Notifiable diseases in Indigenous Australians in the NT: Are we closing the gap?
Matthew Di Palma, GP Registrar at CDC and Vicki Krause, CDC Darwin

Abstract

**Aims:** The incidence of notifiable diseases in Indigenous Australians provides important information on progress towards addressing Indigenous health and social disadvantage. This study describes longitudinal trends in notifiable disease incidence in the Northern Territory (NT), Australia, for the period 2000–2014. Projections to 2020 are calculated from these trends to determine if and when a closure of the incidence gap of the rates of notifiable diseases or conditions between Indigenous and non-Indigenous NT residents is anticipated.

**Methods:** Seven notifiable diseases strongly associated with the social determinants of health were included in the study, grouped into enteric diseases in children under 5 years, sexually transmitted infections and tuberculosis. Notification rates were age-standardised. Exponential projections to 2020 were calculated from these observed rates utilising the method of least squares.

**Results:** The incidence gap for hepatitis A has closed, while closure in the next 5 years is calculated for salmonella enteritis and tuberculosis. Notifications of shigella and rotavirus enteritis declined overall during the study period, although a persistent incidence gap is projected well beyond 2020. Gonorrhoea notifications in Indigenous residents and chlamydia notifications overall are increasing, with persistent gaps projected beyond 2020.

**Conclusion:** Over the period 2000–2014, there was differential progress towards closing the gap in notifiable disease incidence between Indigenous and non-Indigenous Australian NT residents. Meeting this ongoing challenge, particularly in the area of sexual health, must remain a foremost policy priority for government and public health jurisdictions.

Key words: notifiable disease; Indigenous Australians; Northern Territory; incidence; closing the gap

Contents

- Notifiable diseases in Indigenous Australians in the NT: Are we closing the gap? 1
- Lead in the Northern Territory—beyond paint and petrol 7
- Uptake of influenza vaccination by pregnant women in the Northern Territory 11
- No Jab No Pay changes from 1 January 2016 and FREE catch up for young people less than 20 years of age 14
- Syphilis outbreak cases in the NT 16
- Making a referral to the Viral Hepatitis Clinic 17
- Don’t get MELIOIDOSIS poster 18
- Melioidosis fact sheet 19
- Environmental changes – a challenge for mosquito control in the Lee Point area, Darwin, NT, Australia 21
- Splashfest 2015 24
- Abstracts from peer reviewed published articles related to the Northern Territory 25
- NT malaria notifications July-September 2015 34
- NT notifications of disease by onset date and district 35
- Graphs of selected diseases and STIs 36
- Comments on notifications 37
- Fact sheet, guideline and web page update October-December 2015 37
- Immunisation coverage 38
- Senior Immunisation Nurse, CDC, Chris Nagy retires 40
- Farewell to Senior Policy and Coordination Officer Justine Glover 41
- Disease control staff updates 41
- World Antibiotics Awareness Week 42
Introduction

Indigenous Australians continue to live an average of 10 years less than their non-Indigenous counterparts. This difference in life expectancy has become an important summary indicator of the prevailing Indigenous health and social disadvantage in Australia today. Addressing this disadvantage has been a policy priority for various Australian government and public health jurisdictions in recent decades. This agenda has been popularised through the slogan ‘closing the gap.’ The Northern Territory (NT) is the Australian state or territory with the highest proportion of Indigenous residents and, consequently, the region of Australia most disproportionately burdened by this disadvantage.

Routine surveillance of notifiable diseases is a core responsibility of public health jurisdictions in Australia. The majority of conditions under surveillance are communicable, where transmission may be heightened by conditions of social deprivation, such as overcrowding, inadequate housing and water, malnutrition, limited education and insufficient or culturally-inappropriate access to essential services. As such, trends in the incidence of notifiable diseases may provide a useful proxy-indicator of progress towards addressing Indigenous health and social disadvantage.

This study reports on longitudinal trends in selected notifiable disease incidence in the NT for the period 2000–2014. Based on these observed trends, projected incidence to 2020 is modelled to determine if and when a closure of the incidence ‘gap’ between Indigenous and non-Indigenous Australians is anticipated for each disease. The study forms a follow up to a similar study from 2008, in which projections to 2014 were calculated based on data from 2000–2007. As a secondary aim, therefore, the present study seeks to determine to what extent observed notification rates differed from those previously projected.

Methodology

Setting

The NT is the most sparsely populated state or territory of Australia. It spans a broad geographic area from the arid, desert centre to the tropical north. The 2013 population was 241,196, of whom 29% identified as Aboriginal or Torres Strait Islander, compared with the national average of 3%. Of the Indigenous Australians living in the NT, 70% reside in rural or remote regions as compared with only 13% for the non-Indigenous population.

The NT Centre for Disease Control (CDC) is the principal public health authority in the NT and responsible for surveillance of notifiable diseases. Clinicians working in the Territory, along with pathology laboratories, are mandated by law to report suspected and confirmed cases to the CDC. As such, this system endeavours to capture all cases of notifiable disease in the Territory over time.

Study design

The conditions chosen for inclusion in this study were based on the 2008 study and, historically, have been endemic in Indigenous communities in the NT. Several conditions are among the most frequently notified diseases in the NT, and therefore the most burdensome. Diseases were also selected because of a strong association between their transmission and conditions of socioeconomic deprivation. The diseases were divided into 3 groups: (1) enteric diseases in children under 5 years (shigellosis, salmonellosis, rotavirus gastroenteritis, hepatitis A), (2) sexually transmitted infections (chlamydia, gonorrhoea) and (3) tuberculosis.

Notifications received by the NT CDC for the years 2000-2014 were obtained for the above conditions. Notification rates per 100,000 population were calculated for each condition, stratified by Indigenous status. Because NT population figures were only available up to 2013, population growth for the year 2014 was projected based upon the average growth rate over the preceding 5 years. Disease notification rates were then age-standardised against the 2001 ABS standard Australian population, with the exception of enteric diseases in which only the under 5 years population was examined. For each condition, rates were graphed by year for Indigenous and non-Indigenous persons. An exponential curve was subsequently fitted to these data points using the least-squares methodology to calculate the line of best fit.
This curve formed the basis for the predictive model for future notification rates, which were projected to the year 2020. Additionally, the year of ‘gap closure’ was calculated for diseases where the curves for Indigenous and non-Indigenous Australians were projected to converge by 2020. All analyses were performed using Microsoft Excel 2010.

In the previous study from 2008, projected notification rates to 2014 were calculated from notification rates over the period 2000-2007. Since this time, NT population figures for that time period have been revised and, accordingly, projections from 2000–2007 were re-calculated in this study. This enabled a direct comparison to be made between actual vs predicted incidence in 2014.

**Results**

**Enteric diseases in children under 5 years**

In 2000, rotavirus was the most commonly notified enteric disease in Indigenous children under 5 years at 2530.6 notifications per 100 000 persons (Figure 1), followed by salmonella (1646.4), shigella (853.5) and hepatitis A (68.0). In contrast, in non-Indigenous children, salmonella was most commonly notified (921.5), followed by rotavirus (563.9), shigella (79.5) and hepatitis A (38.1).

During the period 2000-2014, year-to-year variability was observed for all enteric diseases in both Indigenous and non-Indigenous children. With the exception of salmonella notifications in non-Indigenous children, however, trends of declining notification rates were observed for all enteric diseases. Additionally, in Indigenous children the observed notification rates in 2014 for all enteric diseases studied were lower than the projected rates for 2014 based on trends from 2000-2007 (Table 1), indicating accelerated rates of decrease over time. There have been no notifications of hepatitis A in Indigenous children under 5 years since 2007. Therefore, for hepatitis A, the ‘gap’ has already closed.

**Sexually transmitted infections**

At the beginning of the study period, gonorrhoea was the most frequently notified sexually transmitted infection in Indigenous Australians in the NT (age-standardised incidence 1469.8 per 100 000), followed by chlamydia (1034.7). Notification rates for gonorrhoea and chlamydia increased over the study period in Indigenous Australians. A similar trend was observed in non-Indigenous Australians for chlamydia, albeit commencing from a lower baseline, while gonorrhoea notifications remained relatively consistently low. While an increase in notification rates for chlamydia and gonorrhoea was projected based on 2000–2007 data for Indigenous persons in the NT, the actual rate in 2014 was lower than these projections (Table 2).

![Figure 1: Rotavirus notifications in children under 5 years per 100 000 population in the NT 2000–2014, stratified by Indigenous status, with projections to 2020.](image-url)
**Tuberculosis**

Age-standardised incidence of tuberculosis in Indigenous Australians in the NT in 2000 was 83.8 per 100 000 population, compared with 15.6 in non-Indigenous Australians (Figure 2). Tuberculosis incidence declined in Indigenous Australians to 28.8 in 2014, consistent with an overall declining trend over this period and a projected incidence in 2020 of 12.2. In contrast, a slight increasing overall trend was observed in non-Indigenous Australians (noting the term non-Indigenous Australians includes Australian-born and overseas-born Australians for this and all diseases examined). The incidence gap between Indigenous and non-Indigenous Australians is projected to close in 2015 (Figure 2).

**Discussion**

Differential progress has been made in reducing the incidence gap between Indigenous and non-Indigenous Australians for notifiable diseases in the NT. Our results suggest the greatest gains have been achieved for selected enteric diseases and tuberculosis, where the gap for some conditions has already closed or is predicted to close in the next 5 years. In contrast, there has been less progress in closing the gap for the sexually-transmitted infections chlamydia and gonorrhoea.

In the area of enteric diseases, hepatitis A and rotavirus vaccinations were introduced onto the childhood vaccination schedule in 2005 and 2006, respectively. This program makes vaccination freely available to eligible children and has been accompanied by ongoing health promotion campaigns to optimise vaccination uptake. The decline in Indigenous notifications to zero for hepatitis A suggests a strong impact from the hepatitis A vaccination program. A similar impact from rotavirus vaccination is less evident in Indigenous children. It appears that notifications of rotavirus were already declining prior to 2006.
without clear evidence for an acceleration of this decline following vaccine introduction. In contrast, in non-Indigenous children the vaccine appears to have had some impact in reducing the magnitude of outbreaks, which since 2006 have not exhibited their historical 2-4 year cycle (Figure 1). Consequently, a persistent incidence gap in rotavirus notifications is still projected well into the future. Nevertheless, these data do not capture the severity of cases of rotavirus gastroenteritis, which may be a more sensitive indicator of vaccine impact. This is because vaccination is more effective at decreasing the incidence of severe gastroenteritis requiring hospitalisation, as compared with its impact on disease incidence of any severity.7

Tuberculosis is a notifiable condition with a historically high burden in remote Indigenous communities. The tuberculosis control program in the NT has had considerable resource investment to facilitate thorough contact tracing of new cases of active disease and provision of antibiotic prophylaxis to those with evidence of latent tuberculosis infection as well as support for all patients to complete curative treatment. Remote communities, which historically have carried a high burden of tuberculosis infection and disease, have been particularly targeted in these efforts. The Indigenous rate of tuberculosis notification reduced encouragingly by 66% over the study period. The projected year of gap closure of 2015 for tuberculosis however is in the context of the data for non-Indigenous Australians, which includes overseas-born NT residents, maritime refugee arrivals and illegal foreign fishers, patient groups from backgrounds with a high burden of tuberculosis and whose numbers increased during the study period.8 The incidence of tuberculosis nationwide in Australian-born non-Indigenous persons remains very low (less than 1 per 100 000).9 The target for Indigenous Australian NT residents needs to be compared to this group to achieve true gap closure for this disease.

Unfortunately, similar gains have not been observed in the area of sexual health. Epidemics of gonorrhoea remain almost exclusively confined to the Indigenous population. Moreover, although the observed notification rates for chlamydia in 2014 were slightly less in both population groups than those projected from the 2000–2007 data, notifications in Indigenous residents continue to considerably exceed non-Indigenous rates. While a proportion of these increases undoubtedly represents detection bias from more widespread availability and uptake of molecular diagnostics, and greater policy emphasis on sexual health screening, this does not account for the notification gap, or, in the case of gonorrhoea, diverging trends
between Indigenous and non-Indigenous residents. Finally, this article did not report trends for syphilis due to an outbreak which was declared in the NT Indigenous population in mid-2014, which rendered trends calculated from notification data to 2014 falsely reassuring, where in reality a considerable and widening gap exists.

Limitations

Predictive models are inherently limited by the assumptions of the model. In this study, historical trends formed the basis for future predictions of disease incidence, which was assumed to behave in a positively- or negatively-exponential manner. Clearly, this cannot take into account those factors, which may alter the trajectory of disease trends, such as changes to public policy, advances in diagnostics and treatment, geography and climate. Secondly, particularly for outbreak-prone diseases, predictive modelling of this type has less utility in determining year-to-year variation in incidence, as compared with its utility in predicting longer-term trends. Nevertheless, in many cases it will be these longer-term trends that are most important for the development of effective public policy.

Conclusion

Achieving Indigenous health and social equity remains a challenging but fundamental goal in our progress towards a more just, cohesive and prosperous Australian society. Over the period 2000-2014, modest improvements in health outcomes have been observed principally in the areas of enteric disease and tuberculosis incidence, gains which are projected to continue into the future. In contrast, similar progress was not evident in the area of sexual health. Meeting this challenge is an immediate public health priority, which should be informed by the policy successes observed for other notifiable diseases.

References


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Lead in the Northern Territory – beyond paint and petrol
Sarah Barklay, Kate Hardie, Steven Skov, Pasqualina Coffey, Sarah Smith, Keith Edwards, Vicki Krause, CDC, Darwin

Abstract

Humans have had a long and complex relationship with lead over the past 6000 years. Its unique properties, which confer a multitude of uses, have developed in parallel to an evolving understanding of its harms particularly for children but also for adults. In recent decades health authorities have repeatedly lowered the acceptable maximum blood lead level as understanding of harms increased. In May 2015 the National Health and Medical Research Council revised its guidelines to recommend that if a person has a blood lead level greater than 5µg/dL the source needs to be investigated and reduced, bringing it in line with recommendations around the world.

Key words: lead; blood lead level; heavy metals; environmental exposure; Northern Territory; NHMRC.

History of lead and humans

Since lead was first mined over 6000 years ago it has been recognised as a useful material due to its unique properties: it is heavy, but also malleable and ductile. Multiple purposes over the centuries have included use in the production of pipes, pottery, paints, glass, ammunition and ships. Romans even used it to sweeten wine. Records, however, from Ancient Egypt describe deleterious effects of lead on human health and throughout history adverse effects among people exposed to lead have been described.1

By the early 1920s, lead paint was widely recognised as a health risk and European countries began banning it. Interestingly, at the same time the automotive industry was adding lead to petrol for its anti-knocking effects. Fifty years on, as it became clear that people were inhaling lead from car emissions, governments began to phase out leaded petrol.

Over the past few decades health authorities have advised on acceptable limits to blood lead levels above which the source must be found and removed. The World Health Organisation (WHO) released their first recommendations on this matter in the form of a booklet in 1980, where the acceptable blood lead level in those with occupational exposure was below 40µg/dL.2 This lowered the previously ‘permissible level’ from 80µg/dL and was met with resistance from industry at the time.1

Both the banning of lead paint and the phasing out of leaded petrol have seen a decrease in population blood lead levels in many developed countries.3,4,5 This can be expected to have had the same effect in Australia, where population lead levels are suggested to be similar to these countries,6,7 and where banning of lead paint occurred in the early 1980s and leaded petrol was phased out by 2002.

Current evidence shows that blood lead levels above 10µg/dL directly cause harm8 and some studies report an inverse association between IQ and levels below 10µg/dL.9,10 As response to this evidence and to the decrease in population blood lead levels, worldwide acceptable blood lead levels as advised by health authorities, have been lowered.

Changes to NHMRC guidelines

As previously reported in the March 2015 edition of this Bulletin, the United States (US) Center for Disease Control and Prevention (CDC) reduced the threshold blood lead level for action from 10µg/dL, to 5µg/dL.11 In response Australia’s National Health and Medical Research Council (NHMRC) appointed an expert steering committee to review the evidence. In May 2015, they revised their recommendations to suggest investigation of sources of lead exposure in people with blood lead levels above 5µg/dL,12 bringing them in line with the US CDC recommendations.

Health risks of lead and indications for testing

Lead is mostly absorbed through ingestion, but inhalation of fine particles is another recognised route, particularly in the instance of leaded
petrol emissions. Acute exposure to very high levels of lead can cause problems ranging from abdominal pain and gastrointestinal upset, to severe neurological damage causing seizures, coma and death. Long-term lower levels of exposure can cause other more subtle yet very damaging health problems. In children, the main risk of lead exposure is to neurodevelopment, which can lead to learning disabilities, behavioural problems and mental retardation. Exposure to lead has been shown to be a risk factor for Attention Deficit Hyperactivity Disorder (ADHD). In adults, exposure to lead is associated with an increase in blood pressure and increase in cardiovascular risk, all cancers, increased risk of renal disease and reproductive problems.

Children are more vulnerable to the toxic effects of lead than are adults, as they have a higher rate of absorption of lead and an immature blood brain barrier. People who are iron deficient absorb more lead in the gut, as lead is absorbed via the iron transporters in the lining of the intestines which are upregulated in iron-deficient states.

People who have been exposed to lead through their occupation or who live in lead-endemic areas (such as Broken Hill or Mount Isa) may have their blood lead levels screened by a work or local screening program.

Paediatricians may do a blood lead level when investigating children referred for behavioural problems, but there are no Australian guidelines that recommend routine testing. The NHMRC draft guidelines on ADHD, written in 2009 but still under review, mention lead and its causative relationship with ADHD but currently do not specifically recommend screening in all children being assessed for behavioural problems. The US CDC recommends testing blood lead levels in children thought to have exposure through known sources in their environment and recommends testing children with increased risk, such as those with iron deficiency, low socioeconomic status and victims of abuse or neglect. The American Academy of Pediatrics refers to these guidelines for blood lead testing in their ‘Recommendations for Preventive Pediatric Health Care’.

Northern Territory context

The Northern Territory (NT) has a number of potential sources of environmental lead exposure. One of the largest lead-silver-zinc mines in the world is in the MacArthur River region near Borroloola. This attracted much media attention earlier this year with concerns about contamination of local waterways and aquatic life.

While lead is no longer used in Australia in petrol, paint, pottery, or for sweetening wine, it is still used for industrial purposes and in ammunition. In the NT use of lead shotgun pellets is illegal for all waterfowl hunting for those requiring permits and is illegal for all waterfowl hunters in all other states in Australia. This leaves lead shot legal for NT Aboriginal hunters, as Aboriginal hunting activity is not limited by permit restrictions.

Lead ammunition and particularly lead shotgun pellets pose risks for exposure through direct handling while preparing and loading ammunition and firing the weapons; through eating meat that contains lead pellets, either from eating the pellets themselves or from fragments and residual lead; or through bioaccumulation. There have been no studies examining the impact on human health of use of lead shot in the NT or anywhere else in Australia. Elevated blood lead levels have however been associated with game consumption in adults in European studies and a Canadian study with First Nation people found a correlation of blood lead level with daily consumption of waterfowl.

In the early 1990s while hunting with lead shot was still legal for all hunters in the NT, a study showed that magpie geese taken in Top End hunting reserves had high levels of lead in muscle and liver tissue through direct ingestion of lead shot by the geese. It is possible that ongoing hunting with lead shot may be resulting in further bioaccumulation of lead in this widely hunted food source.

There are higher incidences of malnutrition and iron-deficiency anaemia in Aboriginal Australians compared with non-Aboriginal Australians. There are also higher rates of
cardiovascular and renal disease, and lower educational attainment in Aboriginal people.\textsuperscript{29} Educational attainment is a significant social determinant of health, and an issue that is under focus in the national Closing the Gap initiative.\textsuperscript{30} In this context, the effects of even a minimally elevated blood lead level on behavioural and cognitive development and increased chronic disease risk need to be taken seriously.

**Conclusion**

Knowing there is no human biological benefit to lead and many proven devastating health impacts, the aim should be for minimal exposure to lead in the environment, particularly in regards to exposure of children to lead.

The new NHMRC guideline highlights the significance of blood lead levels at concentrations as low as 5µg/dL and application of this lower acceptable level will naturally identify more adults and children being exposed to the health risks of lead. With combined effort among government agencies to identify and address new, or previously underestimated, sources of lead in the environment these risks can begin to be mitigated.

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NT CDC, Department of Environmental Health, Department of Land and Resource Management, Parks and Wildlife, Primary Health Care Branch Top End Remote Health.

Professor Dinesh Arya, Chief Health Officer.

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Uptake of influenza vaccination by pregnant women in the Northern Territory

Helen Parkes, Medical student, Northern Territory Medical Program, CDC Darwin

Abstract

Vaccination against influenza is recommended for all pregnant women and women planning pregnancy, because of the increased risks associated with influenza infection in pregnant women compared to the general population. Recent surveys from Western Australia and New South Wales showed that uptake of influenza vaccination during pregnancy was only 23% and 27% respectively. This study shows that the coverage rate for all pregnant women in the Northern Territory in 2013 was 30.2%. Indigenous women had a higher vaccination rate of 53.2% compared to non-Indigenous women with a coverage rate of only 15.3%. It is likely that this difference is associated with the strong yearly campaigns in Indigenous communities to vaccinate everyone 15 years of age and over against influenza.

Strategies to increase the rate of influenza vaccination in pregnant women include education about the seriousness of influenza in pregnancy; being advised by their antenatal care provider to have the vaccination; reassurance that influenza vaccination is safe and protective for the baby and for the pregnant woman; and being offered vaccination at the same time and place as the antenatal visits.

Key words: vaccination; influenza, pregnancy; Indigenous.

Introduction

Two recent papers, one from Western Australia (WA)¹ and the other from New South Wales (NSW),² looked at the uptake of influenza vaccination by pregnant women. In both papers, only about a quarter of pregnant women (23% and 27% respectively), were given influenza vaccination during pregnancy.

The aim of this study was to look at the rate of influenza vaccination in pregnant women in the Northern Territory (NT).

Influenza infection in pregnant women is associated with an increased risk of severe complications compared to the general population. For example, during the 2009 H1N1 influenza pandemic in the United States (US), pregnant women, who made up about 1% of the population, suffered approximately 5% of the deaths, 6% of hospitalisations and 6% of the intensive care admissions due to influenza. Pregnant women are especially at risk of complications in the third trimester of pregnancy and during the first 4 weeks post-partum.³,⁴

Influenza infection in the mother during pregnancy also increases the risks of pre-term birth and low birth weight babies, which are strongly related to poorer long term outcomes for the neonate and infant. There are limited data on whether influenza infection in the mother poses developmental risks to the fetus, however it is well recognised that fever in early pregnancy can cause increased birth defects.³

For the newborn, vaccination of the mother during pregnancy has been shown to decrease the frequency of influenza in babies during their first 6 months of life, and to reduce complications associated with influenza if they do become infected.³

Multiple studies and reviews have looked at possible adverse effects of influenza vaccination during pregnancy, including a review in the US of 20 years of adverse events after vaccination. The H1N1 influenza pandemic in 2009 also allowed large prospective studies to be done. No study to date has shown an adverse consequence of inactivated influenza vaccination in pregnant women or their babies.⁵,⁶

Australian and international guidelines recommend influenza vaccination for all pregnant women regardless of gestation as well as for women planning pregnancy. The Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG),⁷ the Australian Government Department of Health via the Australian...
Immunisation Handbook, and the Women’s Business Manual all actively promote influenza vaccination for pregnant women. The Immunise Australia Program offers free influenza vaccine for all pregnant women in Australia.

Methods

This study was registered with the Human Research Ethics Committee reference number QAAR 2015-2330. Birth data was accessed from the Midwives Collection (Perinatal Register), in the NT Department of Health. All births within the NT public health system during 2013 (which was the most recent data available) were manually cross referenced against vaccination data for women between 15 and 50 years of age from the Northern Territory Immunisation Register (NTIR) using names and hospital record numbers (HRN) to match the women. For all women who delivered within each 1 month period from January to December 2013, the NTIR was checked to see whether they had been vaccinated for influenza in the previous 12 months.

The data included total births in each of the NT public hospitals, including the Darwin Birth Centre, as well as births that occurred in Community Health Clinics or en route to hospital. The mother’s Indigenous status was also included and the month of vaccination. The data were analysed using Excel and are presented in the following tables and graph.

Results

The overall influenza vaccination rate in pregnant women in the NT in 2013 was 30.2% (Table 1). However, there was marked variation between hospitals, with women who gave birth in the regional hospitals having a higher rate of influenza vaccination compared to those who gave birth at Royal Darwin Hospital (RDH).

The influenza vaccination rate in Indigenous women was 53.2% compared to the rate in non-Indigenous women of 15.3% (Table 2). There were more Indigenous mothers delivering in regional hospitals so these hospitals had higher coverage for influenza vaccine (Table 2).

Analysis of the month of vaccination shows the majority of Indigenous women were vaccinated in March to June/July, whereas the non-Indigenous women were vaccinated throughout the year, but with a strong peak from July to September, which is the traditional ‘flu season’ (see Figure 1).

Table 1. Proportion of mothers vaccinated against influenza by place of delivery 2013

<table>
<thead>
<tr>
<th>Site</th>
<th>Total births</th>
<th>Not vaccinated</th>
<th>Vaccinated</th>
<th>%</th>
<th>Confidence Intervals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Royal Darwin Hospital</td>
<td>1930</td>
<td>1459</td>
<td>471</td>
<td>24.4</td>
<td>22.5-26.4</td>
</tr>
<tr>
<td>Alice Springs Hospital</td>
<td>762</td>
<td>457</td>
<td>305</td>
<td>40.0</td>
<td>36.5-43.6</td>
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<tr>
<td>Katherine District Hospital</td>
<td>269</td>
<td>181</td>
<td>88</td>
<td>32.7</td>
<td>27.1-38.7</td>
</tr>
<tr>
<td>Gove District Hospital</td>
<td>148</td>
<td>67</td>
<td>81</td>
<td>54.7</td>
<td>46.3-62.9</td>
</tr>
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<td>Darwin Birth Centre</td>
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<td>91</td>
<td>18</td>
<td>16.5</td>
<td>10.1-24.8</td>
</tr>
<tr>
<td>Community Health Clinic</td>
<td>31</td>
<td>11</td>
<td>20</td>
<td>64.5</td>
<td>45.4-80.8</td>
</tr>
<tr>
<td>Other (en route; unplanned home birth)</td>
<td>26</td>
<td>20</td>
<td>6</td>
<td>23.1</td>
<td>9.0-43.6</td>
</tr>
<tr>
<td>NT – Total</td>
<td>3275</td>
<td>2286</td>
<td>989</td>
<td>30.2</td>
<td>28.6-31.7</td>
</tr>
</tbody>
</table>

Table 2. Proportion of mothers vaccinated against influenza by Indigenous status and place of delivery 2013

<table>
<thead>
<tr>
<th>Site</th>
<th>Indigenous</th>
<th>% vaccinated</th>
<th>Non-Indigenous</th>
<th>% vaccinated</th>
<th>P value</th>
</tr>
</thead>
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<td>RDH</td>
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<td>47.0</td>
<td>1345</td>
<td>14.6</td>
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</tr>
<tr>
<td>ASH</td>
<td>403</td>
<td>62.8</td>
<td>359</td>
<td>14.5</td>
<td>&lt;10^-4</td>
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<tr>
<td>KDH</td>
<td>144</td>
<td>45.8</td>
<td>125</td>
<td>17.6</td>
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<tr>
<td>GDH</td>
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<td>62.5</td>
<td>52</td>
<td>40.4</td>
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<td>DBC</td>
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<td>98</td>
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<tr>
<td>CHC</td>
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<td>0</td>
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</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>37.5</td>
<td>10</td>
<td>0</td>
<td>0.026</td>
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<tr>
<td>NT</td>
<td>1285</td>
<td>53.2</td>
<td>1990</td>
<td>15.3</td>
<td>&lt;10^-4</td>
</tr>
</tbody>
</table>
Discussion

The difference in uptake of influenza vaccination between Indigenous and non-Indigenous women is thought most likely to be related to the recommendation that all Indigenous people 15 years and over are vaccinated for influenza yearly. Each year in the NT as soon as the influenza vaccine becomes available in March or April there is a strong vaccination campaign for the Indigenous population. It seems likely that Indigenous women are being vaccinated as part of this campaign rather than specifically as a result of their pregnancy status.

The uptake of influenza vaccination by non-Indigenous women is 15.3% which is very low compared to the WA and NSW figures. Recognised patient barriers to influenza vaccination during pregnancy include safety concerns, particularly for the fetus; lack of knowledge about the potentially serious consequences of influenza infection during pregnancy; fear of needles; poor or limited previous vaccination history; general mistrust of the medical profession; and poor access to antenatal care.

In the WA study, pregnant women were more likely to have an influenza vaccination if they had been advised by their antenatal care provider to have the vaccination; had been reassured that influenza vaccination was safe and protective for the baby and for themselves; and were offered vaccination at the site of antenatal visits, rather than having to make a separate appointment elsewhere.

Limitations of this study

This study only looked at birth data from the NT public hospital system and did not include patients utilising the private health care system. In 2011, 19% of total NT births were in the Darwin Private Hospital. Of the women who gave birth in the private system 98% were non-Indigenous. Another limitation is that this study only captured vaccination data from the NTIR. It may be that not all vaccinations are reported, in particular from those GP clinics which may not have easy access to reporting mechanisms. This would lead to under-reporting of vaccination. Also some workplaces offer influenza vaccination, including for staff in the Defence Forces and many government workplaces. Again some of this data may not be reported to the NTIR. Women who were vaccinated interstate before coming to the NT would not be on the NTIR either. Influenza vaccination status should have been recorded on each woman’s Pregnancy Health Record which documents all their antenatal care. However a check of Pregnancy Health Records for women who gave birth during 1 month at RDH showed that this information was actually recorded for only about 25% of women.

Conclusion

The overall rate of influenza vaccination in pregnant women in the NT appears to compare well with published rates in WA and NSW. However when the figures are examined more closely there is a big difference in vaccination uptake between Indigenous and non-Indigenous women. The pattern of influenza vaccination in Indigenous women suggests they are being vaccinated during community-wide vaccination programs that encourage influenza vaccination in all Indigenous teenagers and adults aged 15 and over. This has the benefit of raising vaccination coverage of pregnant Indigenous women to over 50%. In comparison, vaccination of non-Indigenous women with influenza vaccine is low at only 15.3%. There are recognised barriers to vaccination that can be
addressed, and pregnant women should be encouraged to have influenza vaccination as part of their routine antenatal care.

References


**********

No Jab No Pay changes from 1 January 2016 and FREE catch-up for young people less than 20 years of age

Ros Webby, CDC

From 1 January 2016, childhood immunisations will be linked to government payments. For families to be eligible for the

- Child Care Benefit
- Child Care Rebate, and
- Family Tax Benefit Part A (end of year supplement)

children will need to:

- Be fully immunised or
- Be on a recognised immunisation catch-up schedule or
- Have a medical contraindication validated by a general practitioner or
- Have documented natural immunity validated by a general practitioner.

An Australian Childhood Immunisation Register (ACIR) Immunisation Exemption form must be completed by a general practitioner for reports of medical contraindications or when documenting natural immunity.

To ensure all children have the opportunity to catch-up with vaccines they may have missed, all young people less than 20 years of age can obtain FREE vaccines from their immunisation provider.

Children less than 10 years of age will use the National Immunisation Program vaccines and for those young people 10 to 19 years of age the Table shows the catch-up vaccine recommendations.

Australian Childhood Immunisation Register

Previously the ACIR only recorded and reported on vaccine information for children up to the age of 7 years. From 1 January 2016 the ACIR will accept vaccine information for young people up to 20 years of age. All general practice immunisers and Aboriginal Medical Services should ensure vaccine data is sent to ACIR in a timely manner.
The NT Immunisation Register (NTIR) will continue to send vaccine data to ACIR on behalf of NT government immunisation clinics. Non-government clinics should advise the Centre for Disease Control’s Immunisation Unit if they want the NTIR to transfer their vaccine data to ACIR so that it occurs in a timely manner.

For access to information about ACIR and how to submit data please see http://www.humanservices.gov.au/health-professionals/services/australian-childhood-immunisation-register/

Table Catch-up recommendations for young people 10 to 19 years of age.

<table>
<thead>
<tr>
<th>Vaccine (generic)</th>
<th>Vaccine brand</th>
<th>Doses required</th>
<th>Min interval between dose 1 and 2</th>
<th>Min interval between dose 2 and 3</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diphtheria, tetanus pertussis (acellular)</td>
<td>Boostrix® or Adacel®</td>
<td>1 dose</td>
<td>4 weeks after dT containing vaccine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diphtheria, tetanus Poliomyelitis</td>
<td>Mass Biologics Td IPOL®</td>
<td>2 doses</td>
<td>4 weeks</td>
<td>4 weeks</td>
<td></td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>Engerix B® paed or HBVAX-II® paed</td>
<td>3 doses</td>
<td>4 weeks</td>
<td>2 months</td>
<td>Min interval between dose 1 and 3 is 4 months</td>
</tr>
<tr>
<td>Varicella*</td>
<td>Varivax® or Varilrix®</td>
<td>1 or 2 doses</td>
<td>4 weeks</td>
<td></td>
<td>2 doses needed ≥ 14 years of age</td>
</tr>
<tr>
<td>Measles, mumps, rubella (MMR)*</td>
<td>MMR-II®, or Priorix®</td>
<td>2 doses</td>
<td>4 weeks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningococcal C</td>
<td>Neisvac-C®,</td>
<td>1 dose</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>*Measles, mumps, rubella varicella (MMRV)</td>
<td>(ProQuad® or PriorixTetra® if less than 14 years of age)</td>
<td>As 2nd dose of MMR</td>
<td>4 weeks after MMR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Syphilis outbreak cases in Northern Territory as of 15 December 2015: 250 cases

Table 1. Syphilis outbreak cases—by region

Table 2. Syphilis outbreak cases—sex and age group

ATTENTION ALL PRIMARY CARE CLINIC STAFF ACROSS THE NT

1. Test all young people aged 15-34 years —for syphilis and HIV (one gold -topped tube)
2. Offer further STI screen – 1st void urine/ self-collected vaginal swabs –for Chlamydia/ Gonorrhoea/ Trichomonas
3. Offer pregnancy test for all young women – aim for ZERO CASES of congenital syphilis in 2016
4. Ask client to return for results
5. Repeat syphilis test every 3 months whenever possible

Primary care givers and young men and women in the NT need to be united in tackling syphilis.
Making a referral to the Viral Hepatitis Clinic

At a recent hepatitis stakeholder meeting a need was identified for a guideline to assist clinicians in ordering the correct tests prior to making a referral to the Royal Darwin Hospital (RDH) Viral Hepatitis Clinic.

Having a patient come to the Viral Hepatitis Clinic with all the necessary tests carried out and results available ensures there is no delay in access to treatment.

In Central Australia people with viral hepatitis are referred to Clinic 34 Alice Springs for treatment. A separate guideline is being produced for them.

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**Hepatitis C virus (HCV) infection referral information for NT Top End General Practitioners**

- HCV antibody (Ab) positive and HCV RNA positive indicates active infection in need of referral
- HCV Ab positive and HCV RNA negative mostly indicates past cleared infection: no referral needed
- Re-infection is possible. If possible exposure in past 4 weeks in HCV Ab positive, HCV RNA negative patient, repeat the HCV RNA test 4 weeks after the exposure

**If HCV infection suspected request serology for HCV Ab**

- **HCV Ab positive**
  - Request HCV RNA to determine if current infection
  - HCV RNA positive
    - Indicates active infection
    - Arrange all the following tests
      - HCV Genotype and Viral Load
      - LFT, FBC, UEC, TFT, INR, AFP
      - ANA, AMA, ASM, Anti-LKM
      - Alpha-lantitrypsin, Ceruloplasmin, Iron Studies
      - HIV, HBV (s/Ag, s/Ab, c/Ab), HAV IgG
      - Lipids (fasting), Hba1c
      - Abdominal Ultrasound
    - When all tests complete, refer to the Viral Hepatitis Clinic - Royal Darwin Hospital
    - Fax: 8945 3068 or Email: RDHOPD@nt.gov.au
    - Include all results with the referral
    - The patient will be notified of an appointment time by mail. An initial appointment may take 3 to 6 months

- **HCV Ab negative**
  - Only repeat if possible exposure in past 3 months
  - HCV Ab negative

- **HCV RNA negative**
  - Indicates past, cleared infection unless recent possible exposure
    - If exposure in past 4 weeks, repeat HCV RNA test 4 weeks after exposure
    - No recent exposure
      - No further follow up
    - HCV RNA negative
      - Indicates active infection

---

**Further information:**


- **Patient support:** NT AIDS and Hepatitis Council ph: 08 8944 7777 or [https://www.facebook.com/pages/Liverzone/1657760844446567?ref=ts](https://www.facebook.com/pages/Liverzone/1657760844446567?ref=ts)

- **Clinical support:** Hepatitis C Clinical Nurse Consultant at RDH Viral Hepatitis Clinic ph: 08 8944 1581

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*Department of Health is a Smoke Free Workplace*

Hepatitis CVC to review December 2017
Don’t get 
MELOIOIDOSIS

Melioidosis is a serious disease caused by germs in our soil that surface after heavy rains. These germs enter your body through cuts and sores or you can breathe them in.

Your risk is greater if you have diabetes, kidney disease, drink too much alcohol, or have a weakened immune system.

Protect yourself from melioidosis
- Wear shoes during the wet season
- Wear gloves when working outside
- Wear a mask when using a high pressure hose
- Stay indoors during storms
- Take it easy with alcohol

For more information visit health.nt.gov.au or web search ‘melioidosis fact sheet’
Melioidosis

What is melioidosis?
Melioidosis is a disease caused by bacteria known as *Burkholderia pseudomallei*. The bacteria live below the soil's surface during the dry season but after heavy rainfall are found in surface water and mud and may become airborne.

How is it spread?
The bacteria that causes melioidosis usually enters the body via cuts and sores in the skin or via inhalation of dust or droplets and very rarely by ingestion of contaminated water.
The disease has been found among some domestic and farm animals. Melioidosis does not usually spread from one person to another or from animals to humans.

Where does melioidosis usually occur?
Melioidosis is found in tropical areas throughout the world, particularly in South East Asia and northern Australia.
In Australia cases typically occur in the Top End of the Northern Territory (NT) and in far north Queensland and the Kimberley region of Western Australia. Cases have been found in the NT occasionally as far south as the Tennant Creek region.

What are the symptoms?
The symptoms of melioidosis depend on the site of the infection and this can vary. Often it starts as a chest infection with shortness of breath, productive cough and fever. Other possible presentations include fever with headache and confusion, or pain and/or difficulty passing urine. People can become ill from 1 to 21 days after being infected and the onset of symptoms may be sudden or gradual. The infection can be fatal and melioidosis requires urgent medical attention and treatment with specific antibiotics.
In some cases the illness may come on much more slowly with weight loss, intermittent fever, chest pain and a cough. Some people may present with skin ulcers, boils or joint or bone infections.
There have also been cases where the disease has caused illness many years after the initial infection. In these cases, the bacteria have been carried by the person and have become active due to a weakening of the immune system.
The diagnosis of melioidosis is made by growing the bacteria with laboratory testing of blood, sputum, urine or a swab from an abscess or non-healing ulcer.

Who is at risk?
People most at risk are those with conditions such as diabetes, heavy alcohol consumption, kidney disease, lung disease, and cancer and those on immunosuppressive therapy including steroids.
Healthy people can also get the disease if they work in muddy soil without good hand and foot protection. Children are at a lower risk for acquiring melioidosis compared with adults. However, it is still possible for children to acquire melioidosis during the wet season, particularly those with chronic diseases or weakened immune systems.

What is the treatment?
All patients should be admitted to hospital initially. They are treated with antibiotics, which usually have to be continued for at least 3 months. If treatment is started early, recovery is usually complete. It is important to complete all antibiotics to prevent a relapse.
How can melioidosis be prevented?

There is currently no vaccine against melioidosis. Therefore preventative measures are the key to avoiding infection. People with past melioidosis can be infected again after new exposure.

Waterproof shoes or boots will protect your feet when you walk in wet soil where there is pooled water or you work in muddy conditions, for example, when gardening or working in excavations. Open footwear such as sandals are not very good protection. Protective gloves should be worn when handling soil, particularly during the wet season.

Wounds should be promptly and thoroughly washed clean and covered.

If necessary, use pumping equipment to control water ingress when working in excavations.

Due to the potential for aerosolisation (airborne droplets) of *Burkholderia pseudomallei* people with risk factors such as diabetes, heavy alcohol consumption, kidney disease, lung disease and cancer and those on immunosuppressive therapy should stay indoors during periods of heavy wind and rain in the Top End. People using high pressure hoses around soil should cover their mouths and noses with a mask to avoid inhalation of bacteria.

Children should avoid playing in muddy areas, wet sandpits or places where water has pooled in grassy areas or where grassed areas are boggy. Sandpits which are dry or dry enough to comfortably play in are also low risk.

These preventative measures are most important if you have any of the following conditions:

- Diabetes
- Heavy alcohol consumption (>20 standard drinks a week or binge drinking)
- Kidney disease
- Lung disease
- Cancer
- Receiving immunosuppressive therapy, including steroids
- Cuts or sores in your skin, particularly on the hands and feet.

For more information contact the CDC in your region

<table>
<thead>
<tr>
<th>Location</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alice Springs</td>
<td>8951 7540</td>
</tr>
<tr>
<td>Darwin</td>
<td>8922 8044</td>
</tr>
<tr>
<td>Katherine</td>
<td>8973 9049</td>
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<tr>
<td>Nhulunbuy</td>
<td>8987 0357</td>
</tr>
<tr>
<td>Tennant Creek</td>
<td>8962 4259</td>
</tr>
</tbody>
</table>

Environmental changes – a challenge for mosquito control in the Lee Point area, Darwin, Northern Territory, Australia

Allan Warchot, Nina Kurucz and Nadine Copley
Medical Entomology, CDC, Darwin

Abstract

Lee Point, at the northern end of Casuarina Coastal Reserve in Darwin, Northern Territory, has historically been a productive breeding area for the northern salt marsh mosquito, Aedes vigilax. The main breeding habitats for this mosquito at Lee Point are coastal interdunal depressions. Sand deposition can form new mosquito breeding sites in the area, with the most recent site to the east of the tip of Lee Point found to be breeding mosquitoes in 2015. Coastal depressions at Lee Point usually breed Aedes vigilax after heavy wet season rainfall, with some sites also breeding after high tides during the wet season. However, the most recently formed interdunal depression was found to breed high numbers of Aedes vigilax larvae following a high tide in the late dry season, indicating the formation of the first dry season Aedes vigilax breeding site at Lee Point. Aedes vigilax is a major pest mosquito and can carry Ross River virus and Barmah Forest virus. This new area of mosquito breeding will be added to the routine larval mosquito control program for Casuarina Coastal Reserve. However, the new site and other interdunal depressions at Lee Point should be investigated for rectification to prevent mosquito breeding.

Key words: Lee Point; mosquito; vector; control.

Background

Lee Point is located at the northern tip of Darwin within Casuarina Coastal Reserve (CCR). The coastal dune and monsoon forest areas around Lee Point contain highly productive breeding depressions for the northern salt marsh mosquito Aedes vigilax. Muirhead, Tiwi and Brinkin are the nearest urban residential areas to Lee Point, with Lyons currently the closest suburb, situated about 2.4km to the south of the tip of Lee Point.

Aedes vigilax is the principal pest mosquito in coastal areas of the Darwin Region from August to early January. As Aedes vigilax is a competent vector of Ross River virus and Barmah Forest virus, it is the most targeted mosquito species in the area for larval control. Due to the long flight range of Aedes vigilax, Lee Point has been targeted for ground mosquito control by Parks and Wildlife Commission and Medical Entomology of the Department of Health (DoH) since the mid 1980’s.

While monthly high tides of ≥7.5m in August or September usually initiate Aedes vigilax breeding in the Sandy Creek mangrove area in CCR near Royal Darwin Hospital, breeding sites at Lee Point usually do not begin to flood and breed mosquitoes until after very heavy rain, which usually occurs in late December. Some Lee Point sites also breed mosquitoes after high tides, mainly during the wet season months of January to March when the water table is high and allows residual tide ponding. Aedes vigilax breeding can continue into March or April in some years, and larval mosquito sampling over the years has consistently identified interdunal depressions ie residual tide ponding as the most productive Aedes vigilax breeding habitat in CCR.

The interdunal mosquito breeding habitat has been constantly evolving at Lee Point, caused by the formation of new frontal beach dunes (see Figures 1-4), particularly since 2000. As a result of the ever changing landscape, regular inspections for the presence of new mosquito breeding sites are carried out by DoH.

Figure 1. Interdunal depressions at eastern side of Lee Point in July 2001.
In September 2015, higher than average adult *Ae. vigilax* numbers were collected in both the Casuarina and Leanyer Gate routine weekly carbon dioxide (CO2) baited encephalitis virus surveillance (EVS) monitoring traps (Figure 5). This raised suspicions that a new productive interdunal salt marsh mosquito breeding site may have formed in the Lee Point area.

### Methods and results

The entire Lee Point area was surveyed for *Ae. vigilax* breeding on 2 October 2015, 2 days after the highest predicted late September tide (7.83m). Areas of ponding water were surveyed using a 350ml white ladle, dipped at the edge of vegetation, and by visually inspecting for mosquito larvae in the flooded areas. Aerial photography from 2000 to 2014 was also examined, to identify changes in the coastal environment at Lee Point that might have resulted in the formation of new mosquito breeding sites. In addition, data from the Medical Entomology Access database was analysed to determine when newly formed and detected sites first began to breed mosquitoes.

During the survey, all of the routine tide mosquito breeding sites in the Lee Point area were found to be dry or damp, which was expected due to the low water table and high evaporation rate at this time of the year. However, a large interdunal depression lower down in the tide zone (see Figure 4), which had not previously been identified as a breeding site, contained very high densities of late 4th instar *Ae. vigilax* larvae and pupae. Very high numbers of adult male *Ae. vigilax* found resting above the water surface on protruding pneumatophores of *Avicennia* mangroves were also observed in the upper reaches of the depression. Larval/pupal densities were over 100-200 per ladle dip along the water margin and amongst mangroves and pneumatophores, and about 2 per ladle dip in open water (see Photos 1 and 2). Overall, the larval/pupal density across the entire water body
was conservatively estimated to be about 50 per ladle dip. Large numbers of larvae and pupae were also located in crab holes above the water margin, most likely a result of them becoming trapped as the water receded.

Tidal ponding in the depression was observed to be larger compared to previous years, and mangrove growth was also much thicker. The area of mosquito breeding was estimated to be about 9000m$^2$. Assuming an overall average of 50 larvae per ladle dip, which equates to about 4500 larvae per square metre, there were potentially 40 million mosquito larvae/pupae in the depression.

Following the survey, the late 4th instar larvae were controlled using ‘Graybate®’ (active constituent temephos), with pupal control carried out using ‘Aquatain®’, a surface barrier product. Follow up sampling 2 hours after the application of graybate revealed dead and dying larvae, indicating the treatment was beginning to take effect. A follow up survey 3 days after the application of both insecticides failed to locate any larvae, pupae or adult mosquitoes, suggesting both products were highly successful at controlling the breeding.

An examination of aerial photography from 2000 to 2014, along with a review of larval mosquito data in the Medical Entomology database, shows that this most recently formed site is the third and largest new interdunal mosquito breeding depression to have formed on the eastern side of Lee Point since 2004. The first new site was found breeding *Ae. vigilax* in 2004, with another site found breeding the following year in 2005, along with this current site in October 2015. The series of aerial photography below outlines the new mosquito breeding sites that have formed since 2004 (red polygons), with historic sites prior to 2004 outlined as orange polygons. The photos are aligned to north, and were sourced from the NT Government Google Earth EC server.

**Photos 1 and 2. Widespread mosquito breeding (pupae and larvae).**

**Discussion**

The discovery of *Ae. vigilax* breeding in the most recently formed interdunal site at Lee Point changes the mosquito management requirements for the area. The current ground larval mosquito control program in CCR is carried out by Medical Entomology, with funding provided by the Parks and Wildlife Commission of the Northern Territory. Routine ground surveys conducted as part of this program have not previously encompassed the Lee Point area prior to mid - late December, due to the absence of dry season breeding sites. However, the discovery of this new interdunal site, which breeds salt marsh mosquitoes after relatively small dry season tides of around 7.3m, indicates...
surveys at Lee Point will now be required from August onwards, and most likely also from May to July. This site is now one of the largest breeding sites in CCR, and due to relatively dense mangrove growth, a difficult and time consuming site to control on ground. The very high productivity of the site indicates that it is of great importance to CCR and the nearby urban residential areas.

All known salt marsh mosquito breeding sites are included in the routine CCR ground larval mosquito control program. However, due to the number and extent of these areas, there is the potential that ground control operations in the future cannot cover all breeding sites if additional sites continue to evolve. Aerial control might be required to enable control of all sites in a timely manner. However, managing spray operations in such a popular and frequented public area would be problematic. Therefore, it is suggested that an investigation should be launched to investigate the feasibility for interdunal mosquito breeding sites within the Lee Point area to be rectified to prevent mosquito breeding.

References

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**Splashfest 2015**

**Meredith Neilson, CDC, Darwin**

On Sunday 20 September, Centre for Disease Control (CDC) and Alcohol and Other Drugs (AOD) staff held a stall at Splashfest. Splashfest is a fun family day held at the Darwin Waterfront to celebrate Water Safety Week (20-26 September) and to remind Territorians to be safe in the water.

Kate Tessman and Meredith Neilson from CDC were there to promote stinger safety messages including staying out of the sea water during the stinger season which is October to May and to provide first aid should a person be stung. John Ah Mat and David Parfitt from the AOD team promoted the message that safe and responsible drinking is needed on and around the water and brought attention to the National Guidelines for Alcohol Consumption and standard drink sizes.

The Northern Territory Health stand was very popular and won ‘Best Dressed Stall’ with floating jellyfish, a throw net, balloons, and colouring in for children. Thanks to all staff who attended for their enthusiasm in delivering these important water safety messages.
Abstracts from peer reviewed published articles related to the Northern Territory

Individual and household-level risk factors for sporadic salmonellosis in children

Williams S, Markey P, Harlock M, Binns P, Gaggin J, Patel M

J Infect DOI: http://dx.doi.org/10.1016/j.jinf.2015.09.014

Objectives: To explore risk factors for sporadic salmonellosis at the individual and household level in children in tropical Darwin, where animal faeces contaminated with Salmonella is thought to be common.

Methods: A 2-year community based case–control study of children aged 0–4 years residing in Darwin and Palmerston from June 2006. Variables included behaviour, health, food, family and housing characteristics. Environmental samples were taken from houses of case and control children.

Results: Of children whose parents were contacted, 59/131 cases and 95/222 controls were included. Salmonella was isolated from 41/56 (73%) case houses and 18/29 (62%) control houses (p=0.29). Multivariate analyses showed breastfeeding 0.16 (p=0.02), increasing age (months) 0.89 (p=0.00) and daily vacuuming 0.18 (p=0.06) were protective; consuming powdered formula milk 4.88 (p=0.02), pet ownership 4.86 (p=0.02), oral contact with animals 7.85 (p=0.05), recent antibiotic use 10.01 (p=0.03) and sweeping in the presence of children 3.73 (p=0.04) were associated with sporadic salmonellosis.

Conclusions: Salmonellosis in children under 5 years of age is associated with potentially modifiable risk factors other than food. Breastfeeding beyond 6 months, careful hygiene when preparing formula milk and around pets, frequent cleaning of infant play areas especially quick removal of animal faeces are behaviours likely to reduce childhood sporadic salmonellosis.

Salmonella in the tropical household environment – Everyday, everywhere


J Infect DOI: http://dx.doi.org/10.1016/j.jinf.2015.09.011

Objectives: To determine the prevalence of Salmonella in the environment of case and control houses, and compare serovars isolated from cases and their houses.

Methods: From 2005 to 2008, we tested samples from houses of 0–4 year old cases and community controls in Darwin and Palmerston for Salmonella. Case isolates were compared with environmental isolates. S. Ball and S. Urbana isolates were compared using Multiple Amplification of Phage Locus Typing (MAPLT) and Multiple-Locus Variable number of tandem repeat Analysis (MLVA).

Results: Salmonella were found in 47/65 (72%) case houses and 18/29 (62%) control houses; these proportions were not significantly different. In 21/47 (45%) houses, case and environmental isolates (from animal faeces, soil and vacuums) were indistinguishable. Multiple serovars were isolated from 20 (31%) case and 6 (21%) control houses. All but 1 environmental isolate are known human pathogens in the Northern Territory (NT). Each of the 4 pairs of S. Ball and S. Urbana were indistinguishable.

Conclusions: Animal faeces were the most likely source of salmonellosis in cases. The similar prevalence of house isolates suggests that Salmonella is ubiquitous in this environment. The distinction of S. Ball and S. Urbana subtypes enabled linkage of human illness to environmental exposure. Environmental contamination with Salmonella is an important source of sporadic infection in children in the tropics.
Respiratory bacterial culture from two sequential bronchoalveolar lavages of the same lobe in children with chronic cough

Hare K, Marsh R, Smith-Vaughan H, Bauert P, Chang B


Identification of bacteria causing lower airway infections is important to determine appropriate antimicrobial therapy. Flexible bronchoscopy with bronchoalveolar lavage (BAL) is used to obtain lower airway specimens in young children. The first lavage (lavage-1) is typically used for bacterial culture. However, no studies in children have compared the detection of cultivable bacteria from sequential lavages of the same lobe.

BAL fluid was collected from 2 sequential lavages of the same lobe in 79 children enrolled in our prospective studies of chronic cough. The respiratory bacteria Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis, Staphylococcus aureus and H. parainfluenzae were isolated and identified using standard published methods. H. influenzae was differentiated from H. haemolyticus using PCR assays. Lower airway infection was defined as ≥104 cfu/mL BAL fluid. We compared cultivable bacteria from lavage-1 to the second lavage (lavage-2) using the kappa statistic.

Lower airway infections by any pathogen were detected in 46% of first lavages and 39% of second lavages. Detection was similar in both lavages for all pathogens; the kappa statistic was 0.7-0.8 for all bacteria except H. parainfluenzae. Of all infections detected in either lavage, 90% were detected in lavage-1 and 78% in lavage-2. However, culture of lavage-2 identified infections that would have been missed in 8% of children, including infections by additional S. pneumoniae serotypes.

Our findings support the continued use of lavage-1 for bacterial culture; however, culture of lavage-2 may yield additional identifications of bacterial pathogens in lower airway infections.

Nasopharyngeal carriage and macrolide resistance in Indigenous children with bronchiectasis randomized to long-term azithromycin or placebo


Although long-term azithromycin decreases exacerbation frequency in bronchiectasis, increased macrolide resistance is concerning. We investigated macrolide resistance determinants in a secondary analysis of a multicenter randomized controlled trial. Indigenous Australian children living in remote regions and urban New Zealand Māori and Pacific Islander children with bronchiectasis were randomized to weekly azithromycin (30mg/kg) or placebo for up to 24 months and followed post-intervention for up to 12 months. Nurses administered and recorded medications given and collected nasopharyngeal swabs 3-6 monthly for culture and antimicrobial susceptibility testing. Nasopharyngeal carriage of Haemophilus influenzae and Moraxella catarrhalis was significantly lower in azithromycin compared to placebo groups, while macrolide-resistant Streptococcus pneumoniae and Staphylococcus aureus carriage was significantly higher. Australian children, compared to New Zealand children, had higher carriage overall, significantly higher carriage of macrolide-resistant bacteria at baseline (16/38 versus 2/40 children) and during the intervention (69/152 versus 22/239 swabs), and lower mean adherence to study medication (63% versus 92%). Adherence ≥70% (versus <70%) in the Australian azithromycin group was associated with lower carriage of any pathogen [odds ratio (OR) 0.19, 95% confidence interval (CI) 0.07-0.53] and fewer macrolide-resistant pathogens (OR 0.34, 95% CI 0.14-0.81). Post-intervention (median 6 months), macrolide resistance in S. pneumoniae declined significantly in the azithromycin group, from 79% (11/14) to 7% (1/14) of positive swabs, but S. aureus strains remained 100% macrolide resistant. Azithromycin treatment, the Australian remote setting, and adherence <70% were significant
independent determinants of macrolide resistance in children with bronchiectasis. Adherence to treatment may limit macrolide resistance by suppressing carriage.

*Haemophilus influenzae* isolates survive for up to 20 years at -70 °C in skim milk tryptone glucose glycerol broth (STGGB) if thawing is avoided during re-culture

K.M. Hare, H.C. Smith-Vaughan, J. Beissbarth, A.J. Leach


Haemophilus influenzae remains a major cause of disease worldwide requiring continued study. Recently, isolates of Streptococcus pneumoniae and Moraxella catarrhalis, but not *H. influenzae*, were reported to survive long-term ultra-freeze storage in STGGB. We show that nontypeable *H. influenzae* isolates survive for up to 20 years when thawing is avoided.

**Pneumococcal conjugate vaccines PREVenar13 and SynflorIX in sequence or alone in high-risk Indigenous infants (PREV-IX_COMBO): protocol of a randomised controlled trial**


**Introduction:** Otitis media (OM) starts within weeks of birth in almost all Indigenous infants living in remote areas of the Northern Territory (NT). OM and associated hearing loss persist from infancy throughout childhood and often into adulthood. Educational and social opportunities are greatly compromised. Pneumococcus and non-typeable *Haemophilus influenzae* (NTHi) are major OM pathogens that densely colonise the nasopharynx and infect the middle ear from very early in life. Our hypothesis is that compared to current single vaccine schedules, a combination of vaccines starting at 1 month of age, may provide earlier, broadened protection.

**Methods and analyses:** This randomised outcome assessor, blinded controlled trial will recruit 425 infants between 28 and 38 days of age and randomly allocate them (1:1:1) to 1 of 3 pneumococcal conjugate vaccine (PCV) schedules: Synflorix™ at 2, 4, 6 months of age, Prevenar13™ at 2, 4 and 6 months of age, or an investigational schedule of Synflorix™ at 1, 2 and 4 months plus Prevenar13™ at 6 months of age. The blinded primary outcomes at 7 months of age are immunogenicity of specific vaccine antigens (geometric mean concentration (GMC) and proportion of participants with above threshold GMC of 0.35 μg/L). Secondary outcomes at all timepoints are additional immunogenicity measures and proportion of participants with nasopharyngeal carriage of vaccine-type pneumococci and NTHi, and any OM, including any tympanic membrane perforation. Parental interviews will provide data on common risk factors for OM.

**Ethics and dissemination:** Ethical approval has been obtained from NT Department of Health and Menzies HREC (EC00153), Central Australian HREC (EC00155) and West Australian Aboriginal Health Ethics Committee (WAAHEC- 377-12/2011). Final trial results, data analyses, interpretation and conclusions will be presented in appropriate written and oral formats to parents and guardians, participating communities, local, national and international conferences, and published in peer-reviewed open access journals.

**Reduced middle ear infection with nontypeable Haemophilus influenzae, but not Streptococcus pneumoniae, after transition to 10-valent pneumococcal nontypeable H. influenzae protein D conjugate vaccine**


**Background:** In October 2009, 7-valent pneumococcal conjugate vaccine (PCV7: Prevenar™ Pfizer) was replaced in the Northern Territory childhood vaccination schedule by 10-valent pneumococcal *Haemophilus influenzae*
protein D conjugate vaccine (PHiD-CV10; Synflorix™ GlaxoSmithKline Vaccines). This analysis aims to determine whether the reduced prevalence of suppurative otitis media measured in the PHiD-CV10 era was associated with changes in nasopharyngeal (NP) carriage and middle ear discharge (ED) microbiology in vaccinated Indigenous children.

Methods: Swabs of the NP and ED were collected in remote Indigenous communities between September 2008 and December 2012. Swabs were cultured using standardised methods for otitis media pathogens. Children less than 3 years of age and having received a primary course of 2 or more doses of one PCV formulation and not more than one dose of another PCV formulation were included in the primary analysis; children with non-mixed single formulation PCV schedules were also compared.

Results: NP swabs were obtained from 421 of 444 (95 %) children in the PCV7 group and 443 of 451 (98 %) children in the PHiD-CV10 group. Non-mixed PCV schedules were received by 333 (79 %) and 315 (71 %) children, respectively. Pneumococcal (Spn) NP carriage was 76 % and 82 %, and non-typeable Haemophilus influenzae (NTHi) carriage was 68 % and 73 %, respectively. ED was obtained from 60 children (85 perforations) in the PCV7 group and from 47 children (59 perforations) in the PHiD-CV10 group. Data from bilateral perforations were combined. Spn was cultured from 25% and 18 %, respectively, and NTHi was cultured from 61 % and 34 % respectively (p = 0.008).

Conclusions: The observed reduction in the prevalence of suppurative OM in this population was not associated with reduced NP carriage of OM pathogens. The prevalence of NTHi-infected ED was lower in PHiD-CV10 vaccinated children compared to PCV7 vaccinated children. Changes in clinical severity may be explained by the action of PHiD-CV10 on NTHi infection in the middle ear. Randomised controlled trials are needed to answer this question.

Pneumum: Impact from a randomised controlled trial of maternal 23-valent pneumococcal polysaccharide vaccination on middle ear disease amongst Indigenous infants, Northern Territory, Australia


Vaccine 11/2015; DOI:10.1016/j.vaccine.2015.10.1013.62 Impact Factor

Background: We assessed maternal 23-valent pneumococcal polysaccharide (23vPPV) vaccine efficacy (VE) against middle ear disease and pneumococcal carriage amongst Australian Indigenous infants.

Methods: In an open label, allocation concealed, outcome-assessor blinded, community stratified, randomised controlled trial, healthy pregnant Indigenous women aged 17-39 years in the Northern Territory of Australia received the 23vPPV (1:1:1) at: 30-36 weeks gestation, birth, or were unvaccinated (ClinicalTrials.gov NCT00714064). Co-primary outcomes were the point prevalences of infant middle ear disease and 23vPPV-type carriage at age 7 months.

Results: The consent rate was 50% (313/632). Among 227 eligible participants randomised, retention rates were 86% (66/77) controls; 89% (67/75) pregnancy vaccinees; 88% (66/75) birth vaccinees. At infant age 7 months, ear disease prevalence was: 71% (47/66) controls, 63% (42/67) pregnancy vaccinees, 76% (50/66) birth vaccinees; and 23vPPV-type carriage was: 26% (17/66) controls, 18% (12/67) pregnancy vaccinees, 18% (12/66) birth vaccinees. For pregnancy vaccinees, VE was 12% (95% CI -12% to 31%) against infant ear disease and 30% (95% CI -34% to 64%) against 23vPPV-type carriage. In a post-hoc analysis, VE against infant ear disease concurrent with carriage of 23vPPV or related types was 51% (95% CI -2% to 76%). There were no serious adverse effects following receipt of the 23vPPV in pregnancy or at birth.
Conclusions: In a high risk population, our study was unable to demonstrate efficacy of 23vPPV in pregnancy against the co-primary outcomes of either all-cause infant ear disease or 23vPPV-type nasopharyngeal carriage at age 7 months. Efficacy against ear disease concurrent with carriage of vaccine-related serotypes (a more specific outcome) suggests 23vPPV in pregnancy may complement childhood pneumococcal vaccination programs.

Impact of an ivermectin mass drug administration on scabies prevalence in a remote Australian Aboriginal community


Background: Scabies is endemic in many Aboriginal and Torres Strait Islander communities, with 69% of infants infected in the first year of life. We report the outcomes against scabies of 2 oral ivermectin mass drug administrations (MDAs) delivered 12 months apart in a remote Australian Aboriginal community.

Methods: Utilizing a before and after study design, we measured scabies prevalence through population census with sequential MDAs at baseline and month 12. Surveys at months 6 and 18 determined disease acquisition and treatment failures. Scabies infestations were diagnosed clinically with additional laboratory investigations for crusted scabies. Non-pregnant participants weighing ≥15 kg were administered a single 200 μg/kg ivermectin dose, repeated after 2–3 weeks if scabies was diagnosed, others followed a standard alternative algorithm.

Principal Findings: We saw >1000 participants at each population census. Scabies prevalence fell from 4% at baseline to 1% at month 6. Prevalence rose to 9% at month 12 amongst the baseline cohort in association with an identified exposure to a presumptive crusted scabies case with a higher prevalence of 14% amongst new entries to the cohort. At month 18, scabies prevalence fell to 2%. Scabies acquisitions 6 months after each MDA were 1% and 2% whilst treatment failures were 6% and 5% respectively.

Conclusion: Scabies prevalence reduced in the 6 months after each MDA with a low risk of acquisition (1–2%). However, in a setting where living conditions are conducive to high scabies transmissibility, exposure to presumptive crusted scabies and population mobility, a sustained reduction in prevalence was not achieved.

The importance of scabies co-infection in the treatment considerations for impetigo

Tasani M, Tong S, Andrews R, Holt D, Currie B, Carapetis J, Bowen A

Pediat Infect Dis J 2015 November 23 http://sumo.ly/d4EI via @QxMD

Background: Skin infections account for a high disease burden in Indigenous children living in northern Australia. Although the relationship between impetigo and scabies is recognised, the prevalence of scabies in children with impetigo is not well reported. We report the prevalence, demographics and treatment success outcomes of impetigo and scabies co-infection in Indigenous children who were participants in a randomized controlled trial of impetigo treatment conducted in remote communities of the Northern Territory, Australia.

Methods: Of 1715 screening episodes for impetigo, 508 children were randomized to receive intramuscular benzathine benzylpenicillin (BPG), twice daily co-trimoxazole (SXT) for 3 days (4mg/kg trimethoprim plus 20mg/kg sulphamethoxazole per dose) or once daily co-trimoxazole (SXT) for 5 days (8mg/kg trimethoprim plus 40 mg/kg sulphamethoxazole per dose). A clinical diagnosis of scabies, tinea of the skin, scalp or nail, and head lice was made on all children. Scabies presence was not confirmed using diagnostic scrapings. In a post-hoc analysis, we determined whether co-infection with scabies had an impact on treatment success for impetigo.

Findings: Of children randomized to receive treatment for impetigo, 84/508 (16.5%) had scabies. The presence of scabies ranged from 14.3% to 20.0% in the three treatment groups. Treatment success for impetigo with and without scabies co-infection, independent of the
treatment groups, was 75.9% and 86.6% respectively, absolute difference 10.7% (95% CI +1% to +21%). Treatment success for impetigo with and without scabies co-infection in the BPG group was 69.6% and 88.0% respectively, absolute difference 18.4% (95%CI -1 to +38%). In the pooled SXT groups the treatment success for impetigo with and without scabies co-infection was 78.6% and 86.0% with absolute difference 7.4% (95%CI -4 to +18%). Treatment success in the pooled SXT group with scabies (78.6%) was higher than in the BPG group (69.6%) with scabies, absolute difference 9.0% (95% CI +0.1 to +18%). Prediction of treatment success for impetigo is dependent on the presence or absence of scabies and for scabies co-infected impetigo it was higher in the group treated with SXT.

Conclusions: The burden of scabies in an impetigo trial for Indigenous children was high. Treatment success for scabies co-infection was lower than for impetigo overall, with a higher success seen in the co-trimoxazole group than the benzylpenicillin group.

Comparison of three methods for the recovery of skin pathogens from impetigo swabs collected in a remote community of Northern Territory, Australia

Bowen A, Tong S, Chatfield M, Andrews R, Carapetis J


Background: Impetigo is a common infection in children living in remote areas. Immediate plating of impetigo swabs is the gold standard for bacterial recovery but is rarely feasible in remote regions. Bacterial culture increases our understanding of antibiotic resistance and strain diversity, which guides treatment protocols and epidemiological monitoring.

Methods: We investigated 3 practical alternatives for recovering Streptococcus pyogenes and Staphylococcus aureus from transported swabs: dry swabs transported at 4°C with desiccant and plated within 48 h; swabs inoculated into skim milk tryptone glucose glycerol broth (STGGB), transported at 4°C, stored at -70°C and plated within 61 days; and ESwabs inoculated into Amies broth, transported at 4°C and plated within 48 h. Detection of Strep. Pyogenes and Staph. Aureus from simultaneously collected swabs was compared for the dry vs STGGB (36 sores) and the STGGB vs Amies (39 sores) methods. Swabs were collected from 43 children (75 sores sampled) in a remote community of Northern Territory, Australia in November 2011. The children had impetigo and were participating in the Skin Sore Trial [Australian Clinical Trials Registry ACTRN12609000858291].

Results: Recovery of Strep. Pyogenes for dry vs STGGB was 72% (26/36) and 92% (33/36) and for STGGB vs Amies was 92% (36/39) for both methods. Staphylococcus aureus recovery for dry vs STGGB was 69% (25/36) and 72% (26/36) and for STGGB vs Amies was 74% (29/39) and 85% (33/39).

Conclusion: STGGB and Amies media provided higher recovery of Strep. Pyogenes than dry swabs. These results and the opportunity to batch and store specimens for molecular studies support the use of STGGB transport media for future impetigo research.

Rheumatic heart disease in Indigenous children in northern Australia: differences in prevalence and the challenges of screening


MJA 203(5) 7 September 2015 doi: 10.5694/mja15.00139

Objectives: To compare regional differences in the prevalence of rheumatic heart disease (RHD) detected by echocardiographic screening in high-risk Indigenous Australian children, and to describe the logistical and other practical challenges of RHD screening.


Setting: Thirty-two remote communities in 4 regions of northern and central Australia.

Participants: 3946 Aboriginal or Torres Strait Islander children aged 5-15 years.
**Intervention:** Portable echocardiography was performed by cardiac sonographers. Echocardiograms were recorded and reported offsite by a pool of cardiologists.

**Main outcome measures:** RHD was diagnosed according to 2012 World Heart Federation criteria.

**Results:** The prevalence of definite RHD differed between regions, from 4.7/1000 in Far North Queensland to 15.0/1000 in the Top End of the Northern Territory. The prevalence of definite RHD was greater in the Top End than in other regions (odds ratio, 2.3; 95% CI, 1.2e4.6, P ¼ 0.01). Fifty-three per cent of detected cases of definite RHD were new cases; the prevalence of new cases of definite RHD was 4.6/1000 for the entire sample and 7.0/1000 in the Top End. Evaluation of socioeconomic data suggests that the Top End group was the most disadvantaged in our study population.

**Conclusions:** The prevalence of definite RHD in remote Indigenous Australian children is significant, with a substantial level of undetected disease. Important differences were noted between regions, with the Top End having the highest prevalence of definite RHD, perhaps explained by socioeconomic factors. Regional differences must be considered when evaluating the potential benefit of widespread echocardiographic screening in Australia.

**Showcasing the application of theory-driven evaluation for a stepped-wedge, community-randomised trial to improve delivery of secondary prophylaxis for rheumatic heart disease.**

*Read C, Johnston V, Ralph A, Bycroft K*

*Abstract conference paper, Australasian Evaluation Society’s International Evaluation Conference, Melbourne Convention and Exhibition Centre, Melbourne, Australia September 2015*

Acute Rheumatic Fever (ARF) and Rheumatic Heart Disease (RHD) are auto-immune diseases caused by untreated streptococcal infection of the throat. ARF and RHD are largely associated with poor socio-economic living conditions and the disease burden in Australia’s Aboriginal populations is among the highest in the world. As a consequence of its proven benefit and demonstrated cost effectiveness, secondary prevention is the focus of most RHD control strategies. This involves secondary prophylaxis (SP), the four-weekly administration of penicillin for at least 10 years to all people with a history of ARF or RHD to control and reduce their chance of progressing to established, or more severe disease outcomes. Continued progress in controlling RHD requires an understanding of how to improve delivery of SP.

Adherence to SP remains unacceptably low in the Northern Territory (NT) of Australia. Between 2007 and 2013 only 24% of clients in the NT received the recommended national target of ≥ 80% of scheduled injections. Our study aims to improve the uptake of SP by implementing and evaluating a sustainable, transferable, systems-based intervention using a stepped-wedge trial in 10 communities in the NT. The intervention, applied at the health centre level, will adopt the Chronic Care Model (CCM) as a framework for activities which will be implemented over a 15 month period.

Mixed-method data collected over the course of the study will inform the evaluation of the intervention’s effectiveness. This complex intervention requires a solid program theory upon which to base a theory-driven evaluation framework. The evaluation framework explores implementation, action theory and conceptual theory successes and takes underlying causal mechanisms into account when assessing the intervention. It will provide an understanding of whether the intervention meets its goals and document the hows and whys of the intervention’s success or failure. The evaluation framework for this study will be showcased in this paper.
Exploring the benefits of molecular testing for gonorrhoea antibiotic resistance surveillance in remote settings


PLoS ONE 10(7): e0133202. doi:10.1371/journal.pone.0133202

Background: Surveillance for gonorrhoea antimicrobial resistance (AMR) is compromised by a move away from culture-based testing in favour of more convenient nucleic acid amplification test (NAAT) tests. We assessed the potential benefit of a molecular resistance test in terms of the timeliness of detection of gonorrhoea AMR.

Methods and Findings: An individual-based mathematical model was developed to describe the transmission of gonorrhoea in a remote Indigenous population in Australia. We estimated the impact of the molecular test on the time delay between first importation and the first confirmation that the prevalence of gonorrhoea AMR (resistance proportion) has breached the WHO-recommended 5% threshold (when a change in antibiotic should occur). In the remote setting evaluated in this study, the model predicts that when culture is the only available means of testing for AMR, the breach will only be detected when the actual prevalence of AMR in the population has already reached 8–18%, with an associated delay of ~43–69 months between first importation and detection. With the addition of a molecular resistance test, the number of samples for which AMR can be determined increases facilitating earlier detection at a lower resistance proportion. For the best case scenario, where AMR can be determined for all diagnostic samples, the alert would be triggered at least 8 months earlier than using culture alone and the resistance proportion will have only slightly exceeded the 5% notification threshold.

Conclusions: Molecular tests have the potential to provide more timely warning of the emergence of gonorrhoea AMR. This in turn will facilitate earlier treatment switching and more targeted treatment, which has the potential to reduce the population impact of gonorrhoea AMR.

A real-time PCR assay for direct characterization of the Neisseria gonorrhoeae GyrA 91 locus associated with ciprofloxacin susceptibility


Objectives The objective of this study was to develop a real-time PCR method for specific detection of the gonococcal GyrA amino acid 91 locus directly in clinical samples so as to predict Neisseria gonorrhoeae ciprofloxacin susceptibility.

Methods The real-time PCR assay, GyrA91-PCR, was designed using 2 probes, 1 for detection of the WT S91 sequence and the other for detection of the S91F alteration. The performance of the assay was initially assessed using characterized N. gonorrhoeae isolates (n=70), a panel of commensal Neisseria and Moraxella species (n=55 isolates) and clinical samples providing negative results by a commercial N. gonorrhoeae nucleic acid amplification test (NAAT) method (n=171). The GyrA91-PCR was then applied directly to N. gonorrhoeae NAAT-positive clinical samples (n=210) from the year 2014 for which corresponding N. gonorrhoeae isolates with susceptibility results were also available.

Results The GyrA91-PCR accurately characterized the GyrA 91 locus of all 70 N. gonorrhoeae isolates (sensitivity=100%, 95% CI=94.9%–100%), whereas all non-gonococcal isolates and N. gonorrhoeae NAAT-negative clinical samples gave negative results by the GyrA91-PCR (specificity=100%, 95% CI=98.4%–100%). When applied to the 210 N. gonorrhoeae NAAT-positive clinical samples, the GyrA91-PCR successfully characterized 195 samples (92.9%, 95% CI=88.5%–95.9%). When compared with the corresponding bacterial culture results, positivity by the GyrA91-PCR WT probe correctly predicted N. gonorrhoeae susceptibility to ciprofloxacin in 161 of 162 (99.4%, 95% CI=96.6%–99.9%) samples.

Conclusions The use of a PCR assay for
detection of mutation in \(\text{gyrA}\) applied directly to clinical samples can predict ciprofloxacin susceptibility in \(N.\ gonorrhoeae\).

**Hepatocellular carcinoma in Australia’s Northern Territory: high incidence and poor outcome**

*Parker P, Tong S, Dempsey K, Condon J, Sharma S, Chen J, Sievert W, Davis J*

*MJA 2014; 201: 470-474 doi: 10.5694/mja13.11117*

**Objective:** To describe the epidemiology, clinical features, management and outcomes of hepatocellular carcinoma (HCC) in the Northern Territory over the past decade.

**Design, setting and patients:** An NT-wide epidemiology study covering the period 1991–2010 and a clinical cohort study including patients diagnosed during 2000–2011. HCC diagnoses were provided by the NT Cancer Registry and crosschecked against clinical records.

**Main outcome measures:** Age-adjusted incidence of HCC; management; clinical features; and median and 1-year survival.

**Results:** There were 145 incident cases of HCC in the NT during 1991–2010, giving an age-adjusted annual incidence of 22.7/100 000 (95% CI, 17.2–26.8) for Indigenous Australians and 4.0/100 000 (95% CI, 2.1–5.8) for non-Indigenous Australians — an incidence rate ratio of 5.9 (95% CI, 4.7–7.4). There was no significant change in annual age-adjusted incidence over this period. The most common causative factors were hepatitis B virus in Indigenous people and hepatitis C virus in non-Indigenous people. Most people were diagnosed late, only 13/80 were diagnosed by screening, and outcomes were poor, with 28/80 overall surviving to 1 year. Outcomes were better among those managed through a centralised multidisciplinary service than among those who were not (adjusted hazard ratio for death at 1 year, 0.35 [95% CI, 0.16–0.81]).

**Conclusion:** HCC incidence remains high in the Indigenous people of the NT. More resources are needed for HCC surveillance and management programs in this population.

**Determining meteorological drivers of salt marsh mosquito peaks in tropical northern Australia**

*Jacups S, Carter J, Kurucz N, McDonnell J, Whelan P*

*J Vector Ecol 2015;40 (2): 1-5*

In northern Australia the northern salt marsh mosquito *Aedes vigilax* is a vector of Ross River virus and is an appreciable pest. A coastal wetland adjacent to Darwin’s residential suburbs offers a favorable habitat for *Ae. vigilax*, and despite vigilant mosquito control efforts, peaks of *Ae. vigilax* occur in excess of 500/trap/night some months. To improve mosquito control for disease and nuisance biting to nearby residential areas, we sought to investigate meteorological drivers associated with these *Ae. vigilax* peaks. We fitted a cross-sectional logistic regression model to weekly counts of female *Ae. vigilax* mosquitoes collected between July, 1998 and June, 2009 against variables, tide, rainfall, month, year, and larval control. *Aedes vigilax* peaks were associated with rainfall during the months September to November compared with January, when adjusted for larval control and tide. To maximize mosquito control efficiency, larval control should continue to be implemented after high tides and with increased emphasis on extensive larval hatches triggered by rainfall between September and November each year. This study reiterates the importance of monitoring and evaluating service delivery programs. Using statistical modelling, service providers can obtain solutions to operational problems using routinely collected data. These methods may be applicable in mosquito surveillance or control programs in other areas.

**Aerial mosquito control of Ilparpa Swamp, Alice Springs 23 January 2015**

*Kurucz N, Roberts A*

*Mosquito Bites in the Asia Pacific Region, Winter 2015;10(1)*

**Summary:** In Alice Springs, the Ilparpa Swamp is the most productive mosquito breeding site for the common banded mosquito, *Culex annulirostris*. The swamp is of major public
health concern due to potential outbreaks of Murray Valley encephalitis (MVE), with the virus transmitted by this mosquito. In 2001, extensive flooding and two MVEV disease cases led to the first aerial control of Ilparpa Swamp, with aerial control also carried out in 2010.

In January 2015, Alice Springs again received heavy rainfall associated with monsoonal activity in the north-east, indicating a possible MVEV disease risk. The Department of Health responded by carrying out another aerial control operation in Ilparpa Swamp, with the successful operation jointly funded by the Power and Water Corporation and the Department of Lands and Planning.

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**NT malaria notifications July to September 2015**

*Belinda Farmer, CDC Darwin*

Six notifications of malaria were received for the 3rd quarter 2015. The table below provides details about where the infection was thought to be acquired, the infecting agent and whether chemoprophylaxis was used.

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<th>No. cases</th>
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<th>Reason Exposed</th>
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<th>Chemoprophylaxis</th>
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<td>1</td>
<td>73</td>
<td>49</td>
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<tr>
<td><strong>Total:</strong></td>
<td>849</td>
<td>1,088</td>
<td>94</td>
<td>158</td>
<td>1,530</td>
<td>1,360</td>
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*The Northern Territory Disease Control Bulletin Vol 22, No. 4 December 2015*
Ratio of the number of notifications in the 3rd quarter (Q3) of 2015 to the mean Q3 2010-14: selected diseases

Ratio of the number of notifications in the 3rd quarter (Q3) of 2015 to the mean Q3 2010-14: sexually transmitted diseases
Comments on notifications

**Campylobacter**
There were 106 cases of campylobacteriosis cases notified in the 3rd quarter which was more than twice the 5 year 3rd quarter mean of 50. Some of this increase may be due to more sensitive testing but the increase is nevertheless being investigated.

**Syphilis**
The increase in cases of infectious syphilis was mainly due to the ongoing outbreak in the Katherine and Alice Springs districts. Additionally, there was also an increase in cases diagnosed in men who have sex with men in Darwin urban area.

The revised national case definition for infectious syphilis (which the NT adopted) came into effect since 1 July 2015. It allows some cases that would have been notified as syphilis of >2 years or unknown duration under the old version of case definition but are highly likely to be infectious, to be notified as ‘probable’ infectious syphilis. This has contributed to the increase in infectious syphilis as well as the decrease in the category of syphilis of >2 years or unknown duration.

**Mumps**
There were 5 cases of mumps notified in the 3rd quarter this year compared with a total of 1 case for the last 5 corresponding quarters. All but 1 of the cases were associated with an outbreak in WA which is now numbering over 350 cases. Public health measures to limit the spread of this outbreak are underway.

**TB**
TB cases in the NT so far this year have been lower than previous years. Overseas arrivals via Christmas Island of people from high TB risk countries or settings contributed to a number of the TB cases reported in the 5 years through to 2014. The trend of TB notifications without these cases has been downward in recent years reflecting NT TB control strategies for early case detection, successful curative treatment (assisted by directly observed therapy) and promotion of appropriate diagnosis and treatment of those with latent TB infection to decrease risk of progression to active TB in the future.

**Zoster**
There were 92 cases of zoster (shingles) notified in the 3rd quarter compared to a 5 year mean of 52 cases (ratio 1.8). Notified zoster cases continue to increase and while it is likely that this is due to the uptake of the PCR test rather than a real increase, further work is being planned to examine the cause of this trend.

**********

**Fact sheet, guideline and web page update, October-December 2015**

The Centre for Disease Control (CDC) fact sheets and guidelines are updated on a regular basis and can be found on the CDC website at http://health.nt.gov.au/Centre_for_Disease_Control/Publications/CDC_Factsheets/index.aspx.

**Updated fact sheets and guidelines**
- Congenital syphilis guidelines
- Rotavirus
- Melioidosis

**New guideline**
- Public health management of invasive Group A streptococcal infection

**********
### Immunisation coverage for children aged 12-<15 months at 30 September 2015

<table>
<thead>
<tr>
<th>Region</th>
<th>Number in district</th>
<th>%DTP</th>
<th>%Polio</th>
<th>%HIB</th>
<th>%Hep</th>
<th>%Pneumo</th>
<th>%Fully vaccinated</th>
</tr>
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<tbody>
<tr>
<td>Darwin</td>
<td>294</td>
<td>93.5%</td>
<td>93.5%</td>
<td>93.5%</td>
<td>93.9%</td>
<td>92.9%</td>
<td>92.2%</td>
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<tr>
<td>Winnellie PO Bag</td>
<td>78</td>
<td>93.6%</td>
<td>93.6%</td>
<td>93.6%</td>
<td>93.6%</td>
<td>93.6%</td>
<td>93.6%</td>
</tr>
<tr>
<td>Palm/Rural</td>
<td>284</td>
<td>95.4%</td>
<td>95.4%</td>
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<td>95.8%</td>
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<tr>
<td>Katherine</td>
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<td>95.7%</td>
<td>95.7%</td>
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<td>95.7%</td>
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</tr>
<tr>
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<td>95.5%</td>
<td>95.5%</td>
<td>95.5%</td>
<td>95.5%</td>
<td>95.5%</td>
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<td>97.4%</td>
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<td>93.4%</td>
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### Immunisation coverage for children aged 24-<27 months at 30 September 2015

<table>
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<th>Region</th>
<th>Number in district</th>
<th>%DTP</th>
<th>%Polio</th>
<th>%HIB</th>
<th>%Hep</th>
<th>%MMR</th>
<th>%MenC</th>
<th>%Varicella</th>
<th>%Fully vaccinated</th>
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<td>Darwin</td>
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<td>93.7%</td>
<td>93.3%</td>
<td>93.3%</td>
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<td>94.1%</td>
<td>94.1%</td>
<td>89.7%</td>
<td>89.7%</td>
</tr>
<tr>
<td>Palm/Rural</td>
<td>253</td>
<td>94.5%</td>
<td>94.5%</td>
<td>92.5%</td>
<td>94.9%</td>
<td>87.0%</td>
<td>92.5%</td>
<td>87.7%</td>
<td>85.4%</td>
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<td>96.9%</td>
<td>96.9%</td>
<td>96.9%</td>
<td>96.9%</td>
<td>89.8%</td>
<td>89.8%</td>
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<td>88.9%</td>
<td>88.9%</td>
<td>88.9%</td>
<td>88.9%</td>
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<td>90.4%</td>
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</tr>
<tr>
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<td>96.2%</td>
<td>96.2%</td>
<td>96.2%</td>
<td>88.5%</td>
<td>96.2%</td>
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<td>93.3%</td>
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<td>86.7%</td>
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<td>86.7%</td>
</tr>
<tr>
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<td>95.0%</td>
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<td>92.2%</td>
<td>94.6%</td>
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<td>90.4%</td>
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### Immunisation coverage for children aged 60-<63 months at 30 September 2015

<table>
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<tr>
<th>Region</th>
<th>Number in district</th>
<th>%DTP</th>
<th>%Polio</th>
<th>%MMR</th>
<th>%Fully vaccinated</th>
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<tbody>
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<td>90.1%</td>
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<tr>
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<td>97.0%</td>
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<td>95.8%</td>
</tr>
<tr>
<td>Katherine</td>
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<td>97.7%</td>
<td>96.6%</td>
</tr>
<tr>
<td>Barkly</td>
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<td>84.2%</td>
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<td>86.0%</td>
<td>86.0%</td>
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<tr>
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<td>88.6%</td>
</tr>
<tr>
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<td>92.3%</td>
</tr>
<tr>
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<tr>
<td>Non-Indigenous (NT)</td>
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<td>91.1%</td>
</tr>
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<td>93.2%</td>
<td>93.2%</td>
<td>92.6%</td>
</tr>
</tbody>
</table>
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 34.

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 30 September 2015 were born between 1 April 2014 and 30 June 2014 inclusive. To be considered fully vaccinated, these children must have received 3 valid doses of vaccines containing diphtheria, tetanus, pertussis, and poliomyelitis antigens, either 2 or 3 doses of PRP-OMP Hib or 3 doses of another Hib vaccine, 3 doses of hepatitis B vaccine and 3 doses of pneumococcal vaccine. All vaccinations must have been administered by 12 months of age.

The cohort of children assessed at 24 to <27 months of age on 31 September 2015 were born between 1 April 2013 and 30 June 2013 inclusive. To be considered fully vaccinated, these children must have received meningococcal C vaccination (given at the 12 month schedule point), and dose 2 of measles, mumps, rubella (MMR) and dose 1 varicella vaccination (given in combination as MMRV at the 18 months schedule point). All vaccinations must have been administered by 24 months of age.

The inclusion of these 3 additional immunisations has caused a drop in the reported coverage rates which are measured at 2 years of age. The primary reason for the decrease is that uptake and/or reporting of the 18 month dose of MMRV is lower than for other vaccines. It is expected that these children will catch-up by their 4th birthday when they present for their next scheduled vaccination, if not before. Over time parents and providers will become more familiar with the due date for MMRV and timely coverage should improve.

The cohort of children assessed at 60 to <63 months of age on 31 March 2015 were born between 1 April 2010 and 30 June 2010 inclusive. To be considered fully vaccinated, these children must have received 4 or 5 valid doses of vaccines containing diphtheria, tetanus, pertussis antigens, 4 doses of poliomyelitis vaccine and 2 valid doses of MMR vaccine. All vaccinations must have been administered by 60 months (5 years) of age.

Interpretation and comment

The vaccination coverage rates for children in the NT are comparable with the national average for all age cohorts: 12 <24 months cohort (NT 93.2%, National 93.0%); and for the 60 to <63 months cohort (NT 92.2%, National 92.6%) and lower in the 24 to <27 months cohort (NT 86.7%, National 90.4%).

Indigenous children had similar coverage rates to non-Indigenous children (Indigenous 93.0%, non-Indigenous 93.3%) in the 12 to <15 month cohort and 24 to <27 cohort (Indigenous 86.6%, non-Indigenous 86.7%) but Indigenous children were more likely to be fully immunised in the 60 to <63 cohort (Indigenous 94.0%, non-Indigenous 91.1%).

Further information about the Australian Childhood Immunisation Register coverage may be found at: http://nicirs.edu.au/immunisation/coverage/index.php.

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Senior Immunisation Nurse, CDC, Chris Nagy retires

Chris Nagy has retired from the Department of Health after over 30 years of service. She began working with the Department of Health in 1979 when she accepted a registered nurse position at Tennant Creek Hospital.

In 1983 Chris moved to Darwin and commenced work at Royal Darwin Hospital (RDH). Her desire to broaden her skills resulted in further study in midwifery at the RDH School of Nursing. Chris then commenced work with Community Health in Darwin in 1987 where she was involved in home nursing and palliative care. Chris completed further training in child health and worked as a child and family health nurse at Casuarina Community Care Centre.

Chris moved to the Immunisation Unit within the Centre for Disease Control (CDC) in 1996 where she remained until her retirement. Chris held the position of Senior Immunisation Nurse at the CDC from 2002. During this time she was well known as the “go-to” person for immunisation queries and liaised across the Territory with immunisation providers on all issues surrounding vaccines. She worked to achieve best coverage to put a stop to vaccine preventable diseases. Chris was a well-regarded teacher and successfully implemented key initiatives which included:

- Numerous new childhood vaccination schedule programs, such as rotavirus, chickenpox, measles, meningococcal and pneumococcal disease
- The human papillomavirus vaccine program
- The diphtheria, tetanus and pertussis vaccine programs for pregnant and postnatal women and their partners.

Chris has been an advocate for safe and effective vaccine practice and developed health resources for immunisation providers and the public.

Chris also looked after those exposed to rabies overseas and raised awareness around Australian Bat Lyssavirus and provided the needed preventive vaccines to many a bat bite/scratch victim.

Beyond these duties she was an excellent general public health nurse who expertly contributed to outbreak responses such as for SARs, pandemic flu and measles.

Chris was the “CDC resident poet”— and this novel, entertaining and clever talent will be sorely missed.

Chris has been an exceedingly knowledgeable and dedicated nurse who has advocated and worked to obtain best immunisation practice for providers and high immunisation coverage in the NT for all Territorians while being a cherished and unforgettable colleague.

Photo: Lesley Scott and Chris Nagy

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Farewell to CDC Senior Policy and Coordination Officer Justine Glover

A farewell was held on 27 November 2015 for Justine Glover who resigned from the Department of Health after twenty years of dedicated service.

Justine demonstrated a desire to expand her skills and knowledge over her time with the Department by extending herself through a range of roles. These roles included a registered nurse at Royal Darwin Hospital; various roles at the Centre for Disease Control (CDC) including the chronic disease project officer, project officer working with the Community Physician, injury prevention coordinator, senior policy and coordination officer; project and policy roles with the Nursing and Midwifery Office and the Office of Disability; and the Department Liaison Officer for the Minister for Health. 15 years of her career in the Department was with CDC where she successfully assisted with coordination of the NT Chronic Disease Network; published the Chronicle and the Northern Territory Disease Control Bulletin; coordinated the NT Falls Network, numerous April Falls Days, dementia workshops, the annual fireworks injury survey, and the annual CDC Conference. While at CDC Justine also worked with other agencies such as the City of Palmerston to establish Palmerston Safe Communities and the lifestyle program Palmlesstonnes; and the NT Water Safety Advisory Council. Justine was a constantly happy, enthusiastic and productive member of the team and will be greatly missed at CDC. We wish her well on her new ventures in private industry.

![Photo: Janine Weston, Steven Skov, Justine Glover, Vicki Krause](image)

CDC staff updates October-December 2015

Top End

Congratulations to Natasha Tatipata, Sexual Health Aboriginal Health Practitioner, who won the Urban Award at the NT Aboriginal and Torres Strait Islander Health Practitioner Excellence awards. The Excellence Awards, recognise and reward members of this profession for their dedication and vital work that they do in providing primary health care, often in challenging circumstances and locations, while bridging the gap between Western medicine and traditional ways. The Urban Award acknowledges those Aboriginal and Torres Strait Islander Health Practitioners in urban settings who face different challenges to their remote counterparts. The Sexual Health and Blood Borne Virus Unit (SHBBVU) staff are extremely proud of Natasha’s achievement.

Geoff Stewart, Medical Officer SHBBVU, has completed his contract with Centre for Disease Control (CDC) and is now working in the Cocos Islands. Roxanna Sherry has transferred from Clinic 34 to the Syphilis Coordinator position. Sara-Dane Reekie commenced with CDC at
Clinic 34 as a Public Health Nurse. Sara-Dane previously worked at in Sydney with a background of working in Family Planning.

**Chris Nagy** retired from her position as Senior Immunisation Nurse with **Jayne Porter** successful in winning her position. Welcome back to **Linda Pitts** who returned to the Public Health Nurse Immunisation position after completing a contract with Hearing Health.

Business Manager **Marilou Lehmann** has moved from CDC to the Finance and Budgets Services area. **Siew Kim Chai** who has a past career in accounting has replaced Marilou.

**Alanna Barr** has joined the Community Paediatrics team to share the Community Paediatrics Project Officer position with **Kate Tessman**. Alanna is an Occupational Therapist who has previously worked at Royal Darwin Hospital. **Noela Davies** resigned from her position as the Toop End Rheumatic Heart Disease Nurse Coordinator. Noela is now the Manager of the Birdsville Health Service in Queensland. **Cathy Blacker** has assumed Noela’s previous position.

**Central Australia**

**Helen Tindall**, TB Public Health Nurse has returned to her position following 2 years of leave.

**Jessica Harries** joined the Trachoma Team as a Public Health Nurse.

**Chelsea Lodge** will commence as the Rheumatic Heart Disease Register Coordinator backfilling for **Nina Missen** who is on maternity leave. Congratulations to Nina who has given birth to a cute baby boy.

**Ellie Hagan** commenced as the Administrative Support Officer for CDC in Tennant Creek. Ellie previously worked with the Australian Regional Remote Community Services as an Administration/Community Care Coordinator.

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**World Antibiotic Awareness Week**

*Judy Burke, CDC, Katherine*

The CDC team at Katherine joined in the activities organised by Jo Bird (Infection Control Nurse Katherine Hospital) for World Antibiotic Awareness Week 16-22 November 2015. The week was aimed at increasing awareness of global antibiotic resistance and to encourage best practices among the general public, health workers and policy makers to avoid the further emergence and spread of antibiotic resistance.

The CDC team participated in the daily quizzes and eagerly submitted their results by 4pm each day resulting in CDC staff members Carmel Whalley and Judy Burke receiving prizes. The grand finale of the week was a ‘bake a bug’ cook-off. Judy made the most of the opportunistic education with a ‘spirochaetes on agar plate’ cake contribution (some poetic license) to promote the current syphilis outbreak message to nurses, midwives, doctors and medical students and the importance of opportunistic screening for STIs. Sadly this was not the winning entry with the first prize going to Leanne McGill for her ‘Bug Bin.’ However there was a lot of enthusiasm and bugs were everywhere including other well represented STI causative organisms.

Photo: ‘Spirochaetes on agar plate’ cake