that allegedly had a gastroenteritis outbreak. That data would have provided a stronger epidemiological link between the disease in the 2 groups.

Secondly, the second school group did not seek medical attention, so it was not possible to confirm norovirus in that group. Informal enquiries via OzFoodNet regarding recent norovirus outbreaks did not reveal any reports of norovirus outbreaks in the groups' home town.

Thirdly, there was no capacity to test the food, the water nor the environment, so the source of the norovirus cannot be proven.

Even without the pathology tests to prove that norovirus was the causative pathogen, the clinical and epidemiological characteristics of this outbreak fit the Kaplan criteria¹⁶ to indicate that norovirus was the likely cause. These characteristics include:

1. Stools negative for bacterial and (if performed) parasitic pathogens.
2. Percentage of cases with vomiting $\geq 50\%$.
3. Mean (or median) duration of illness 12-60 hours.
4. If available, mean (or median) incubation period of 24-48 hours.

With limited information available, it is reasonable to assume that the most likely event where transmission occurred was on the afternoon of Saturday 1 May when the 2 groups socialised. The exact method of spread cannot be ascertained with the existing information, but is likely to be either person-to-person or through food contamination.

Hygiene measures are of utmost importance in the control of such outbreaks of gastroenteritis, including hand washing and cleaning the environment.¹⁷ The small number of new cases on 4 and 5 May compared to earlier days is likely due to the additional hand washing and hand sanitising measures that were implemented in the school group after the first cases occurred. If hygiene measures had not been reinforced at the beginning of this outbreak, then more cases could have occurred by secondary spread on subsequent days.

A travelling school group where students are living in very close proximity to each other provides an easy means of transmitting gastroenteritis, particularly that of viral aetiology. This outbreak was not unlike other outbreaks in holidaying school groups. In an outbreak investigation report from South Korea, 97 of 309 students (31%) and 97 of 207 students (47%) who stayed at adjacent hotels became ill with norovirus from a contaminated water source.⁹ Another outbreak involved a school group on a skiing holiday in Austria where 1 vomiting student with norovirus led to 9 others in his group of 44 students to become ill, followed by another 159 out of 240 students from 3 other schools who became ill in subsequent days while staying at the same youth hostel.¹⁸ It is important that groups such as this recognise the need to observe scrupulous hygiene. They should adhere to guidelines that have been developed in Australia to prevent outbreaks; these guidelines also encourage teachers and other camp supervisors to assist public health personnel in investigating outbreaks should they occur.¹⁹

Outbreaks often attract media attention because the impression of 'contagion' in the community invokes fear for public safety and this case was no exception: both CDC staff and the school teachers were approached by media and statements were released. Over a week after the outbreak, a newspaper published an article about the event, which wrongly assumed the outbreak was caused by contact with the black water on the top of Uluru.²⁰

Along with high-profile media coverage, norovirus outbreaks can have serious non-medical consequences. In the case of 'The Fat Duck', a Michelin-starred restaurant in the United Kingdom was closed for some months due to a norovirus outbreak with a financial loss of £300,000.²¹ Litigation is sometimes a consequence of such outbreaks, regardless of the number of people affected. For example, 17 passengers affected by norovirus while on a cruise mounted high-profile legal action against Britain's largest tour operator.²² The relatively small outbreak reported here resolved without any continuing adverse consequences (as far as CDC is aware).

Conclusion

Norovirus is a very common cause of outbreaks of gastroenteritis, especially in settings where people have close contact with each other, such as in this incident in a travelling school group. Investigations in this outbreak were limited by time and resources, and as a result, a cohort study and testing of food, water and the environment was not possible. Scrupulous attention to hygiene is the key to preventing and controlling such outbreaks.

References

1. UNICEF/WHO. Diarrhoea: why children are still dying and what can be done. UNICEF/WHO: New York and Geneva; 2009.
2. E Scallan et al. Foodborne illness acquired in the United States—major pathogens. *Emerging Infectious Diseases*. 2011;17(1).
3. G Hall et al. Estimating foodborne gastroenteritis, Australia. *Emerging Infectious Diseases*. 2005;11(8).
4. MM Patel et al. Noroviruses: a comprehensive review. *Journal of Clinical Virology*. 2009;44:1-8.
5. AZ Kapikian et al. Visualisation by immune electron microscopy of a 27-nm particle associated with acute infectious nonbacterial gastroenteritis. *Journal of Virology*. 1972; 10(5): 1075-1081.
6. B Rockx et al. Natural history of human Calicivirus infection: a prospective cohort study. *Clinical Infectious Diseases*. 2002;35(3):246-253.
7. PJ Marks et al. A school outbreak of Norwalk-like virus: evidence for airborne transmission. *Epidemiology and Infection*. 2003;131:727-736.
8. HM Wu et al. A norovirus outbreak at a long-term care facility: the role of environmental surface contamination. *Infection Control and Hospital Epidemiology*. 2005;26(10).
9. SH Kim et al. Outbreaks of gastroenteritis that occurred during school excursions in Korea were associated with several waterborne strains of Norovirus. *Journal of Clinical Microbiology*. 2005;43(9):4836-9.
10. CJBA Hoebe et al. Norovirus outbreak among primary schoolchildren who had played in a recreational water fountain. *Journal of Infectious Diseases*. 2004;189(4):699-705.
11. M Hamano et al. Epidemiology of acute gastroenteritis outbreaks caused by Noroviruses in Okayama, Japan. *Journal of Medical Virology*. 2005;77:282-289.
12. Centers for Disease Control and Prevention. Outbreak updates for international cruise ships. 2011 [accessed on 23/2/11]. Available on <http://www.cdc.gov/nceh/vsp/surv/GIlist.htm>
13. Australian Government Department of Health and Ageing. Guidelines for the public health management of gastroenteritis outbreaks due to norovirus or suspected viral agents in Australia. Canberra: Communicable Diseases Network Australia; 2010.
14. T Westrell et al. Norovirus outbreaks linked to oyster consumption in the United Kingdom, Norway, France, Sweden and Denmark, 2010. *Eurosurveillance*. 2010;15(12).
15. RJ Webby et al. Internationally distributed frozen oyster meat causing multiple outbreaks of norovirus infection in Australia. *Clinical Infectious Diseases*. 2007;44:1026-1031.
16. JE Kaplan et al. The frequency of a Norwalk-like pattern of illness in outbreaks of acute gastroenteritis. *American Journal of Public Health* 1982;72: 1329–1332.
17. MB Lee, JD Greig. A review of gastrointestinal outbreaks in schools: effective infection control interventions. *Journal of School Health*. 2010;80(12).
18. HW Kuo et al. A non-foodborne norovirus outbreak among school children during a skiing holiday, Austria 2007. *The Middle European Journal of Medicine*. 2009;121:120-124.
19. Central Population Health services. Gastroenteritis outbreaks in camp facilities. Queensland: Queensland Health; 2008.
20. No author stated. Students sick at Uluru. NT News, 14 May 2010.
21. H Wallop. Fat Duck roasted over norovirus-infected staff. The Telegraph, 20 March 2009
22. C Starmer-Smith. Thomson could face legal action over norovirus outbreak. The Telegraph, 23 July 2009.

The NT Disease Control Bulletin Index can be found at:

<http://www.health.nt.gov.au/Centre for Disease Control/Publications/NT Disease Control Bulletin/index.aspx>

The NT Immunisation Register: towards whole-of-life vaccination records

Charles Roberts and Chris Nagy, CDC, Darwin

Abstract

Childhood immunisation encounters have been recorded on a central database in the Northern Territory (NT) since the early 1990s. Since that time the NT has expanded its capacity to record immunisation encounters to include those vaccines delivered to adults and adolescents as part of national and school based programs. Current plans to amalgamate all immunisation encounters recorded in the NT onto a single electronic database will pave the way for the first 'whole-of-life' immunisation register in Australia.

Background

The Northern Territory Immunisation Register (NTIR or The Register) is funded by the Northern Territory (NT) Department of Health and the Australian Childhood Immunisation Register (ACIR). It came into existence in the early 1990s with the aim to record all childhood vaccinations delivered to children aged up to 7 years in the NT. These vaccinations were recorded on what was then known as the Childhood Immunisation Database (CID).^{1,2} In early 2001, vaccinations recorded on the CID were electronically transferred to Community Care Information Systems (CCIS).

In the late 1990s, the NT also began recording vaccinations given to adults such as Pneumovax23® and Adsorbed diphtheria-tetanus (ADT®) on what was known as the Adult Immunisation Database (AID) which was a stand-alone database not connected to CCIS. Vaccination catch-up programs in 1998 for hepatitis B and measles-mumps-rubella (MMR) were also recorded on stand-alone databases as was the 2000-2004 catch-up program for meningococcal C. Due to resource incapacity influenza vaccine, a yearly vaccination, has not been recorded consistently on any centralised immunisation database in the NT until 2011. Influenza had previously been recorded in an adhoc manner depending on receipt of vaccine data from providers.

In April 2007, to coincide with the commencement of the national human papillomavirus (HPV) vaccination program, all HPV vaccines administered in the NT were

recorded onto the NTIR before also being entered on the national HPV Vaccination Register. Since September 2007 all vaccinations given to children, adolescents and adults in the NT have been recorded directly onto the NTIR. No new stand-alone databases have been created.

The data migration process

When the NTIR began recording all vaccinations on CCIS, a process to integrate the AID and the stand alone vaccine-specific databases was initiated. After a 4 year period culminating in February 2011, the AID is now completely integrated into the NTIR. The MMR database is currently being transferred into CCIS with the anticipated time to completion being 12 months. The hepatitis B and meningococcal C stand-alone databases will be the last to be transferred to the NTIR.

The NTIR currently contains over 1.5 million vaccination records delivered to over 180,000 patients for 70 vaccines.

The future

The integration of all existing databases into the NTIR is expected to be complete by the end of 2013. In addition, from 2011 onward a record of all influenza vaccinations is being included in the NTIR. The advantages of a single immunisation register include the capacity to:

- provide patients with a single immunisation record detailing all the vaccinations they have received throughout their life
- prevent over and under immunisation by the provision of current immunisation status
- reduce wastage of vaccines through duplication of service
- provide doctors and other health care providers with information so as to ensure their patients have completed appropriate vaccination schedules and are protected from disease
- provide data to highlight areas of low coverage and measure herd immunity
- enable evaluation of vaccine program effectiveness and
- better monitor vaccine failures.

There have been numerous calls for a national whole-of-life immunisation register,^{3,4} as well as a scoping study commissioned and completed from the 2006-7 Commonwealth budget⁵ on such a register. At this stage, there is still no national whole-of-life immunisation register despite the recognition of the numerous advantages to individuals, immunisation providers and public policy decision makers such a register would provide.

Should a national whole-of-life immunisation register be created, the NT will be well positioned to contribute its extensive knowledge and experience, as well as data to the national register.

References

1. Thorman, S, Merianos, A, Review of the NT immunisation database, *NT Dis Control Bull* 1996,3(1):13.
2. Merianos, A, Childhood immunisation uptake in the NT: Part 1 - The Top End, *NT Dis Control Bull* 1997,4(1):1.
3. Lee, S All of Life Vaccine Register Needed, 6 minutes (of interesting stuff for doctors): 6 November 2007 [cited 2011]; Available from <http://www.6minutes.com.au/news/all-of-life-vaccine-register-needed>
4. Hambleton, S *Speech to the PHAA National Immunisation Conference*, AMA doctors4health: 19 August 2010 [cited 2011]; Available from <http://ama.com.au/node/5990>
5. Childhood Immunisation Register – Redevelopment scoping study, Department of Health and Ageing Australian: 9 May 2006 [cited 2011]; Available from Department of Health and Ageing Australian <http://www.health.gov.au/internet/budget/publishing.nsf/content/budget2006-hfact62.htm>

Announcing 2 new notifiable diseases—**invasive group A streptococcal infection and disseminated strongyloidiasis**

There were 2 new notifiable diseases scheduled in the Northern Territory (NT) Government Gazette of May 11 2011; *invasive group A streptococcal infection and disseminated strongyloidiasis*.¹ These are in addition to *invasive vibrio disease and ciguatera fish poisoning* which were added last year. Both of the newly scheduled diseases are notifiable by laboratories only and both are non-urgent. The Figure presents the current listing of all notifiable conditions in the NT.

Invasive group A streptococcal infection

Group A streptococcus is a bacterium which causes a range of diseases but most commonly pharyngitis (or tonsillitis) and impetigo (skin sores, school sores, infected scabies). These diseases are significant in the Indigenous population because the infections can lead to complications such as acute rheumatic fever and acute glomerulo-nephritis, both of which are already notifiable diseases in the NT. More rarely, the Group A streptococcus can invade beyond the throat or skin and cause life-threatening blood infection including toxic shock syndrome and necrotizing fasciitis, the so-called “flesh-eating disease”.^{2,3} Importantly, invasive disease can rarely occur in clusters, so contact tracing may contribute to controlling spread.^{4,5} Knowing about invasive infections will also contribute to understanding the epidemiology of this bacteria and associated infections. Centre for Disease Control is currently developing a public health response.

We are asking laboratories to send us the results of detection of group A streptococcus by culture or nucleic acid testing from an otherwise sterile site.

Disseminated strongyloidiasis

This is a rare but serious complication of strongyloidiasis, infection with the soil-

transmitted worm *Strongyloides stercoralis*. The infection is primarily in the bowel and can last for many years with or without symptoms, but if the person’s immune system is weakened through disease or medication, the *Strongyloides* worms and larvae can spread to other parts of the body causing serious disease.⁶ The true burden of disease caused by *Strongyloides* in the NT is unknown but infection is presumed to be common in some NT remote communities.⁷

We are asking laboratories to send us the results of positive microscopy of *Strongyloides* larva seen in non-enteric (ie those outside the gut) specimens.

The NT Notifiable Diseases Committee makes recommendations to the Minister concerning notifiable conditions and meets annually.

References

1. NT Government Printing Office. *Government Gazette* 2011;G19 May11:9
2. American Academy of Pediatrics. Committee on Infectious Diseases. Severe invasive group A streptococcal infections: a subject review. *Pediatrics* 1998;101(1 Pt 1):136-40.
3. Carapetis JR et al. The global burden of group A streptococcal diseases. *Lancet Infect Dis* 2005;5 (11):685-94.
4. Robinson KA et al. Risk for severe group A streptococcal disease among patients' household contacts. *Emerg Infect Dis* 2003;9(4):443-7.
5. Smith A et al. Invasive group A streptococcal disease: should close contacts routinely receive antibiotic prophylaxis? *Lancet Infect Dis* 2005;5 (8):494-500.
6. Davis SJ, Currie BJ, Fisher DA et al. Prevention of opportunistic infections in immunosuppressed patients in the tropical Top End of the Northern Territory. *Communicable Disease Intelligence* 2003;27(4):326-332.
7. Johnston FH, Morris PS, Speare R, McCarthy J et al. Strongyloidiasis: A review of the evidence for Australian practitioners *Aust. J. Rural Health* 2005;13:247-254.

Figure: Notifiable conditions to be reported in the NT; May 2011

Northern Territory Government		Notifiable conditions to be reported in the NT			healthy Territory A Territory Government Initiative		
AIDS	D	Donovanosis (granuloma inguinale)	D L	Japanese encephalitis	D L ☎	Ross River virus infection	L
Acute post-streptococcal glomerulonephritis	D ☎	Food or water borne disease in 2 or more related cases	D ☎	Kunjin virus infection	D L ☎	Rotavirus infection	L
Adverse vaccine reaction	D	Gastroenteritis involving 1 or more related cases in an institution or food handler	D ☎	Legionellosis	L ☎	Rubella	D L
Amoebiasis	L	Gonococcal infection	L ☎	Leprosy	D L	Salmonellosis (including paratyphoid)	L
Anthrax	D L ☎	Gonococcal conjunctivitis	D L ☎	Leptospirosis	L	Severe acute respiratory syndrome (SARS)	D L ☎
Arbovirus infection - not otherwise specified	L	Gonococcal neonatal ophthalmia	L ☎	Listeriosis	L	Shiga-like toxin (verocytotoxin) producing E coli infection	L ☎
Australian bat lyssavirus	D L ☎	Group A streptococcal infection (invasive)	L	Lymphogranuloma venereum	D L	Shigellosis	L
Avian influenza	D L ☎	Haemolytic uraemic syndrome	D ☎	Lyssavirus - not otherwise specified	D L ☎	Smallpox	D L ☎
Barmah Forest virus infection	L	<i>Haemophilus influenzae</i> - type b (invasive)	D L ☎	Malaria	D L ☎	Strongyloidiasis (disseminated)	L
Botulism	D L ☎	- non-type b (invasive)	L	Measles	D L ☎	Syphilis	D L
Brucellosis	L	Hepatitis A	D L	Melioidosis	L	Tetanus	D L
Campylobacteriosis	L	Hepatitis B	D L	Meningococcal infection	D L ☎	Trichomoniasis	L
Chancroid	D L ☎	Hepatitis C	D L	Mumps	D L	Tuberculosis	D L ☎
Chickenpox	D L	Hepatitis D	L	Murray Valley encephalitis	D L ☎	Tularaemia	D L ☎
Chlamydial conjunctivitis	L	Hepatitis E	L ☎	Non-tuberculous mycobacterial disease	D L	Typhoid	D L ☎
Chlamydial genital infection	L	Hepatitis not otherwise specified	D	Ornithosis	L	Typhus (all forms)	D L
Cholera	D L ☎	HIV	L	Pertussis	D L ☎	Varicella infection unspecified	D L
Ciguatera fish poisoning	D ☎	HTLV1*	L	Plague	D L ☎	Vibrio disease (invasive)	D L ☎
Congenital rubella syndrome	D	Hydatid infection	L	Pneumococcal disease (invasive)	L	Vibrio food poisoning	L ☎
Congenital syphilis	D	Influenza	L	Poliomyelitis	D L ☎	Viral haemorrhagic fevers	D L ☎
Creutzfeldt-Jakob disease	D			Q Fever	L	Yellow fever	D L ☎
Cryptosporidiosis	L			Rabies	D L ☎	Yersiniosis	L
Dengue virus infection	D L ☎			Rheumatic fever	D	Zoster	D L
Diphtheria	D L ☎						

D	Notifiable by doctors	☎	Urgent if PPNG	HTLV1* - Adult T cell leukaemia/lymphoma and Tropical spastic paraparesis notifiable by doctors	CDC Darwin	(08) 8922 8044
L	Notifiable by laboratories	☎	Please notify CDC urgently by phone. Doctors please notify on clinical suspicion (while awaiting laboratory confirmation)		CDC Alice Springs	(08) 8951 7540
☎	Urgent if suspected to have been acquired in the NT				CDC Tennant Creek	(08) 8962 4259
					CDC Katherine	(08) 8973 8049
					CDC Nhulunbuy	(08) 8987 0357

May 2011 Centre for Disease Control www.healthynt.nt.gov.au

Northern Territory CDC Conference
Darwin
6-8 September 2011
Darwin Convention Centre

For information
Call Justine Glover 8922 7776
Email Justine.glover@nt.gov.au



Centre for Disease Control

Date January 2011

Strongyloidiasis

What is Strongyloidiasis?

Strongyloidiasis (pronounced strong-a-loyd-eye-a-sis) is an infection caused by a type of worm (roundworm) called *Strongyloides stercoralis* that establishes itself in the gut.

How is it spread?

The infective form of the worm, the larvae, lives in soil which has been contaminated by faeces of an infected person. If a person comes in contact with this soil, the larvae may burrow through the person's skin to the lungs and then the gut where they become adult worms and produce eggs that hatch and develop into the infective larvae. The larvae can pass out in the faeces but sometimes burrow into the skin near the anus and continue to re-infect the individual (auto-infection).

Transmission from person-to-person can occur but this is uncommon.

Strongyloidiasis spreads only when there is human faeces in the environment so it is usually confined to places where sanitation is poor. However, because of the possibility of continued auto-infection, strongyloidiasis can last for many years after leaving the contaminated environment.

What are the symptoms?

Many people infected with *Strongyloides stercoralis* do not have any symptoms. Some people get a migrating itchy rash when the larvae are burrowing under the skin and some have chest symptoms such as wheeze and cough when the larvae reach the lungs.

When gut symptoms are present the common features are abdominal pain, diarrhoea, and bloating. Some people may experience, nausea, vomiting, weight loss, weakness or constipation. Pseudo intestinal obstruction has been described in Aboriginal children (also known as swollen belly syndrome). In chronic infections skin and chest symptoms can persist.

The time from infection until a person might develop symptoms is variable. Importantly the disease can become more severe if the person's immune system is weakened by other illnesses or medication (eg chemotherapy or steroid therapy). People infected but without symptoms may become unwell many years after they acquired the disease if their immune systems are weakened.

Very rarely, when the immune system is weakened enough to allow large numbers of larvae to migrate throughout the body, a severe form of the disease can occur. This is called 'disseminated strongyloidiasis' and is life-threatening. This rare complication is almost exclusively seen in immunocompromised people, most commonly in those on high dose steroids for more than 2 weeks. In addition disseminated strongyloidiasis has been associated with HTLV-I infection which is present in Central Australian Aboriginal people.

What is the infectious period?

As long as there are female worms in the gut excreting eggs, an infected person can pass the infection on to others via the soil cycle.

Some infected people may require medication but many people clear the worms without anti-worm treatment. Because of the possibility of auto-infection, *Strongyloides* worms can persist in people for many decades and therefore be a source of transmission to others. Once treated people are no longer infectious to others.

It is possible to become re-infected if exposed to contaminated soil again, as the body does not become immune to the *Strongyloides* worm.

Who is at risk?

In Australia, strongyloidiasis is most commonly seen in those living in or travelling to Aboriginal communities, World War II veterans, immigrants from SE Asia, Africa and South American tropical and subtropical regions.

CENTRE FOR DISEASE CONTROL

People in these groups who are about to start medications that affect the immune system, such as steroids or chemotherapy, should talk to their doctor and be tested for strongyloidiasis before starting treatment.

What is the treatment?

Strongyloidiasis is treated with specific anti-worm medication, depending on the age of the person with the infection.

Anyone with diarrhoea should drink extra fluids to avoid dehydration. Children with diarrhoea, who vomit or refuse fluids should see a doctor. Anyone with prolonged or severe diarrhoea, or who is concerned, should see a doctor.

Medicines to prevent vomiting or diarrhoea should not be given, especially to children, except when prescribed by a doctor.

How can strongyloidiasis be prevented?

Good hygiene and sanitation is the best way to prevent strongyloidiasis making the provision of functioning sewerage systems and avoiding faecal contamination of the soil the most important preventative measures.

In settings where strongyloidiasis is prevalent it is important to avoid skin contact with contaminated soil by:

- Wearing footwear in areas known or likely to have contaminated soil

- Wearing gloves when handling soil known or likely to have been contaminated and
- Thorough and frequent hand washing.

In these settings it is always important to check for *Strongyloides* infection in at risk people before starting immunosuppressive medication (steroids, chemotherapy).

Other preventative measures include:

- Washing hands thoroughly after going to the toilet, after changing soiled linen and after every nappy change.
- Ensuring there are effective and well maintained septic systems in place to dispose of faeces in a safe manner.

There is no vaccine available for the prevention of *Strongyloides* infection.

For more information contact your nearest Centre for Disease Control (CDC)

Darwin 89228044

Katherine 89739049

Nhulunbuy 89870357

Tennant Creek 89624259

Alice Springs 89517540

Disease Control fact sheets are available from your nearest CDC or from our website at www.nt.gov.au/health/cdc/cdc.shtml

Nits? Not! - Head lice control program

Keith Edwards, CDC, Darwin

Abstract

Head lice infestation continues to be a problem for school age children in the Northern Territory. A review of the condition, treatments and newer forms of management including changes to the Nits? Not! Action Pack Protocol are presented.

Changes to the Nits? Not! Program Action Pack

The climate of the Top-End of the Northern Territory (NT) is especially conducive to the spread and nurturing of head lice. This is because they thrive on warmth and humidity. Many children in most primary schools in the Top End have head lice infestation most years.

This infestation is hyper-endemic in the Top End and the direct costs are considerable as a complete treatment for 1 child is around \$15 which for many parents becomes a financial hardship when several re-treatments are required per term. Compounding this is the fact that head lice have developed resistance to some degree to first-line topical insecticides. Another issue is that many of the alternative treatments are ineffective or dangerous.

The mainstay of effective treatment has become fine-tooth combing with conditioner. This is laborious and time consuming and therefore often not done by parents. However, it does allow the accurate diagnosis of the condition by the finding of live lice and also, more importantly, the physical removal of live lice which are resistant to insecticide treatment. On its own though, fine tooth combing with conditioner has only been shown to cure 1/3 of cases.¹

Head-to-head contact by children in schools is the main way that the lice are spread. What looks like treatment failure is often really due to re-infestation. Treatment of 1 child is less effective than the treatment of the whole class or the whole school at the same time when trying to control head lice.

The Nits? Not! Program has achieved some success in standardising the approach to head lice infestation for school children in the NT but treatment failure, real or apparent, has resulted in more alternative treatments being promoted. The recent availability of dimeticone 4% as an

effective² topical head lice treatment has made it worthwhile to update the Nits? Not! Program to include this treatment as a first-line option.

This also brings with it the need to re-introduce the Program to the Education Department. A coordinated and concurrent approach to treatment in all schools will increase the likelihood of a real reduction in prevalence. Dimeticone 4% currently costs 50% more than the current insecticide formulations and works by effectively suffocating the live lice. It does not kill lice eggs effectively however and these will hatch after 7-10 days so a re-treatment at the right time is critical to success. In a randomised-controlled assessor-blind trial dimeticone 4% has been shown to be more effective than malathion in the cure of head lice infestation.³

The changes to the Nits? Not! Program Action Pack are as below:

- Insecticide shampoos are no longer recommended as they have been shown to be less effective due to dilution with water. Also, continual use as a prophylactic may promote resistance and also increases the risk of toxicity.
- Treatment failure that is not due to inadequate/incorrect treatment or is not re-infection should be managed by changing to a different insecticide preparation and not using the same preparation again.
- Dimeticone 4% is recommended as a first-or second-line treatment.

The updated Nits? Not! Action Pack Protocol will be available on the internet late August 2011 at www.health.nt.gov.au/Centre_for_Disease_Control/Publications/CDC_Protocols

References

1. Roberts RJ, Cassey D, Morgan DA, Petrovic M, Comparison of wet combing with Malathion for treatment of headlice in the UK: a pragmatic randomised trial. *Lancet* 2000;356(9229)540-4.
2. Burgess IF, Brown CM, Lee PN (2005) Treatment of head louse infestation with 4% dimeticone lotion: randomised controlled equivalence trial, *BMJ* 2005, 330(7505)1423.
3. Burgess IF, Lee PN, Matlock G: Randomised, controlled, assessor blind trial comparing 4% dimeticone lotion with 0.5% malathion liquid for head louse infestation. *PLoS ONE* 2007, 2 (11):e1127.

Busting the myths about trachoma

Myth #1

Trachoma is not a problem.

If more than 5% of children aged 1-9 yrs have active trachoma in a community, then TRACHOMA IS A VERY REAL PUBLIC HEALTH PROBLEM.

Myth # 2

We need more information on trachoma before we act.

Data collection can be improved but the current data indicate that we have an unacceptably high prevalence of trachoma and trachoma needs to be eliminated in Australia.

Myth # 3

Trachoma control doesn't work.

Evidence from overseas shows that the SAFE strategy works and that countries that implement it eliminate trachoma.

Myth # 4

We can't control trachoma "cause indigenous people move around too much..."

Sure it's difficult; but not impossible. Most transmission occurs within the family. Trachoma control is everyone's business – families, schools, clinics and communities.

Myth # 5

Trachoma doesn't blind Indigenous Australians...

Trachoma trichiasis is the third most common reason for people to go blind in indigenous communities.

Myth #6

It's normal for kids to have dirty faces.

Kids do get dirty but secretions from eyes and nose (apart from tears!) are not normal. A dirty face is a health risk.

Myth # 7

Staff movement makes trachoma elimination difficult.....

Staff turnover means that momentum and information can be lost.... that is why education and sharing the 'Trachoma Story' is so important. We can eliminate trachoma.

Myth # 8

We need to fix housing before we can fix trachoma...

Overcrowding is an important risk factor for trachoma. Removing the barriers that prevent face washing and good hygiene are the key.

Myth # 9

Trachoma and the STI, chlamydia, are the same.

The bacterial strain of *Chlamydia trachomatis* which causes trachoma is different from the genital, STI strain.

Myth # 10

Old people usually have sore eyes and poor vision.

It is not normal for older people to have sore eyes and poor vision. Never give soothing eye drops without checking for trichiasis or other causes for these findings.

Fact

- Trachoma is entirely preventable.
- Trachoma is the most common cause of infectious blindness worldwide.
- Australia is the only developed country where trachoma still exists.
- We will eliminate trachoma from the Northern Territory in the next 10 years.

Let's correct the myths and eliminate trachoma

Adapted with permission from Correcting 10 myths about eliminating trachoma. Indigenous Eye Health Unit, the University of Melbourne. 2010.

For advice and assistance on trachoma control measures contact your local Centre for Disease Control and trachoma control officers (see page 23 for details).

TRACHOMA IS
EVERYONE'S BUSINESS



Melbourne Demons join fight against trachoma

The Melbourne Demons have joined the fight against trachoma led by the University of Melbourne's Harold Mitchell Chair of Indigenous Eye Health, Professor Hugh Taylor. After accompanying Professor Taylor up to Yuendumu in Central Australia, Melbourne Demons President Jim Stynes gave the ok for Indigenous players Liam Jurrah and Aaron Davey to work with Professor Taylor as he endeavours to eliminate trachoma, from Indigenous communities.

The idea to involve the football stars came to Professor Taylor while he was working with Indigenous communities. Many of the health clinics he visited had health related posters on the walls, and Professor Taylor explains that, 'The best ones had footballers featured on them, so it seemed like a really great idea to involve them in the promotion of our work'.

Professor Taylor, a lifelong Demons fan, made a strong connection with Jim Stynes during their trip to Yuendumu and immediately thought that involving players from his beloved club would be a perfect fit.

'I knew that Melbourne have some fantastic Indigenous footballers, including Liam Jurrah, a Walpiri man, from Yuendumu, a community where I've done a lot of work', Professor Taylor says

Having players such a Jurrah, as well as Aaron

Meet Milpa

Milpa, which means 'eye' in Walpri is the name of the Trachoma mascot.

Milpa was seen at the Melbourne Demons versus Port Power AFL match at Marrara recently with Yamba, the honeyant from Central Australia, promoting the trachoma program message of 'clean face, strong eyes'.

The Melbourne Demons AFL football team recently joined Milpa in the fight against trachoma in the Northern Territory.

Milpa promotes fight against trachoma at AFL match ⇒

Davey and Austin Wonaemirri involved is a perfect catalyst for growing awareness about eye health in Indigenous communities. 'Not only are they fantastic footballers, but they are great Indigenous people who are fantastic role models', Professor Taylor explains.

Professor Taylor began working alongside Fred Hollows in the seventies, and for 30 years he's been striving to eradicate trachoma, which is a treatable eye disease that disproportionately affects Indigenous Australians.

Jurrah and his fellow players have already started communicating the key messages of good health and having a clean face, which are crucial to preventing trachoma, at footy clinics in communities in Central Australia. The Demons and Professor Taylor are also looking to develop a range of DVD's and e-tools, which will involve tips on footy and healthy living.

'The players are such heroes for the community, and they really look up to them, in fact Liam Jurrah is 6ft2in so most people look up to him anyway!', says Professor Taylor.

Whether they are looking up to Liam Jurrah and his counterparts in person or on the new posters that will go into health clinics soon, the message of good eye health will be loud and clear.

Source: http://www.iehu.unimelb.edu.au/media/launch/melbourne_demons_join_fight_against_trachoma



Red Flag tool for recognition of acute rheumatic fever (ARF)

Lisa Paton, CDC, Alice Springs

The Red Flags tool was initially created by the Nurse Educator at the Emergency Department at Alice Springs Hospital to highlight diseases that are specific to Central Australia for doctors that may not have previously worked in the area. Although acute rheumatic fever (ARF) may be seen in patients from other areas of Australia, it is quite common for doctors from interstate to be unaware of this condition. Therefore, the Red Flag tool for ARF has been developed as a quick reference, in accordance with the National Heart Foundation Guidelines (Reference), to assist with the recognition of symptoms, diagnosis and treatment of ARF for doctors and other health care professionals working in acute care settings. This Red Flag tool will also be available on PROMPT later in 2011.

Introduction

Acute rheumatic fever (ARF) is an autoimmune response to group A streptococcal (GAS) infection that has not been treated successfully with antibiotics.

5-14 year olds are predominantly the at-risk group. However, ARF has also been seen in patients into their mid 40s and should not be ruled out.

Recurrences of ARF may occur especially if 4-weekly LA Bicillin prophylaxis is missed. It is important to recognise and notify such recurrences.

Presenting symptoms

Arthritis/Arthralgia

The arthritis can be mono or poly-arthritis and is often migratory. Arthralgia is only significant if poly-arthralgia is present.

Sydenhams Chorea

- Up to a quarter of all presentations display this symptom.
- Described as uncoordinated, jerky movements usually on one side of the body that stop when the patient is asleep and

become worse when the patient attempts to control the movements. Other symptoms include 'milk maids grip' to the hands, and inability to maintain protrusion of the tongue.

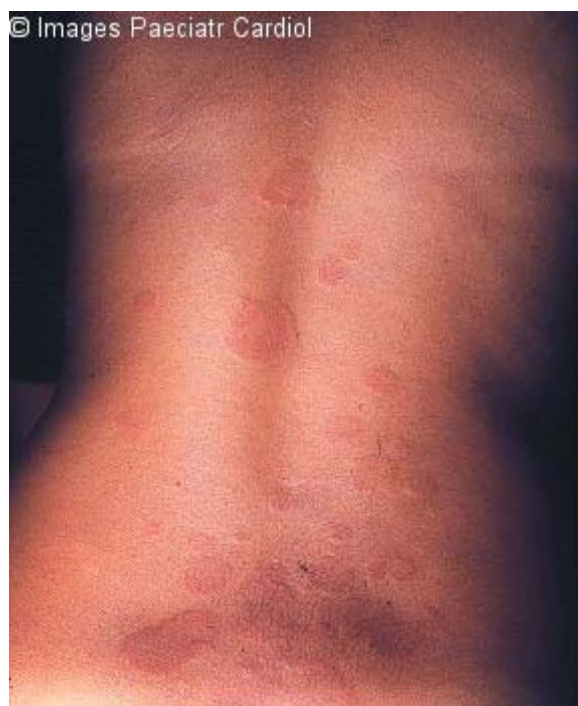
- Usual onset is a few weeks after GAS infection; symptoms can last a few months and in rare cases up to 3 years.
- This symptom on its own is enough to diagnose ARF. It often occurs some months after the other acute symptoms of ARF, which may have been missed i.e. sub clinical.

Please refer to the *National Guidelines* (Reference) for a description of more symptoms.

Erythema marginatum

- Often mistaken for ringworm, this skin condition is rare but can be seen in cases of ARF (Figure 1).
- The rash is predominantly on the trunk and extremities of the body and can appear, disappear, then reappear over several days.
- Can occur with subcutaneous nodules.

Figure 1. Erythema Marginatum



Subcutaneous nodules

- Firm, round nodules under the skin, which move freely and are usually found around the joints or tendons (Figure 2).
- Nodules vary in size from 0.5cm-2cm.
- They can occur in crops up to 1 dozen but usually 3-4 in 1 place.
- Associated with severe carditis.

Figure 2. Subcutaneous nodules



Carditis

- Associated with an apical systolic murmur or valvulitis (mitral regurgitation) and/or a basal diastolic murmur (aortic regurgitation).
- May affect other muscle structures of the heart including endocardium, myocardium and pericardium.

Fever ($\geq 38^{\circ}\text{c}$)

Assessment and notification

ARF is a notifiable disease in the Northern Territory (NT). All suspected cases of ARF should follow the Modified Jones Criteria and be notified to the NT Centre for Disease Control (CDC) for entry onto the Rheumatic Heart Disease (RHD) Register and NT Disease Surveillance System. All cases of suspected RHD should also follow the Modified Jones Criteria.

The Modified Jones Criteria for high endemic areas

- Initial episode of ARF: 2 major or 1 major and 2 minor manifestations PLUS evidence of preceding GAS infection.
- Recurrent attack of ARF: in patient with known past ARF or RHD: 2 major or 1 major and 2 minor or 3 minor manifestations PLUS evidence of preceding GAS infection.

Major manifestations

- Carditis (including sub-clinical evidence of rheumatic valve disease on echocardiogram).
- Polyarthritits or aseptic arthritis or aseptic mono-arthritis or poly-arthralgia.
- Chorea.
- Erythema marginatum.
- Subcutaneous nodules.

Minor manifestations

- Fever $\geq 38^{\circ}\text{c}$
- ESR $\geq 30\text{mm/hr}$ or CRP $\geq 30\text{mg/l}$
- Prolonged P-R interval on ECG
*see *National Guidelines* (Reference) as duration varies with age.

Management/treatment

1. Take bloods for streptococcal serology and inflammatory markers: ASOT, AntiDnase, ESR, CRP and consider repeating after 2 weeks.
2. Take a throat swab for streptococcal isolation.
3. Ensure an ECG has been taken; observe for widening P-R interval. See *National Guidelines* (Reference) page 6.
4. Treat pain with paracetamol and codeine if required until diagnosis is confirmed. Do not use non-steroidal anti-inflammatory drugs prior to diagnosis as they may mask the patients symptoms and cause interference with anti-inflammatory markers.
5. Give IM LA Benzylpenicillin 900mg for patients $\geq 20\text{kg}$; 450mg for patients $< 20\text{kg}$.

Give into the upper outer quadrant on the buttocks.

6. Consider giving high dose aspirin and in some cases steroids and diuretics when the diagnosis is confirmed.
7. Admit patient for observation, echocardiogram and referral to cardiologist.
8. Contact the RHD public health nurse for patient +/- family education and to place on the NT RHD Register and Notifiable Disease Surveillance System (NDSS)
9. Once the patient is notified onto the NT RHD register the patient will be followed up according to their priority which will be determined by the patient's echocardiogram.

Reference

National Heart Foundation of Australia (RF/RHD guideline development working group) and the Cardiac Society of Australia and New Zealand. Diagnosis and management of acute rheumatic fever and rheumatic heart disease in Australia – an evidence-based review. 2006. Available at http://www.racgp.org.au/Content/NavigationMenu/ClinicalResources/RACGPGuidelines/DiagnosisandmanagementofacuterheumaticfeverandrheumaticheartdiseaseinAustralia/NHFA-CSANZ_ARF_RHD_2006.pdf

Acknowledgements

Dr Keith Edwards, Community Paediatrician, Marea Fittock, NT Coordinator RHD Control Program, Nina Missen Register coordinator.

NT Rheumatic Heart Disease Control Program Contacts

Central Australia Region

RHD Coordinator (08) 8951 6909 /0437650730
Register Coordinator (08) 8951 6903
Fax (08) 8951 9620

Top End Region

RHD Coordinator (08) 8922 8310
Register Coordinator (08) 8922 8454
Fax (08) 8922 8310

Katherine Region

Register Coordinator (08) 8973 9042
Fax (08) 8973 4420

East Arnhem District

RHD Coordinator (08) 8987 0510

Mosquito-borne diseases in the Northern Territory: an historical overview

Susan Jacups^{1,2} and Peter Whelan³

¹School for Environmental Research, Charles Darwin University

²Public Health and Tropical Medicine, James Cook University, Cairns

³CDC, Darwin

The importance of mosquito control for a reduction in mosquito-borne disease is locally and globally valid. The most important mosquito-borne diseases in Australia's history are malaria, dengue and the endemic arboviruses. These are outlined briefly below.

Malaria---no longer acquired in Australia

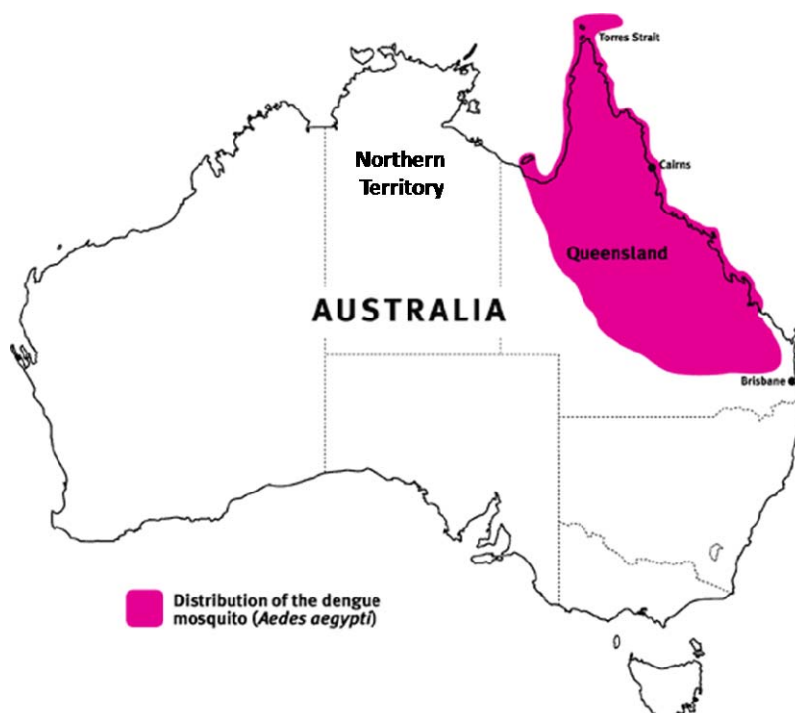
Malaria, causes substantial morbidity and mortality globally, each year. The World Health Organisation (WHO) estimates that malaria causes over 780 000 deaths and more than 200 million clinical cases annually.¹ Malaria was historically endemic in Australia. It was eradicated from the Northern Territory (NT) in 1962² and WHO declared Australia "malaria-free" in 1981.¹ Each year, Australia receives numerous imported cases, with occasional local transmission occurring in far north Queensland^{3,4}; however, due to public health measures and vigilant mosquito control, malaria has failed to re-establish in the NT. The NT and Queensland are however particularly receptive to reintroduction, as many competent vector Anopheline mosquito species breed near urban residential areas above latitude 19° S, suggesting that in the absence of adequate border surveillance and control and/or health

regulations, malaria could indeed become endemic in northern Australia once again.⁵

Dengue---NT is free of the dengue mosquito

Dengue virus infection is increasingly recognized as the world's most important emerging tropical disease.⁶ Already it is the leading arboviral infection in the world, causing higher rates of morbidity and mortality than any other mosquito-borne virus. The WHO currently estimates 50 million dengue infections occur worldwide every year, with a further 2 billion people at risk.¹ Dengue disease reappeared in Australia in north Queensland during 1981-2, after an absence of more than 28 years.⁷ Since then, north Queensland has annually faced cases of people presenting with dengue infection acquired overseas, but leading to outbreaks of local dengue and each year Queensland struggles to prevent dengue from becoming an endemic disease. Presently the primary vector mosquito *Aedes aegypti* exists in Australia only in the state of Queensland (Figure 1), however, another dengue vector *Aedes albopictus*, the Asian tiger mosquito, is considered endemic on Christmas Island and in the Torres Strait.⁸

Figure 1, *Aedes aegypti* range, Australia (Source- Queensland Health⁹)



Dengue virus and its primary vector, *Ae. aegypti*, have been endemic in the NT in the past. There are historical records documenting infection in Australian Aborigines¹⁰ and documented outbreaks in troops during WWII.¹¹ The eradication process of dengue virus in the NT differed from that of malaria, as the mosquito vector was targeted, rather than the infecting organism. *Aedes aegypti* was eradicated from the NT during the 1950s and 1960s, with the last record of local breeding in 1956¹², and by 1969 Darwin was considered *Ae. aegypti* free.¹³ Since eradication, this species has been regularly imported into the NT, as larvae or eggs in water containers on board boats visiting from dengue endemic countries to the north, but it has yet to re-establish. This lack of establishment is largely due to the activities of Medical Entomology (ME), as part of the Centre for Disease Control (CDC), NT Department of Health (DoH), in conducting surveillance and eradication programs. Recent incursions in 2004 into Tennant Creek and 2006 on Groote Eylandt resulted in expensive eradication programs, each continuing for over 2 years.¹⁴⁻¹⁷ Recently, a lone *Ae. aegypti*, possibly arriving via an airplane flight from a dengue endemic country, is thought to be responsible for a single case of local transmission in Darwin, in August 2010.¹⁸ To maintain dengue-free status, the NT DoH commits appreciable resources into border control and surveillance of exotic mosquito species.

Murray Valley encephalitis

Murray Valley encephalitis virus (MVEV) is a mosquito-borne arbovirus in the flavivirus family and the human disease is commonly referred to simply as 'Murray Valley encephalitis' (MVE). Infection in humans can result in severe disease with symptoms including quadriplegia, and death.^{19,20} From 1974 to 2010, 30 cases have been recorded in the NT and 4 of these were fatal.²¹ Waterbirds such as herons and egrets are the most probable vertebrate hosts involved in the MVEV cycle²², while the implicated vector in the NT is the common banded mosquito *Culex annulirostris* (Skuse)^{22,23},

which is abundant after seasonal heavy rainfall. The virus is considered to be enzootic in the Top End of the NT and the Barkly region (including Tennant Creek) and epizootic in the Alice Springs region, where it occurs seasonally after widespread heavy wet season rainfall.

In Alice Springs, high summer rainfall (December – February) and relatively high mosquito vector numbers have been found to be significantly associated with sentinel chicken MVEV seroconversions.²⁴ Summer rainfall >100 mm and vector numbers of *Cx. annulirostris* >300 per battery operated carbon dioxide baited EVS trap per night can indicate a high risk of MVE disease.²⁴ The presence of MVEV activity in the Alice Springs region has been associated with monsoonal weather conditions in the north in the NT and northwest in Western Australia, possibly assisting infected bird and wind-blown mosquito dispersal into the region.

Kunjin

Kunjin virus (KUNV), also a flavivirus, is a subtype of West Nile virus found in the Oceania region. The disease it causes has a much lower mortality rate compared to MVE, with initial presenting symptoms similar but usually milder.²⁵ As with MVEV, KUNV is considered endemic in the Top End, Katherine and Barkly region of the NT and until 2000, KUNV disease had not been recorded in Central Australia.²⁶ However in 2001, 2 cases of KUNV disease were notified from the Alice Springs urban locality without preceding human cases in known endemic areas.²⁶ Following a major mosquito control drainage intervention in the Alice Springs area, cases have not occurred in the region. Two further cases were reported from the endemic Top End, 1 in 2009 and the other in 2010.²⁷ The NT sentinel chicken program conducted by ME, volunteers and the NT Department of Resources investigates KUNV as well as MVEV activity in the major townships around the NT and serves as an early warning system for seasonal risk of both diseases.²⁸

Ross River and Barmah Forest

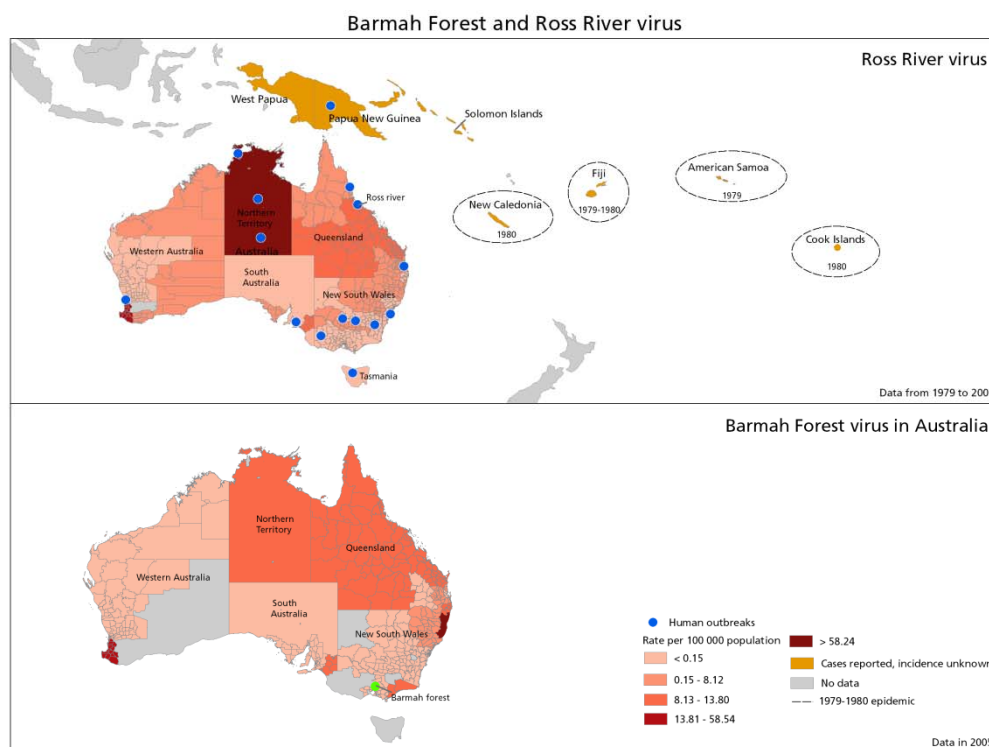
Ross River virus (RRV) and Barmah Forest virus (BFV) are alphaviruses endemic to the Australian mainland, with RRV also endemic in Tasmania and Papua New Guinea (Figure 2). These 2 viruses constitute the majority of arbovirus infections in Australia²⁹ with the NT reporting the highest incidence of these diseases, with averages for 1995-2010, for BFV 23/100 000 and RRV 109/100 00 population.^{30, 31} The main presenting symptoms for these diseases are joint pains, fever and rash; while not life threatening, the symptoms are debilitating enough to be of economic concern, as some people suffer myalgia and fatigue for up to 6 months.³² Harley et al estimated the cost to Australia of between US\$2.0 and US\$4.6 million annually.³³ The primary vectors in the NT are the northern salt-marsh mosquito *Aedes vigilax* (Skuse) and the common banded mosquito *Cx. annulirostris*. RRV is thought to be maintained primarily by enzootic cycles between reservoir hosts and the primary vectors. Marsupials are implicated as the most likely RRV reservoir hosts³⁴ as they provide the best

disease amplification, with humans considered poor amplifiers; and usually regarded as dead-end hosts in the cycle.³⁴

NT medical entomology (ME) activities

In addition to the surveillance of mosquito-borne virus activity in the NT, the ME unit conducts weekly adult mosquito trapping to monitor mosquito species and their populations; larval surveillance to inform of impending populations and control needs, ovi-trapping for exotic species detection, strategic larval spraying operations throughout the year, and ongoing maintenance of artificial drainage channels. Furthermore, understanding the many facets of mosquito ecology is vital to identifying vulnerable locations and periods in its lifecycle to better target effective mosquito control. There is much to be learned about the various mosquito breeding habitats and habitat dynamics such as flooding and vegetation change, which subsequently relate to fluctuations or trends in mosquito numbers and diversity. Investigating ecological habitats will further elucidate mechanisms to facilitate vector control efforts and therefore reduce potential disease

Figure 2, RRV and BFV endemic regions³⁵



transmission. The ecology and biology of mosquito pest and vector species in the NT continues to be studied by staff at the NT ME unit, with the aim to publish and share this information.

References

- World Health Organisation. World malaria report: World Health Organization, 2010. <http://www.who.int/malaria/publications/atoz/9789241564106/en/index.html>
- Black RH. Malaria in Australia. In: School of Public Health and Tropical Medicine, editor. The University of Sydney Science Publication. Sydney: Australian Government Publishing Service; 1972.
- Hanna JN, Ritchie SA, Eisen DP, Cooper RD, Brookes DL, Montgomery BL. An outbreak of Plasmodium vivax malaria in Far North Queensland, 2002. *Med J Aust.* 2004 Jan 5;180(1):24-8.
- Hanna JN, Brookes DL, Ritchie SA, van den Hurk AF, Loewenthal MR. Malaria and its implications for public health in Far North Queensland: a prospective study. *Aust N Z J Public Health.* 1998 Apr;22(2):196-9.
- Russell RC. Mosquito-borne disease and climate change in Australia: time for a reality check. *Aust J Ent.* 2009;48:1-7.
- World Health Organization. Dengue: guidelines for diagnosis, treatment, prevention and control Geneva: World Health Organization, 2009. www.who.int/dengueNet
- Kay BH, Barker-Hudson P, Stallman ND, Wiemers MA, Marks EN, Holt PJ, et al. Dengue fever. Reappearance in northern Queensland after 26 years. *Med J Aust.* 1984 Mar 3;140(5):264-8.
- Ritchie SA, Moore P, Carruthers M, Williams C, Montgomery B, Foley P, et al. Discovery of a widespread infestation of Aedes albopictus in the Torres Strait, Australia. *J Am Mosq Control Assoc.* 2006 Sep;22(3):358-65.
- Queensland Health. Dengue Fever. Brisbane: Queensland health, Queensland government; 2010 [updated 24 April 2009; cited 2010]; Available from: http://www.health.qld.gov.au/dengue/dengue_fever/mosquito.asp#dengueAustralia.
- Basedow HMA. Diseases in the Australian Aborigines. *The Journal of Tropical Medicine and Hygiene.* 1932;XXXV(13):193-4.
- Sabin AB. Research on dengue during World War II. *Am J Trop Med Hyg.* 1952 Jan;1(1):30-50.
- O'Gower AK. The mosquitoes of North West Australia. In: Publication SoPHaTMS, editor. Sydney 1958. p. 40-2.
- Northern Territory Government. Mosquito control measures in Darwin: Task force review 1989. Darwin: Northern Territory Government and Darwin City Council 1989.
- Whelan PI. Mosquito vector control in the Northern Territory. *Northern Territory Communicable Diseases Bulletin.* 2007;14(2):12-8.
- Whelan PI, Kulbac M, Bowbridge D. The eradication of Aedes aegypti from Groote Eylandt NT Australia 2006-2008. *Arbo Res Aust.* 2009;10:188-99.
- Whelan PI, Pettit W, Krause V. Dengue mosquito eradication project Tennant Creek. *Bull Mos Control Assoc Aust.* 2005;17(1):16-23.
- Whelan PI, Pettit W, Krause V, Lamache G, Kurucz N. Aedes aegypti, vector of dengue found in Tennant Creek- elimination campaign in progress. *Northern Territory Communicable Diseases Bulletin.* 2004;11(1):1-4.
- Hall L. Lone mozzie blamed for dengue. *The Australian.* 2010 25 August, 2010.
- Bennett NM. Murray Valley encephalitis, 1974: clinical features. *Med J Aust.* 1976 Sep 18;2(12):446-50.
- Burrow JN, Whelan PI, Kilburn CJ, Fisher DA, Currie BJ, Smith DW. Australian encephalitis in the Northern Territory: clinical and epidemiological features, 1987-1996. *Aust N Z J Med.* 1998 Oct;28(5):590-6.
- Communicable Diseases Australia. Notifications of Murray Valley encephalitis virus infection. [website] Canberra: Commonwealth Department of Health and Ageing; 2010 [cited 2010 9/8/2010]; Available from: http://www9.health.gov.au/cda/Source/Rpt_4.cfm.
- Russell RC, Dwyer DE. Arboviruses associated with human disease in Australia. *Microbes Infect.* 2000 Nov;2(14):1693-704.
- Russell RC. Vectors vs. humans in Australia--who is on top down under? An update on vector-borne disease and research on vectors in Australia. *J Vector Ecol.* 1998 Jun;23(1):1-46.
- Whelan PI, Jacups SP, Melville L, Broom A, Currie BJ, Brogan B, et al. Rainfall and vector mosquito numbers as risk indicators for mosquito-borne disease in central Australia. *Commun Dis Intell.* 2003;27(1):110-6.
- Muller D, McDonald M, Stallman N, King J. Kunjin virus encephalomyelitis. *Med J Aust.* 1986 Jan 6;144(1):41-2.
- Brown A, Bolisetty S, Whelan P, Smith D, Wheaton G. Reappearance of human cases due to Murray Valley encephalitis virus and Kunjin virus in central Australia after an absence of 26 years. *Commun Dis Intell.* 2002;26(1):39-44.
- Communicable Diseases Australia. Notifications of Kunjin virus infection. [website] Canberra: Commonwealth Department of Health and Ageing; 2010 [cited 2010 9/9/2010]; Available from: www.health.gov.au/cda/Source/Rpt_4.cfm.
- Kurucz N, Whelan P, Jacups S, Broom A,

- Melville L. Rainfall, mosquito vector numbers and seroconversions in sentinel chickens to Murray Valley encephalitis virus in the Northern Territory. *Arbo Res Aust.* 2005;9:188-92.
29. Russell RC. Ross River virus: disease trends and vector ecology in Australia. *Bull Soc Vector Ecol.* 1994;19(1):73-81.
30. Communicable Diseases Australia. Notifications of Ross River virus infection. [website] Canberra: Commonwealth Department of Health and Ageing; 2010 [cited 2010 9/11/2006]; Available from: www.health.gov.au/cda/Source/Rpt_4.cfm.
31. Communicable Diseases Australia. Notifications of Barmah Forest virus infection. [website] Canberra: Commonwealth Department of Health and Ageing; 2010 [cited 2010 9/11/2006]; Available from: www.health.gov.au/cda/Source/Rpt_4.cfm.
32. Westley-Wise VJ, Beard JR, Sladden TJ, Dunn TM, Simpson J. Ross River virus infection on the North Coast of New South Wales. *Aust N Z J Public Health.* 1996 Feb;20(1):87-92.
33. Harley D, Sleight A, Ritchie S. Ross River virus transmission, infection, and disease: a cross-disciplinary review. *Clin Microbiol Rev.* 2001 Oct;14(4):909-32.
34. Kay BH, Fanning ID, Carley JG. Vector competence of *Culex pipiens quinquefasciatus* for Murray Valley encephalitis, Kunjin, and Ross River viruses from Australia. *Am J Trop Med Hyg.* 1982 Jul;31(4):844-8.
35. Wertheim HFL, Horby P, Woodall J, editors. World Atlas of Human Infectious Diseases. Oxford: Wiley-Blackwell; 2011-In Press.

Centre for Disease Control website

The Northern Territory Centre for Disease Control (CDC) website has a wide range of useful resources, including: communicable disease information for visitors to the Territory, CDC fact sheets, CDC Protocols, NT Disease Control Bulletin and the NT Sexual Health and Blood Borne Virus Unit Surveillance. The CDC website address is:

http://health.nt.gov.au/Centre_for_Disease_Control/index.aspx

Centre for Disease Control contact details

Darwin	8922 8044
Katherine	8973 9049
Alice Springs	8951 7540
Tennant Creek	8962 4259
Nhulunbuy	8987 0357

Subscribe to receive the *Northern Territory Disease Control Bulletin* by email

Save desk clutter and the environment by subscribing to receive the *Northern Territory Disease Control Bulletin* by email. To receive your copy electronically, please email your contact details to DaHye Baker at dahye.baker@nt.gov.au. A perfect option for forwarding onto colleagues!

Another exotic mosquito interception at Frances Bay port facility, Darwin, January 2011

Peter I Whelan¹, Huy Nguyen¹ and Mary Finlay-Doney²

¹CDC, Darwin ²Australian Quarantine Inspection Service Darwin

Abstract

The introduction of target-specific adult mosquito traps (Biogents® (BG) sentinel mosquito traps) in 2009/10 to detect exotic dengue vectors at Darwin port facilities has apparently increased the ability and frequency of their detection. The latest detection of Aedes aegypti at Frances Bay in Darwin in January 2011 was followed by subsequent successful elimination measures and heightened surveillance responses, which indicated no further presence of adults or larvae of this species.

Key words: Aedes aegypti; Darwin port facility; interception response

Introduction

In early January 2011, the dengue mosquito *Aedes aegypti* was detected at the Darwin port facility of Perkins Shipping at Frances Bay in Darwin, Northern Territory (NT) of Australia. The NT is regarded as one of the very few areas of the tropics free of any of the potential vectors of dengue.¹ The adult collection was made in a Biogents (BG) sentinel trap², which is usually baited with cylinder dispensed carbon dioxide (CO₂), but was unbaited on this occasion due to unavailability. The trap was run continuously from 29/12/10 and collected on 04/01/11. The Medical Entomology (ME) section of the Centre for Disease Control, NT Department of Health (DoH), in cooperation with the Australian Quarantine Inspection Service (AQIS), engages in programs for the inspection, surveillance and treatment of risk cargo and port environs to prevent the establishment of exotic mosquitoes in the NT.³

Detection

The mosquito collection from a routine AQIS BG trap was received by ME on the day of collection (04/01/11). ME entomologists confirmed the identification of 1 male and 2 female *Ae. aegypti*.

The marine vessel implicated in the introduction (CEC Accord Voyage CA009) berthed in Darwin on 26/12/2010 and was cleared by AQIS on 29/12/10. The manifest of the vessel indicated there were 18 transport containers, with 16 of these being tank container types, which have previously been shown capable of collecting water in a section of their access hatch⁴. However none of the tank containers from the vessel voyage of 26 December were found to be capable of pooling water in their access hatches. The remaining 2 transport containers were open topped, with 1 housing oversized tyres. These tyres had already been unloaded onsite at Perkins and cleared by AQIS.

Control response

Adult Mosquito Control

On the evening of 06/01/11, ME conducted a vehicle mounted Ultra Low Volume (ULV) fogging application of bioresmethrin insecticide to eliminate any further exotic adult mosquitoes that may have been present. The application of the fog was conducted along a similar route to previous interception responses^{3,4} and included the Perkins Shipping international berthing area, the general Perkins Shipping yards, and the adjacent area to the south at the Frances Bay Marine premises (Figure).

Larval Survey and Control

On the following day (07/01/11), 2 AQIS officers and 5 ME personnel conducted a larval survey and receptacle treatment of the entire Perkins Shipping yards. Alpha-cypermethrin insecticide (a pyrethroid) was applied by hand held pressure sprayers to all actual and possible water holding receptacles. AQIS personnel conducted larval surveys of the adjoining premises of Frances Bay Marine on 10/01/11, while ME personnel conducted an insecticide treatment of this site on the following day.

Figure. *Aedes aegypti* detection location and area of ULV application Perkins shipping and Frances Bay Marine – January 2011



Enhanced adult mosquito surveillance

AQIS responded to this exotic detection by increasing the level of passive surveillance in the port area. The details are as follows. Three cylinder dispensed CO₂ baited BG adult mosquito traps were deployed on the day of detection. The BG traps were run continuously for 1 week. Catch bags were collected and reset after every 24 hrs. After the initial week, CO₂ baited BG traps were still run continuously, but catch bags were collected every 5 days. This trapping schedule was maintained for 3 weeks. A CO₂ baited encephalitis virus surveillance (EVS) trap was set weekly in the Perkins area as per routine, with trapping conducted overnight from mid-afternoon to approximately 10:00 am the next morning. Four extra ovitraps (special traps used to collect eggs laid by *Aedes* mosquitoes) were set on the 28/01/10 and serviced weekly for 4 weeks by AQIS.

Results

No *Ae. aegypti* adults or larvae were recovered

from any of the heightened surveillance activities in response to the initial detection. There were a number of breeding sites recorded from the larval survey, including vehicle tyres, skip bins holding water, and a septic tank that required mosquito proofing. Perkins undertook to rectify the breeding sites as a source reduction measure.

Discussion

A number of detections of exotic mosquito breeding in cargo arriving at Darwin port have been made over the past 18 months. Tank containers used to transport fuel have been identified as high risk cargo and are now routinely inspected to ensure they are not capable of holding water in the area near their access hatches.⁴ Other risk cargo include tyres and machinery capable of holding water.⁵

A recent detection of 3 x 3rd instar *Aedes albopictus* larvae was made on the 29/12/10. These larvae were detected in a cable drum, a break bulk consignment from the same

international vessel detailed above (CEC Accord CA009). No ME adult fogging or receptacle inspection and treatment response was deemed necessary at the time, as there was no evidence of pupae or pupal skins in the receptacle or amongst debris collected, indicating that there was little potential for adults to be present. All cavities in the cable drum that could pond water were flooded by Perkins personnel with chlorine solution after a quarantine direction. It is not likely that the present detection of *Ae. aegypti* had emerged from the cable drum breeding site after treatment.

The current *Ae. aegypti* detection was assessed as a medium risk importation, because relatively low numbers of both male and female *Ae. aegypti* were involved and no breeding sites could be located. Male mosquitoes are generally collected when a nearby breeding site is present. This indicated that a breeding site was present either on the vessel, in recent cargo, or in receptacles onshore nearby. Since the adult numbers were low and no onshore breeding sites were uncovered, the risk for establishment of the species was believed to be medium to low, although this did not preclude the presence of an undetected cryptic breeding site.

Surveillance carried out over 4 weeks following the elimination responses yielded negative results suggesting that the importation was very limited. It was likely to be only a few adults mosquitoes that originated either from the vessel or on the cargo soon after arrival. The results of the subsequent investigations indicate that the probability of an establishment of *Ae. aegypti* in the vicinity of Perkins wharf from the interception is negligible.

This is the 4th detection of imported exotic *Aedes* mosquitoes by a BG trap at the Darwin port area since 05/02/10, when it was first put into operation during an enhanced surveillance measure for an *Ae. aegypti* detection on 25/01/10⁴. In the course of writing this article, a 5th detection involving *Ae. albopictus* occurred on 10/03/11 from a similar CO₂ baited BG trap. A similar response to this detection detailed here was mounted, with no further specimens detected and no onshore breeding source located.

In comparison, no adult exotic mosquitoes have been detected in routine CO₂ baited EVS traps at Darwin port areas since the current routine monitoring program recommenced in 29/09/99. It is therefore recommended that routine CO₂ baited BG traps be incorporated into quarantine surveillance around risk ports in Australia to detect exotic *Aedes* mosquitoes. These should be run continuously for at least 5 days each week to ensure increased trapping efficiency.

The current enhanced surveillance and elimination procedures following these importation events significantly reduce the likelihood of a viable population of the dengue vectors entering through the port areas and establishing in Darwin, or spreading to other NT towns.

Acknowledgements

Participants of this recent survey and control operation, including operational support include:

- AQIS personnel - Mary Finlay-Doney, Chris Ganambar and Louise Baume; Medical Entomology personnel – Peter Whelan, Nina Kurucz, William Pettit, Jane Carter, Alex Roberts, and Eva Molenaar.
- Perkins personnel are thanked for their ongoing assistance. The Department of Health and Ageing are thanked for their funding support to NT Department of Health for these elimination responses.

References

1. Whelan PI, Kulbac M, Bowbridge D, and Krause V (2009). The eradication of *Aedes aegypti* from Groote Eylandt NT Australia *Arbovirus Research in Australia* 2006-2008 10: 188-199.
2. Biogents. <http://www.bg-sentinel.com/en/bg-sentinel.html>.
3. Nguyen H, Whelan PI (2007). Detection and elimination of *Aedes albopictus* on cable drums at Perkins Shipping, Darwin, NT. *Northern Territory Disease Control Bulletin*. 14(3):39-41.
4. Nguyen H, Whelan PI, Finlay-Doney M, Ying Soong S (2010). Interceptions of *Aedes aegypti* and *Aedes albopictus* in the port of Darwin, NT, Australia, 25 January and 5 February 2010. *Northern Territory Disease Control Bulletin* 17 (1):29-35.
5. Medical Entomology branch report 2009/2010, 19-21. <http://hdl.handle.net/10137/466>

A year of mosquito monitoring at Robertson Barracks and the nearby Millner Swamp, Northern Territory, Australia

Donald C. Franklin¹, Lubomir Bisevac¹ and Peter Whelan²

¹Research Institute for the Environment and Livelihoods, Charles Darwin University

²CDC, Darwin

Abstract

Large numbers of military personnel are based in northern Australia, generating risks to them from endemic tropical mosquito-borne diseases. In addition, posting of the military to Timor-Leste and other overseas locations poses a risk that mosquito-borne disease, notably malaria and dengue fever, will be imported back to Australia, a potential problem both for those personnel and the wider community. Robertson Barracks, near Palmerston in the Northern Territory (NT), lies adjacent to a seasonal freshwater wetland and 1.5 km from the seasonal fresh, brackish and saline habitats of Millner Swamp, and its mosquito incidence is consequently an issue of concern.

Here, we report weekly monitoring over 12 months from October 2005 to September 2006 at 2 sites, 1 in the Barracks area, and the other between the Barracks and Millner Swamp. 6 mosquito species of particular concern were common to abundant at both sites; *Anopheles farauti* s.l. and *Anopheles bancroftii* as potential vectors of malaria, *Aedes vigilax* and *Culex annulirostris* as vectors of prevalent arboviral diseases due to Ross River, Barmah Forest and Murray Valley encephalitis virus infection, and *Coquillettidia xanthogaster* and *Mansonia uniformis* as nuisance value. However, there was considerable fewer *An. bancroftii* and even less *An. farauti* s.l. and *Ma. uniformis* at the Barracks compared to Millner Swamp. *An. farauti* s.l., a key potential vector for malaria, and other disease vector species breed in Millner Swamp.

Maintenance of the buffer distance separation between the Barracks and Millner Swamp is an important part of the strategy to prevent local transmission of malaria, and to reduce the pest and vector-borne disease potential to Barracks personnel. Recommendations for management are made.

Keywords: wetlands; army; malaria; northern Australia; arbovirus; mosquitoes

Introduction

The incidence of Ross River virus (RRV), Barmah Forest virus (BFV) and Murray Valley encephalitis virus (MVEV) infection is a major public health concern in the monsoonal tropics of Australia.¹ The concentration of the Australian military in northern Australia in recent decades, and in particularly the position of military establishments in the vicinity of tropical wetlands, means that disease management is an issue of concern to the military. Further, the posting of military personnel overseas and in particular to Timor-Leste, where malaria and various arboviral diseases are prevalent, exposes both these personnel and the wider community to the importation of diseases not currently endemic in the NT.²

Robertson Barracks is a major military establishment near Darwin in the NT. It lies adjacent to a seasonal freshwater wetland and 1.5km from the seasonally variable fresh, brackish and saline habitats of Millner Swamp. The latter is a known breeding area for *An. farauti* s.l. and *An. bancroftii*, with *An. farauti* s.l. being the major potential vector for malaria in the region and *An. bancroftii* being a potential secondary vector. Other mosquito species of prevalence and concern in the vicinity of the Barracks are *Ae. vigilax* and *Cx. annulirostris*, both vectors of endemic arboviral disease, and *Coquillettidia xanthogaster* and *Mansonia uniformis*, both nuisance species.³

Before the Barracks were established, Medical Entomology of the NT Centre for Disease Control (CDC) provided monitoring data and an assessment of vector borne disease risks and recommendations for management.⁴ In this report we provide an update on the incidence of these 6 key mosquito species based on intensive surveys conducted over 12 months in 2005-06, and provide further recommendations for reducing potential mosquito-borne disease in this and other military establishments in northern Australia.

Figure 1. Relative location of Robertson Barracks infrastructure, nearby swampland, and mosquito traps.

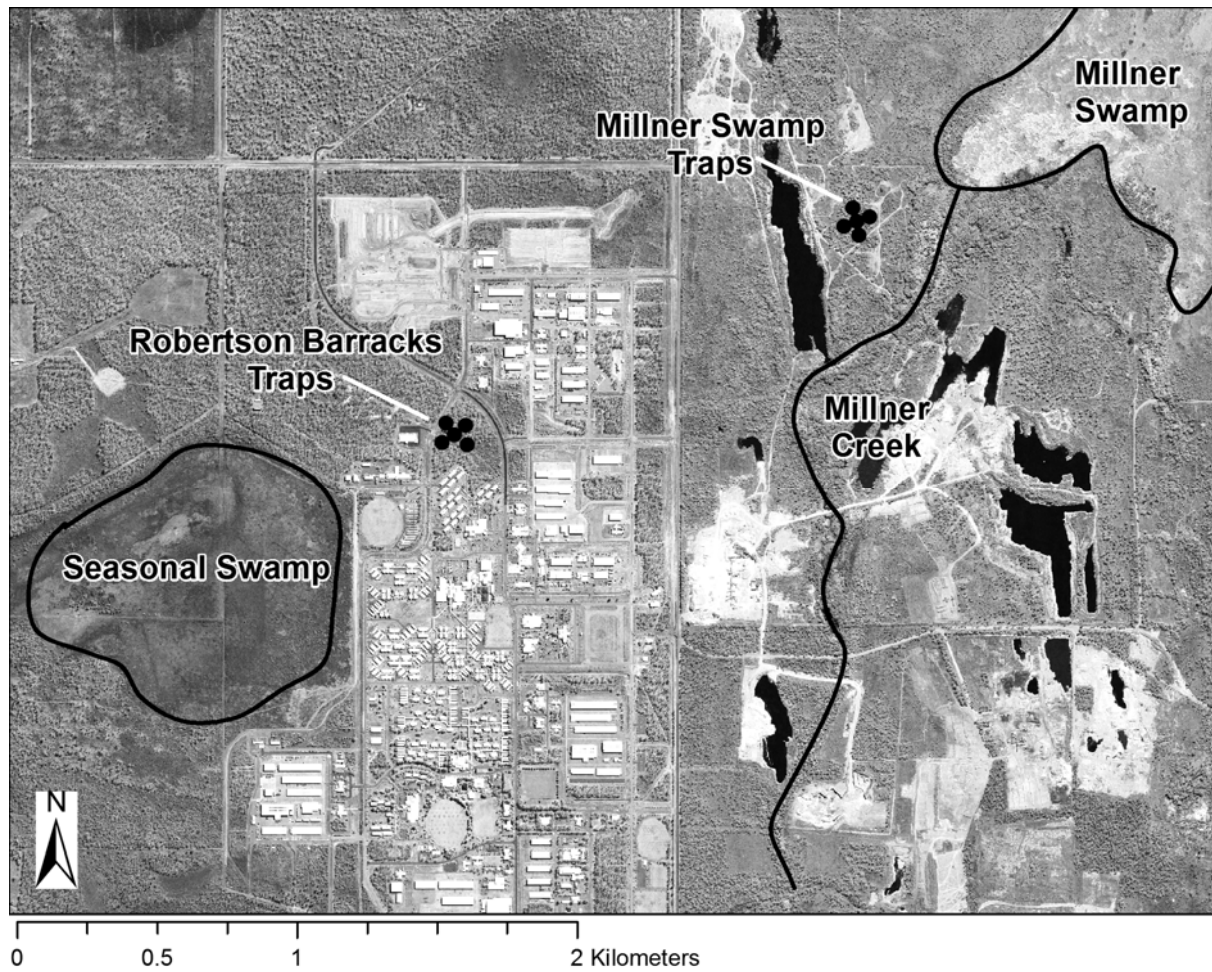


Table 1. Number of individuals of 6 mosquito species trapped over one year at Robertson Barracks (RB) and the nearby Millner Swamp (MS) , 5 traps per site combined.

Species	Robertson Barracks	Millner Swamp	Ratio (MS / RB)
<i>Aedes vigilax</i>	4,103	12,491	3.0
<i>Anopheles bancroftii</i>	1,515	8,282	5.5
<i>Anopheles farauti s.l.</i>	98	1,723	17.6
<i>Coquillettidia xanthogaster</i>	11,226	23,611	2.1
<i>Culex annulirostris</i>	21,402	62,605	2.9
<i>Mansonia uniformis</i>	632	6,949	11.0

Methods

The study area

Robertson Barracks (12° 26' S, 130° 59' E) is a major accommodation, service and training facility for troops from the Australian Army. It is 1 km north-east of the Pinelands industrial area and 3.5 km north of urban residential areas in Palmerston near Darwin in the NT. The facility extends over approximately 4 km² (Figure 1). It is situated immediately adjacent to a wetland and 1.5 km from the edge of Millner Swamp (Figure 1).

Rainfall at the nearby Darwin Airport during the study period (Oct. 2005 to Sept. 2006) was close to the average of 1700 mm except for very-much above average rainfall of 398 mm in April compared to the April mean of 100 mm.

Mosquito trapping

The abundance and diversity of adult female mosquitoes was monitored with standard EVS CO₂-baited traps.⁵ At each of 2 sites (Figure 1), 5 traps were set 1 night per week for each week from October 2005 to September 2006 inclusive. The 5 traps were arranged in a cross with a central trap; the 4 at the points of the cross being 50 m from the central trap. One site (hereafter Robertson Barracks) was in woodland surrounded by the Barracks, while the other (hereafter Millner Swamp) was in woodland 0.5 km from Millner Swamp between the Swamp and Robertson Barracks. The aim of the site design was to detect mosquitoes emanating from Millner Swamp, as well as those present in the Barracks area, and gauge the attrition, in particular, of the saltmarsh-breeding *An. farauti s.l.* with distance from Millner Swamp. The 5-trap design was part of a larger experiment, to be reported elsewhere, on the efficacy of a single trap in monitoring local site conditions.

Trapping around the proposed Robertson Barracks site in 1986-87 was conducted using the same type of traps, with mosquitoes sampled fortnightly at 4 dispersed points around the site.⁴

Mosquito samples were killed by freezing prior to microscopic identification. Samples of less than 300 individuals were identified and counted fully. For larger samples, the full sample and a sub-sample of 300 specimens were weighed and

the subsample fully identified and enumerated. The sample was checked for species absent from the subsample. The ratio of weights provided a conversion factor to estimate the number of individuals of each species in the sample. The abundance of species present in the sample but absent from the sub-sample was scored as the total number present in the sample.

Results

All 6 mosquito species occurred at both Robertson Barracks and Millner Swamp, and all were more abundant at Millner Swamp (Table 1). The attenuation at the Barracks was particularly marked for *An. farauti s.l.* and *Ma. uniformis*, which were 17 and 11 times more prevalent at Millner Swamp respectively, whereas the ratio for the other species ranged from 2.1 to 5.5.

Cx. annulirostris and *Cq. xanthogaster* were present throughout the year with limited seasonality but for generally lower numbers in the October to December period (Figure 2). *Ae. vigilax* was present for most of the year, although with low numbers in February and March and greatest abundance in October to January. *An. bancroftii* was most abundant from January to August, with low numbers in October to December. *Ma. uniformis* was present through most of the year with a peak in December to January and short periods of complete absence in July and late October. *An. farauti s.l.* exhibited the greatest seasonality, with a peak in April and May and near to complete absence from October to December.

Discussion

Patterns of mosquito abundance

Standardised comparisons (Table 2) of the current survey with the 1986-87 survey of mosquitoes in the then proposed Barracks area should be interpreted with great caution because:

- both are annual surveys which may not reflect long-term trends;
- trap sites are were not matched; and
- the impact of positioning 5 traps in close proximity is unknown.

In addition, there has been some alterations to

Figure 2. Time series (Oct. 2006 to Sept. 2007) of abundance for 6 mosquito species of management concern in five traps set weekly at each of Robertson Barracks and nearby Millner Creek.

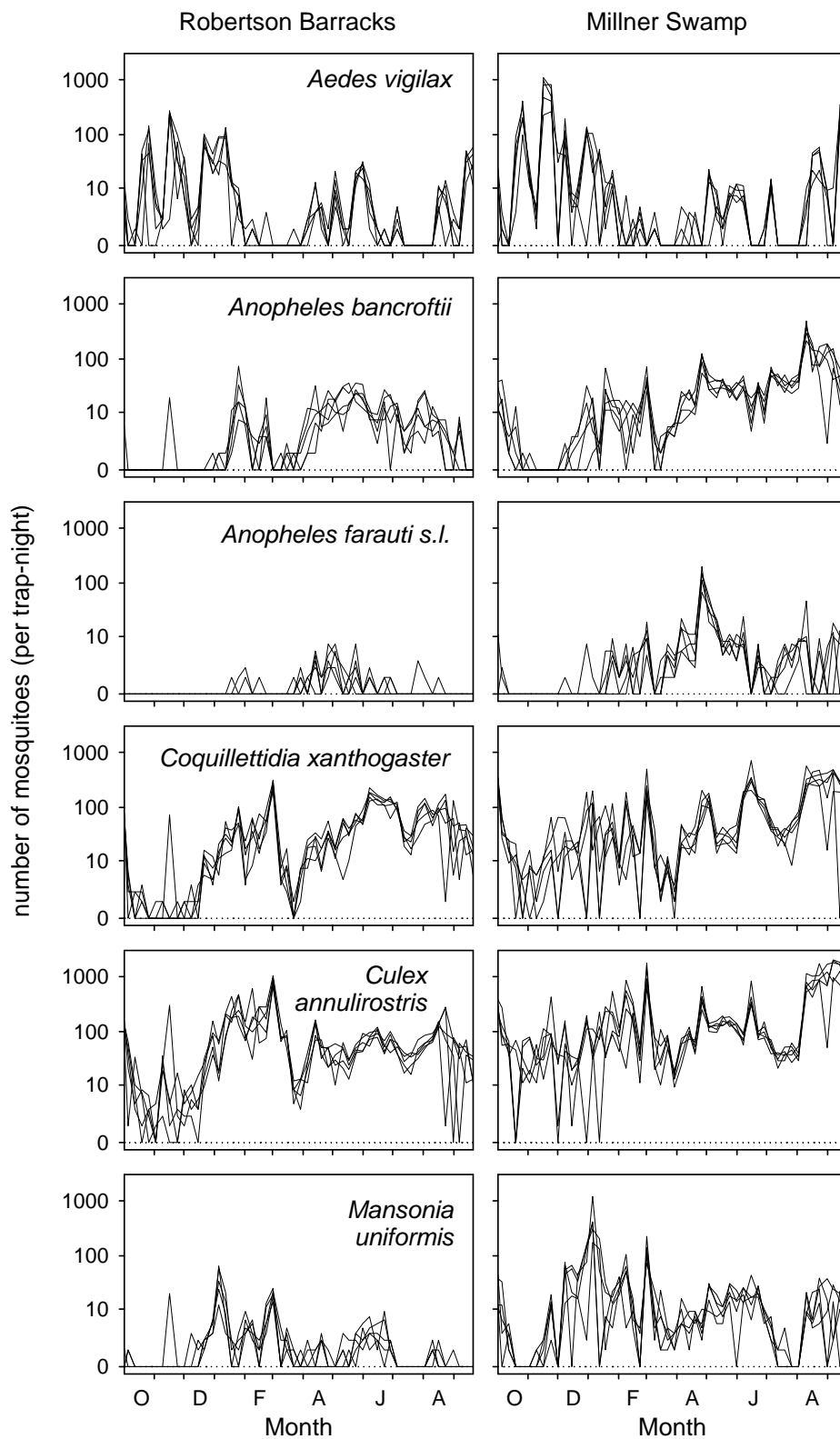


Table 2. Summary comparison of trap rates of 6 mosquito species in 1986-87⁴ and this study (2005-06). Rates are annual mean totals per trap; those for 1986-87 have been doubled to standardise from fortnightly to weekly trapping.

Species	1986-87	2005-06
<i>Aedes vigilax</i>	618	1,659
<i>Anopheles bancroftii</i>	3,602	980
<i>Anopheles farauti s.l.</i>	94	182
<i>Coquillettidia xanthogaster</i>	1,771	3,484
<i>Culex annulirostris</i>	9,951	8,401
<i>Mansonia uniformis</i>	620	758

drainage with the development of the Barracks, with some minor drainage of the seasonal freshwater swamp possibly contributing to the reduced numbers of *An. bancroftii* currently at the Barracks (Table 2). However, the abundance of *Cx. annulirostris* and *Ma. uniformis* has not changed to a marked degree, suggesting that the majority of numbers arose from both swamp areas in a similar manner over the 2 periods. The variation in *Ae. vigilax* numbers is expected due to variable trap times in relation to days after tidal flooding. The apparent doubling of abundance of *An. farauti* and *Cq. xanthogaster* may be partly due to bias, with more traps in more favourable locations in the current survey compared with the wider dispersal of traps in the previous survey.

The observed seasonal patterns are consistent with those previously reported for the Darwin region,^{6,7,8} perhaps reflecting the relative constancy from year to year in the seasonal structure of the region's mosquito assemblage.⁹ They therefore provide a good basis for consideration of seasonal management responses.

The lower numbers of mosquitoes at Robertson Barracks compared with the Millner Swamp trap site at least partly reflects an attenuation with distance from the swamp. This is likely to be particularly true of *Ma. uniformis* and *An. farauti s.l.* The latter is a complex of at least 3 species in the NT, with a key local species strongly associated with brackish wetlands such as Millner Swamp. While some freshwater breeding sites of this species possibly occur closer to the Barracks and may include the seasonal open freshwater swamp to the west,

they are more likely to occur in isolated pools at the edge of the densely forested Millner Creek immediately to the east that feeds into Millner Swamp. These possible freshwater sites are not likely to be as productive as the brackish water species breeding sites associated with Millner Swamp.

Ma. uniformis is closely associated with aquatic and semi aquatic plants and is likely to be breeding in the permanent to semi-permanent habitats in Millner Swamp rather than the closer densely forested creek areas. This species is known to have a relatively short flight range, which is supported by the reduction in numbers at the Barracks and an origin from the swamp itself.

While *Cx. annulirostris* and *Ae. vigilax* are known to have relatively long flight ranges of up to and in excess of 10 km, and *An. bancroftii* and *Cq. xanthogaster* have moderate flight ranges in excess of 2 km, they are also known to have reduced numbers with distance from point sources, depending on the nature of the intervening distance.^{10,11,12} This study has shown a considerable reduction of *Cx. annulirostris*, *Cq. xanthogaster*, *An. bancroftii* and *Ae. vigilax* at the 2 km distance between the 2 trap positions. Although part of this reduction is probably due to the buffer effect of lights, people and buildings in the intervening area in the north section of the Barracks between the 2 trap positions, it is clear that there has also been a considerable reduction in numbers of these species with distance from the swamp to the Barracks.

The deep-water pits of the quarry between the

Barracks and Millner Swamp are unlikely to be appreciable breeding sites for mosquitoes because of the lack of marginal vegetation and the presence of fish, so these features need not be regarded as potential sources of mosquitoes or requiring rectification to maintain a buffer distance from the Swamp.

Mosquitoes as pests

The time of year when mosquitoes are a pest (nuisance) does not necessarily or completely coincide with the time when they pose a major risk as disease vectors. *Cq. xanthogaster* and *Cx. annulirostris* can be present at pest levels at the Barracks from July to September, but during this period they are generally not vectors of disease due to reduced longevity.⁷ *Ae. vigilax* is an appreciable pest mosquito usually starting later in the dry season from September to the end of January, although primarily up to November, but in December and January the species more frequently acts as a vector of RRV and BFV.³

Pest problems may occur at the Barracks throughout the year. During the wet season from November to April, *Ae. vigilax* and *Cx. annulirostris* are the principal pest species. *Cx. annulirostris* can be a particular pest problem from December to February after appreciable rain floods the wetlands, and also from April to June as formerly upright grass and reeds topple over and intertwine in the water as water levels decrease. These latter conditions reduce fish access in the wetlands, thus reducing predation on mosquito larvae. Pest numbers continue until the swamps progressively dry up. *An. bancroftii* can be an additional and appreciable pest problem from January to February but can continue to May. *An. farauti* does not constitute a pest problem at the Barracks, as their numbers never reach pest proportions. *Cq. xanthogaster* can be a pest in January and February and re-emerge as a pest in April to June. *Ma. uniformis* may occasionally be a pest problem at the Barracks in January but this will be rare unless dwellings are built closer to the swamp breeding sites, as it has a relatively short flight range.

Mosquitoes as vectors of disease

The malaria parasite completes its life cycle in anopheline mosquitoes, of which *An. farauti s.l.* is the major potential vector in the Top End of the NT.⁷ Malaria was endemic in northern Australia, but is no longer so, with the last local

case being at Roper River in 1962.¹³ At least 2 outbreaks in northern Australia were the result of troops returning from overseas during and after the 2 world wars, with the outbreak during and after the second world war being a major and sustained one.¹⁴ Given the relatively high prevalence of *An. farauti s.l.* near Millner Swamp, the potential for introduced cases of malaria at the Barracks (local transmission following transmission from an imported case) through interaction between the mosquito and persons returning from endemic malaria areas overseas is real and of considerable public health concern. Despite its importance as a malaria vector, the flight distance of *An. farauti s.l.* is not well documented and interpretation is doubtless complicated by taxonomic uncertainties. However, the attenuation with distance from Millner Swamp observed in our data is consistent with a previous assessment that the effective flight distance is about 1.6 km.⁴ The results of collections of *An. farauti s.l.* at the Barracks points to the presence of potential breeding sites of possibly both fresh and brackish water species in sites associated with the dense forested creek as well as the brackish swamp. Our results emphasize that the risk associated with military personnel returning to Robertson Barracks from overseas malaria areas can be minimised by maintaining the maximum possible separation between Barracks accommodation and the Millner Creek and Swamp complex.

Endemic arboviruses are also a matter of public health concern. The NT has the highest attack rate in Australia for both RRV and BFV,¹⁵ with areas in the Darwin rural area, which includes rural residential suburbs around the Barracks, having a much higher rate than Palmerston or urban Darwin.¹⁶ The principal vectors of RRV and BFV in the Top End of the NT are *Ae. vigilax* and *Cx. annulirostris*, which are both in relatively high numbers seasonally at Millner Swamp.

The serious diseases caused by infection with the MVEV and Kunjin virus (KUNV) are of particular concern. While human cases are relatively rare compared to RRV disease, MVEV disease has a 25% mortality rate, and any local case can cause considerable concern to the public. NT Department of Health (DoH) has a regular mosquito monitoring program around

urban Darwin and, based on results of this monitoring, analysis of environmental factors, and sentinel chickens to detect the presence of MVEV and KUNV, advises the public of high risk periods. In the event of high risk situations and human infection, NT DoH issues public health warnings for people to take precautions to prevent mosquito exposure. In 2010 there was a case of KUNV encephalitis in the Howard Springs locality which is not far from the Barracks.¹⁷

Exotic arboviruses including chikungunya, Japanese encephalitis and dengue are also of concern, with the risk of either troops or equipment returning from overseas importing the viruses or, in the case of dengue, the dengue mosquito *Ae. aegypti*. Chikungunya in particular can be vectored by *Ae. vigilax*,¹⁸ and *Cx. annulirostris* is a potential vector of Japanese encephalitis virus.¹⁹

The greatest vector-borne disease potentials at the Barracks are infection with RRV and BFV by *Ae. vigilax* from December to January inclusive and by *Cx. annulirostris* from January to April inclusive, and infection with MVEV and KUNV by *Cx. annulirostris* from March to June.

Management of mosquitoes at Robertson Barracks

Barrier protection by bifenthrin applications is best programmed from the start of November and repeated every 4 weeks to June to cope with at first RRV and then seasonal MVE risks, as well as the expected almost continual pest problems. Where people are exposed to mosquito attack at night by being outdoors, applications can be by hand held sprayers to outside walls, screens and nearby low vegetation. In key areas, hedges of vegetation can be established and subsequently treated.

If the Department of Defence wishes to control the pest and disease potential risks more efficiently than the barrier applications allow, this could be achieved by aerial spraying of the Millner Swamp system in a program that is carefully targeted in both time and space. The Millner Swamp system is not included in the routine aerial mosquito control program of the DoH. This control cannot be routine but must be based on monitoring of both adult numbers and the presence of larvae with the latter after

initiating events such as rain or tides or both. Areas to be targeted can be deduced partly from the vegetation types identified in 3 recent publications.^{20,21,22} Aerial control methods are detailed in DoH publications, where control has been achieved by periodic application of either *Bti* or methoprene products.

At expected times of seasonal occurrence of mosquito problems at the Barracks, detailed personal protection measures could be publicised, ranging from protective clothing, including permethrin impregnated clothing, to the use of personal insect repellents. In addition, protection can be enhanced by the use of mosquito lanterns and other new mosquito repellent devices.

In the course of transport links with north Queensland and overseas, the exotic mosquito vectors of dengue may be imported as eggs in water-filled containers, as has happened previously in Darwin.²³ Institutions such as Robertson Barracks appear particularly vulnerable to this importation. To reduce this risk, it is recommended that an exotic mosquito surveillance and precautionary control program be established at the Barracks. This would involve periodic inspection of water-filled receptacles, preventative spraying with alpha-cypermethrin or lambda-cyhalothrin, annual clean-up of receptacles, and the establishment of sentinel ovitraps or sentinel tyres, and/or insecticide-treated adult mosquito control tyre stations.^{2,23}

Conclusion

Because of its position in the landscape and the pattern of human movements, Robertson Barracks faces significant problems from mosquitoes as pests and as vectors of disease throughout the year. These require substantive action, including mosquito surveillance, control and personal protection, and could include an extensive, seasonal program of aerial control of mosquitoes in the nearby Millner Swamp.

Acknowledgements

We wish to thank the Australian Defence Force for their contribution to mosquito research in the NT. This work was also supported by an Australian Research Council Linkage grant and

the NT DoH. Grant Williamson prepared Fig. 1. We would also like to thank all personnel of Medical Entomology, CDC, NT DoH for their help making this work possible.

References

- Jacups SP, Whelan PI, Currie BJ. Ross River virus and Barmah Forest virus infections: A review of history, ecology, and predictive models, with implications for tropical northern Australia. *Vector-Borne and Zoonotic Diseases*. 2008;8: 283-297.
- Whelan P. Mosquito vector control in the Northern Territory. *Northern Territory Disease Control Bulletin*. 2007;14: 12-18.
- Whelan P, Kelton W. Common mosquitoes in the Northern Territory. Descriptions of species, habitats and disease potential. Casuarina: Department of Health and Community Services - Medical Entomology Branch; 2004.
- Whelan P. Potential Pest and Vector Mosquito Problems, Proposed Second Cavalry Regiment Site, Yarrowonga, Area, Darwin, NT. Casuarina: Department of Health and Community Services; 1988.
- Rohe DL, Fall RP. A miniature battery powered CO₂-baited trap for mosquito-borne encephalitis surveillance. *Bulletin of the Society for Vector Ecology*. 1979;4: 24-27.
- Russell RC, Whelan PI. Seasonal prevalence of adult mosquitoes at Casuarina and Leanyer, Darwin. *Australian Journal of Ecology*. 1986;11: 99-105.
- Russell RC. Seasonal abundance, longevity and population age composition of potential malaria vectors in northern and southern Australia. *Australian Journal of Zoology*. 1987;35: 289-306.
- Yang G-J, Brook BW, Bradshaw CJA. Predicting the timing and magnitude of tropical mosquito population peaks for maximizing control efficiency. *PLOS Neglected Tropical Diseases*. 2009;3: e385.
- Franklin DC, Whelan PI. Tropical mosquito assemblages demonstrate 'textbook' annual cycles. *PLoS ONE*. 2009;4: e8296.
- Russell RC, Kay BH. Changes in the spectrum of mosquito-borne disease in Australia and other vector threats and risks, 1972–2004. *Australian Journal of Entomology*. 2004;43: 271-282.
- Whelan PI. Mosquito Control in Leanyer Swamp. *Northern Territory Disease Control Bulletin*. 2007;14: 19-20.
- Russell RC. Vectors vs. humans in Australia— who is on top down under? An update on vector-borne disease and research on vectors in Australia. *Journal of Vector Ecology*. 1998;23: 1-46.
- Walker J. Malaria in a changing world: an Australian perspective. *International Journal of Parasitology*. 1998;28: 947-953.
- Black RH. Malaria in Australia. Canberra: Australian Government Publishing Service; 1972.
- Fitzsimmons GJ, Wright P, Johansen CA, Whelan PI, National Arbovirus and Malaria Advisory Committee. Arboviral diseases and malaria in Australia, 2008-09: Annual report of the National Arbovirus and Malaria Advisory Committee. National Arbovirus and Malaria Advisory Committee; 2010.
- Whelan PI, Merianos A, Hayes G, Krause V. Ross River virus transmission in Darwin, Northern Territory, Australia. *Arbovirus Research in Australia*. 1997;7: 337-345.
- Gray T, Burrow J, Markey P, Whelan PI, Jackson J, Smith D, Currie B. West Nile virus (Kunjin subtype) disease in the Northern Territory of Australia – a case of encephalitis and review of all reported cases. *American Journal of Tropical Medicine & Hygiene* in press.
- Van den Hurk AF, Hall-Mendelin S, Pyke AT, Smith GA, Mackenzie JS. Vector competence of Australian mosquitoes for chikungunya virus. *Vector-Borne and Zoonotic Diseases*. 2010;10: 489-495.
- Van den Hurk AF, Nisbet DJ, Hall RA, Kay BH, Mackenzie JS, Ritchie SA. Vector competence of Australian mosquitoes (Diptera: Culicidae) for Japanese Encephalitis virus. *Journal of Medical Entomology*. 2003;40: 82-90.
- Jacups SP, Kurucz N, Whelan PI, Carter JM. A comparison of *Aedes vigilax* larval population densities and associated vegetation categories in a coastal wetland, Northern Territory, Australia. *Journal of Vector Ecology*. 2009;34: 311-316.
- Kurucz N, Whelan PI, Carter JM, Jacups SP. A geospatial evaluation of *Aedes vigilax* larval control efforts across a coastal wetland, Northern Territory, Australia. *Journal of Vector Ecology*. 2009;34: 317-323.
- Kurucz N, Whelan P, Carter J, Jacups S, McDonnell J. Salt marsh mosquito larval control in Leanyer coastal wetland, Northern Territory. *Northern Territory Disease Control Bulletin*. 2010;17: 35-39.
- Nguyen H, Whelan P, Finlay-Doney M, Soong SY. Interceptions of *Aedes aegypti* and *Aedes albopictus* in the port of Darwin, NT, Australia, 25 January and 5 February 2010. *Northern Territory Disease Control Bulletin*. 2010;17: 29-35.

My mosquito run

Graeme Mattison

Visiting medical elective student, CDC, Darwin

The opportunity to undertake a medical elective is one that requires a considerable amount of thought when planning. One key determinant of my chosen destination was to gain experience in an area of medicine unfamiliar to me in the United Kingdom (UK). The chance to shadow the Medical Entomology team was therefore an exciting prospect that I was keen to pursue (generally mosquitoes dislike the UK and its pale-skinned food).

In all honesty, one of my tasks prior to arriving at the Centre for Disease Control (CDC) was to understand just what entomology was (and how to spell it) and how the process of insect study integrated with medical practice. The main problem with attempting to research entomology from the UK is that the vector-borne diseases are quite rare and therefore difficult to place into context. I had previously only read about conditions such as dengue and Murray Valley encephalitis, without considering how they are monitored at the public health level. My understanding of arbovirology has improved significantly since my arrival at the CDC. I have been fortunate to consolidate my knowledge with the practical experience of the 'adult mosquito run' provided by the Medical Entomology unit. So here's what I learned on my mosquito run adventure!

Mammals and bird species constantly exhale carbon dioxide, which can be detected by most mosquito species (using chemoreceptors) from a distance of up to 30m. The mosquito trap itself is therefore based around the idea that mosquitoes are attracted to CO₂ which mimics a source of blood to prey upon. Carbon dioxide is emitted from canisters containing dry ice, which undergoes sublimation to release CO₂ into the nearby surroundings. Underneath the canister is a motor (with a light attached to further attract mosquitoes) and collection chamber (Figure). The motor powers a constant flow of air down into the collection chambers which causes mosquitoes to fall into the trap and prevents their escape. These traps are strategically placed in multiple locations around the outskirts of various suburbs of Darwin to accurately determine mosquito populations arising from adjacent

Figure: Mosquito trap



breeding sites. Traps are set in the afternoon before sundown, and collected the following morning after sunrise. After overnight trapping, trapped mosquitoes are collected and brought to the entomology laboratories for analysis and data collection.

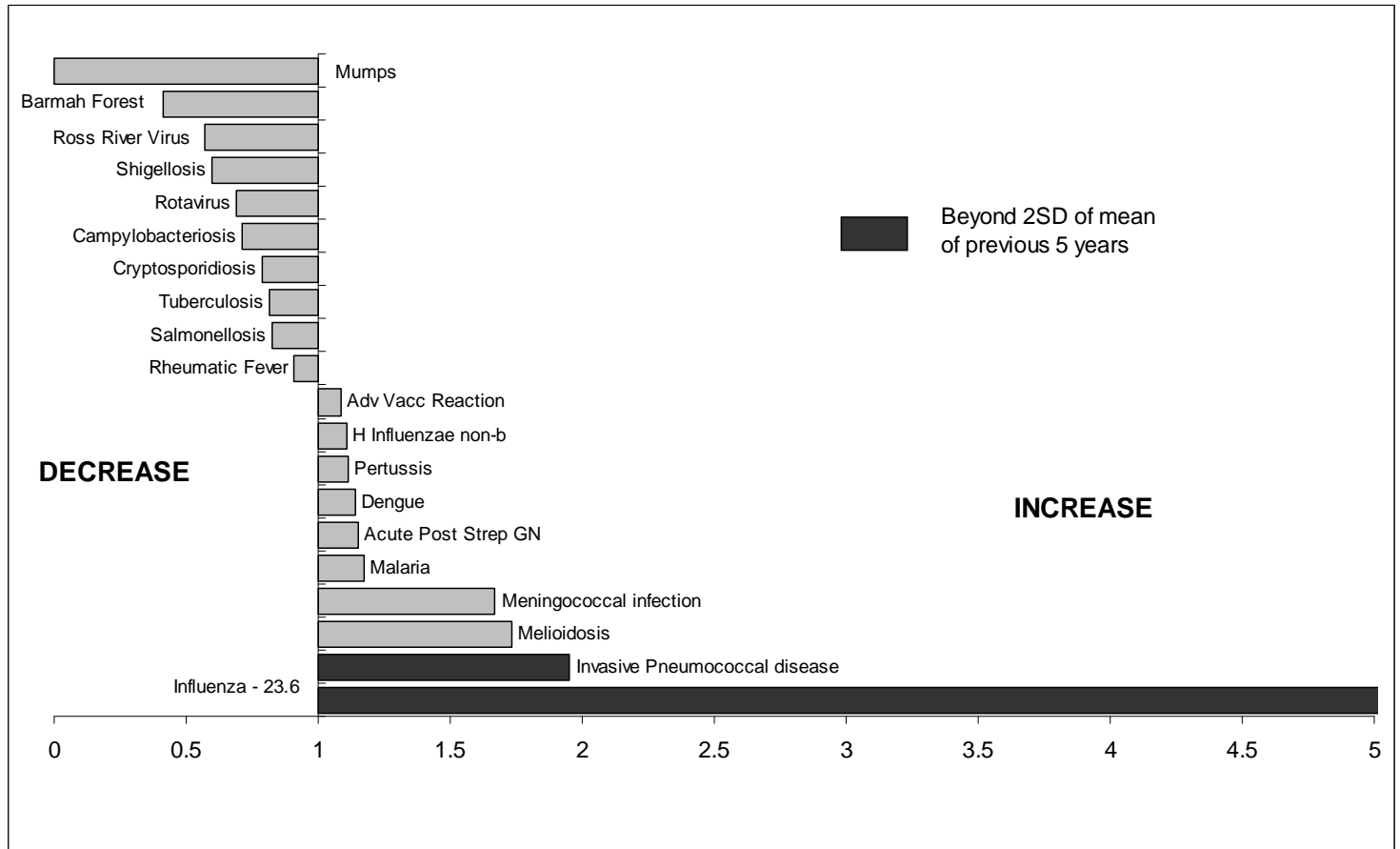
As well as identifying mosquitoes, data is obtained on the crude number of mosquitoes trapped and whether particular species of mosquitoes are found in different areas. For example, the mosquito *Aedes aegypti*, which is the primary vector for dengue, yellow fever and chikungunya virus, needs to be reported should it be discovered, as the mosquito has been eliminated from the NT (and the NT means to keep it that way), however it is found in neighbouring regions such as Indonesia and Northern Queensland. Endemic mosquitoes such as the northern salt marsh mosquito *Aedes vigilax* and the common banded mosquito *Culex annulirostris* are closely monitored, to assess the potential risk of mosquito borne disease transmission.

Overall, my experience of Medical Entomology while at the CDC has been insightful as a learning opportunity and fascinating as a medical student resident in the UK. Many thanks to the Medical Entomology unit at the CDC for a remarkable experience.

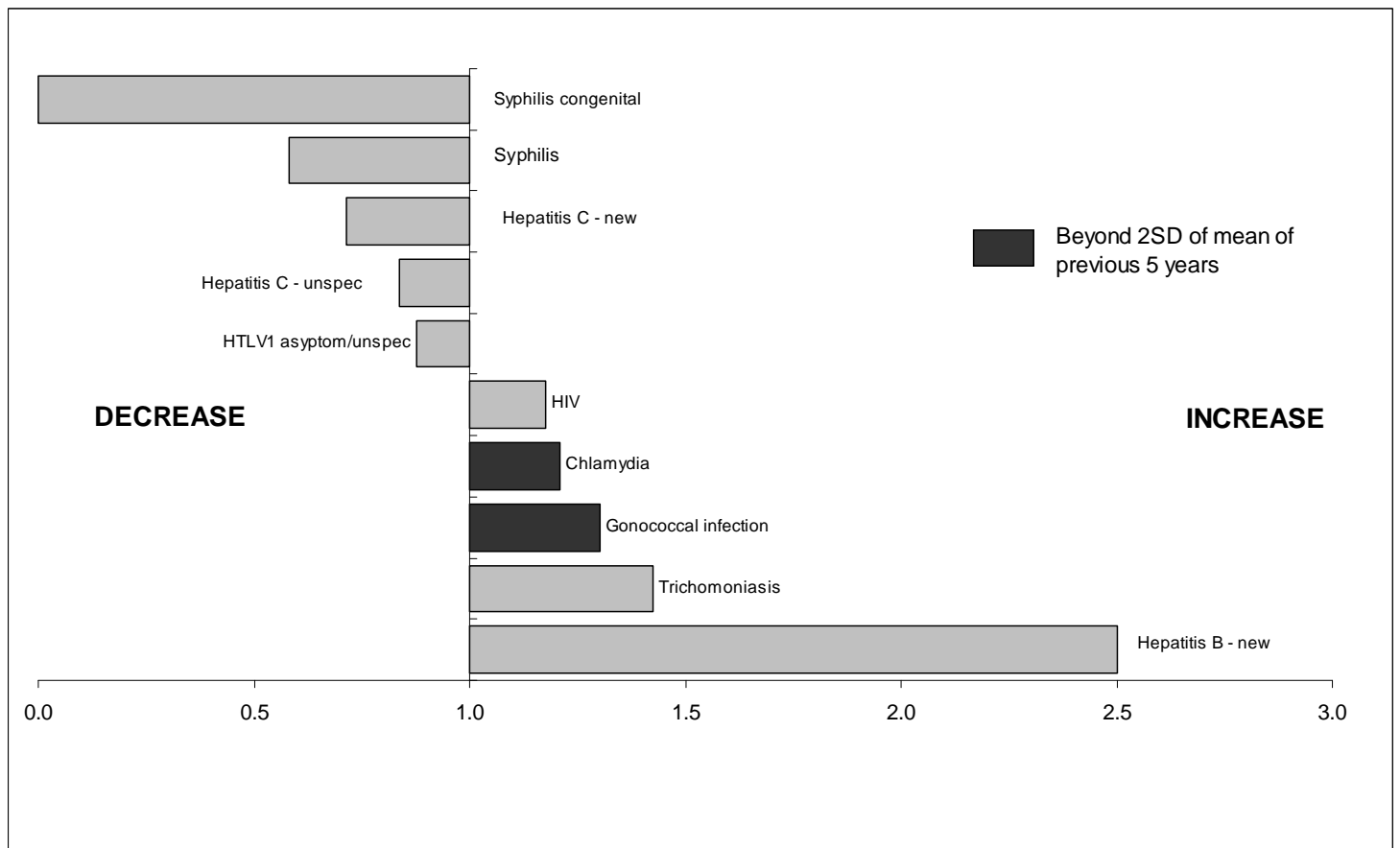
NT NOTIFICATIONS OF DISEASES BY ONSET DATE & DISTRICTS
1 January—30 March 2011 & 2010

	Alice Springs		Barkly		Darwin		East Arnhem		Katherine		N T	
	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010	2011	2010
Acute Post Strep glomerulonephritis	1	0	0	0	2	0	0	0	3	1	6	1
Adverse Vaccine Reaction	5	3	0	0	6	14	1	2	3	2	15	21
Arbovirus NOS	0	0	0	0	0	2	0	0	0	0	0	2
Barmah Forest	1	3	2	0	9	34	1	1	3	4	16	42
Brucellosis	0	0	0	0	0	2	0	0	0	0	0	2
Campylobacteriosis	7	7	2	1	27	26	4	1	5	3	45	38
Chickenpox	0	2	0	0	7	6	2	4	5	0	14	12
Chlamydia	229	195	10	15	314	315	65	56	68	68	686	649
Chlamydial conjunctivitis	0	5	1	0	1	2	0	0	0	2	2	9
Cryptosporidiosis	10	15	0	0	10	7	6	3	8	2	34	27
Dengue	0	0	0	0	15	22	1	0	0	1	16	23
Food/water borne disease	2	0	0	0	0	0	0	0	0	0	2	0
Gonococcal conjunctivitis	1	1	0	0	1	0	0	0	0	0	2	1
Gonococcal infection	287	250	23	14	99	75	41	29	82	46	532	414
Hepatitis B - chronic	5	13	0	1	8	5	9	19	4	10	26	48
Hepatitis B - new	1	0	0	0	1	0	0	0	0	0	2	0
Hepatitis B - unspecified	19	8	0	0	29	31	1	2	6	3	55	44
Hepatitis C - new	0	0	0	0	1	0	0	0	0	0	1	0
Hepatitis C - unspec	8	8	0	1	34	19	2	1	4	6	48	35
H Influenzae b	0	1	0	0	0	0	0	0	0	0	0	1
H Influenzae non-b	2	1	0	0	0	0	0	0	0	0	2	1
HIV	0	0	0	0	3	5	1	0	0	0	4	5
HTLV1 asymptomatic/unspecified	16	12	0	1	0	1	0	0	1	0	17	14
HUS	0	0	0	0	0	0	0	0	1	0	1	0
Influenza	5	1	0	0	127	2	75	2	104	0	311	5
Legionellosis	0	0	0	0	2	0	1	0	0	0	3	0
Leprosy	0	0	0	0	0	1	1	0	0	0	1	1
Leptospirosis	0	1	0	0	1	1	0	0	0	0	1	2
Listeriosis	1	0	0	0	0	0	0	0	0	0	1	0
Malaria	0	0	0	0	8	8	0	0	0	0	8	8
Measles	0	0	0	0	0	1	0	0	0	0	0	1
Melioidosis	3	0	0	1	23	37	3	4	5	3	34	45
Meningococcal infection	0	0	0	0	2	0	1	0	0	0	3	0
MVE	1	0	1	0	0	0	0	0	0	0	2	0
Non TB Mycobacteria	0	1	0	0	2	1	0	0	0	0	2	2
Pertussis	19	26	3	1	23	31	1	1	8	1	54	60
Pneumococcal disease	20	7	1	0	2	3	0	0	2	0	25	10
Rheumatic Fever	4	4	0	0	5	2	1	4	5	5	15	15
Ross River Virus	8	11	3	3	55	101	3	5	14	13	83	133
Rotavirus	18	14	1	3	3	4	6	4	5	5	33	30
Salmonellosis	22	25	2	5	76	93	6	7	13	27	119	157
Shigellosis	9	12	0	0	9	6	1	3	6	1	25	22
Syphilis	9	8	5	0	7	14	5	1	6	11	32	34
Trichomoniasis	182	126	36	24	137	168	97	84	167	128	619	530
Tuberculosis	0	1	0	0	7	2	0	0	0	2	7	5
Typhoid	0	0	0	0	0	1	0	0	0	0	0	1
Typhus	0	0	0	0	0	1	0	0	0	0	0	1
Vibrio food poisoning	0	0	0	0	0	0	0	0	1	0	1	0
Zoster	6	5	1	2	32	17	2	3	4	3	45	30
Total:	901	766	91	72	1,088	1,060	337	236	533	347	2950	2481

Ratio of the number of notifications (1st Quarter 2011 cases to the mean Q1 2006-10): selected diseases



Ratio of the number of notifications (1st Quarter 2011 cases to the mean Q2 2006-10): sexually transmitted diseases



Comments on notifications P37

Influenza

There were 311 cases of influenza in the first quarter of 2011 which is over 23 times the expected number of 13 cases. This increase is due to continued transmission of influenza through the Top End wet season as part of the late 2010 flu season. Most of the flu cases in 2011 have been of the A/H3N2 subtype (ie not the previous season's pandemic H1N1 strain) and have been mainly in the Top End. In addition, the increase in influenza testing since the pandemic of 2009 would also have contributed to the increase (please see Figure).

Pneumococcal disease

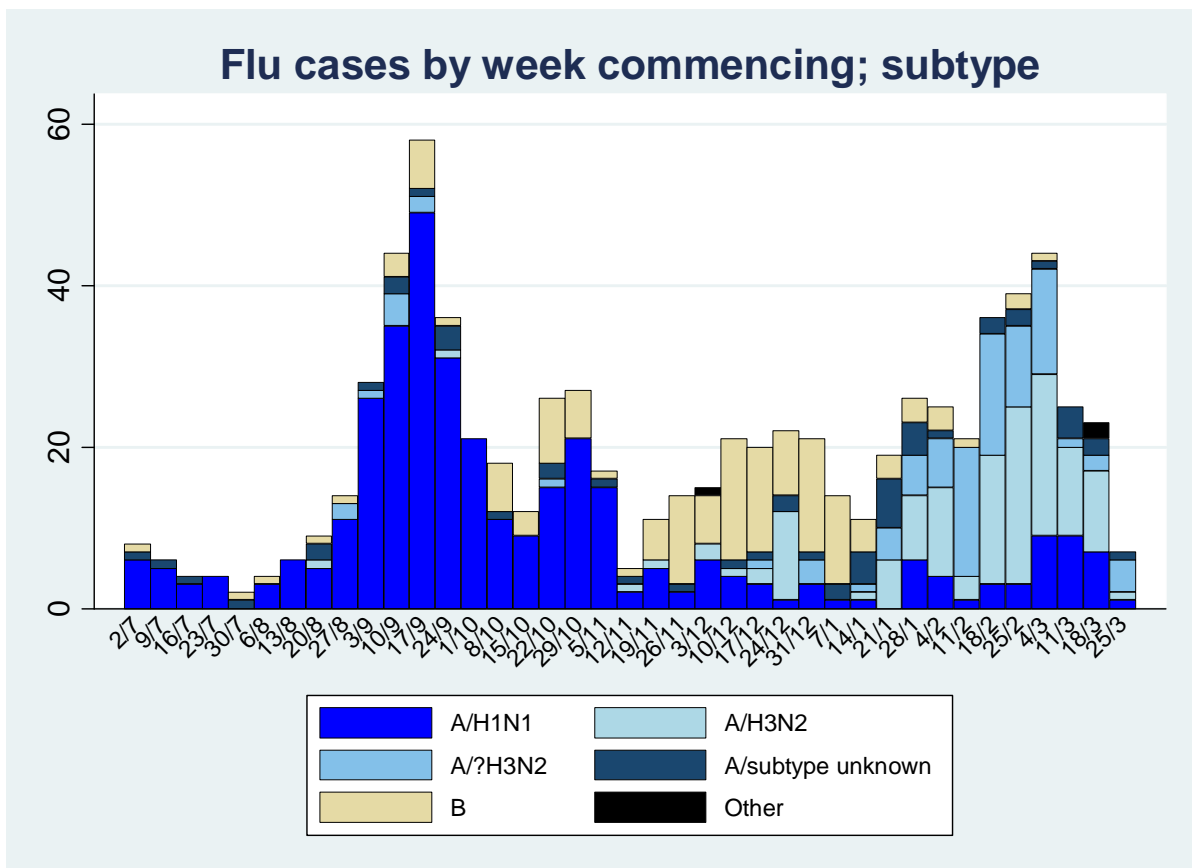
There were 25 cases of invasive pneumococcal disease in the first quarter of 2011, almost twice

the expected 13 cases (5 year first quarter mean). This is due to the ongoing outbreak of serotype-1 invasive pneumococcal disease in Central Australia which is currently being investigated by Centre for Disease Control.

Chlamydia and gonorrhoea

Additional STI testing was undertaken during this quarter. This is believed to be due to efforts within Remote Health to address the high rates of STIs and to a large-scale randomised control trial (STRIVE study) currently being rolled out in many NT remote communities. With the STRIVE study being rolled out, more testing is expected and STI notifications are expected to increase further.

Figure: Influenza cases notified type and week of occurrence



Immunisation coverage for children aged 12-<15 months at 31 March 2011

Region	Number in District	% DTP	% Polio	% Hib	% Hep B	% Fully vaccinated
Darwin	293	90.4%	90.4%	90.1%	90.1%	90.1%
Winnellie PO Bag	88	89.8%	89.8%	89.8%	89.8%	89.8%
Palm/Rural	203	89.7%	89.7%	89.7%	89.7%	89.7%
Katherine	109	93.6%	93.6%	93.6%	93.6%	93.6%
Barkly	25	92.0%	92.0%	92.0%	92.0%	92.0%
Alice Springs	133	92.5%	92.5%	92.5%	92.5%	92.5%
Alice Springs PO Bag	62	85.5%	85.5%	85.5%	85.5%	85.5%
East Arnhem	48	89.6%	89.6%	89.6%	89.6%	89.6%
NT	961	90.5%	90.5%	90.4%	90.4%	90.4%
Indigenous	391	87.0%	87.0%	87.0%	87.0%	87.0%
Non-Indigenous	570	93.0%	93.0%	92.8%	92.8%	92.8%
Australia Indigenous	3,328	85.1%	85.0%	85.0%	85.0%	85.0%
Australia Non Indigenous	71,245	92.6%	92.5%	92.4%	92.2%	92.1%
Australia Total	74,573	92.2%	92.2%	92.1%	91.9%	91.8%

Immunisation coverage for children aged 24-<27 months at 31 March 2011

The immunisation coverage for the 24 to <27 months cohort is not presented with this report.

Immunisation coverage for children aged 60-<63 months at 31 March 2011

Region	Number in District	% DTP	% Polio	% MMR	% Fully vaccinated
Darwin	246	83.7%	83.3%	82.1%	81.7%
Winnellie PO Bag	90	92.2%	92.2%	92.2%	92.2%
Palm/Rural	240	87.1%	87.1%	87.1%	86.7%
Katherine	74	94.6%	94.6%	94.6%	94.6%
Barkly	9	77.8%	77.8%	88.9%	77.8%
Alice Springs	106	90.6%	90.6%	89.6%	89.6%
Alice Springs PO Bag	43	95.3%	95.3%	97.7%	95.3%
East Arnhem	52	90.4%	90.4%	90.4%	90.4%
NT	860	88.3%	88.1%	87.9%	87.4%
Indigenous	338	90.2%	90.2%	90.8%	89.9%
Non-Indigenous	522	87.0%	86.8%	86.0%	85.8%
Australia Indigenous	2,953	85.2%	85.1%	85.4%	84.7%
Australia Non Indigenous	68,210	90.0%	89.9%	89.7%	89.4%
Australia Total	71,163	89.8%	89.7%	89.5%	89.2%

Immunisation coverage 31 March 2011

Compiled by Charles Roberts, CDC, Darwin

Immunisation coverage rates for NT children by regions based on Medicare address postcode as estimated by the Australian Childhood Immunisation Register are shown on page 39.

Background information to interpret coverage

Winnellie PO Bag is postcode 0822, which includes most Darwin Rural District communities, some East Arnhem District communities and some people who live in the Darwin "rural area" who collect mail from the Virginia store or Bees Creek. Alice Springs PO Bag is postcode 0872, which includes Alice Springs District, Nganampa and Ngaanyatjarra communities.

The cohort of children assessed at 12 to <15 months of age on 31 Mar 2011 were born between 1 Oct 2009 and 31 Dec 2009 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 doses of PRP-OMP Hib or 3 doses of another Hib vaccine, and 2 doses of hepatitis B vaccine (not including the birth dose) (latest doses due at 6 months of age). 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 Mar 2011 born between 1 Oct 2008 and 31 Dec 2008 inclusive is not presented in this report and will be updated in future issues

The cohort of children assessed at 60 to <63 months of age on 31 Mar 2011 were born

between 1 Oct 2005 and 31 Dec 2005 inclusive. To be considered fully vaccinated, these children must have received 4 valid doses of vaccines containing diphtheria, tetanus, pertussis antigens, 4 doses of poliomyelitis vaccine and 2 valid doses of measles, mumps, rubella vaccine (latest doses due at 4 years of age). All vaccinations must have been administered by 60 months (5 years) of age.

Interpretation

The immunisation coverage for the 24 to <27 months cohort is not presented with this report. As reported in the March 2011 Bulletin a request for a recalculation of the data has been made to the Department of Health and Ageing and the Australian Childhood Immunisation Register because of a reported decline in the number of children considered fully vaccinated in relation to Hib. The outcome of this recalculation has not been finalised.

Immunisation coverage in NT children was below the national average across the other 2 cohorts.

Immunisation coverage in Indigenous children in the NT was higher across the 12 to <15 months and 60 to <63 months cohorts as compared to coverage for Indigenous children at the national level. Indigenous NT children had lower coverage than non-Indigenous NT children at 12<15 months but higher coverage at 60<63 months.

We will provide an update regarding the 24 to <27 months cohort in a future issue of the *Bulletin*.

NT malaria notifications January - March 2011

Merv Fairley, CDC, Darwin

There were 7 notifications of malaria received for the first quarter of 2011. The following table provides details about where the infection was thought to be acquired, the infecting agent and whether chemoprophylaxis was used.

Number of cases	Origin of infection	Reason exposed	Agent	Chemoprophylaxis
1	Vietnam	Holiday	<i>P falciparum</i>	No
1	India	Holiday	<i>P vivax</i>	No
1	Ghana	Holiday	<i>P falciparum</i> & <i>P. ovale</i>	No
1	Ghana	Holiday	<i>P falciparum</i>	No
1	Cote de Ivoire	Holiday	<i>P falciparum</i>	No
1	Indonesia	Holiday	<i>P falciparum</i>	No
1	Indonesia	Holiday	<i>P vivax</i>	No

Disease Control staff updates April—June

Darwin

Jaana Wenham has joined the Medical Entomology Unit as a Technical Officer.

Alex Roberts has resigned from the Medical Entomology Unit and moved to Cairns in late April.

Helen Wassman who has worked several years at Royal Darwin Hospital (RDH) as the Occupational Therapy Unit manager, has joined the Community Paediatrician as a Project Officer for 6 months.

Welcome back to **Michelle Harlock**, OzFoodNet Epidemiologist who has returned from maternity leave and farewell to **Jenine Gunn** who acted in the position.

Holly McLauchlan from the immunisation database has relocated to NSW but will continue to enter data remotely.

Florence Henaway, Remote Sexual Health Coordinator Aboriginal Health Worker, has returned from maternity leave to work 3 days a week.

Blake Edwards joined the SHBBV Unit as an Adolescent Sexual Health Promotion Officer.

Patricia Angco, has transferred to Ministerial Liaison and **Danielle Bowen** has commenced as the Administration Officer for the Community Physician.

Lesley Nuttall, Public Health Nurse, has transferred from The Child Health Strategy Unit in Health Development to the Trachoma Team to work part-time job sharing the co coordinators position with **Cate Coffey**. Their hours are:

Cate Coffey- based Alice Springs
Monday, Tuesday, Wednesday 0800 - 1500

Lesley Nuttall – based Darwin
Monday, Thursday, Friday 0800 – 1500

On 16 June **Kirsten Thompson**, Hepatitis C CNC Clinic 34 Darwin, was formally commended and thanked by the Chief Minister, Paul Henderson, for her significant and outstanding role in the flood recovery at Daly River - congratulations Kirsten!

Alice Springs

Nina Missen, RHD Register Co-ordinator, will be on leave for 6 month starting on 18 July and **Lorraine Geperth** will act in her position .

Ruth Primrose, Public Health Nurse has joined the Trachoma Team covering Central Australia south.

Christine Barrett and **Gweneth White**, Public Health Nurses, have both joined the Trachoma Team on a casual basis.

Nhulunbuy

Kathy Shields, Public Health Nurse, has transferred to CDC from Airmed and will be working in the areas of rheumatic heart disease (RHD), trachoma and About Giving Vaccines (AGV). Kathy has lived in Nhulunbuy for 25 years and worked in numerous communities in East Arnhem District and is very experienced. Liz and the team are very excited that she has joined CDC Nhulunbuy.

Centre for Disease Control 2011 Conference

Darwin Convention Centre 6-8 September

The annual 3 day Centre for Disease Control (CDC) Conference will be held in Darwin from 6 - 8 September 2011. The conference has been held on an annual basis since 1990 and provides a valuable forum for CDC staff and invited public health workers from across the Northern Territory to meet and share information each year.

The CDC Conference provides a unique opportunity to present on topics of public health importance and to discuss key issues which results in greater awareness and understanding of public health activities and priorities across the NT. The annual Conference is highly regarded by CDC staff and other health staff attributing to improved public health outcomes.

Topics covered (a full program will be available mid August)

- Day 1: Mosquito borne diseases, melioidosis, opportunistic infections, potential zoonotic diseases in the NT, TB/Leprosy, Sexual Health and Blood Borne Viruses.
- Day 2: Rheumatic Heart Disease, Trachoma, Pertussis, Invasive Pneumococcal disease, alcohol reforms and further issues Sexual Health and Blood Borne Viruses.
- Day 3: Q Fever, Immunisation and whole-of-life register, vaccination and more.

Speakers include:

Dr Christine Selvey Senior Director of Communicable Diseases, Queensland Health	Dr Vicki Krause Director Centre for Disease Control, NT Department of Health	Professor Bart Currie Infectious diseases physician, RDH
Dr Josh Davies Infectious diseases physician, RDH	Professor Nick Anstey Infectious diseases physician, RDH	Professor Ric Price Infectious diseases physician, RDH
Dr Sue Fitzpatrick & Dr Lorna Melville Veterinary Virologist, Berrimah Veterinary Laboratories	Kate Senior Menzies School of Health Research	Dr Rob Baird Director of Microbiology, Royal Darwin Hospital
Dr Peter Markey Head of Surveillance NT, Department of Health	Dr Nathan Ryder Sexual Health NT, Department of Health	Cate Coffey Coordinator Trachoma NT, Department of Health

For more information contact Justine Glover at Justine.glover@nt.gov.au