Master of Applied Epidemiology

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A thesis submitted for the degree of Master of Philosophy in Applied Epidemiology

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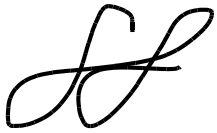
Originality statement

I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the award of any other degree or diploma at ANU or any other educational institution, except where due acknowledgement is made in the thesis. Any contribution made to the research by others with whom I have worked with is explicitly acknowledged in the thesis. I also declare that the intellectual content of this thesis is the product of my own work, except to the extent that assistance from others in the project's design and conception or in style, presentation or linguistic expression is acknowledged.

Signed: Sarah Sim



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Acknowledgement of Country

I would like to acknowledge the Larrakia people, the traditional custodians of the land on which this research was conducted in Darwin, Northern Territory. I pay my respects to their Elders, past, present and emerging and honour their enduring connection to land, water, culture and community.

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Abbreviations

ACCHO	Aboriginal Community Controlled Health Organisation
AOM	Acute Otitis Media
ARF	Acute Rheumatic Fever
CCMM	Chronic Conditions Management Model
CCPMS	Chronic Conditions Prevention and Management Strategy
CDC	Centre for Disease Control
HSAK	Healthy School Aged Kids
MBS	Medicare Benefit Schedule
NACCHO	National Aboriginal Community Controlled Health Organisation
NT	Northern Territory
OME	Otitis Media Effusion
PCIS	Primary Clinical Information System
PHC	Primary Health Care
REDCap	Research Electronic Database Capture
RHD	Rheumatic Heart Disease
SoNG	Series of National Guidelines
TLR	Traffic Light Report
TLRR	Traffic Light Recall Reporting

Abstract

This thesis examines four public health topics conducted at the Health Statistics and Informatics Branch, Department of Health in Darwin, Northern Territory (NT). The projects explored key health issues and services delivered across the Northern Territory (NT) with particular focus on primary health care services (PHC) in remote Aboriginal communities.

The Mothers and Babies 2021 Annual Report is a descriptive analysis using numbers and proportions to summarise key perinatal newborn outcome. Utilising cross-sectional population-based data of all births of NT resident mothers in the NT in 2021, this annual report provides a neutral display of these characteristics and aims to inform policy and program decisions for perinatal and newborn health services across the NT.

The evaluation of the Traffic Light Recall Reporting (TLRR) surveillance system that is used within NT Health remote PHC services to support chronic disease prevention and management, was conducted to assess the system's overall effectiveness and identify areas for improvement. By evaluating a number of appropriate surveillance attributes, this evaluation showed the TLRR surveillance system supports data-driven chronic disease management, however its full potential is limited by poor integration into routine PHC practice across NT Health's service infrastructure. Strengthening collaboration among governance stakeholders and providing standardised clinician training and support in using the TLRR, were identified as key opportunities for improvement of the TLLR surveillance system to ensure it is supporting sustainable and effective chronic disease care across NT Health remote communities.

An outbreak investigation was conducted in response to a single notification of measles, was notified to the Centre for Disease Control in Darwin, NT— the first case in the NT since 2019. A total of 162 contacts were identified; 94% (n=153/162) completed follow-up: 84% (n=136/162) were considered immune, 90% (146/162) were provided advice only, 2% (n=4/162) received the measles-mumps-rubella vaccine, and one contact was given normal human immunoglobulin. No further cases were reported in the NT in the two months following the notification.

The final epidemiological project is a cross-sectional descriptive analysis of the utilisation of targeted health service programs, screening coverage and the incidence of specific health outcomes of Aboriginal children aged 5–15 years presenting to remote NT Health PHC centres in 2024. This project highlights a degree of fragmentation among health programs for this age group despite the high level of clinical presentations the study identified among the study population in 2024. By examining health service delivery and uptake with the incidence of specific health outcomes, this project discusses key priority areas for improving targeted health programs and resource allocation.

Chapter One –

Introduction to the Masters of Applied Epidemiology, Darwin Northern Territory.

Introduction

This chapter introduces my field placement and outlines the four major projects and minor competencies undertaken to meet the core competencies of the Masters of Applied Epidemiology (MAE) program.

Overview of Field Placement

During my placement I was based in Darwin at the Northern Territory Health Statistics and Informatics unit within NT Health. This unit focuses on translating research and statistics into policy development and advancement. Amongst a team of epidemiologists, health economists, data registrars and demographers, the core business of the unit prepares health and wellbeing information through statistical analysis, research, and reporting to inform policy and service planning and delivery across the Northern Territory. Throughout the first year of my placement, I was part of the perinatal data registry team – working alongside senior epidemiologists and data managers. I also worked with the health informatics unit, providing clinical contributions to the transition of child health reports to online dashboards that are to be made accessible for clinicians working in remote primary health care centres.

During my second year, I was based two days a week at NT Health's Darwin Centre for Disease Control Public Health Response and Surveillance unit. Led by a public health physician, this team includes epidemiologists, public health surveillance nurses and data managers. The main functions of this unit involves coordinating public health responses to notifiable diseases, disease surveillance and monitoring of trends, provides an on-call advice and support service, and also supports local and regional units located across the NT. Throughout the six months I worked alongside public health staff and was part of the outbreak investigation response team during the single notification of measles that occurred in January 2025. I'm very grateful for being able to combine these two placements as they provided a complementary view of the ways in which epidemiology is applied in varying public health specialties.

Summary of major and minor competency projects

This thesis aims to meet the major and minor competencies of the Master of Philosophy in Applied Epidemiology which are described in the following chapter and summarised in Table 1.

Chapter 2 – Analysis of a Public Health Dataset

Major competency

- NT Mothers and Babies Annual Report, 2021.

The NT Mothers and Babies annual report describes the perinatal health and wellbeing outcomes for NT resident mothers and babies for the year of 2021. It is a routine, cross-sectional collection of population-based data used to summarise key characteristics of NT resident mothers and babies, including maternal demographics, maternal health variables, labour and delivery details and baby outcomes. This analysis allows critical perinatal outcomes and risk factors to be monitored and is used to inform perinatal health service delivery across the NT.

Minor competency

- Presented the *'NT Health's Perinatal Trends Report 2010-2021'* at the Australian College of Midwives Conference in Darwin, Northern Territory 2024.

Chapter 3 – Evaluation of a Surveillance System

Major competency

- Evaluating the Traffic Light Recall Reporting surveillance system for remote NT Health primary health care centres.

The Traffic Light Recall Reporting surveillance system is a NT Health primary health care (PHC) surveillance system that aims to deliver best practice in population management of chronic conditions across the NT. The surveillance system provides data through a variety of Traffic Light Recall reports that aim to support PHC clinicians in delivering and managing chronic disease care and provide clear program goals and benchmarking against peer remote PHC services. The reports also equip clinical teams for data learning and innovation and allocating scarce resources for PHC services efficiently. The evaluation of the surveillance system was based on core surveillance attributes which were selected in accordance with the evaluations objectives. These included acceptability, timeliness, simplicity, representativeness and effectiveness. The evaluation provided a framework for continuous quality improvement activities for chronic disease surveillance across remote primary health care.

Minor competency

- Outline of a detailed literature search and synthesis regarding public health surveillance for chronic disease management across NT Health primary health care services.
- Teaching topics in field epidemiology included delivering a lesson from the field as a scenario-based teaching session on '*Translating Public Health Policy and Quality Improvement Initiatives in Community Settings*.'

Chapter 4 – Respond to a Public Health threat or Outbreak

Major competency

- Measles outbreak investigation at Darwin Centre for Disease Control, NT Health 2025.

This outbreak investigation responded to a single notification of measles. Measles is a highly contagious airborne viral disease, usually presenting with high fever, cough, conjunctivitis, and a rash. Although no longer endemic in Australia, imported cases occur, with each one considered a public health emergency. In January 2025, a returned traveler with measles was notified to the Centre for Disease Control (CDC) in Darwin, NT— the first case in the NT since 2019. An outbreak management team was formed at Darwin CDC over a weekend including the lead public health physician, epidemiologists, surveillance nurses and myself as the MAE student. It was well coordinated outbreak response, with no further cases reported two months following the initial notification.

Minor competency

- Publication of a peer reviewed article in the NT Disease Control Bulletin, March 2025 edition: '*A single imported case of measles and the subsequent outbreak response, Darwin, Northern Territory, January 202*5.'
- Presented *'A single imported case of measles and the subsequent outbreak response, Darwin NT January 2025'* at the Communicable Diseases & Immunisation Conference, Adelaide South Australia, 2025.
- Teaching of topics in field epidemiology included teaching first year MAE students an overview of a recommended public health unit approach to an outbreak of syphilis by delivering a lesson on '*Syphilis in priority and sub-population*s.'

Chapter 5 – Design and Conduct an Epidemiological Study Design

Major competency

- Health profile of 5–15-year-old Aboriginal children living in remote Northern Territory.

This project examined and reported on the utilisation of health services, coverage of screening activity and incidence of specific health outcomes among Aboriginal children aged 5-15 years attending remote NT Health primary health care centres in 2024. Screening activity and associated health outcomes focused on ear, cardiac, nutrition and growth-related conditions. Through a cross-sectional descriptive analysis, the project aims to provide NT Health with an overview of the current health service utilisation of this age group status and insight into specific health outcomes, highlighting priority areas for targeted health programs and resource allocation.

Coursework

I passed the following coursework subjects of the MAE program:

POPH8916 Outbreak Investigation

POPH8917 Public Health Surveillance

POPH8913 Analysis of Public Health Data

POPH8915 Research Design and Methods

POPH8914 Issues in Applied Epidemiology

Table 1. Summary of the Masters of Applied Epidemiology projects and core course competencies.

MAE projects and core course competencies	**Chapter Two**	**Chapter Three**	**Chapter Four**	**Chapter Five**	**Chapter Six**
Analysis of a Public Health Data Set	**X**				
Evaluation of a Public Health Surveillance System		**X**			
Outbreak Investigation			**X**		
Epidemiological Study				**X**	
Teaching topics in field epidemiology					**X**
Literature Review		**X**			
Lay summary		**X**			
Conference presentation	**X**		**X**		
Peer reviewed publication			**X**		

Chapter Two – Mothers and Babies Report 2021, Northern Territory.

Analysis of a Public Health Data Set

Prologue

Rationale

The annual Northern Territory (NT) Mothers and Babies Report for 2021 describes key maternal and newborn indicators aimed to inform and guide governments maternal health policy.

My role

For this project, I led the analysis, writing, and publication of the routine annual NT Mothers and Babies 2021 report. As lead, I sought feedback from NT Health colleagues with a clinical midwifery background regarding the acceptability and appropriateness of how the report is received by clinicians working within maternity services. I used this feedback to implement changes to the report by including figures (graphs and other visuals) throughout the report. As a member of the perinatal registry team, I attended weekly to fortnightly data-request and team meetings and learned from senior epidemiologist(s) in their approach to conducting analysis.

Prior to the publication of the report, a draft report was reviewed by co-authors and supervisors. As the lead author of this report, I was responsible for reviewing comments and implementing changes. I submitted a memorandum to the Chief Health Officer (CHO) with the final report for approval. Once the CHO approved, the report was published online in the NT Health Library collection, Health Statistics and Informatics (HSI) website and disseminated to stakeholders via email.

Lessons learned

This project provided me with a variety of invaluable foundational skills and knowledge in the management of large cross-sectional population datasets. I learnt how to clean and prepare data for analysis using STATA, calculate total fertility rates, utilise Excel for generating result tables and was able to consolidate my learning of descriptive statistics through STATA initially, but also during the write up stage of the report. I was able to participate in collaborating with stakeholders regarding the suitability of the report format, and learnt the processes required prior to publication, including final report reviews and comments amongst the perinatal registry team, and final approval from the Chief Health Officer of NT Health. Throughout this project I also learnt the value of asking questions early and consolidated the benefits of approaching a large workload by organising it into manageable sections aligned with estimated timeframes for completion. Overall, I feel this project really highlighted the benefits of a learning process that involves applying theory into practice.

Public health impact

The annual perinatal Mothers and Babies report for the NT provides a foundational tool for key stakeholders i.e. frontline clinicians, local and regional management and policy makers to refer to in the NT. By providing a detailed representation and description of perinatal and newborn health outcomes, the report facilitates key stakeholders to identify where improvements in maternity services and associated policies have been achieved, and areas to be addressed. This can be seen in the implementation of the Darwin Midwifery Group Practice (MGP) which addresses improving antenatal care for women living in remote areas of the NT where the provision of health services in primary health care is low resourced. This initiative aims to improve the continuity of care for women throughout their pregnancy with greater access to antenatal midwifery care and can be informed and guided based on outcomes illustrated in the annual Mothers and Babies Report. Another example of how this report impacts public health can be seen in program initiatives to expand awareness regarding contraception among young adolescent women in the NT which has resulted in a considerable decrease in the proportion of teenage mothers in both urban and rural and remote parts of the NT.[4]

Acknowledgements

I would like to first and foremost acknowledge the mothers and babies, their family and community of which this report has been based on during 2021. To the invaluable midwives and nurses working across the NT – your dedication and hard work is acknowledged and greatly appreciated. A sincere thank you and acknowledgement to the NT perinatal data registry team at Health Statistics including Dr Alyson Wright, Dr Lillian Li, Leanne Hill, Sunil Bhat and Stacey Hill for sharing your knowledge, skills and expertise. Thank you to my academic supervisors – Dr Amy Parry and Kirsty Nichols also for your ongoing teaching(s) and guidance with this project.

Abstract

Understanding the epidemiology of perinatal and newborn health outcomes across the Northern Territory (NT) is crucial in ensuring that targeted health services are well informed, equipped and supported. The aim of this report is to provide a neutral display of the perinatal and newborn characteristics during 2021. By summarising and identifying key health outcomes, this report aims to provide evidence towards policy and program decisions for perinatal and newborn health services throughout the NT.

The NT Mothers and Babies report for 2021 includes a collection of cross-sectional population-based data of all births that occurred in the NT, by Mothers who are NT resident only. For mothers with multiple pregnancies, the data of the baby first born is used only. Data is collected from the births that occurred in public and private hospitals, planned home births and in unintended locations including community health centres and non-hospital births. The data are then described by a range of characteristics including maternal Aboriginal status, geographical location, country of birth and descriptively analysed predominantly through numbers and proportions, summarising key perinatal and newborn health outcomes.

In 2021, there were 3785 babies born to 3741 mothers who resided in the NT. Amongst these resident births, 32% were Aboriginal and 29% were born overseas. Forty-one mothers who were interstate or international residents gave birth to 41 babies. Of all NT births, 97% (n=3642/3741) occurred in a hospital whilst the remaining 3% (n=99/3741) were planned homebirths and unintended locations. The most common medical complication of pregnancy was gestation diabetes mellitus for both Aboriginal and non-Aboriginal mothers 21% (n=251/1198) and 28% (n=677/2395) respectively. The proportion of preterm babies born to Aboriginal mothers was more than double that of preterm babies born to non-Aboriginal mothers 15% (n=181/1178) and 6% (n= 164/2545) respectively.

Amidst the geographical, eco-social complexities and individual maternal lifestyles that pose significant influence on maternal and newborn health outcomes, this report highlights the tremendous effort in maternity services that occurs in the NT. However, this report also clearly demonstrates that alarming health risk factors and outcomes do still exist amongst NT mothers and their newborns i.e. smoking status, low birth weight, highlight the need for transparent, practical and sustainable collaboration between clinicians, their clients and policy makers.

Chapter format: The remainder of this chapter will be presented as the full report.

Mothers and Babies 2021

Northern Territory Midwives' Collection

NORTHERN TERRITORY GOVERNMENT

Document title	Mothers and Babies 2021
Contact details	PerinatalRegistry.DoH@nt.gov.au
Approved by	Adjunct Professor Paul Burgess, Acting Chief Health Officer
Date approved	April 2025
Document review	Annually
TRM number	EDOC2025/81500

Acronyms	Full form
ABS	Australian Bureau of Statistics
AF	artificial feeding
AIHW	Australian Institute of Health and Welfare
CPAP	continuous positive airway pressure
CS	caesarean section
DPH	Darwin Private Hospital
ECM	external cardiac massage
ERP	estimated resident population
IPPV	intermittent positive pressure ventilation
mL	millilitres
NT	Northern Territory
n	number
np	not presented
PPH	post-partum haemorrhage
TFR	total fertility rate
WHO	World Health Organization

Mothers and Babies 2021

Northern Territory Midwives' Collection

Sarah Sim

Lin Li

Stacey Hill

Leanne O'Neil

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Summary

This report summarises 2021 perinatal data from the Northern Territory (NT) Midwives' Collection. It includes population characteristics of mothers, maternal health status, antenatal information, conditions and procedures used in labour and childbirth, as well as birth outcomes of all births that occurred in 2021. The trend tables (see Appendix B) demonstrate changes over time for key demographic and obstetric indicators and birth outcomes over the period 2007–2021. Unless otherwise stated, the following key findings are for NT resident mothers and their babies only.

Key findings

- In 2021, there were 3785 babies born to 3741 mothers who resided in the NT, 32% of whom were Aboriginal, and 29% were born overseas. In addition, there were 41 babies born in the NT to 41 mothers who were interstate or international residents. The total number of births in the NT for 2021 was 3826 babies born to 3782 mothers.
- Aboriginal women in the NT had a total fertility rate (TFR) of 1.9 in 2021, while non-Aboriginal women had a rate of 1.6. The TFR for all NT women was 1.8.
- The mean age of Aboriginal mothers (26 years) was five years younger than that of non-Aboriginal mothers (31 years). Fifteen percent of Aboriginal mothers were below 20 years of age. Non- Aboriginal mothers were more than twice as likely to be in the oldest age group (35 years and over) as Aboriginal mothers (26% and 10%, respectively).
- A greater proportion of Aboriginal mothers (20%) had three or more previous births compared with non-Aboriginal mothers (6%). A smaller proportion of Aboriginal mothers gave birth to their first baby in 2021 than non-Aboriginal mothers (38% and 48%, respectively).
- Eighty seven percent of all mothers in the NT received their antenatal visit during their first trimester of pregnancy (<14 weeks gestation), whilst 8% of all mothers at 32 weeks gestation or more, attended less than five antenatal visits. There has been an increase in the proportion of mothers attending five or more antenatal visits for both Aboriginal and non-Aboriginal mothers (77% to 87% and 91% to 97%, respectively) during the reporting period 1989 – 2020.[1]
- Aboriginal mothers were seven times more likely to report smoking before 20 weeks of pregnancy compared with non-Aboriginal mothers (49% and 7%, respectively). Of those who reported smoking in the first 20 weeks of pregnancy, non-Aboriginal mothers were more likely to have quit smoking post 20 weeks gestation than Aboriginal mothers (7% and 3%, respectively).
- Four percent of all NT mothers reported drinking alcohol during their pregnancy at their first antenatal visit. Aboriginal mothers were four times more likely to report drinking alcohol at this first visit compared with non-Aboriginal mothers (8% and 2%, respectively).
- Ninety-seven percent of all NT births occurred in a hospital, while the remaining 3% occurred in other locations including planned homebirths and births at health centres.
- Onset of labour was induced for approximately one third (36%, n=1334) of all NT mothers.
- Fifty-six percent of all NT mothers had a normal vaginal birth, while instrumental deliveries using forceps or ventouse (vacuum suction) accounted for 12% of births. Around one third (32%) of all NT mothers had a caesarean section (CS). Of mothers experiencing no labour, 41% had not had a previous CS.
- Among NT mothers who gave birth vaginally, 28% had a second degree perineal laceration, while 3% had a third degree, and less than 1% had a fourth degree laceration. Twenty-one percent had an episiotomy.

- The most common medical complication of pregnancy was gestational diabetes mellitus for both Aboriginal and non-Aboriginal mothers (21% and 28% respectively). The proportion of mothers with pre-existing diabetes mellitus was higher for Aboriginal than non-Aboriginal mothers (6% and 1%, respectively).
- The most common complication of labour and childbirth for all NT mothers was post-partum haemorrhage (37%). Post-partum haemorrhage was more common among mothers who had a CS birth (49%) than vaginal birth (30%). This difference is expected because intraoperative blood loss is included in the blood loss measurement.
- Nine percent of all NT live births were preterm (less than 37 weeks gestation). The proportion of preterm babies born to Aboriginal mothers was more than double that of preterm babies born to non-Aboriginal mothers (15% and 6%, respectively).
- Eight percent of all NT live births were low birthweight (less than 2500 grams). The proportion of low birthweight babies born to Aboriginal mothers was three times that of those born to non-Aboriginal mothers (15% and 5%, respectively).
- Seven percent of all NT singleton liveborn term (≥37 weeks) babies were low birthweight; 5% of those born to Aboriginal mothers and 2% to non-Aboriginal mothers.
- By five minutes after birth, 2% of term singleton liveborn babies had an Apgar score below seven. The proportion of term singleton liveborn babies with an Apgar score below seven in Aboriginal and Non-Aboriginal babies was similar (2% and 1.5% respectively).
- Sixteen percent of all NT term liveborn babies received some form of resuscitation, excluding tactile stimulation. The requirement for resuscitation was higher among Aboriginal babies (21%) than non-Aboriginal babies (14%).
- There were 79 perinatal deaths comprising 62 fetal deaths (stillbirths) and 17 neonatal deaths. The stillbirth rate was 30 per 1,000 births for Aboriginal and 10 per 1,000 births for non-Aboriginal mothers. The overall perinatal death rate was 38 per 1,000 births for the Aboriginal population and 13 per 1,000 births for the non-Aboriginal population.

1. Introduction

The foundational months of pregnancy and birth are an extraordinary time for women, their partners, families and communities.[2] The relationship between mother and fetus plays a pivotal role in determining the long term health and wellbeing for baby.[3] Antenatal care in this period provides mothers and families support, and ensures pregnancy complications such as gestational diabetes, pre-term birth and pre-eclampsia are identified and monitored.[4] Health information collected in this antenatal period, captured in perinatal data records, provides an important insight into maternal risk factors, labour complications and birth outcomes at a population level. Importantly, this data also highlights the complex interplay between long term health outcomes as a result of exposure to maternal risks, eco-social influences and the environment.[5]

To monitor policy and quality improvement initiatives within maternity health care services across Australia there is a need for public health surveillance of maternal and baby outcomes. In Australia, each state and territory are accountable through legislated population health monitoring to collect and report on characteristics of perinatal and newborn health outcomes.[6] The Northern Territory (NT) specifically, contributes a unique compilation of perinatal information for national reporting complied by the Australian Institute Health Welfare. The NT also reports specific perinatal data through the publication of this report - the Mothers and Babies Annual Report, and the periodical trend reports for the NT.[7]

The distinctive demography of the NT makes our perinatal data story very different to other Australian states and territories. We account for only 1% of the Australian population,[8] and have a population that is geographically dispersed widely across regional and remote areas, with 27% of the population identifying as Aboriginal,.[9]

This annual report summarises data for NT mothers and babies for the year 2021. The annual monitoring of key perinatal indicators across three broad areas—including, the antenatal period, birth and labour, and birth outcomes — remains cornerstone in delivering and improving quality health care services. Analysis by Aboriginal status allows the NT to identify service and inequity gaps among key population groups. As such, the focus is on resident mothers only, who gave birth in the NT. Unless otherwise stated, mothers and babies residing interstate or overseas are omitted from the statistical tables. Perinatal reports compiled annually by the Australian Institute of Health and Welfare (AIHW) publish estimated numbers of NT women who gave birth interstate. According to the AIHW's 2021 web report it was estimated that approximately 48 NT women gave birth interstate, in South Australia (29 births) and Queensland (19 births).[10]

This report presents a brief description of the results with key tables and figures used to highlight key findings from 2021. Narrative information is followed by a comprehensive presentation of data in a series of tables and trend figures. As specified elsewhere, most tables present statistics by Aboriginal status and/or by place of mother's usual residence for mothers with an NT resident address. Place of mother's usual residence is classified by NT regions, and urban and rural/remote areas. The urban area includes Darwin Urban and Alice Springs Urban and the towns of Katherine, Tennant Creek, and Nhulunbuy; whilst the rural/remote area covers the balance of the NT.[11]

1.1. Data sources

1.1.1. Northern Territory Midwives' Collection

The NT Midwives' Collection is a population-based census of all births that occurred in the NT, including births in public and private hospitals, planned home births, births in unintended locations such as community health centres, and other non-hospital births. All liveborn babies and fetal deaths (stillbirths) of at least 20 weeks gestation are included. These criteria align with national reporting practices.

The majority of information about births in the NT is captured directly in electronic format. In the public sector, midwives enter data shortly after the birth of a baby via the Birthing Suite Module of CareSys (or via Acacia where this is available) in the public hospital information system. At present, data capture covers births that occurred in public hospitals and births before arrival to public hospitals, whereas the births in Darwin Private Hospital (DPH) are entered via the NT Midwives' Collection website. Births that occurred in community health centres or planned home births, that did not involve being admitted to hospital, are submitted in paper form and then entered by the Perinatal Data Manager.

1.1.2. NT Neonatal and Infant Death Register

The Health Statistics and Informatics Branch of NT Health has maintained information on stillbirths, neonatal deaths and infant deaths (up to one year of age) since 1986. The primary source is the NT Midwives' Collection, and the secondary source is data from the NT Births, Deaths and Marriages Registry that contains information on all deaths, including those that occurred in the community.

1.2. Quality Summary

Several data items in the NT Midwives' Collection, notably antenatal information including number of antenatal visits, gestational age at first antenatal visit, smoking during pregnancy, alcohol consumption during pregnancy, maternal medical conditions, pregnancy complications and indications for caesarean section are incomplete or of low accuracy. This is usually due to the data input errors.

The data item 'Not stated' includes those missing due to the woman declining to provide information and can also be missing due to data entry error. This report uses the AIHW recommendation that 'Not stated' are shown in tables as numbers and excluded from the calculation of percentage distributions. This methodology assumes the 'Not stated' have the same distribution as the data presented.[12] This approach differs from reports compiled prior to the 2003 report. In these earlier reports, 'Not stated' data were included as a percentage of the total in each table.

The effect of this change is that the proportional distribution for certain data items, particularly alcohol consumption and smoking during pregnancy, is now markedly higher than previously reported. Comparative analyses involving reports published since the 2003 Mothers and Babies report and those published prior to 2003 Mothers and Babies report need to take this methodological change into account.

The data used in this report are limited to health information available at the time of data entry. In instances where an antenatal record is incomplete or missing, the midwife entering information into the Birthing Suite Module of CareSys or the NT Midwives' Collection website was limited to the details available. Key antenatal indicators such as visit dates and health behaviours are the most likely to be affected as this information is only recorded in the pregnancy health record (hand-held record).

In this report, unless stated otherwise, maternal Aboriginal status was used during the analysis of both mother and baby information. This is obtained through the available information at the time of data entry, however was not available for the reporting on interstate births to NT women. Validity of Aboriginal status was supported by the AIHW's quality national report on Indigenous identification in hospital admissions, whereby the NT was found to have a 98% (CI 96-99%) completeness in Indigenous identification status.[13] For information on labour and childbirth in the 'Mothers' section of this report, data of the first baby born was used for mothers with multiple births in one pregnancy.

For some medical conditions, procedures, and complications related to labour and childbirth, data in the NT Midwives' Collection are different to the information recorded in the NT hospital patient data system. This is due to the different data coding and entry methods, with midwives responsible for data in the NT Midwives' Collection and medical coders responsible for data entry in the NT hospital patient data system.

Commencing in 2012, data for post-partum blood loss volume for all public hospital admissions was made available for analysis. In 2014, information on blood loss volume for DPH births was also made available.

Prior to 2012 (and 2014 for DPH births), data on post-partum haemorrhages (PPH) were collected using the midwives PPH data item flag entered at the time of birth which may not accurately represent the proportion of PPH within hospitals. To improve the accuracy and standardisation of the data, a new definition of PPH was developed to include all episodes with a post-partum blood loss volume of 500 millilitres or more (including caesarean sections), regardless of whether the PPH data item flag was used. Comparative analyses involving reports published since 2014 and those published prior to 2014 will need to take this method change into account.

Information on a mother's post-partum complications and baby's health outcomes are not collected in the NT Midwives' Collection because they occur after the mothers and babies have left the birthing suite, where data entry occurs.

Gestational age and birthweight are key indicators of population health. In the *Mothers and Babies report 2012* and onwards, these indicators are reported for liveborn babies in the Appendix A (Hospitals profiles tables) and Appendix B (Trends of perinatal indicators tables). As a result, the birthweight and gestational age data may differ slightly from previous reports, where the gestational age and birthweight of both stillborn and liveborn babies were included.

The denominator used to calculate fertility rates is the 2021 NT Estimated Resident Population based on the Australian Bureau of Statistics (ABS) estimated resident population (ERP) by age and sex at 30 June of 2021 (Appendix C).[14]

Because the NT population is small, when data is disaggregated by Aboriginal status, region, or place of birth, the denominator and numerator can be very small. Percentages and rates with a denominator less than 100 are not reliable and can fluctuate significantly even with minimal changes in the overall count. For this reason, we suggest that comparisons should be made based on counts when denominators are small. Where the denominator is small (<100), percentages have been included in the table for completeness only.

When there is a risk of attributes about an individual being disclosed due to a small number of cases, relevant cells or tables are suppressed. For example, in 2021, there were only five births at Tennant Creek Hospital, as a result, this hospital's profile have not been presented in Appendix A.

A further issue with data disaggregated by region is the difficulty that some individuals may identify with one or more usual place of residence.[15] This is particularly relevant and true for pregnant women who have to travel and stay in an urban area from 38 weeks gestation to be close to a hospital that provides birthing services. The location they are staying at prior to the birth could be recorded as their current place of residence and not their usual residence. An audit of NT hospital demographic data in 2011 found 91% congruence between hospital records of patients' recorded health district of residence and the health district people identified as their usual place of residence when asked in an interview.[13]

2. Mothers and babies of the Northern Territory

2.1. Mothers

In 2021, a total of 3,741 mothers gave birth to 3,785 babies in the NT, of which 3,723 were live births. Of the six regions in the NT, Greater Darwin had the highest number of mothers at 2,278 mothers (Figure 1). The proportion of Aboriginal mothers compared to non-Aboriginal mothers was higher in all NT regions, except in the more urban regions of Greater Darwin and Central Australia. Mothers born overseas were highest in Greater Darwin (38%) and Central Australia (27%). Central Australia had a relatively even split between the sub-populations: 43% of mothers identifying as Aboriginal; 30% of mothers identifying as non-Aboriginal; and, 27% of mothers born overseas. A number of main characteristics of mothers and their births are summarised in Table 1, this is followed by a detailed description of key maternal indicators and birth outcomes.

Figure 1. Proportion of mothers who gave birth by NT region, Aboriginal status, and birth country, 2021

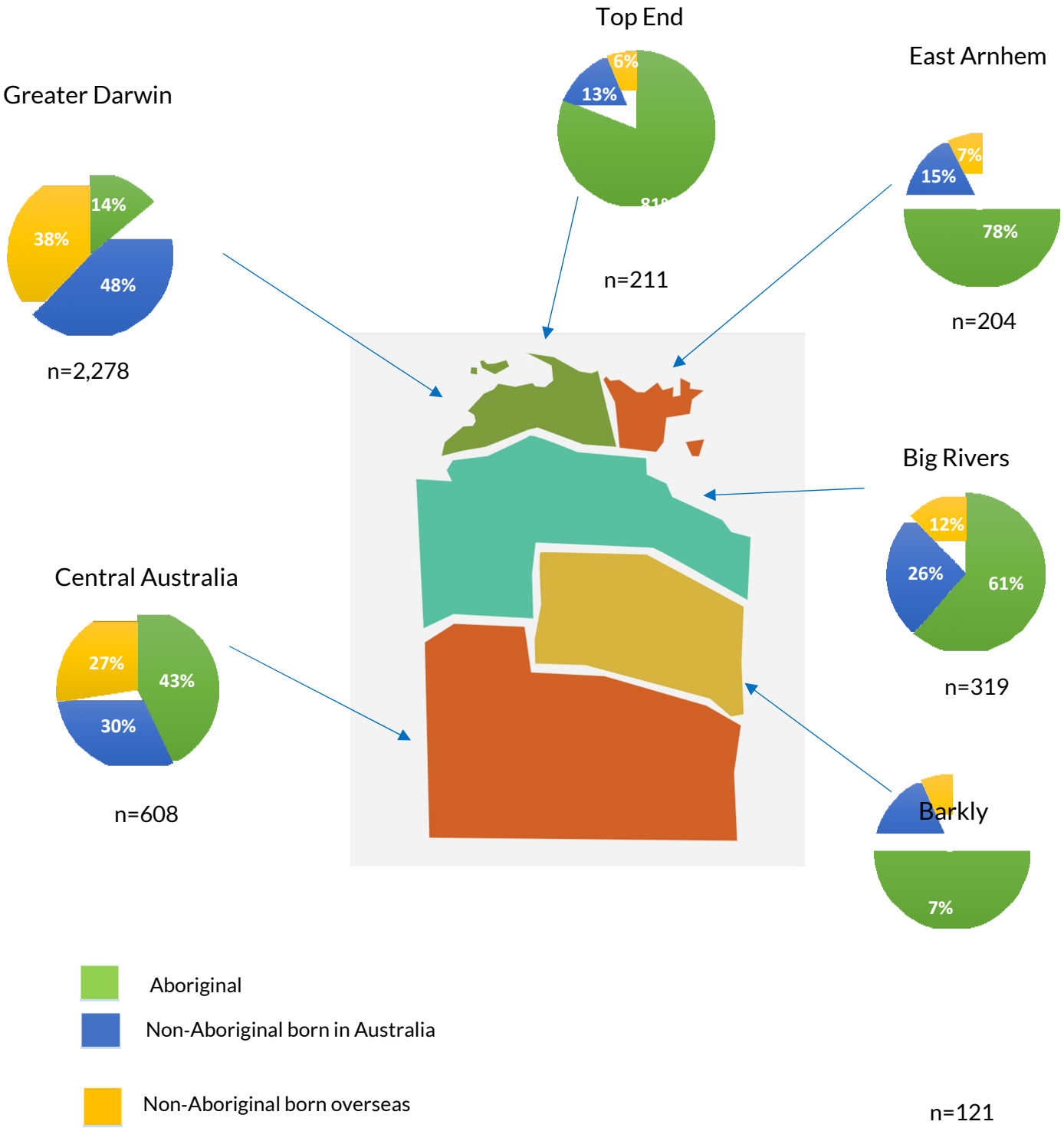


Table 1. Characteristics of NT mothers and their births by Aboriginal status, 2021

	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
All MOTHERS						
Total	**1200**	**32.1**	**2541**	**67.9**	**3741**	**100**
Maternal age						
<20	178	14.8	22	0.9	200	5.3
20-34	899	74.9	1870	73.6	2769	74.1
35+	123	10.3	649	25.5	772	20.6
Place of birth						
Hospital	1171	97.6	2471	97.2	3642	97.4
Non-hospital[3]	29	2.4	70	2.8	99	2.6
Type of labour onset						
Spontaneous (Not augmented)	415	34.6	804	31.6	1219	32.6
Spontaneous (Augmented)	165	13.8	314	12.4	479	12.8
Induced	406	33.8	928	36.5	1334	35.7
No labour	214	17.8	494	19.4	708	18.9
Method of birth[1]						
Normal vaginal	723	60.3	1369	53.9	2092	55.9
Forceps	62	5.2	163	6.4	225	6.0
Ventouse	57	4.8	161	6.3	218	5.8
Caesarean section	353	29.4	845	33.3	1198	32.0
Gestation at birth						
<37	204	17.0	167	6.6	371	9.9
>=37	996	83.0	2374	93.4	3370	90.1
FIRST-TIME MOTHERS						
Total	**450**	**37.5**	**1211**	**47.7**	**1661**	**10.7**
Maternal age						
<20	158	35.1	20	1.7	178	10.7
20-34	288	64.0	982	81.1	1270	76.5
35+	4	0.9	209	17.3	213	12.8
TOTAL FERTILITY RATE[2]		**1.9**		**1.6**		**1.7**

Note: 1. Not stated in the category (method of birth) was not included in the table but included in the percentage calculations.
2. Total fertility rate is the average number of births per woman over her life time if she experienced the age-specific rates seen in 2021.
3. Non-hospital includes planned homebirths.

2.1.1. Place of residence

Among all babies born in the NT, 3785 (99%) were born to mothers who were residents in the NT at the time of the birth. There were 41 mothers from interstate or overseas who gave birth to 41 babies (1% of all babies born in the NT in 2021).

Most NT non-Aboriginal mothers were living in urban areas (96%), which includes Darwin Urban and Alice Springs Urban regions and the towns of Katherine, Tennant Creek, and Nhulunbuy. In contrast, Aboriginal mothers were more likely to reside in rural and remote areas (52%).

2.1.2. Country of birth

Seventy one percent of NT women who gave birth in 2021 were born in Australia and 29% of NT mothers who were born overseas (Figure 2). The largest proportion of overseas born mothers came from

the following country groups: Southern and Central Asia, South-East Asia, and North-West Europe (Figure 3). The key countries for overseas born mothers were: India (4%), Philippines (3%) and Nepal (3%). Other contributing locations were the United Kingdom (2%) and New Zealand (2%), followed by Pakistan (1%) and Indonesia (1%).

Figure 2. Country of birth for NT Mothers, 2021

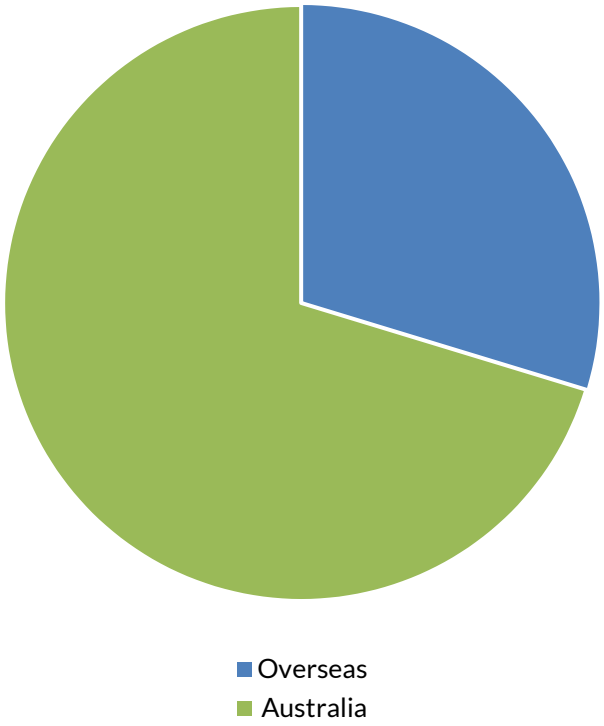
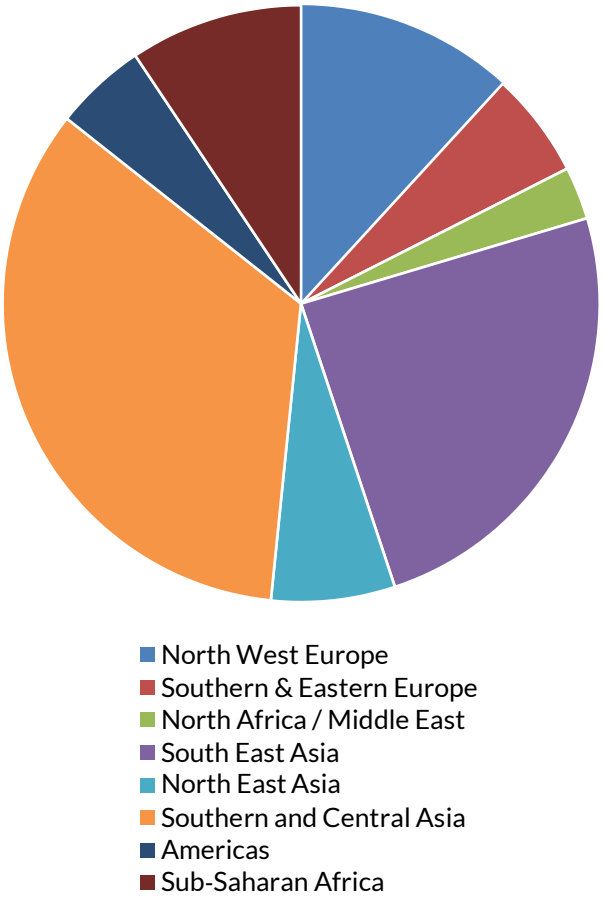


Figure 3. Main country group for NT Mother's born overseas, 2021



2.1.3. Fertility rate

The total fertility rate (TFR) for the NT was 1.8 live births per woman (of child-bearing age) in 2021, lower than the national replacement rate of 2.1 births per woman,[16] and slightly higher than the TFR of 1.7 births per woman for the whole of Australia in 2021.[17] In the NT, Aboriginal women had a TFR of 1.9 in 2021, while non-Aboriginal women had a slightly lower rate of 1.6 live births per woman.

Aboriginal women residing in urban areas had a higher TFR compared with those residing in rural/remote areas (2.5 and 1.5, respectively). In 2021, Barkly (2.2) had the highest TFR for all NT women followed by Greater Darwin, Central Australia and Big Rivers (all 1.8), East Arnhem (1.7) and Top End (1.6). Aboriginal women had a higher TFR compared with non-Aboriginal women in all NT regions.

The age-specific fertility rates show differences in the age of child-bearing between Aboriginal and non-Aboriginal populations in the NT. The fertility rate of the youngest age group (less than 20 years of age) was more than seven times higher for Aboriginal women compared with non-Aboriginal women (51 and 6 births per 1,000, respectively). Conversely, the fertility rate of the 35 years and older age group was higher for non-Aboriginal than Aboriginal women (34 and 16 births per 1,000, respectively).

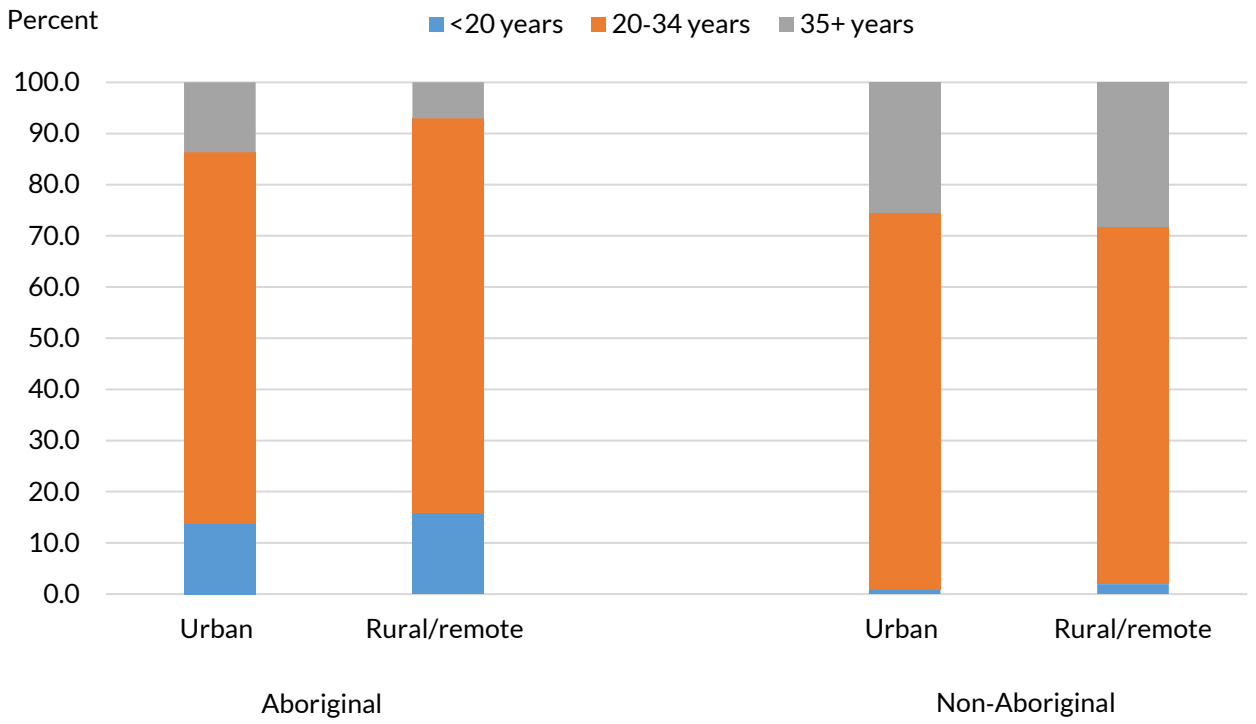
2.1.4. Maternal age

The mean age of Aboriginal mothers was 26 years, which was almost five years younger than the mean age of non-Aboriginal mothers (mean age 31 years). Forty six percent of Aboriginal mothers and 9% of non-Aboriginal mothers were less than 25 years old. Most non-Aboriginal mothers (65%) and 26% of Aboriginal mothers were aged 30 years or more. Fewer Aboriginal mothers (10%) were of an advanced maternal age (>35 years) compared with non-Aboriginal mothers (26%) (Figure 3).

As presented in the statistical tables (table 12 and 13) an earlier age of childbearing was more common among Aboriginal mothers, a pattern that was consistent in all NT Regions, and in urban and remote areas. The proportion of Aboriginal mothers giving birth and aged less than 20 years, ranged from 9% in Greater Darwin to 22% in Central Australia. The proportion of young Aboriginal mothers was slightly lower in urban (14%) compared to rural/remote areas (16%) (Figure 4), and the difference between the proportions for non-Aboriginal mothers living in urban compared to those rural/remote was minimal (1% versus 2%, respectively).

The difference in the mean maternal age at time of birth, between Aboriginal and non-Aboriginal women, was more pronounced among first-time mothers. There was a ten year difference (21 and 30 years of age, respectively). The majority of non-Aboriginal first-time mothers were aged 25 years or older (87%) compared with 20% for Aboriginal mothers. Aboriginal first-time mothers aged less than 20 years and less than 18 years constituted 35% and 14% respectively whereas, non-Aboriginal first-time mothers in the same age groups (age less than 20 years and 18 years) were 2% and 0.2%, respectively. However, the proportion of Aboriginal first-time mothers, aged less than 20 years, has decreased by 17% from 2011 to 2021 (52% to 35%, respectively). In the same time period, the proportion of first-time non-Aboriginal mothers, aged less than 20 years, fell by 4% (from 6% in 2011 to 2% in 2021).

Figure 4. Maternal age by area of remoteness and Aboriginal status, NT 2021



2.1.5. Parity

Fifty-six percent of NT mothers giving birth in 2021 had given birth previously; 45% had one or two previous births and 11% had three or more previous births. Aboriginal women were three times more likely as non-Aboriginal mothers to have had three or more previous births (20% and 6% respectively).The remaining 44% of women gave birth to their first child in 2021. First-time mothers were proportionally higher among non-Aboriginal mothers (48%) than Aboriginal mothers (38%).

2.1.6. Antenatal care

It is important for maternal and fetal outcomes for women to have their initial antenatal visit within the first trimester of pregnancy. This is defined as a gestational age less than 14 weeks calculated from first day of last menstrual period, which aligns with the METEOR 2020 definition.[18] The definition differs from the NT perinatal reports published prior to the 2008 report.[19] In this report, gestational age at the first antenatal visit was derived from three sources including the date of the first antenatal visit, the date of the first ultrasound, and/or the recorded gestational age at the time of the first ultrasound.

The majority of mothers had information on antenatal visits recorded. Not stated or missing information about the date of first visit or frequency of visits was slightly over 1%. Overall, 87% of mothers who attended antenatal care attended in the first trimester. This varied by NT health region. Eighty one percent of mothers in the Greater Darwin region had an antenatal visit in the first trimester. The proportion of mothers, having first antenatal visit in the first trimester, was the lowest in the Barkly region (48%). Aboriginal mothers were more likely to have their first antenatal visit later in the pregnancy, compared with non-Aboriginal mothers (69% and 96%, respectively). The proportion of Aboriginal mothers attending a first antenatal visit in the first trimester was slightly higher in urban than in rural/remote areas (78% and 62%, respectively).

Five or more antenatal visits were recorded for 83% of Aboriginal mothers and 97% of non-Aboriginal mothers. Seventeen percent of Aboriginal mothers had less than 5 antenatal visits with the highest proportion of Aboriginal mothers that received less than five antenatal visits were in the Barkly region (44%) whilst in the Greater Darwin region it was 13%.

2.1.7. Alcohol consumption during pregnancy

Self-reported alcohol consumption during pregnancy is collected at the first antenatal visit and again at approximately 36 week's gestation. Although the collection of this indicator has improved in recent years, the number of mothers with missing data remains significant (5%). In 2021, 5% of alcohol consumption data at the first antenatal visit were missing.

At their first antenatal visit, 4% of all NT mothers reported drinking alcohol during the pregnancy. The prevalence of self-reported alcohol consumption was higher for Aboriginal mothers (8%) than for non-Aboriginal mothers (2%) at this first visit. The prevalence of alcohol consumption reported did not include missing data (n=117 Aboriginal mothers, n=57 non-Aboriginal mothers).

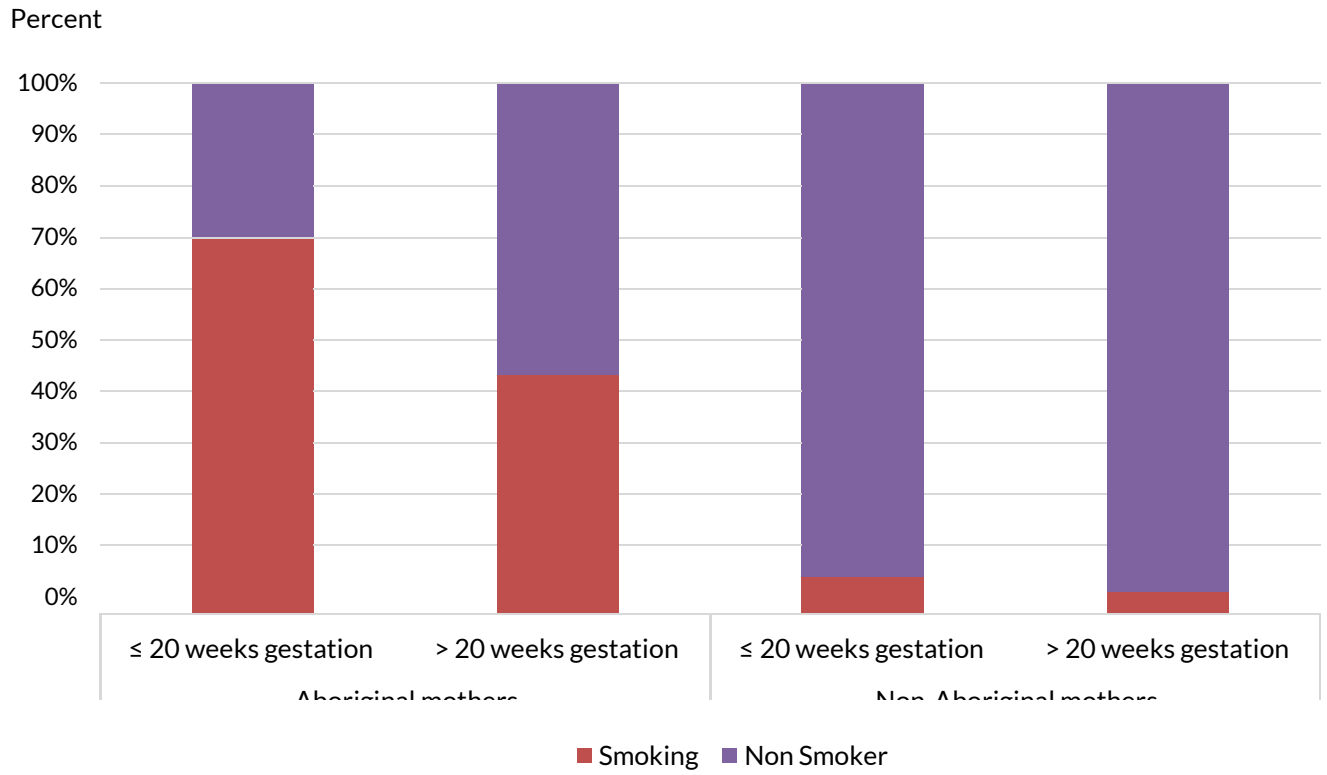
2.1.8. Smoking status during pregnancy

Self-reported smoking status during pregnancy is recorded as two items: (1) smoked before 20 weeks gestation and (2) smoked after 20 weeks gestation. The estimated self-reported average daily quantity of cigarettes smoked is also collected after 20 weeks gestation. The prevalence of reported smoking during pregnancy in this report was calculated after removing records with missing data (n=53).

Twenty percent of all NT mothers reported smoking before 20 weeks of pregnancy. As depicted in Figure 4, Aboriginal mothers were seven times more likely than non-Aboriginal mothers to report smoking before 20 weeks of pregnancy (49% and 7%, respectively). Sixty one percent of Aboriginal mothers aged less than 20 years, 50% of Aboriginal mothers aged 20-34 years and 35 years or more, reported smoking before 20 weeks gestation. Non-Aboriginal mothers aged less than 20 years were much more likely to smoke (27% reported smoking) than those aged 20-34 years and those over 35 years (6% for both age groups). Of NT mothers who reported smoking before 20 weeks of pregnancy, non-Aboriginal mothers were more likely to have reported quitting smoking by 20 weeks gestation than Aboriginal mothers (37% and 13%, respectively).

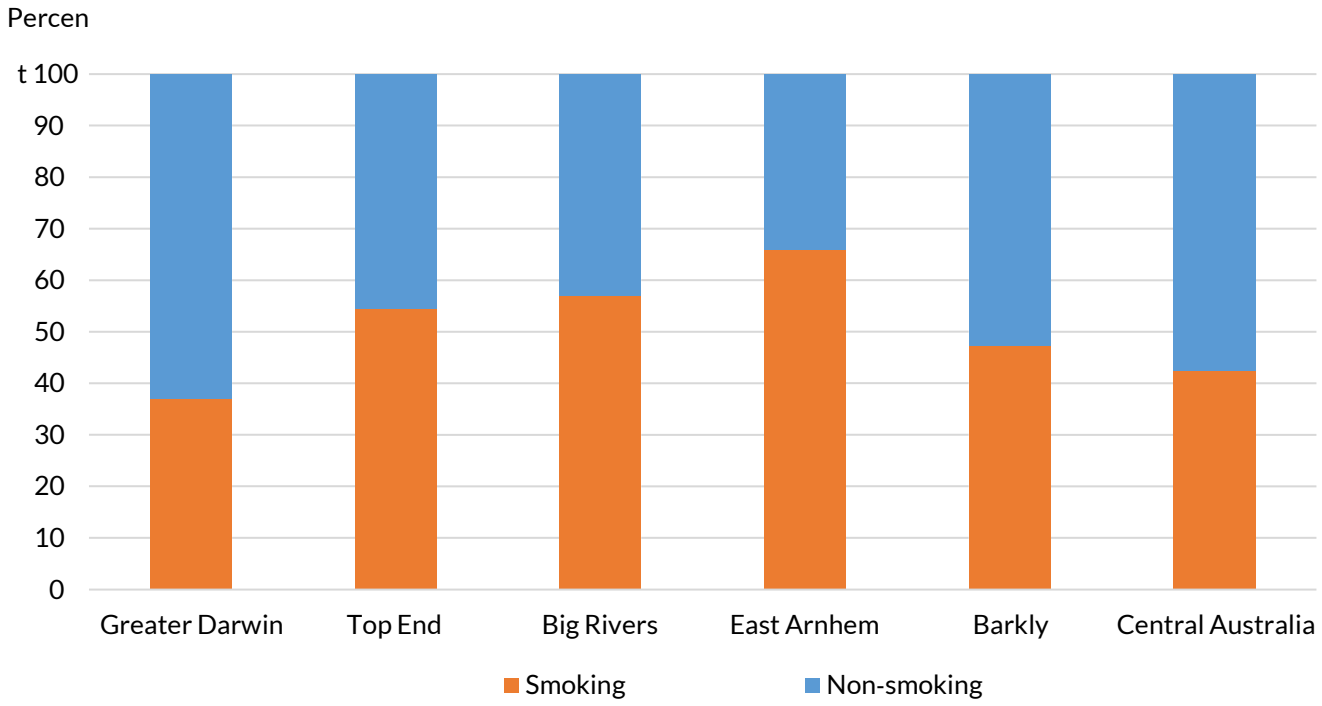
Among Aboriginal mothers, those living in the Greater Darwin region had the lowest smoking rates compared to other NT regions, with 37% of mothers reporting smoking before 20 weeks gestation (Figure 5). The highest smoking prevalence was recorded among mothers in East Arnhem (66%) (Figure 6). The pattern of lower smoking rates in Central Australia (42%) was consistent with data from previous years. In this region, smoking prevalence may be lower as it may be supplemented with the local practice of chewing tobacco (pituri).[20]

Figure 5. Maternal smoking status[1] during and after 20 weeks gestation by Aboriginal status, NT 2021



Note: 1. Smoking status includes mothers with a recorded response.

Figure 6. Aboriginal maternal smoking status[1] before 20 weeks gestation by NT Region, 2021



Note: 1. Smoking status includes mothers with a recorded response.

2.1.9. Birth facility

Almost all NT births occurred in a hospital (97%) in 2021. The majority of hospital births took place at one of the six public hospitals in the NT (87%) and the rest were at DPH, the only private hospital in the NT. Most mothers who gave birth at DPH were non-Aboriginal (97%).

There were 99 births that occurred out of hospital. Among these, 6 births were planned homebirths (with the public hospital midwifery home birth service), 15 births occurred in remote community health centres and 38 occurred in transit to a health service, at home or in temporary accommodation.

Remote community health centres were the most common place for non-hospital births for Aboriginal mothers (1% of all births for NT Aboriginal mothers). Central Australia had the largest proportion of non-hospital births for Aboriginal mothers (over 3%), with the proportion in the remainder of the NT Regions ranging from 1% to 3%.

2.1.10. Onset of labour and induction of labour

Spontaneous onset of labour occurred for 45% of mothers, 36% had labour induced, and the remainder had no labour (19%).

Of women giving birth at term gestation, the proportion with spontaneous onset of labour was higher for Aboriginal than non-Aboriginal mothers (47% and 44%, respectively), and also different for women with spontaneous onset of labour at preterm gestation (53% and 44%, respectively).

Of women giving birth at term gestation, the proportion induced was lower for Aboriginal than non-Aboriginal women (36% and 37%, respectively), and also for women induced at preterm gestation (22% and 26%, respectively).

Of women giving birth at term, the proportion with no labour was lower for Aboriginal than non-Aboriginal women (16% and 19%, respectively), and also for women with no labour at preterm gestation (25% and 29%, respectively).

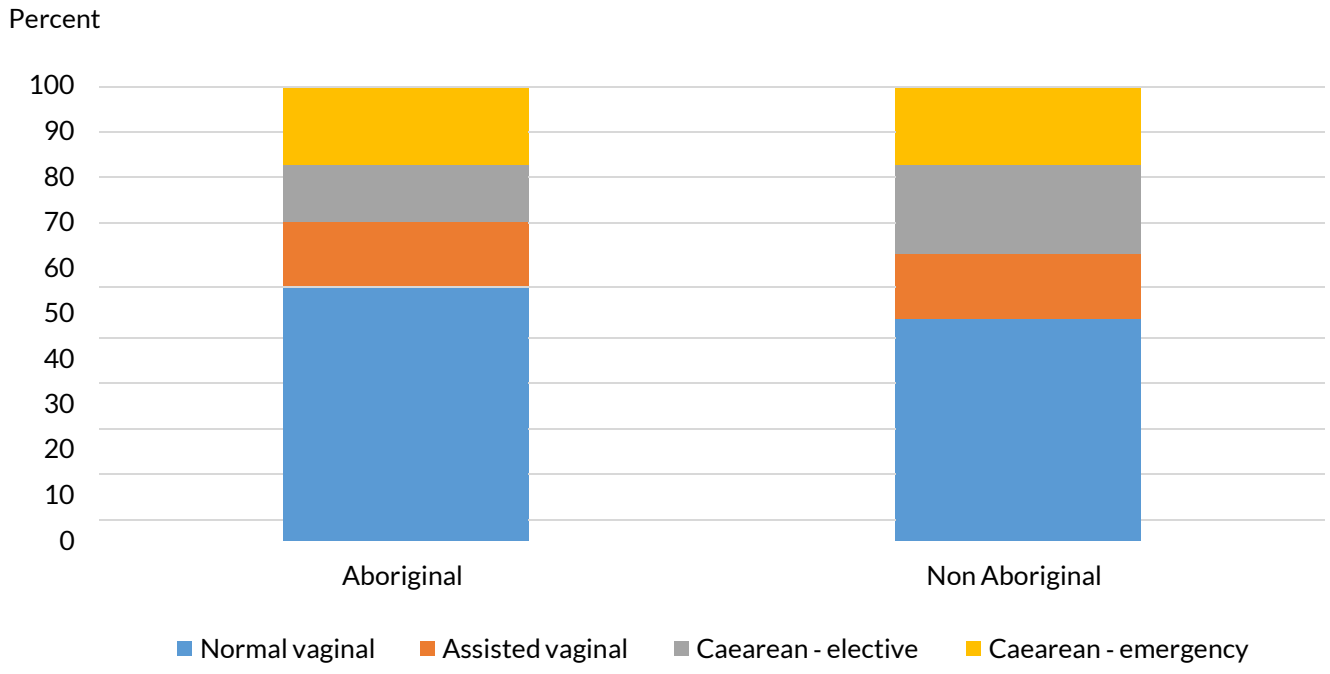
2.1.11. Fetal presentation and method of birth

The majority of fetal presentations in NT mothers were vertex (95%) while breech accounted for 5% and other presentations less than 1%.

Of all NT mothers giving birth in 2021, 56% had a normal vaginal birth. Instrumental vaginal births using forceps or ventouse (vacuum extraction) accounted for 12% of all births. Aboriginal mothers were more likely to have a normal vaginal birth than non-Aboriginal mothers (60% and 54%, respectively) and less likely to have an instrumental birth than non-Aboriginal mothers (10% and 13%, respectively) (Figure 7).

Nearly one third (32%) of births were by caesarean section (CS), with Aboriginal mothers less likely to have a CS birth than non-Aboriginal mothers (29% and 33% respectively). Among all NT hospitals, DPH had the highest proportion of CS births (51%), and the lowest proportion of normal vaginal births (41%). Nationally, the proportion of births that were via CS in the private hospital sector during 2021 was 51%.[21]

Figure 7. Method of birth[1,2] by Aboriginal status, NT 2021



Note: 1. The reporting of normal vaginal birth and assisted vaginal birth excludes vaginal births that were breech delivery.
2. The category assisted vaginal births includes both ventouse and forcep delivery.

2.1.12. Analgesia and anaesthesia for childbirth

The vast majority of mothers who laboured (spontaneous or induced) used some form of analgesia (86%). Analgesia uptake was slightly higher among Aboriginal than non-Aboriginal mothers (88% and 85%, respectively). Non-Aboriginal mothers were more likely to have an epidural as an analgesic than Aboriginal mothers (19% and 15%, respectively).

Anaesthesia was used in nearly all operative births (forceps, ventouse and/or CS) (98%), with the same rates among non-Aboriginal mothers and Aboriginal mothers. Non-Aboriginal mothers were more likely than Aboriginal mothers to have epidural/caudal anaesthesia (31% and 29%, respectively). There was slightly higher use of spinal anaesthesia for Aboriginal mothers than non-Aboriginal mothers (54% and 52%, respectively). Local and pudendal anaesthesia was administered in similar proportions to non-Aboriginal and Aboriginal women having operative births (7% and 8%, respectively).

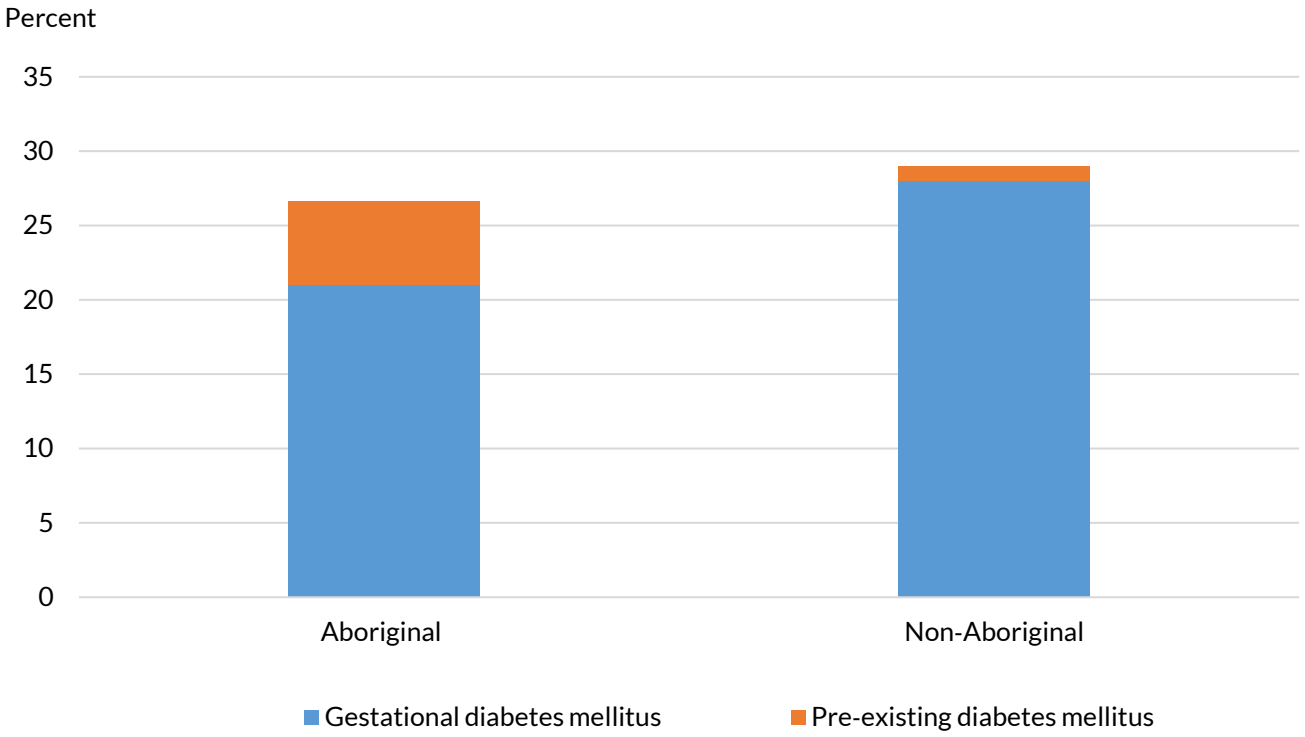
2.1.13. Pregnancy and childbirth complications

Complications in pregnancy and labour/childbirth provide areas for potential learnings and health service improvement and as such, a selection of the more common pregnancy and labour/childbirth complications are reported. Thirty-one percent of all NT mothers experienced at least one listed pregnancy complications in 2021, while 63% experienced at least one complication of labour/childbirth. Non-Aboriginal mothers had a similar proportion of pregnancy complications than Aboriginal mothers (31% compared with 30%), whilst Aboriginal mothers had a similar proportion of any labour/childbirth complications than non-Aboriginal mothers (65% and 63%, respectively).

In terms of specific pregnancy complications, the most common medical complication of pregnancy was gestational diabetes mellitus, affecting 26% of all NT mothers. The proportion of mothers with gestational diabetes mellitus was higher for non-Aboriginal than Aboriginal mothers (28% and 21%, respectively)

(Figure 8). The proportion of mothers with pre-existing diabetes mellitus was higher for Aboriginal than non-Aboriginal mothers (6% and 1%, respectively). Aboriginal mothers also had a higher proportion of gestational hypertension than non-Aboriginal mothers (6% and 3%, respectively).

Figure 8. NT Mothers with diabetes mellitus by type and Aboriginal status, 2021



Postpartum Haemorrhage (PPH) was assigned to cases that recorded having a blood loss volume of 500 millilitres (mL) or more. PPH is the most common childbirth complication for all NT mothers (36%), and was more prevalent in Aboriginal mothers (38%) than non-Aboriginal mothers (35%). A PPH was more common among mothers with CS birth than vaginal birth (49% and 30%, respectively). Among mothers with a CS birth, PPH was slightly higher for non-Aboriginal than Aboriginal mothers (50% and 47%, respectively). However, among mothers who had a vaginal birth, the PPH proportion was higher for Aboriginal than non-Aboriginal women (34% and 27%, respectively). Considering vaginal birth and blood loss volume of 1000 millilitres or more, the proportion affected was also higher for Aboriginal mothers than non-Aboriginal mothers (14% and 10%, respectively).

2.1.14. Perineal status

For mothers who gave birth vaginally, 25% had an intact perineum, 23% had a first degree perineal laceration or graze, 28% had a second degree perineal laceration, and a small proportion (4%) had a third degree laceration or a fourth degree laceration. The procedure episiotomy (incision in the perineum) was performed on 21% of mothers who gave birth vaginally. Aboriginal mothers were more likely than non-Aboriginal mothers to have an intact perineum (32% and 21%, respectively).

2.1.15. Postnatal hospital stay

The average length of stay for all NT mothers was 2.5 days, while for first time mothers it was 3 days. The majority of mothers who gave birth in hospital stayed in hospital for one day or more following the birth (93%). Only 2% of women stayed for eight or more days. Aboriginal mothers were more likely than non-Aboriginal mothers to have a hospital stay of one day or more (95% and 92%, respectively) and more likely to stay for eight or more days (3% and 1%, respectively). This difference may be associated with remote residence, as more Aboriginal mothers are from remote areas. Aboriginal mothers living in

rural/remote areas were more likely than those living in urban areas to have a hospital stay of four days or more (32% and 20%, respectively). This difference can also be attributed to Aboriginal mothers having a higher rates of preterm births. Mothers who had a CS had an average length of stay of 4 days while mothers who had a normal vaginal birth had an average length of stay of 2 days.

2.2. Babies

2.2.1. Birth status

In 2021, a total of 3826 babies were born in the NT. Of these, 41 were born to mothers who were not NT residents. Of the 3785 babies born to NT mothers, 62 (2%) were fetal deaths and 3723 (98%) were live births. The proportion of stillborn babies (fetal deaths) was slightly higher among babies born to Aboriginal mothers compared to babies born to non-Aboriginal mothers (3% and 1%, respectively).
Seventy-seven percent of fetal deaths had an extremely low birthweight of less than 1000 grams and 34 (71%) fetal deaths were born at an extremely preterm gestation, between 20-28 weeks gestation. Table 2 provides a summary of some of the characteristics of babies born to NT mothers in 2021.

Table 2. Characteristics of NT births by maternal Aboriginal status, 2021

	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Birth status						
Live birth	1178	97.0	2545	99.0	3723	98.4
Stillbirth	36	3.0	26	1.0	62	1.6
Baby's sex						
Male	634	52.2	1283	49.9	1917	50.6
Female	576	47.4	1287	50.1	1863	49.2
Indeterminate[1]	4	0.3	1	0.0	5	0.1
Plurality						
Singleton	1186	97.7	2511	97.7	3697	97.7
Multiple	28	2.3	60	2.3	88	2.3
Birthweight						
<1500	71	5.8	43	1.7	114	3.0
1500 - 2499	140	11.5	107	4.2	247	6.5
2500 - 3999	907	74.7	2199	85.6	3106	82.1
4000+	96	7.9	221	8.6	317	8.4
Not stated	0	0.0	1	0.0	1	0.0
Gestational age						
<28 weeks	48	4.0	30	1.2	78	2.1
28-36 weeks	167	13.8	157	6.1	324	8.6
37+ weeks	999	82.3	2384	92.7	3383	89.4
Total	**1214**		**2571**		**3785**	

Note: 1. Indeterminate is where sex cannot be determined. Some percentages may not total 100% due to rounding.

2.2.2. Plurality

There were 88 twin births to NT mothers in 2021 and no other multiple order births. The proportion of twin births was the same for non-Aboriginal and Aboriginal mothers (2%).

2.2.3. Gestational age and birthweight of liveborn babies

Altogether, there were 345 (9%) pre-term live births (gestational age less than 37 weeks). The proportion of pre-term liveborn babies born to Aboriginal mothers was more than twice that of non-Aboriginal mothers (15% and 6%, respectively).

Of all liveborn babies, 8% were low birthweight (less than 2500 grams). The proportion of low birthweight liveborn babies born to Aboriginal mothers was three times that of non-Aboriginal mothers (15% and 5%,

respectively). In the very low birthweight category (less than 1500 grams), the proportion of babies born to Aboriginal mothers was three times that of non-Aboriginal mothers (3% and 1%, respectively).

Aboriginal mothers were more likely to have low birthweight or pre-term live births than non-Aboriginal mothers, across all NT Regions. The NT Region with the highest proportion of low birthweight babies born to Aboriginal mothers was Top End (23%) whereas Barkly had the lowest (less than 12%). It should be noted that pregnant women in Central Australia, who are predicted to give birth before 30 weeks gestation, or who have a medical condition that requires specialist intensive care services, may be transferred interstate for continuing care and birth.

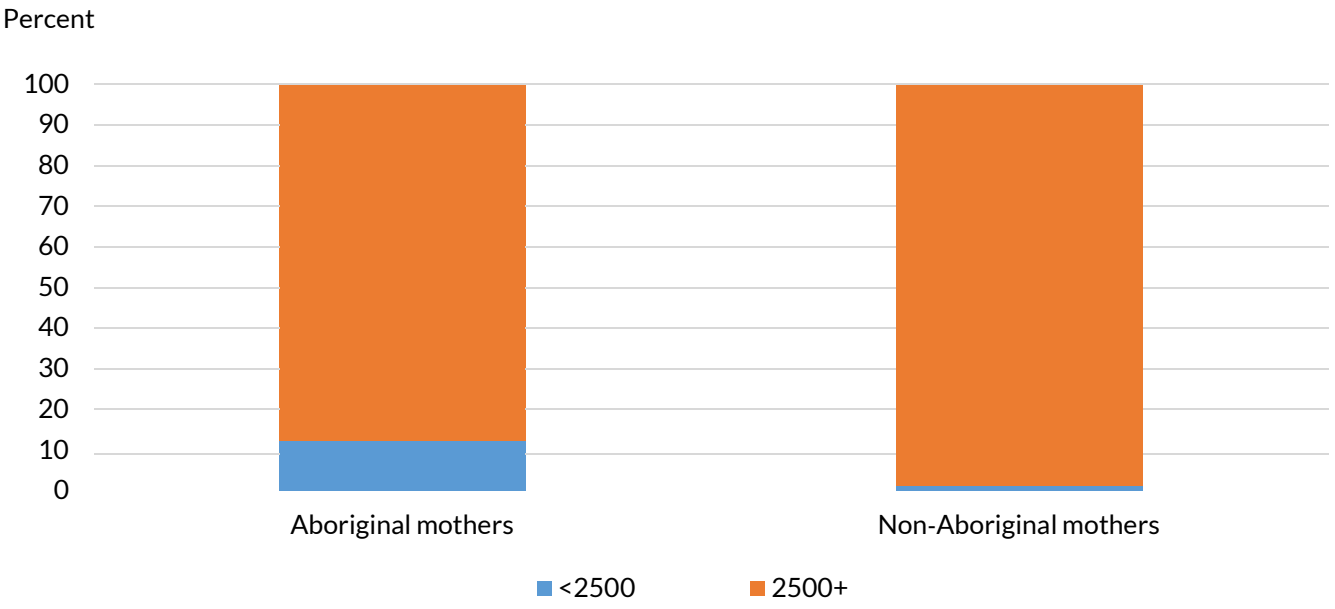
The proportion of low birthweight among term gestation (greater than 37) singleton liveborn babies born to Aboriginal mothers was almost three times that of those born to non-Aboriginal mothers (5% and 2%, respectively).

2.2.4. Birthweight adjusted for gestational age

Babies are defined as being small for gestational age if their birthweight is below the 10th percentile for their gestational age and sex, and babies are defined as large for gestational age if their birthweight is above the 90th percentile for their gestational age and sex, as determined by national percentiles. Data on birthweight adjusted for gestational age is limited to liveborn singleton babies.

Overall in the NT, 11% of liveborn singleton babies were small for gestational and 9% were large for gestational age. The proportion of liveborn singleton babies, small for gestational age, born to Aboriginal mothers was 16% compared to 9% for non-Aboriginal mothers (Figure 9). The proportion of large for gestational age of singleton babies born to Aboriginal mothers was the same as babies born to non-Aboriginal mothers (both 9%). For liveborn singleton babies born to Aboriginal mothers, the highest proportion of small for gestational age was in the Top End (22%), while the highest proportion of large for gestational age was in the Barkly (14%), followed by Central Australia (11%).

Figure 9. Birthweight of singleton live births by baby Aboriginal status, NT 2021



2.2.5. Apgar scores

The Apgar score is a clinical indicator of the condition of the baby at birth and is based on physical characteristics (pulse, breathing, skin colour, muscle tone and reflex irritability). Each characteristic is assigned a score of 0, 1, or 2, with the highest total Apgar score being 10. A score of 7-10 indicates a healthy baby.[22] By five minutes after birth, 97% of all NT liveborn babies had an Apgar score above seven.

For pre-term babies the proportion for Aboriginal babies with a five-minute Apgar score of 7 or more was slightly higher than that of non-Aboriginal babies (88% and 85%, respectively). For term babies the proportion with a five-minute Apgar score of 7 or more for Aboriginal babies was the same as non-Aboriginal babies (98%).

2.2.6. Resuscitation of liveborn babies

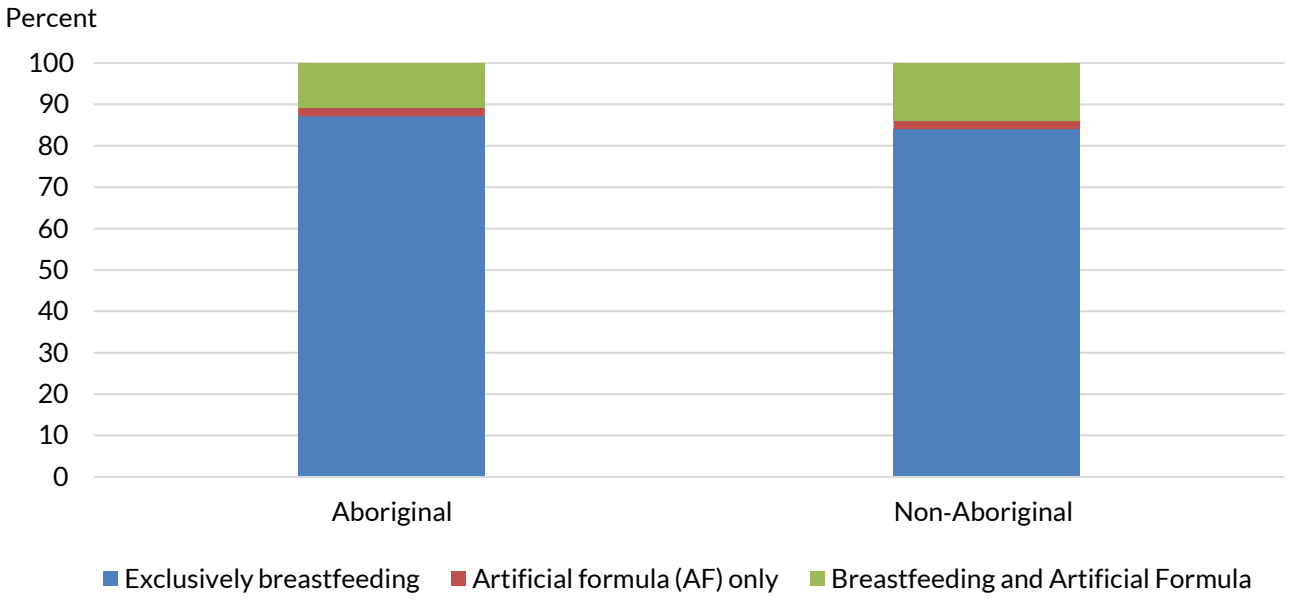
Sixteen percent of babies born alive received some form of resuscitation, excluding tactile stimulation. The proportion of babies requiring resuscitation was higher among Aboriginal compared with non-Aboriginal liveborn babies (21% and 14%, respectively). This is partially attributed to the higher proportion of preterm Aboriginal babies. Eight percent of liveborn babies received intermittent positive pressure ventilation. Methods such as intubation, external cardiac massage (ECM) and ventilation were uncommon.

2.2.7. Infant feeding

Information regarding infant feeding status is captured upon hospital discharge of the mother. The information in this report was calculated after removing records with missing data (less than 1% in 2021) or instances of perinatal death or babies remaining in special care nursery after a mother's discharge.

Among singleton term babies discharged with their mother (n=3053), 98% were ever breastfed. Of these, 85% had been exclusively breastfed, 12% of babies who were breastfeeding on discharge had received at least one formula feed during their admission, 1% of mothers had ceased breastfeeding prior to discharge, and 2% of babies were never breastfed. The percentage of singleton term babies of primiparous mothers (first baby) that had ever breastfed was 99%, compared with 97% of babies of multiparous mothers (previously had a baby). Exclusive breastfeeding rates of babies born to first time mothers were higher among babies born to Aboriginal mothers (86%) than those born to non-Aboriginal mothers (80%) (Figure 10).

Figure 10. Feeding status for full-term[1] liveborn babies[2] born in hospital by Aboriginal status, NT 2021



Note: 1. Full-term > 36 weeks gestation.
2. Singleton live births only.

2.2.8. Perinatal mortality

Content warning: The following content contains information some readers may find distressing as it relates to the loss of a newborn and stillbirth.

Perinatal mortality includes fetal deaths (stillbirth) and neonatal deaths (born alive and dies within 28 days of birth). In 2021, there were 79 perinatal deaths in the NT, comprising 62 fetal deaths and 17 neonatal deaths. Of the 17 neonatal deaths, 10 were Aboriginal and 7 non-Aboriginal. The Aboriginal perinatal death rate was higher than the non-Aboriginal rate (37.9 and 12.8 deaths per 1000 births, respectively).
Rates of perinatal death vary across Australia, with the AIHW reporting the NT had the highest rate of perinatal death in 2021. This may reflect a higher proportion of women in the NT giving birth with at least one risk factor associated with perinatal death (including living in remote and very remote areas, smoking throughout pregnancy, and First Nations women[23]) and warrants further examination.

The perinatal death rates can vary due to changes in legislation (including termination legislation implemented in 2017 and 2021), and may mean that trends on the total perinatal death rate are not directly comparable across years. We present adjusted perinatal death rates for the last four years 2018 to 2021 to help with interpretation of perinatal death rates. After the removal of congenital anomaly and/or termination of pregnancy from total perinatal death, the perinatal death rate declined from 20.9 to 12.4 deaths per 1,000 births in 2021.

Table 3. Perinatal deaths by Perinatal Mortality Classifications sub-categories from 2018 to 2021, NT

	2018	2019	2020	2021
Perinatal deaths due to congenital anomaly and/or termination of pregnancy	17	19	31	32
Total perinatal deaths	**64**	**54**	**67**	**79**
Total perinatal death rate (per 1000 births)	**17.2**	**15.3**	**18.4**	**20.9**
Perinatal deaths minus deaths due to congenital anomaly and/or termination of pregnancy	47	35	36	47
Adjusted perinatal death rate (per 1,000 births)	**12.7**	**9.9**	**9.9**	**12.4**

Note: 1. Total perinatal deaths is the number of total perinatal deaths for each corresponding year.
2. Adjusted perinatal death rate is based on the total perinatal deaths minus perinatal deaths due to congenital anomaly and/or termination of pregnancy.

3. Statistical tables

Tables in 3.1 and 3.2 report on mothers that reside in NT only. Chapter 4 (Appendix A) reports all mothers regardless of their residential location.

3.1. Mothers

Table 4. Summary statistics for pre-term birth by Aboriginal status, NT 2021

	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
ALL MOTHERS						
Total	**204**	**55.0**	**167**	**45.0**	**371**	
Maternal age						
20-34	150	73.5	122	73.1	272	73.3
Place of birth						
Hospital	184	90.2	166	99.4	350	94.3
Type of labour onset						
Spontaneous (Not augmented)	92	45.1	62	37.1	154	41.5
Spontaneous (Augmented)	16	7.8	11	6.6	27	7.3
Induced	45	22.1	44	26.3	89	24.0
No labour	51	25.0	49	29.3	100	27.0
Method of birth[1]						
Normal vaginal	126	61.8	85	50.9	211	56.9
Forceps	10	4.9	5	3.0	15	4.0
Ventouse	2	1.0	5	3.0	7	1.9
Caesarean section	61	29.9	71	42.5	132	35.6
FIRST-TIME MOTHERS						
Total	**77**	**37.7**	**75**	**44.9**	**152**	
Maternal age						
20-34	50	64.9	55	73.3	105	69.1

Note: 1. Not stated was not included in the table, but included in the percentage calculations.

Table 5. Summary statistics for term birth, by Aboriginal status, NT 2021

	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
ALL MOTHERS						
Total	**996**	**29.6**	**2374**	**70.4**	**3370**	
Maternal age						
<20	149	15.0	21	0.9	170	5.0
20-34	749	75.2	1748	73.6	2497	74.1
35+	98	9.8	605	25.5	703	20.9
Place of birth						
Hospital	987	99.1	2305	97.1	3292	97.7
Non-hospital	9	0.9	69	2.9	78	2.3
Type of labour onset						
Spontaneous (Not augmented)	323	32.4	742	31.3	1065	31.6
Spontaneous (Augmented)	149	15.0	303	12.8	452	13.4
Induced	361	36.2	884	37.2	1245	36.9
No labour	163	16.4	445	18.7	608	18.0
Method of birth						
Normal vaginal	597	59.9	1284	54.1	1881	55.8
Forceps	52	5.2	158	6.7	210	6.2
Ventouse	55	5.5	156	6.6	211	6.3
Caesarean section	292	29.3	774	32.6	1066	31.6
FIRST-TIME MOTHERS						
Total	**373**	**37.4**	**1136**	**47.9**	**1509**	
Maternal age						
<20	134	35.9	20	1.8	154	10.2
20-34	238	63.8	927	81.6	1165	77.2

Table 6. Mother's country group and main countries, NT 2021

Country-group[1] / *Major countries*	Number	%
Oceania & Antarctica	**2730**	**72.5**
Australia	*2635*	*71.0*
New Zealand	*57*	*1.5*
North-West Europe	**116**	**3.5**
United Kingdom	*60*	*1.6*
Southern & Eastern Europe	56	1.5
North Africa & The Middle East	28	0.8
South-East Asia	241	6.5
Philippines	*126*	*3.4*
Indonesia	*33*	*0.9*
North-East Asia	66	1.8
Southern & Central Asia	334	9.0
India	*151*	*4.1*
Nepal	*100*	*2.7*
Pakistan	*39*	*1.1*
Americas	*49*	*1.3*
Sub-Saharan Africa	92	2.5
Total stated	***3712***	***100.0***
Not stated	29	0.8
Total	**3741**	

Note: 1. The defining of country groups is based on classification by the Australian Bureau of Statistics. (2016). 1269.0 - Standard Australian Classification of Countries (SACC).

Table 7. NT Region of usual residence by Aboriginal status and maternal birth place, 2021

NT Region	Aboriginal		Non-Aboriginal				All NT
			Born in Australia		Born overseas		
	Number	%	Number	%	Number	%	Number
Greater Darwin	318	14.0	1099	48.2	861	37.8	2278
Top End	171	81.0	27	12.8	13	6.2	211
Big Rivers	196	61.4	84	26.3	39	12.2	319
East Arnhem	159	77.9	30	14.7	15	7.4	204
Barkly	95	78.5	18	14.9	8	6.6	121
Central Australia	261	42.9	180	29.6	167	27.5	608
Total	**1200**	**32.1**	**1438**	**38.4**	**1103**	**29.5**	**3741**

Table 8. Area of remoteness, by Aboriginal status, NT 2021

Area	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Urban area[1]	577	48.1	2438	95.9	3015	80.6
Rural/remote area[2]	623	51.9	103	4.1	726	19.4
Total	**1200**	**100.0**	**2541**	**100.0**	**3741**	**100.0**

Note: 1. Urban area covers the two urban regions of Darwin and Alice Springs plus the major townships of Katherine, Tennant Creek, and Nhulunbuy.
2. Rural/remote area covers the rest of the NT.

Table 9. NT region of usual residence and area of remoteness by Aboriginal status, NT 2021

Health Region	Area	Aboriginal		Non-Aboriginal		All NT	
		Number	%	Number	%	Number	%
Darwin Urban		317	26.4	1942	76.4	2259	60.4
Darwin Rural		173	14.4	60	2.4	233	6.2
Katherine	Urban	71	5.9	112	4.4	183	4.9
	Rural/remote	115	9.6	9	0.4	124	3.3
East Arnhem	Urban	14	1.2	27	1.1	41	1.1
	Rural/remote	155	12.9	18	0.7	173	4.6
Barkly	Urban	56	4.7	24	0.9	80	2.1
	Rural/remote	23	1.9	0	0.0	23	0.6
Alice Springs	Urban	119	9.9	333	13.1	452	12.1
	Rural/remote	157	13.1	16	0.6	173	4.6
Non-NT/interstate[1]		*79*	*6.6*	*24*	*0.9*	*103*	*2.8*
Total		**1200**	**100.0**	**2541**	**100.0**	**3741**	**100.0**

Note: 1. Non-NT relates to non-resident mothers that birthed in the NT. This group is not included in the calculation of percentages and totals.

Table 10. Total fertility rate[1] by Aboriginal status and NT region of usual residence, 2021

NT Region	Aboriginal	Non-Aboriginal	All NT
Greater Darwin	2.5	1.7	1.8
Top End	1.7	1.2	1.6
Big Rivers	2.1	1.5	1.8
East Arnhem	2.0	1.0	1.7
Barkly	2.5	1.6	2.2
Central Australia	2.1	1.5	1.8
Total	**1.9**	**1.6**	**1.7**

Note: 1. Total fertility rate is the average number of live births per woman over her life time.

Table 11. Total fertility rate[1] by Aboriginal status and area of remoteness, NT 2021

Remoteness	Aboriginal	Non-Aboriginal	All NT
Urban area[2]	2.5	1.6	1.8
Rural/remote area[2]	1.5	1.7	1.6

Note: 1. Total fertility rate is the average number of live births per woman over her life time.
2. Urban area covers the two urban regions of Darwin and Alice Springs plus the major townships of Katherine, Tennant Creek, and Nhulunbuy. Rural/remote area covers the rest of the NT.

Table 12. Age-specific fertility rates and total fertility rate by Aboriginal status, NT 2021

Aboriginal status	Age specific fertility rate (births per 1000)[1]			Total fertility rate[2]
	<20 years	20-34 years	35+ years	
Aboriginal	50.8	94.2	15.6	1.9
Non-Aboriginal	5.9	84.2	33.5	1.6
All NT	**26.7**	**87.2**	**28.4**	**1.8**

Note: 1. Age-specific fertility rate is the number of live births per 1000 women in each age group. The rate for the <20 age group is calculated using the female population aged 15-19 years, the rate for the 35+ group is calculated using the female population aged 35-49 years.
2. Total fertility rate is the average number of births per woman over her life time.

Table 13. Maternal parity[1] by Aboriginal status and area of remoteness, NT 2021

Parity[1]	Aboriginal						Non-Aboriginal					
	Urban area		Rural/remote area		Total		Urban area		Rural/remote area		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
0	197	34.1	253	40.6	450	37.5	1164	47.8	47	45.6	1211	47.7
1-2	246	42.6	266	42.7	512	42.7	1127	46.2	48	46.6	1175	46.3
3+	134	23.2	104	16.7	238	19.8	146	6.0	8	7.8	154	6.1
Total	**577**	**100.0**	**623**	**100.0**	**1200**	**100.0**	**2437**	**100.0**	**103**	**100.0**	**2541**	**100.0**

Note: 1. Parity is the number of previous births a woman has had of at least 20 weeks gestation.

Table 14. Maternal age of all mothers by Aboriginal status, NT 2021

Maternal age (years)	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Mean age (years)	***25.8***		***31.3***		***29.5***	
<20 years	178	14.9	22	0.9	200	5.3
20-24 years	371	30.9	210	8.3	581	15.6
25-29 years	335	27.9	649	25.5	984	26.3
30+ years	316	26.3	1660	65.3	1976	52.8
Total	**1200**	**100.0**	**2541**	**100.0**	**3741**	**100.0**

Table 15. Maternal age of first-time mothers by Aboriginal status, NT 2021

Maternal age (years)	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Mean age (years)	***21.4***		***30.1***		***27.7***	
<20 years	158	35.1	20	1.7	178	10.7
20-24 years	202	44.9	139	11.5	341	20.5
25-29 years	69	15.3	386	31.9	455	27.4
30+ years	21	4.7	666	55.0	687	41.4
Total	**450**	**100.0**	**1211**	**100.0**	**1661**	**100.0**

Table 16. Maternal age by Aboriginal status and area of remoteness, NT 2021

Area[1]	Maternal age (years)			Total
	<20	20-34	35+	
	%	%	%	Number
Aboriginal				
Urban area	13.7	72.6	13.7	**577**
Rural/remote area	15.9	77.0	7.1	**623**
Total	**14.8**	**74.9**	**10.3**	**1200**
Non-Aboriginal				
Urban area	0.8	73.7	25.4	**2438**
Rural/remote area	1.9	69.9	28.2	**103**
Total	**0.9**	**73.6**	**25.5**	**2541**

Note: 1. Urban area includes the two urban districts of Darwin and Alice Springs plus the major townships of Katherine, Tennant Creek, and Nhulunbuy. Rural/remote area includes the rest of the NT.

Table 17. Antenatal visits by Aboriginal status, NT 2021

Number of antenatal visits	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
0	25	2.1	0	0.0	25	0.7
1-4	176	14.9	82	3.2	258	7.0
5-6	180	15.3	146	5.8	326	8.8
7-9	313	26.5	745	29.4	1058	28.5
10+	486	41.2	1557	61.5	2043	55.1
Total stated	1180	***100.0***	***2530***	***100.0***	***3710***	***100.0***
Not stated[1]	20		11		31	
Total	**1200**		**2541**		**3741**	

Note: 1. Not stated includes women that had antenatal care but unknown number of visits.

Table 18. Number of antenatal visits for Aboriginal mothers and NT region of usual residence, 2021

Health Region	Number of antenatal visits 1 - 4 %	5 - 6 %	7-9 %	10+	*Total stated Number*	Not stated Number	Total Number
Greater Darwin	10.9	13.2	28.9	45.3	***311***	318	**629**
Top End	16.4	12.9	22.2	45.0	***171***	171	**342**
Big Rivers	12.5	15.1	21.9	47.9	***192***	196	**388**
East Arnhem	9.6	14.6	24.8	49.7	***157***	159	**316**
Barkly	22.2	23.3	36.7	16.7	***90***	95	**185**
Central Australia	21.7	17.3	28.0	32.7	***254***		
Total	**14.9**	**15.3**	**26.5**	**41.2**	***1180***	20	**1200**

Table 19. Antenatal visits by Aboriginal status and area of remoteness, NT 2021

Area[1]	Number of antenatal visits 0 %	1 - 4 %	5 - 6 %	7-9 %	10+ %	*Total stated Number*	Not stated Number	Total Number
Aboriginal								
Urban area	2.6	13.3	14.9	27.0	42.1	***570***	7	**577**
Rural/remote area	1.6	16.4	15.6	26.1	40.3	***610***	13	**623**
Total	2.1	14.9	15.3	26.5	41.2	***1180***	20	**1200**
Non-Aboriginal								
Urban area	0.0	3.1	5.6	29.7	61.5	***2430***	8	**2438**
Rural/remote area	0.0	6.0	9.0	23.0	62.0	***100***	3	**103**
Total	0.0	3.2	5.8	29.4	61.5	***2530***	11	**2541**

Note: 1. Urban area includes the two urban districts of Darwin and Alice Springs plus the major townships of Katherine, Tennant Creek, and Nhulunbuy. Rural/remote area covers the rest of the NT.

Table 20. Gestation at first antenatal visit by Aboriginal status, NT 2021

Gestation at first antenatal visit[1]	Aboriginal Number	%	Non-Aboriginal Number	%	All NT Number	%
First trimester	808	69.3	2420	95.7	3228	87.4
Second trimester	286	24.5	99	3.9	385	10.4
Third trimester	72	6.2	10	0.4	82	2.2
Total stated	***1168***	***100.0***	***2529***	***100.0***	***3695***	***100.0***
Not stated[2]	34		12		46	
Total	**1200**		**2541**		**3741**	

Note: 1. First trimester is less than 14 weeks gestation; second trimester is 14-26 weeks gestation; third trimester is ≥27 weeks' gestation.
2. Not stated includes mothers with zero antenatal visits recorded and/or mothers with no date of first antenatal visit recorded.

Table 21. Gestation at first antenatal visit by NT region of usual residence for Aboriginal mothers only, 2021

Health Region	Gestation at first antenatal visit[1]			*Total stated*	Not Stated[2]	Total
	First Trimester	Second trimester	Third trimester			
	%	%	%	*Number*	Number	**Number**
Greater Darwin	80.6	4.2	2.6	***310***	8	**318**
Top End	65.3	7.1	0.6	***170***	1	**171**
Big Rivers	72.2	4.3	4.8	***187***	9	**196**
East Arnhem	58.6	7.0	1.3	***157***	2	**159**
Barkly	47.7	13.6	8.0	***88***	7	**95**
Central Australia	70.1	6.3	2.8	***254***	7	**261**
Total	**69.3**	**24.5**	**6.2**	***1166***	34	**1200**

Note: 1. First trimester is less than 14 weeks gestation; second trimester is 14-26 weeks gestation; third trimester is ≥27 weeks' gestation.

Table 22. Gestation at first antenatal visit by Aboriginal status and area of remoteness, NT 2021

Area[2]	Gestation at first antenatal visit[1]			*Total stated*	Not stated	Total
	First trimester	Second trimester	Third trimester			
	%	%	%	*Number*	Number	**Number**
Aboriginal						
Urban area	77.5	17.7	4.8	***560***	17	**577**
Rural/remote area	61.7	30.9	7.4	***606***	17	**623**
Total	69.3	24.5	6.2	***1166***	34	**1200**
Non-Aboriginal						
Urban area	95.7	3.9	0.4	***2426***	12	**2438**
Rural/remote area	96.1	3.9	0.0	***103***	0	**103**
Total	95.7	3.9	0.4	***2529***	12	**2541**

Note: 1. First trimester is less than 14 weeks gestation; second trimester is 14-26 weeks gestation; third trimester is ≥27 weeks' gestation.
2. Urban area covers the two urban regions of Darwin and Alice Springs plus the major townships of Katherine, Tennant Creek, and Nhulunbuy; rural/remote area covers the rest of the NT.

Table 23. Self-reported alcohol consumption at first antenatal visit by Aboriginal status, NT 2021

Alcohol consumption	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Alcohol	83	7.7	44	1.8	127	3.6
No alcohol	1000	92.3	2440	98.2	3440	96.4
Total stated	***1083***	***100.0***	***2484***	***100.0***	***3567***	***100.0***
Not stated	117		57		174	
Total	**1200**		**2541**		**3741**	

Table 24. Self-reported smoking status before 20 weeks gestation by Aboriginal status, NT 2021

Smoking status	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Smoking	571	48.6	163	6.5	734	19.9
Non-smoking	603	51.4	2351	93.5	2954	80.1
Total stated	***1174***	***100.0***	***2514***	***100.0***	***3688***	***100.0***
Not stated	26		27		53	
Total	**1200**		**2541**		**3741**	

Table 25. Self-reported smoking status before 20 weeks gestation by maternal age and Aboriginal status, NT 2021

Age	Smoking status		*Total stated*	Not stated	Total
	Smoking	Non-smoking	*Number*	Number	Number
	%	%			
Aboriginal					
<20	39.3	60.7	***173***	5	**178**
20-34	50.2	49.8	***884***	15	**899**
35+	50.4	49.6	***117***	6	**123**
Total	**48.6**	**51.4**	***1174***	26	**1200**
Non-Aboriginal					
<20	27.3	72.7	***22***	0	**22**
20-34	6.3	93.7	***1847***	23	**1870**
35+	6.2	93.8	***645***	4	**649**
Total	**6.5**	**93.5**	***2514***	27	**2541**

Table 26. Self-reported smoking status after 20 weeks gestation in women who reported smoking before 20 weeks by number of cigarettes smoked per day and Aboriginal status, NT 2021

Number of cigarettes per day	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
0 cigarettes (ceased smoking)	67	12.7	54	36.5	121	17.9
<10[1] cigarettes	345	65.5	62	41.9	407	60.3
10+ cigarettes	115	21.8	32	21.6	147	21.8
Total stated	***527***	***100.0***	***148***	***100.0***	***675***	***100.0***
Not stated	44		15		59	
Total	**571**		**163**		**734**	

Note: 1. The '<10' category includes mothers who reported smoking less than one daily cigarette after 20 weeks.

Table 27. Self-reported smoking status of Aboriginal mothers before 20 weeks gestation by NT Region of usual residence, 2021

NT Health Region	Smoking %	Non-smoking %	*Total stated Number*	Not stated Number	Total Number
Greater Darwin	37.1	62.9	***310***	8	**318**
Top End	54.5	45.5	***167***	4	**171**
Big Rivers	57.1	42.9	***191***	5	**196**
East Arnhem	66.0	34.0	***156***	3	**159**
Barkly	47.3	52.7	***91***	4	**95**
Central Australia	42.5	57.5	***259***	2	**261**
Total	**48.6**	**51.4**	***1174***	26	**1200**

Table 28. Maternal diabetes by NT region of usual residence and Aboriginal status, 2021

	Aboriginal		Non-Aboriginal	
NT Region[2]	**% (With diabetes[1])**	**Total**	**% (With diabetes[1])**	**Total**
Greater Darwin	28.0	318	29.9	1,960
Top End	25.1	171	20.0	40
Big Rivers	29.6	196	24.4	123
East Arnhem	31.4	159	17.8	45
Barkly	25.3	95	15.4	26
Central Australia	21.1	261	18.4	347
Total	**26.6**	**1200**	**27.5**	**2541**

Note: 1. Diabetes includes all forms of diabetes: type 1 diabetes, type 2 diabetes and gestational diabetes.
2. NT Region based on maternal residence.

Table 29. Actual place of birth by Aboriginal status, NT 2021

Actual place of birth[1]	Aboriginal		Non-Aboriginal		All NT	
	Number	**%**	**Number**	**%**	**Number**	**%**
RDH	597	49.8	1590	62.6	2,187	58.5
RDH Birth Centre	7	0.6	31	1.2	38	1.0
DPH	13	1.1	358	14.1	371	9.9
GDH	100	8.3	28	1.1	128	3.4
KH	114	9.5	110	4.3	224	6.0
TCH	<5	<5	<5	<5	5	0.1
ASH	336	28.0	353	13.9	689	18.4
Other[2]	29	2.4	70	2.8	99	2.6
Total	**1200**	**100.0**	**2541**	**100.0**	**3741**	**100.0**

Note: 1. Royal Darwin Hospital (RDH), Darwin Private Hospital (DPH), Gove District Hospital (GDH), Katherine Hospital (KH), Tennant Creek Hospital (TCH), Alice Springs Hospital (ASH).
2. Other includes location unintended (births that occurred in transit to hospitals and unplanned and planned homebirth and in remote health centres).

Table 30. Method of induction by Aboriginal status, NT 2021

Method of induction[1]	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
ARM[2]	309	76.1	686	73.9	995	74.6
Oxytocics	333	82.0	721	77.7	1054	79.0
Prostaglandins	132	32.5	297	32.0	429	32.2
Other methods[3]	79	19.5	227	24.5	306	22.9
Total	**406**	**100.0**	**928**	**100.0**	**1334**	**100.0**

Note: 1. Multiple methods may be applied to one mother.
2. ARM = Artificial rupture of membranes.
3. 'Other' methods' Includes balloon catheter.

Table 31. Main reasons for induction[1] for term live birth by Aboriginal status, NT 2021

Main reason for induction	Aboriginal		Non-Aboriginal		Total	
	Number	%	Number	%	Number	%
Diabetes	91	25.2	225	20.3	316	21.5
Fetal compromise	47	13.0	124	11.2	171	11.6
Prolonged pregnancy	44	12.2	93	8.4	137	9.3
Prelabour rupture of membranes	47	13.0	146	13.2	193	13.1
Other[2]	132	36.6	294.0	33.3	426.0	34.3
Total	**361**	**100**	**882**	**100**	**1243**	**100**

Note: 1. Induction includes failed inductions recorded as no labour. That is induction methods ceased before onset of labour became established.
2. Other includes hypertensive disorders, multiple pregnancy, maternal age, maternal obstetric or medication indication, fetal macrosomia, maternal choice.

Table 32. Fetal presentation at birth by Aboriginal status, NT 2021

Presentation at birth	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Vertex	1126	94.2	2417	95.2	3543	94.9
Breech	62	5.2	112	4.4	174	4.7
Other[1]	2	0.2	4	0.2	6	0.2
Total stated	**1195**	**100.0**	**2538**	**100.0**	**3733**	**100.0**
Not stated	5		3		8	
Total	**1200**		**2541**		**3741**	

Note: 1. Other includes face and brow presentation at birth.

Table 33. Method of birth, by Aboriginal status, NT 2021

Method of birth	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Normal vaginal	723	60.3	1369	53.9	2092	55.9
Assisted vaginal						
Forceps	62	5.2	163	6.4	225	6.0
Ventouse	57	4.8	161	6.3	218	5.8
Caesarean - elective	148	12.3	391	15.4	539	14.4
Caesarean - emergency	205	17.1	454	17.9	659	17.6
Other	5	0.4	3	0.1	8	0.2
Total	**1200**	**100.0**	**2541**	**100.0**	**3741**	**100.0**

Table 34. Method of birth, by type of labour onset, NT 2021

Type of labour onset	Method of birth						
	Vaginal			Caesarean			
	Normal vaginal	Instrumental Vaginal[1]	Total	Caesarean-elective	Caesarean-emergency	Total	Total
	%	%	%	%	%	%	Number
Spontaneous (Not augmented)	81.9	8.5	90.4	1.6	7.9	9.4	**1219**
Spontaneous (Augmented)	55.7	26.5	82.3	0.2	17.5	17.7	**479**
Induced	60.9	16.9	77.8	0.0	22.1	22.1	**1334**
No labour	0.0	0.1	0.1	73.3	25.8	99.2	**708**
Total	**55.5**	**12.2**	**67.8**	**14.4**	**17.6**	**32.0**	**3741**

Note: 1. Instrumental vaginal births include forceps and ventouse births.

Table 35. Method of birth, by gestational age and Aboriginal status, NT 2021

Gestational age (weeks)	Method of birth				Total
	Normal vaginal	Instrumental vaginal[1]	Caesarean-elective	Caesarean-emergency	
	%	%	%	%	Number
Aboriginal					
<37	61.8	5.9	4.4	25.5	**204**
37+	59.9	10.7	14.0	15.4	**996**
Total	**60.3**	**9.9**	**12.3**	**17.1**	**1200**
Non-Aboriginal					
<37	50.9	6.0	9.6	32.9	**167**
37+	54.1	13.2	15.8	16.8	**2374**
Total	**53.9**	**12.8**	**15.4**	**17.9**	**2541**

Note: 1. Instrumental vaginal births include forceps and ventouse births.

Table 36. Main indication for caesarean section for selected mothers[1] by Aboriginal status, NT 2021

Main reason for caesarean section	Indigenous		Non-Indigenous		All NT	
	Number	%	Number	%	Number	%
Previous caesarean	95	50.5	126	30.5	221	36.8
Lack of progress	41	21.8	124	30.0	165	27.5
Fetal compromise	27	14.4	74	17.9	101	16.8
Suspected fetal macrosomia	4	2.1	9	2.2	13	2.2
Other[2]	21	11.2	80	19.4	101	16.8
Total	**188**	**100.0**	**413**	**100.0**	601	**100.0**

Note: 1. Selected mothers include women aged between 20-34 years, with a singleton baby in vertex presentation at gestational age between 37 and 40 weeks.
2. Other includes malpresentation, placenta praevia, placental abruption, antepartum/intrapartum haemorrhage, unsuccessful attempt at assisted delivery, cord prolapse, previous adverse perinatal intrapartum outcome, previous severe perineal trauma, previous shoulder dystocia, other obstetric, medical, surgical, psychological indications, and maternal choice.

Table 37. Analgesia during labour by Aboriginal status, NT 2021

Analgesia[1]	Aboriginal		Non-Aboriginal		All NT	
Total number of method used	Number	%	Number	%	Number	%
Nitrous oxide	687	42.2	1260	35.6	1947	37.7
Narcotics	235	14.4	415	11.7	650	12.6
Epidural	249	15.3	681	19.3	930	18.0
Other[2]	258	15.9	663	18.7	921	17.8
None	198	12.2	518	14.6	716	13.9
Total stated	***1627***	***100.0***	***3537***	***100.0***	***5164***	***100.0***

Note: 1. Multiple types of analgesia may be recorded for one mother.
2. Other may include non-pharmaceutical pain relief methods.

Table 38. Anaesthesia for operative births[1] by Aboriginal status, NT 2021

Anaesthesia: highest rank of method used	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
General	28	5.9	43	3.7	71	4.3
Spinal	253	53.6	613	52.4	866	52.8
Epidural/Caudal	137	29.0	359	30.7	496	30.2
Spinal and Epidural	12	2.5	40	3.4	52	3.2
Pudendal	5	1.1	32	2.7	37	2.3
Local	26	5.5	58	5.0	84	5.1
Other	0	0.0	5	0.4	5	0.3
None	11	2.3	19	1.6	30	1.8
Total stated	***472***	***100.0***	***1169***	***100.0***	***1641***	***100.0***
Not stated	0		2		2	
Total	**472**		**1171**		**1643**	

Note: 1. Operative birth methods include forceps, ventouse and caesarean section.

Table 39. Complications of pregnancy and birth by Aboriginal status, NT 2021

Type of complication[1]	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Pregnancy						
Gestational diabetes mellitus	251	21.0	677	28.3	928	25.8
Pre-existing diabetes mellitus	67	5.6	22	0.9	89	2.5
Gestational hypertension	71	5.9	79	3.3	150	4.2
Any pregnancy complication[4]	***361***	***30.1***	***746***	***31.1***	***1107***	***30.8***
Labour/childbirth						
Fetal distress/compromise	245	20.5	558	23.3	803	22.3
Retained placenta	46	3.8	44	1.8	90	2.5
Meconium stained liquor	138	11.5	311	13.0	449	12.5
Lack of progress[2]	114	9.5	307	12.8	421	11.7
Post-partum haemorrhage[3]	454	37.9	880	36.7	1334	37.1
Other[4]	183	15.3	322	13.4	505	14.1
Any labour/childbirth complication	***773***	***64.5***	***1505***	***62.8***	***2278***	***63.4***
Total	**1198**		**2395**		**3593**	

Note: 1. Mothers may have more than one complication.
2. Includes obstructed labour.
3. Post-partum haemorrhage is defined as cases with a recorded blood loss volume of 500mL or more.
4. Other complications include ante-partum haemorrhage, cord prolapse as well as other unclassified complications.

Table 40. Estimated blood loss volume at birth by method[1] of birth and Aboriginal status, NT 2021

Birth method	Blood loss	Aboriginal		Non-Aboriginal		All NT	
		Number	%	Number	%	Number	%
Vaginal births	0-499 mL	554	65.9	1223	72.7	1777	70.4
	500-999 mL	171	20.3	291	17.3	462	18.3
	1000 mL +	116	13.8	169	10.0	285	11.3
	Total stated	841	100.0	1683	100.0	2524	100.0
	Not stated	1		10		11	
	Total	**842**		**1693**		**2535**	
Caesarean births	0-499 mL	187	53.0	422	50.1	609	51.0
	500-999 mL	129	36.5	299	35.5	428	35.8
	1000 mL +	37	10.5	121	14.4	158	13.2
	Total stated	353	100.0	842	100.0	1195	100.0
	Not stated	0		3		3	
	Total	**353**		**845**		**1198**	

Note: 1. Birth methods in this table include only the categories of vaginal and caesarean births n=3733. We do not include births that were missing birth method (n=8).

Table 41. Blood transfusions for postpartum haemorrhage[1] by amount of blood loss, NT 2021

	Blood loss					
	500-999mL		1000mL +		All	
	Number	%	Number	%	Number	%
Transfused	19	2.1	97	21.9	116	8.7
Not transfused	871	97.9	346	78.1	1217	91.3
Total	890	100.0	443	100.0	1333	100.0

Note: 1. Postpartum haemorrhage is defined as a postpartum blood loss of at least 500mls.

Table 42. State of the perineum after vaginal birth by Aboriginal status, NT 2021

State of the perineum	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Intact	264	31.6	353	20.9	617	24.5
1st degree laceration/graze[1]	249	29.8	328	19.5	577	22.9
2nd degree laceration	160	19.1	537	31.9	697	27.6
Episiotomy[2]	*135*	16.1	392	23.3	527	20.9
3rd/4th degree laceration	22	2.6	67	4.0	89	3.5
Other[3]	6	0.7	9	0.5	15	0.6
Total stated	***836***	***100.0***	***1686***	***100.0***	***2522***	***100.0***
Not stated	6		7		13	
Total	***842***		***1693***		***2535***	

Note: 1. First degree laceration may include a perineal graze only.
2. Episiotomy can include episiotomy alone or episiotomy with a 3rd or 4th degree laceration.
3. Other may include posterior wall laceration or haematoma.

Table 43. Mother's length of hospital stay after birth by Aboriginal status, NT 2021

Length of postnatal stay (days)[1]	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
0	53	4.5	208	8.4	261	7.2
1-3	808	69.0	1742	70.5	2550	70.0
4-7	274	23.4	499	20.2	773	21.2
8 & more	36	3.1	22	0.9	58	1.6
Total	**1171**	**100.0**	**2471**	**100.0**	**3642**	**100.0**

Note: 1. Length of stay is calculated from the formula (length of stay = date of discharge – date of admission). This table includes only mothers with a hospital birth (n=3642).

Table 44. Mother's average length of hospital stay after birth by Aboriginal status and method of birth, NT 2021

Method of birth	Aboriginal	Non-Aboriginal	All NT
	Average length (days) of postnatal stay		
Normal vaginal	2.3	1.8	1.9
Instrumental vaginal[1]	3.1	2.4	2.6
Caesarean - elective	3.1	3.3	3.3
Caesarean - emergency	4.4	3.5	3.8
Total	**2.8**	**2.4**	**2.5**

Note: 1. Instrumental vaginal births include forceps and ventouse assisted births.

Table 45. Average length of hospital stay after birth for primipara mothers by Aboriginal status and method of birth, NT 2021

Method of birth	Aboriginal	Non-Aboriginal	All NT
	Average length (days) of postnatal stay		
Normal vaginal	2.7	2.2	2.3
Instrumental vaginal[1]	3.2	2.5	2.7
Caesarean[2]	4.6	3.7	3.9
Total	**3.3**	**2.8**	**2.9**

Note: 1. Instrumental vaginal births include forceps and ventouse assisted births.
2. Caesarean includes elective and emergency.

Table 46. Average length of hospital stay after birth for multipara mothers by Aboriginal status and method of birth, NT 2021

Method of birth	Aboriginal	Non-Aboriginal	All NT
	Average length (days) of postnatal stay		
Normal vaginal	2.1	1.5	1.7
Instrumental vaginal[1]	2.6	1.8	2.1
Caesarean[2]	7.1	6.2	6.6
Total	**2.5**	**2.1**	**2.2**

Note: 1. Instrumental vaginal births include forceps and ventouse assisted births.
2. Caesarean includes elective and emergency.

3.2. Babies

Table 47. Gestational age by maternal Aboriginal status, NT 2021

	Gestational age (weeks)	Aboriginal Number	Aboriginal %	Non-Aboriginal Number	Non-Aboriginal %	All NT Number	All NT %
Stillbirth							
	<28	27	75.0	17	65.4	44	71.0
	28+	9	25.0	9	34.6	18	29.0
	Total	**36**	**100.0**	**26**	**100.0**	**62**	**100.0**
Live birth							
	<28	21	1.8	13	0.5	34	0.9
	28 - 36	160	13.6	151	5.9	311	8.4
	37+	997	84.6	2381	93.6	3378	90.7
	Total	**1178**	**100.0**	**2545**	**100.0**	**3723**	**100.0**
All birth							
	<28	48	4.0	30	1.2	78	2.1
	28 - 36	167	13.8	157	6.1	324	8.6
	37+	999	82.3	2384	92.7	3383	89.4
	Total	**1214**	**100.0**	**2571**	**100.0**	**3785**	**100.0**

Table 48. Birthweight by maternal Aboriginal status, NT 2021

Birthweight (g)	Aboriginal Number	Aboriginal %	Non-Aboriginal Number	Non-Aboriginal %	All NT Number	All NT %
Stillbirth						
<1000	30	83.3	18	69.2	48	77.4
>=1000	6	17	8	31	14	22.6
Total	**36**	**100.0**	**26**	**100.0**	**62**	**100.0**
Mean birthweight (g)	***732***		***898***		***802***	
Live birth						
<1000	19	1.6	13	0.5	32	0.9
1000 - 1499	20	1.7	8	0.3	28	0.8
1500 - 2499	137	11.6	106	4.2	243	6.5
2500+	1002	85.1	2417	95.0	3419	91.8
Total	**1178**	**100.0**	**2545**	**100.0**	**3723**	**100.0**
Mean birthweight (g) term babies	***3124***		***3346***		***3276***	

Table 49. Gestational age at birth by maternal Aboriginal status and NT region of usual residence, NT 2021

NT Health Region	Gestational age (weeks)		Total
	<37	37+	
	%	%	Number
Aboriginal			
Greater Darwin	13.2	86.8	**317**
Top End	21.7	78.3	**175**
Big Rivers	16.1	83.9	**192**
East Arnhem	17.6	82.4	**153**
Barkly	11.8	88.2	**93**
Central Australia	12.9	87.1	**248**
Total	**15.4**	**84.6**	1178
Non-Aboriginal			
Greater Darwin	6.7	93.3	**1971**
Top End	10.3	89.7	**39**
Big Rivers	n<5	np	**np**
East Arnhem[1]	0.0	100.0	**44**
Barkly[1]	0.0	100.0	**26**
Central Australia	6.7	93.3	**343**
Total	**6.4**	**93.6**	**2545**

Note: 1. Results are suppressed due to small numbers and recorded as n<5 or np "not presented".

Table 50. Gestational age at birth by maternal Aboriginal status and remoteness, NT 2021

Area[1]	Gestational age (weeks)			Total
	<28	28-36	37+	
	%	%	%	Number
Aboriginal				
Urban area	1.6	12.2	86.2	**567**
Rural/remote area	2.0	14.9	83.1	**611**
Total	**1.8**	**13.6**	**84.6**	**1178**
Non-Aboriginal				
Urban area	0.5	5.9	93.6	**2444**
Rural/remote area	n<5	np	np	**101**
Total	**0.5**	**5.9**	**93.6**	**2545**

Note: 1. Urban area covers the two urban regions of Darwin and Alice Springs plus the major townships of Katherine, Tennant Creek, and Nhulunbuy. Rural/remote area covers the rest of the NT

Table 51. Liveborn babies birthweight by maternal Aboriginal status and NT region of usual residence, 2021

NT Region	Birthweight (g) <2500 %	2500-3999 %	4000+ %	Total Number	*Mean Birthweight-term babies (g)*
Aboriginal					
Greater Darwin	12.0	79.5	8.5	**317**	*3349*
Top End	22.9	73.7	3.4	**175**	*3174*
Big Rivers	17.7	75.5	6.8	**192**	*3267*
East Arnhem	15.0	79.1	5.9	**153**	*3284*
Barkly	11.8	76.3	11.8	**93**	*3327*
Central Australia	12.1	75.8	12.1	**248**	*3332*
Total	**14.9**	**76.9**	**8.1**	**1178**	***3298***
Non-Aboriginal					
Greater Darwin	5.3	86.8	7.9	**1970**	*3398*
Top End	7.7	76.9	15.4	**39**	*3539*
Big Rivers	2.5	86.1	11.5	**122**	*3531*
East Arnhem	2.3	88.6	9.1	**44**	*3506*
Barkly	0.0	76.9	23.1	**26**	*3438*
Central Australia	4.4	85.1	10.5	**343**	*3447*
Total	**5.0**	**86.3**	**8.7**	**2545**	***3416***

Table 52. Liveborn babies birthweight[1] by maternal Aboriginal status and remoteness, NT 2021

Area[2]	Birthweight (g) <1500 %	1500-2499 %	2500-3999 %	4000+ %	Total Number	*Mean birthweight (g)*
Aboriginal						
Urban area	3.2	10.4	77.1	9.3	**567**	*3186*
Rural/remote area	3.4	12.8	76.8	7.0	**611**	*3067*
Total	**3.3**	**11.6**	**76.9**	**8.1**	**1178**	*3124*
Non-Aboriginal						
Urban area	0.8	4.1	86.5	8.5	**2444**	*3344*
Rural/remote area	1.0	5.0	80.2	13.9	**101**	*3414*
Total	**0.8**	**4.2**	**86.3**	**8.7**	**2545**	*3346*

Note: 1. Excludes stillbirths.
2. Urban area covers the two urban regions of Darwin and Alice Springs plus the major townships of Katherine, Tennant Creek, and Nhulunbuy. Rural/remote area covers the rest of the NT.

Table 53. Liveborn babies[1] birthweight by gestational age and maternal Aboriginal status, NT 2021

Gestational age (weeks)	Birthweight (g) <1500 %	1500-2499 %	2500+ %	Total Number	*Mean birthweight (g)*
Aboriginal					
<28	100.0	0.0	0.0	**19**	*730*
28 - 36	12.1	45.7	42.1	**140**	*2366*
37+	0.1	5.3	94.6	**991**	*3303*
Total	**3.2**	**10.2**	86.6	**1150**	*3146*
Non-Aboriginal					
<28	100.0	0.0	0.0	**9**	*689*
28 - 36	5.1	41.0	53.8	**117**	*2546*
37+	0.0	1.6	98.4	**2362**	*3420*
Total	**0.6**	**3.4**	95.9	**2488**	*3369*

Note: 1. Reports on singleton live births only.

Table 54. Birthweight of NT Aboriginal singleton live births[1], NT 2021

Birthweight (g)	Aboriginal babies		Non-Aboriginal babies		All	
	Number	%	Number	%	Number	%
<2500	154	13.4	13	6.3	167	12.3
2500+	996	86.6	193	93.7	1189	87.7
Total	**1150**	**100.0**	**206**	**100.0**	**1356**	**100.0**

Note: 1. Reports by using Aboriginal status of baby.

Table 55. Size for gestational age[1] among liveborn singleton births by maternal Aboriginal status and NT region of usual residence, 2021

	NT Health Region	Size for gestational age		Total
		Small (<10th percentile)[2]	Large (>90th percentile)[3]	
		%	%	Number
Aboriginal				
	Greater Darwin	12.3	10.4	**309**
	Top End	22.1	6.7	**163**
	Big Rivers	21.4	9.4	**192**
	East Arnhem	13.2	4.6	**151**
	Barkly	19.8	14.3	**91**
	Central Australia	13.9	10.7	**244**
	Total	**16.3**	**9.3**	**1150**
Non-Aboriginal				
	Greater Darwin	8.6	15.4	**1825**
	Top End	2.6	12.5	**112**
	Big Rivers	8.2	n<5	**53**
	East Arnhem	6.8	n<5	**20**
	Barkly	15.4	36.7	**333**
	Central Australia	10.3		
	Total	**8.7**	**8.8**	**2488**

Note: 1. Reports on singleton live births only.
2. Babies are defined as small for gestational age if their birthweight is below the 10th.
3. Babies are defined as large for gestational age if their birthweight is above the 90th percentile.

Table 56. Apgar score at 5 minutes for singleton term liveborn babies[1] by maternal Aboriginal status, NT 2021

Apgar score	Aboriginal		Non-Aboriginal		All NT	
at 5 minutes	Number	%	Number	%	Number	%
<7	20	2.0	35	1.49	55	1.6
7 - 10	970	98.0	2319	98.5	3289	98.4
Total stated	***990***	***100.0***	***2354***	***100.0***	3344	***100.0***
Not stated	1		8		**9**	
Total	**991**		**2362**		**3353**	

Note: 1. Reports on singleton term live births only.

Table 57. Resuscitation method[1] by maternal Aboriginal status, NT 2021

Resuscitation methods	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
IPPV[2]	116	9.9	163	6.4	279	7.5
Other[3]	88	7.5	119	4.7	207	5.6
Oxygen therapy	11	0.9	9	0.4	20	0.5
Suction	29	2.5	53	2.1	82	2.2
None	923	78.5	2188	86.1	3111	83.7
Total stated	***1176***	***100***	***2542***	***100***	***3718***	***100***
Not stated	2		3		5	
Total	**1178**		**2545**		**3723**	

Note: 1. Resuscitation methods exclude tactile stimulation. The data reports on singleton term live births only.
2. IPPV = intermittent positive pressure ventilation.
3. 'Other' includes continuous positive airway pressure, external cardiac massage and endotracheal intubation.

Table 58. Infant feeding status for liveborn babies[1] on discharge by maternal Aboriginal status, NT 2021

Infant feeding status	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Exclusive breastfeeding	781	87.2	1820	84.4	2601	85.2
Breastfeeding at discharge but >=1 AF[2] feed	94	10.5	273	12.7	367	12.0
Breastfeeding initiated but AF[2] at discharge	2	0.2	19	0.9	21	0.7
Never breastfed	19	2.1	45	2.1	64	2.1
Total stated	***896***	***100.0***	***2157***	***100.0***	***3053***	***100.0***
Not stated	1		0		1	
Total	**897**		**2157**		**3054**	

Note: 1. Reports on singleton term live births that are born in hospital and discharged with mother only. It excludes babies admitted to Special Care Nursery.
2. AF = artificial feeding of infant formula.

Table 59. Infant[1] feeding status on discharge with primiparous mother by maternal Aboriginal status, NT 2021

Infant feeding status	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Exclusive breastfeeding	280	85.6	826	80.3	1106	81.6
Breastfeeding at discharge but >=1 AF[2] feed	42	12.8	183	17.8	225	16.6
Breastfeeding initiated but AF[2] at discharge	1	0.3	9	0.9	10	0.7
Never breastfed	4	1.2	11	1.1	15	1.1
Total stated	***327***	100.0	***1029***	100.0	***1356***	100.0
Not stated	0		0		0	
Total	**327**		**1029**		**1356**	

Note: 1. Singleton infants only.
2: AF = artificial feeding of infant formula.

Table 60. Infant[1] feeding status on discharge with multiparous mother by maternal Aboriginal status, NT 2021

Infant feeding status	Aboriginal		Non-Aboriginal		All NT	
	Number	%	Number	%	Number	%
Exclusive breastfeeding	501	88.0	994	88.1	1495	88.1
Breastfeeding at discharge but >=1 AF[2] feed	52	9.1	90	8.0	142	8.4
Breastfeeding initiated but AF[2] at discharge	1	0.2	10	0.9	11	0.6
Never breastfed	15	2.6	34	3.0	49	2.9
Total stated	***569***	100.0	***1128***	100.0	***1697***	100.0
Not stated	1		0		1	
Total	**570**		**1128**		**1698**	

Note: 1. Singleton infants only.
2. AF = artificial feeding of infant formula.

Table 61. Stillbirth, neonatal deaths and perinatal deaths by maternal Aboriginal status, NT 2021

	Aboriginal		Non-Aboriginal		All NT	
	Number	Rate	Number	Rate	Number	Rate
Stillbirths[1]	36	29.7	26	10.1	62	16.4
Neonatal deaths[2]	10	8.5	7	2.8	17	4.6
Perinatal deaths[1]	**46**	**37.9**	**33**	**12.8**	**79**	**20.9**

Note: 1. Rate of stillbirths and perinatal deaths is the number of deaths per 1000 total births.
2. Rate of neonatal deaths is the number of deaths per 1000 live births. Neonatal deaths includes deaths in the community.

Appendix A. Hospital profiles

The profile table of each hospital includes all births that occurred in that hospital in 2021, including births by mothers who were non-NT residents. Tennant Creek hospital data is not provided due to the low number of births in 2021 at this hospital (n=5).

Table 62. Summary statistics[4], Royal Darwin Hospital, 2021

	Aboriginal		Non-Aboriginal		All	
	Number	%	Number	%	Number	%
MOTHERS	**607**		**1625**		**2232**	
Onset of labour						
Spontaneous (Not augmented)	199	32.8	484	29.8	683	30.6
Spontaneous (Augmented)	68	11.2	209	12.9	277	12.4
Induced labour	214	35.3	639	39.3	853	38.2
No labour	126	20.8	293	18.0	419	18.8
Method of birth						
Normal vaginal[1]	339	56.2	844	52.0	1183	53.1
Forceps	44	7.3	132	8.1	176	7.9
Ventouse	22	3.6	114	7.0	136	6.1
Caesarean section	198	32.8	534	32.9	732	32.9
Pregnancy and/or labour/childbirth complications[5]						
Fetal compromise	155	25.5	453	27.9	608	27.2
Diabetes in pregnancy[2]	188	31.0	542	33.4	730	32.7
Manual removal of placenta	17	2.8	27	1.7	44	2.0
Meconium stained liquor	59	9.7	206	12.7	265	11.9
Lack of progress	57	9.4	222	13.7	279	12.5
Post-partum haemorrhage	213	35.1	658	40.5	871	39.0
Pre-eclampsia	42	6.9	54	3.3	96	4.3
Other	87	14.3	231	14.2	318	14.2
Any complication	***441***	***72.7***	***1243***	***76.5***	***1684***	***75.4***
MOTHERS HAVING VAGINAL BIRTH	**70**		**286**		**356**	
Perineum status						
2nd degree laceration	84	20.8	368	33.9	452	30.4
3rd/4th degree laceration	5	1.2	29	2.7	34	2.3
Episiotomy[3]	70	17.4	286	26.4	356	23.9
LIVEBORN BABIES	**603**		**1630**		**2233**	
Gestational age						
<28 weeks	14	2.3	11	0.7	25	1.1
28-36 weeks	107	17.7	106	6.5	213	9.5
37+ weeks	482	79.9	1513	92.8	1995	89.3
Birthweight						
<1500 g	28	4.6	21	1.3	49	2.2
1500-2499 g	86	14.3	74	4.5	160	7.2
2500 g+	489	81.1	1,535	94.2	2024	90.6

Note: 1. Vaginal breech are combined with normal vaginal births.
2. Diabetes in pregnancy includes gestational diabetes mellitus and pre-existing diabetes mellitus.
3. Episiotomy is included in 2nd degree laceration.
4. This table presents all births that occurred in RDH, including births by mothers who were non-NT residents.
5. Multiple pregnancy and/or childbirth complications may apply to one mother.

Table 63. Summary statistics[4], Alice Springs Hospital, 2021

	Aboriginal		Non-Aboriginal		All	
	Number	%	Number	%	Number	%
MOTHERS	**366**		**353**		**719**	
Onset of labour						
Spontaneous (Not augmented)	106	29.0	114	32.3	220	30.6
Spontaneous (Augmented)	53	14.5	48	13.6	101	14.0
Induced labour	134	36.6	144	40.8	278	38.7
No labour	73	19.9	47	13.3	120	16.7
Method of birth						
Normal vaginal[1]	223	60.9	227	64.3	450	62.6
Forceps	10	2.7	15	4.2	25	3.5
Ventouse	19	5.2	19	5.4	38	5.3
Caesarean section	114	31.1	92	26.1	206	28.7
Pregnancy and/or childbirth complications[5]						
Fetal compromise	63	17.2	48	13.6	111	15.4
Diabetes in pregnancy[2]	87	23.8	67	19.0	154	21.4
Manual removal of placenta	14	3.8	11	3.1	25	3.5
Meconium stained liquor	58	15.8	65	18.4	123	17.1
Lack of progress	28	7.7	37	10.5	65	9.0
Post-partum haemorrhage	164	44.8	127	36.0	291	40.5
Pre-eclampsia	24	6.6	17	4.8	41	5.7
Other	50	13.7	49	13.9	99	13.8
Any complication	***282***	***77.0***	***247***	***70.0***	***529***	***73.6***
MOTHERS HAVING VAGINAL BIRTH	**252**		**261**		**513**	
Perineum status						
2nd degree laceration	40	16.3	77	29.7	117	23.2
Episiotomy[3]	39	15.9	55	21.2	94	18.6
LIVEBORN BABIES	**357**		**349**		**706**	
Gestational age at birth						
<37 weeks	43	12.0	23	6.6	66	9.3
37+ weeks	314	88.0	326	93.4	640	90.7
Birthweight						
<2500 g	41	11.5	15	4.3	56	7.9
2500 g+	316	88.5	334	95.7	650	92.1

Note: 1. Vaginal breech are combined with normal vaginal births.
2. Diabetes in pregnancy includes gestational diabetes mellitus and pre-existing diabetes mellitus.
3. Episiotomy is included in 2nd degree laceration.
4. This table presents all births that occurred in ASH, including births by mothers who were non-NT residents.
5. Multiple pregnancy and/or childbirth complications may apply to one mother.

Table 64. Summary statistics[4], Katherine Hospital, 2021

		Aboriginal		Non-Aboriginal		All	
		Number	%	Number	%	Number	%
MOTHERS		**115**		**113**		**228**	
Onset of labour							
	Spontaneous (Not augmented)	42	36.5	38	33.6	80	35.1
	Spontaneous (Augmented)	23	20.0	20	17.7	43	18.9
	Induced labour	38	33.0	31	27.4	69	30.3
	No labour	12	10.4	24	21.2	36	15.8
Method of birth							
	Normal vaginal[1]	75	65.2	62	54.9	137	60.1
	Caesarean section	24	20.9	36	31.9	60	26.3
Pregnancy and/or childbirth complications[5]							
	Fetal compromise	21	18.3	22	19.5	43	18.9
	Diabetes in pregnancy[2]	27	23.5	27	23.9	54	23.7
	Lack of progress	11	9.6	21	18.6	32	14.0
	Post-partum haemorrhage	12	10.4	17	15.0	29	12.7
	Other	24	20.9	23	20.4	47	20.6
	Any complication	***82***	***71.3***	***86***	***76.1***	***168***	***73.7***
MOTHERS HAVING VAGINAL BIRTH		**91**		**77**		**168**	
Perineum status							
	2nd degree laceration	21	23.1	30	39.0	51	30.4
	Episiotomy[3]	21	23.1	12	15.6	33	19.6
LIVEBORN BABIES		**115**		**113**		**228**	
Gestational age at birth							
	<37 weeks	5	4.3	2	1.8	7	3.1
	37+ weeks	110	95.7	111	98.2	221	96.9
Birthweight							
	<2500 g	13	11.3	2	1.8	15	6.6
	2500 g+	102	88.7	111	98.2	213	93.4

Note: 1. Vaginal breech are combined with normal vaginal births.
2. Diabetes in pregnancy includes gestational diabetes mellitus and pre-existing diabetes mellitus.
3. Episiotomy is included in 2nd degree laceration.
4. This table presents all births that occurred in KDH, including births by mothers who were non-NT residents.
5. Multiple pregnancy and/or childbirth complications may apply to one mother.

Table 65. Summary statistics,[4,6,7] Gove District Hospital, 2021

		All	
		Number	%
MOTHERS		**128**	
Aboriginal status			
	Aboriginal	100	78.1
	Non-Aboriginal	28	21.9
Onset of labour			
	Spontaneous (Not augmented)	47	36.7
	Spontaneous (Augmented)	27	21.1
	Induced labour	38	29.7
	No labour	16	12.5
Method of birth			
	Vaginal birth[1]	83	64.8
	Caesarean section	35	27.3
Pregnancy and/or childbirth complications[5]			
	Fetal compromise	16	12.5
	Diabetes in pregnancy[2]	25	19.5
	Manual removal of placenta	6	4.7
	Meconium stained liquor	16	12.5
	Lack of progress	17	13.3
	Post-partum haemorrhage	53	41.4
	Other	12	9.4
	Any complication	***88***	***68.8***
MOTHERS HAVING VAGINAL BIRTH		**93**	
Perineum status			
	2nd degree laceration	21	22.6
	Episiotomy[3]	15	16.2
LIVEBORN BABIES		**127**	
Gestational age			
	<37 weeks	4	3.1
	37+ weeks	123	96.9
Birthweight			
	<2500 g	4	3.1
	2500 g+	123	96.9

Note: 1 Vaginal breech are combined with normal vaginal births.
2. Diabetes in pregnancy includes gestational diabetes mellitus and pre-existing diabetes mellitus.
3. Episiotomy is included in 2nd degree laceration.
4. This table presents all births that occurred in GDH, including births by mothers who were non-NT residents.
5. Not stated category is not presented, and therefore the total may differ from the sum of the components.
6. Multiple pregnancy and/or childbirth complications may apply to one mother.
7. Due to small cell count data is not presented by Indigenous status.

Table 66. Summary statistics,[4,6] Darwin Private Hospital, 2021

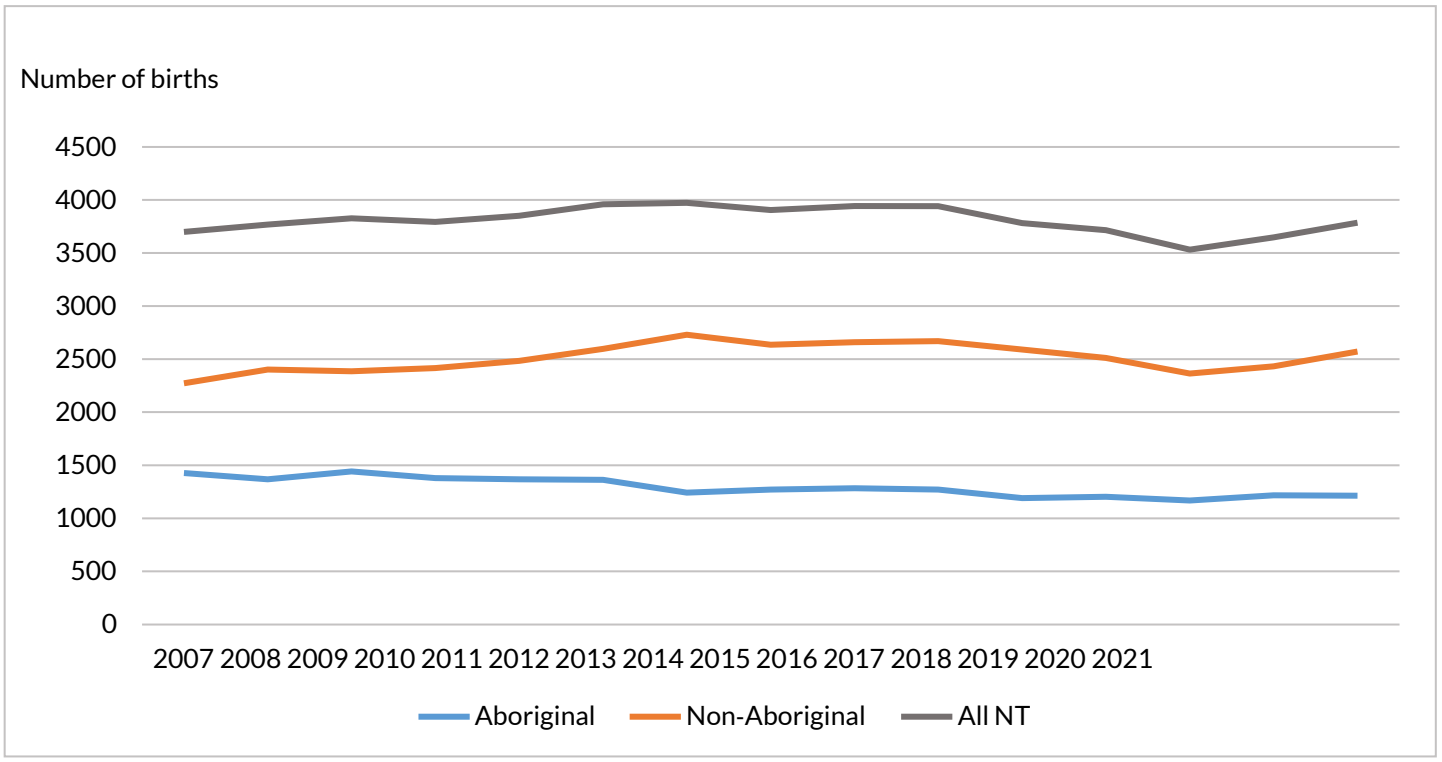
		All	
		Number	**%**
MOTHERS		**371**	
Aboriginal status			
	Aboriginal	13	3.5
	Non-Aboriginal	358	96.5
Onset of labour			
	Spontaneous (Not augmented)	96	25.9
	Spontaneous (Augmented)	33	8.9
	Induced labour	111	30.0
	No labour	130	35.1
Method of birth			
	Vaginal[1] birth	152	41.3
	Caesarean section	186	50.5
Pregnancy and/or childbirth complications			
	Fetal compromise	32	8.6
	Diabetes in pregnancy[2]	58	15.6
	Meconium stained liquor	12	3.2
	Lack of progress	32	8.6
	Post-partum haemorrhage	33	8.9
	Other	16	4.3
	Any complication	***145***	***39.1***
MOTHERS HAVING VAGINAL BIRTH		**42**	
Perineum status			
	2nd degree laceration	30	17.1
	Episiotomy	43	24.6
LIVEBORN BABIES		**373**	
Gestational age			
	<37 weeks	24	6.4
	37+ weeks	349	93.6
Birthweight			
	<2500 g	16	4.3
	2500 g+	356	95.7

Note: 1 Vaginal breech are combined with normal vaginal births.
2. Diabetes in pregnancy includes gestational diabetes mellitus and pre-existing diabetes mellitus.
3. Episiotomy is included in 2nd degree laceration.
4. This table presents all births that occurred in DPH, including births by mothers who were non-NT residents.
5. Multiple pregnancy and/or childbirth complications may apply to one mother.
6. Due to small cell count data is not presented by Indigenous status.

Appendix B. Trends of perinatal indicators, by Aboriginal status, NT, 2007–2021

The following trends figures and tables summarise key indicators over time by Aboriginal status. Numbers are provided in tables 65, 66 and 67. Proportions are provided in tables 68, 69 and 70.

Figure 11. Births[1] by maternal Aboriginal status, NT 2007–2021



Note: 1. Includes all births inclusive of singleton and multiple births.

Figure 12. Fertility rate by Aboriginal status, NT 2007–2021

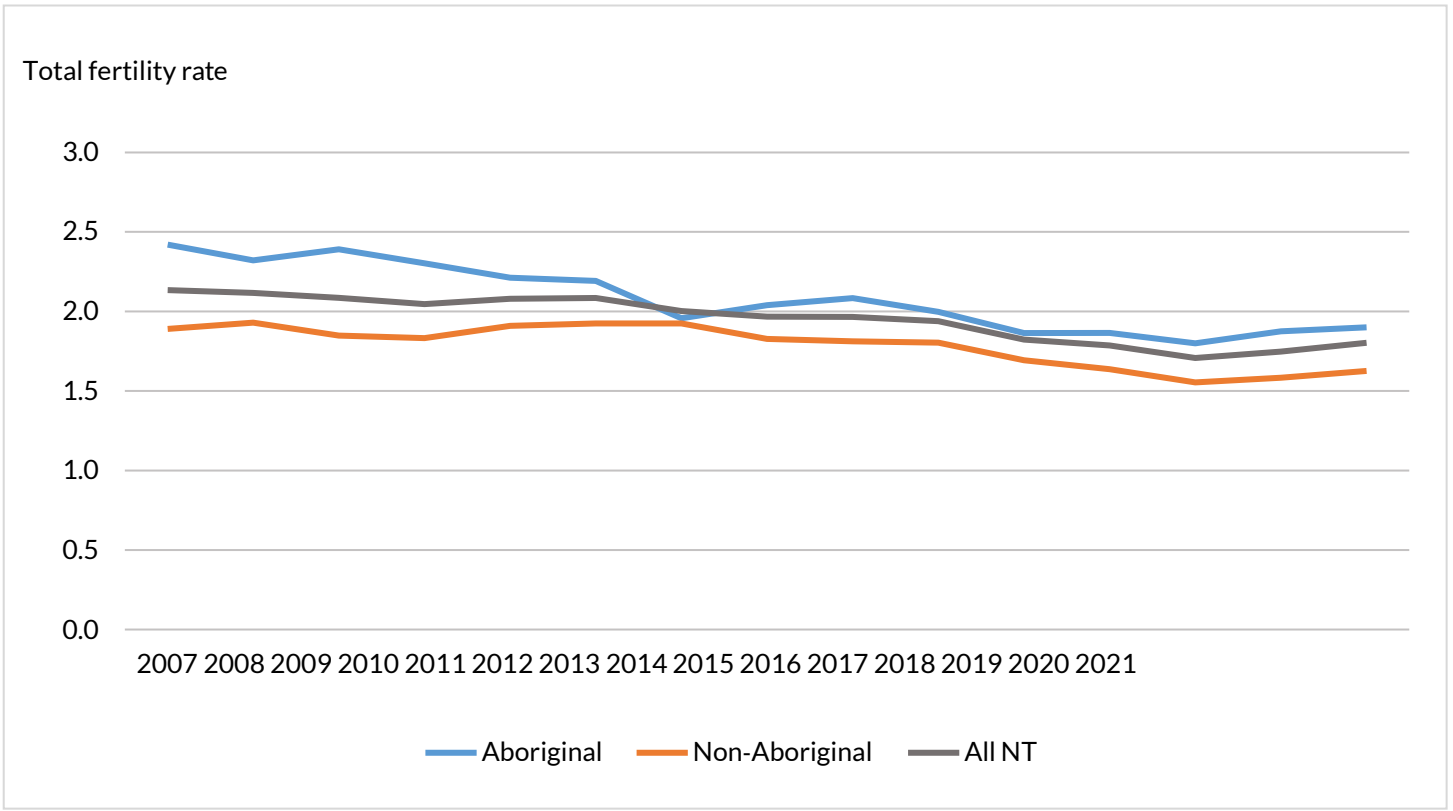


Figure 13. Maternal age by Aboriginal status, NT 2007–2021

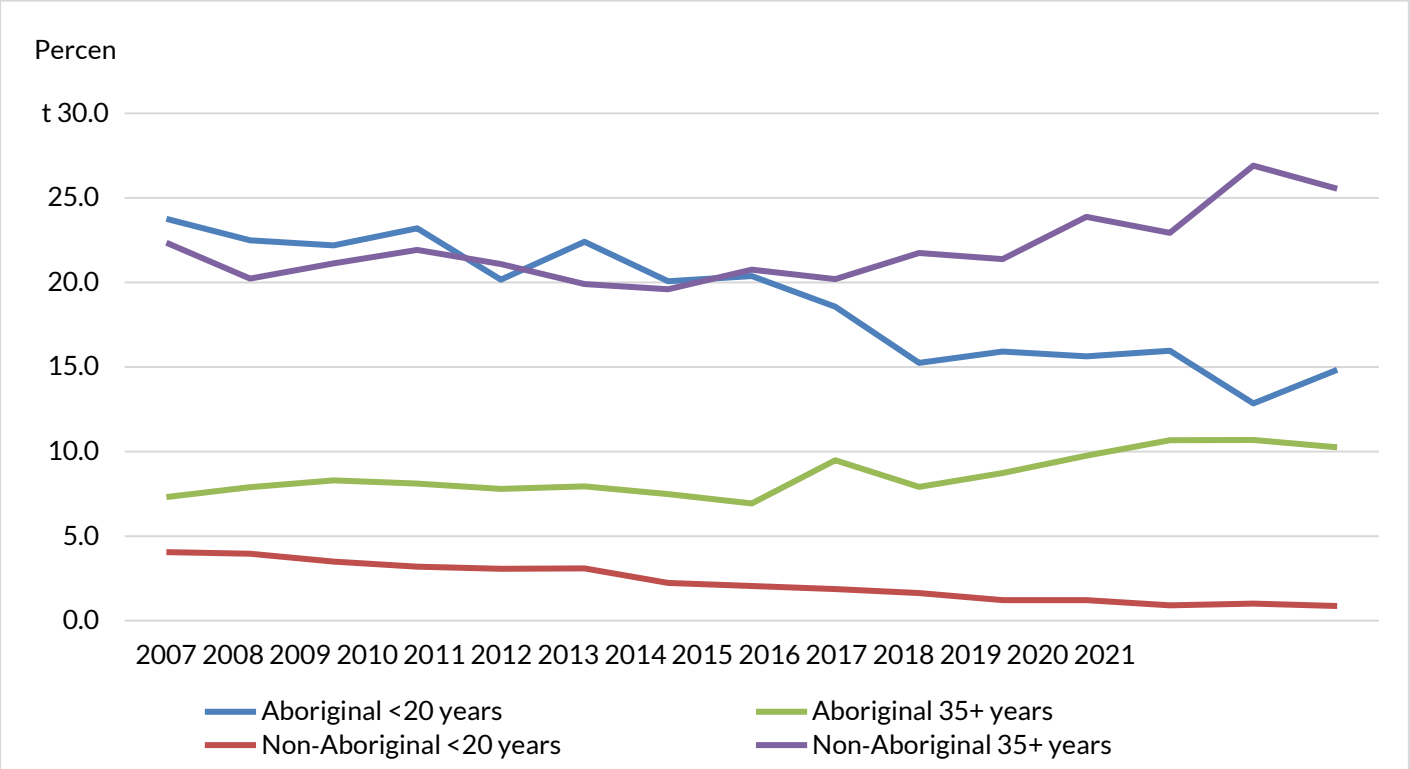


Figure 14. Onset of labour by Aboriginal status, NT 2007–2021

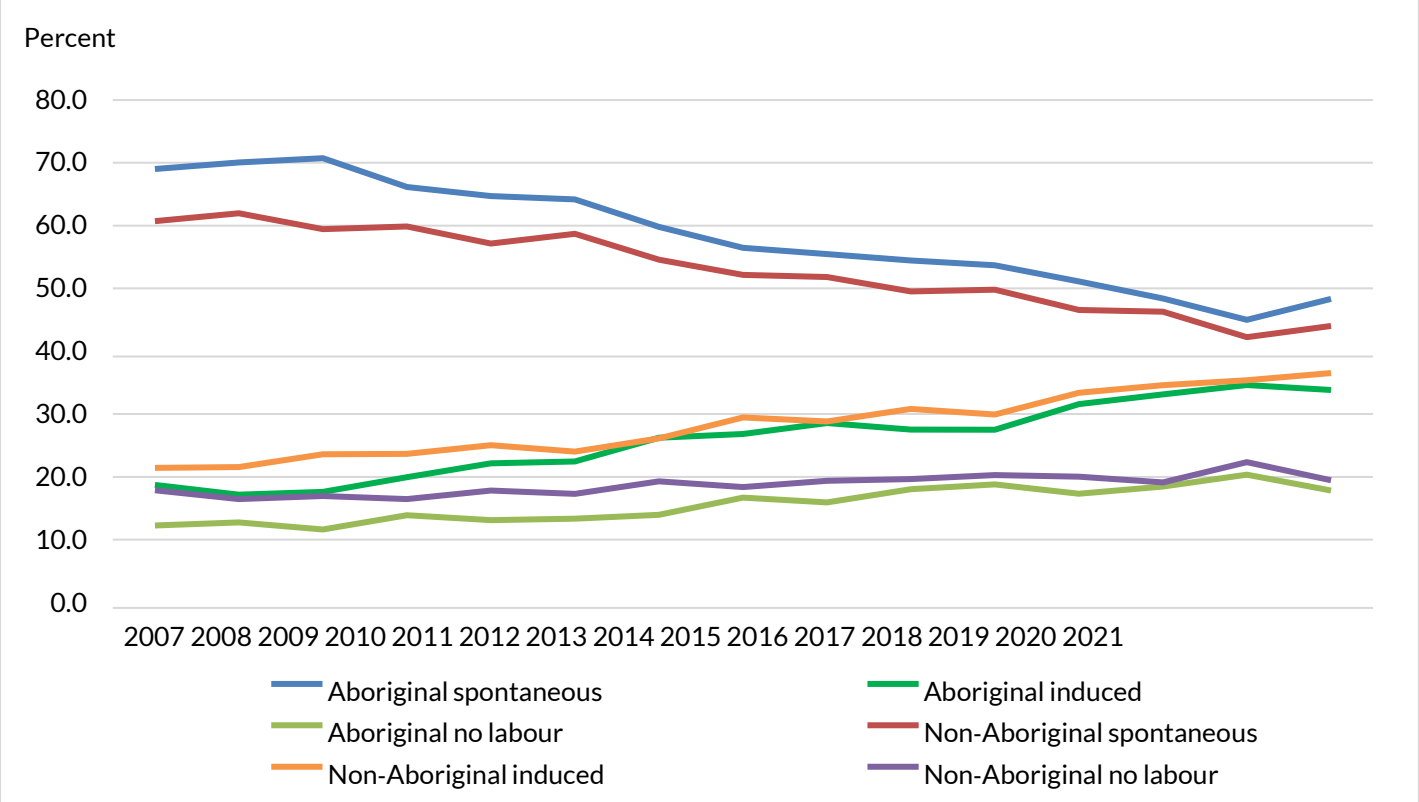


Figure 15. Birth method by Aboriginal status, NT 2007–2021

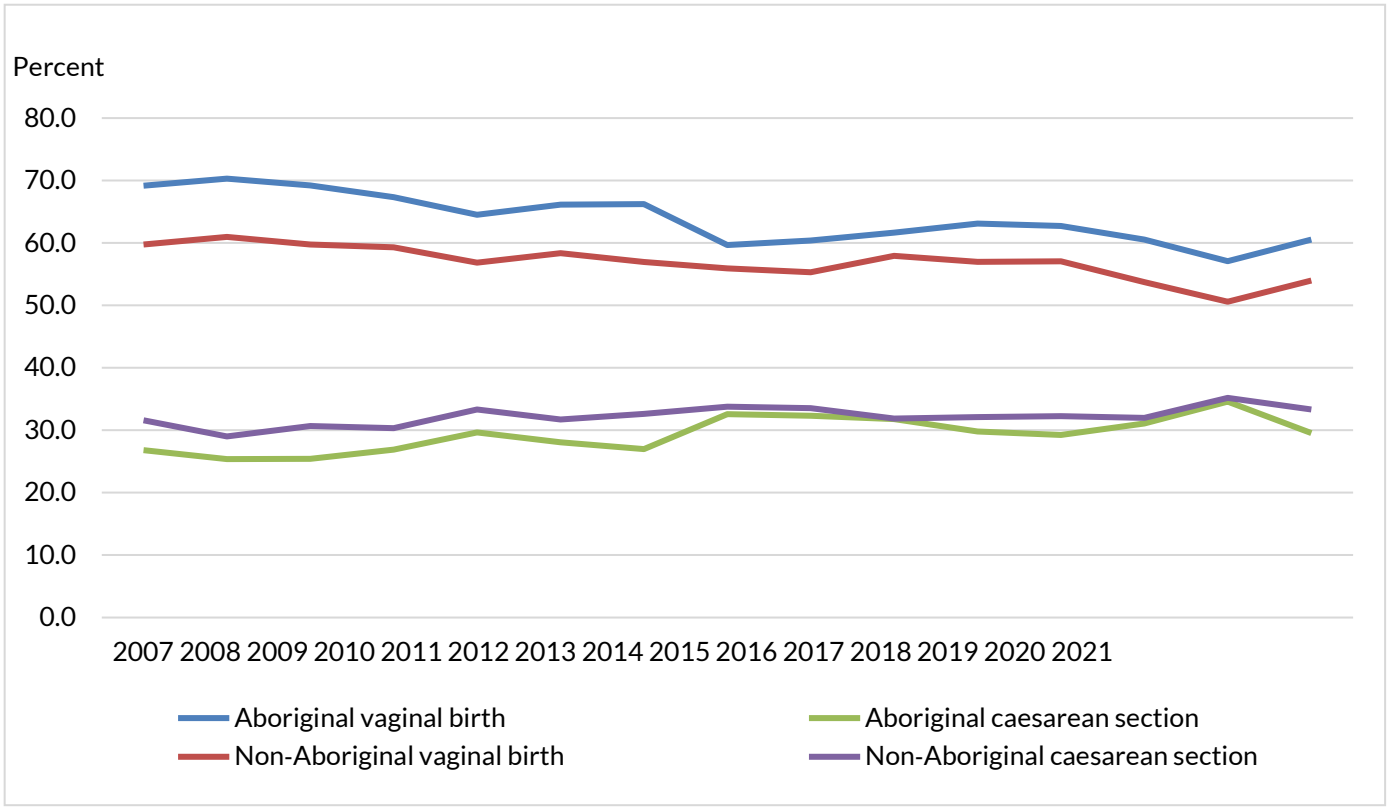


Figure 16. Age category of first-time mother by Aboriginal status, NT 2007–2021

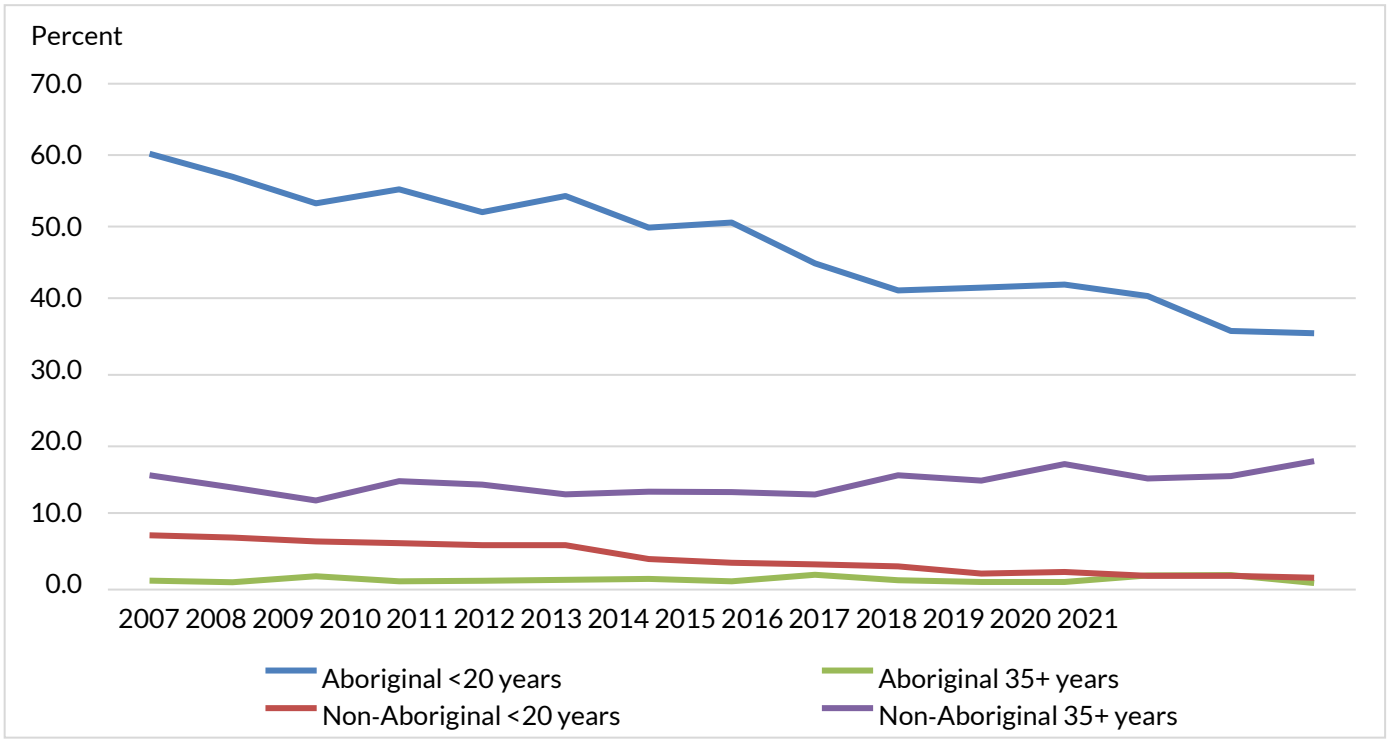
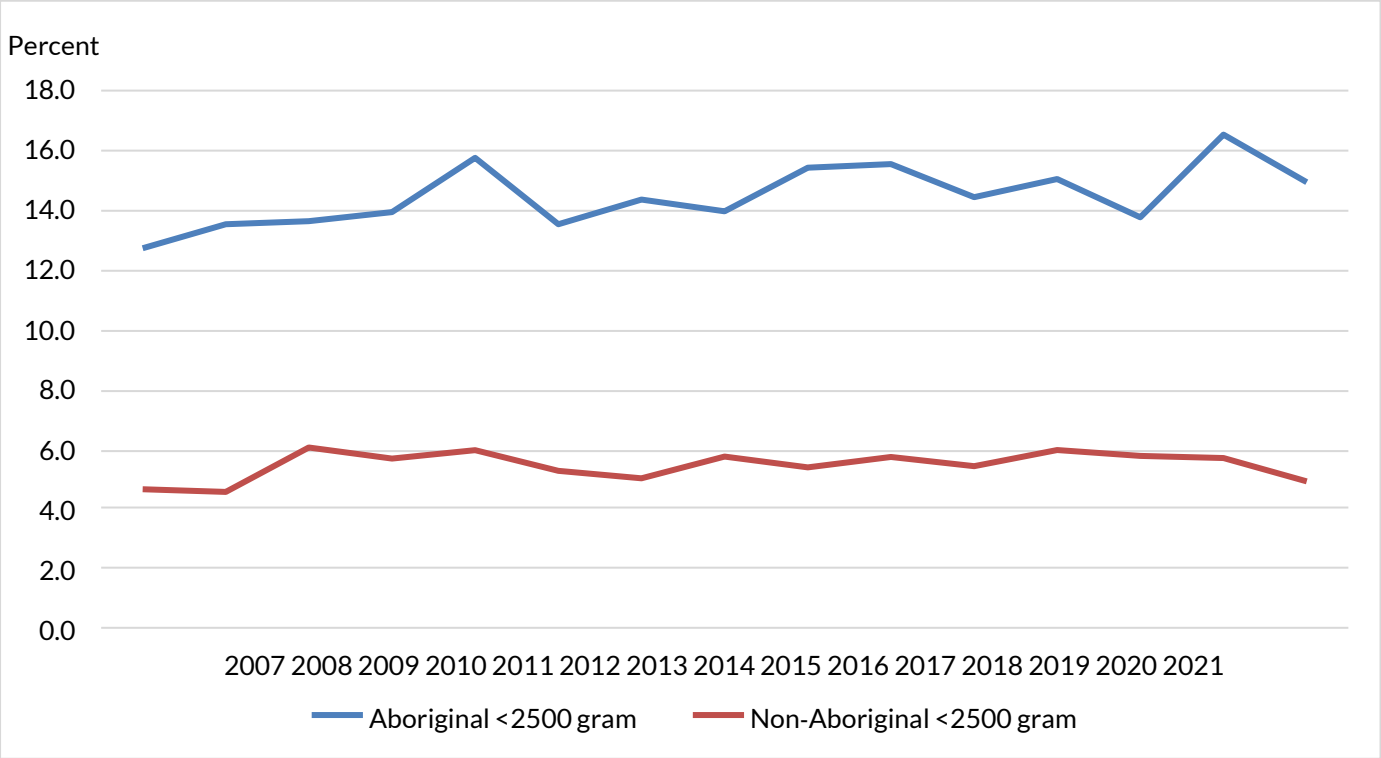
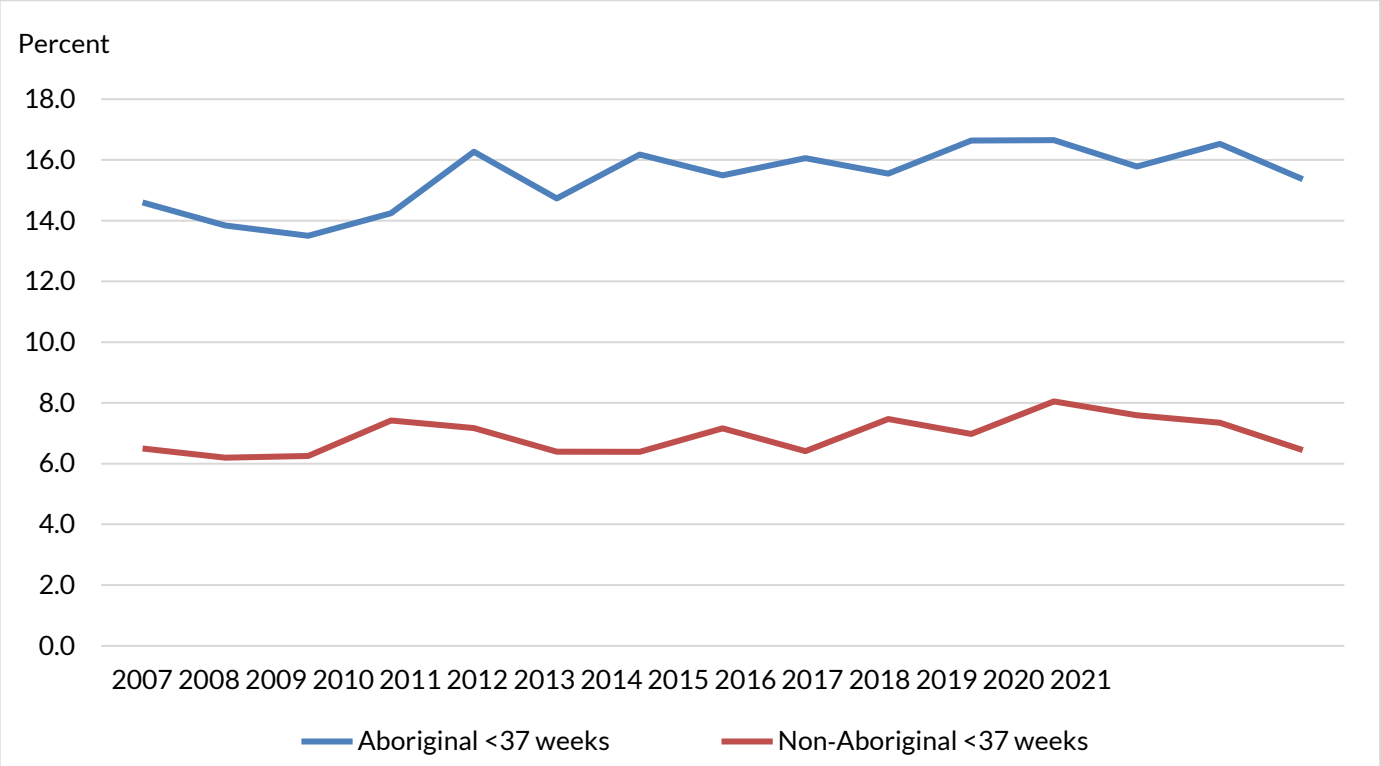


Figure 17. Low birthweight liveborn babies[1] by maternal Aboriginal status, NT 2007–2021



Note: 1. Includes all live births.

Figure 18. Pre-term liveborn babies[1] by maternal Aboriginal status, NT 2007–2021



Note: 1. Includes preterm births for all reasons, including medical indications.

Table 67. Trends in numbers for selected measures, NT Aboriginal mothers and babies, 2007–2021

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Total fertility rate	2.4	2.3	2.4	2.3	2.2	2.2	2.0	2.0	2.1	2.0	1.9	1.9	1.8	1.9	2.1
								Number								
ALL MOTHERS	**Total**	**1410**	**1356**	**1424**	**1358**	**1349**	**1348**	**1231**	**1256**	**1266**	**1253**	**1181**	**1190**	**1153**	**1198**	**1200**
	Maternal age															
	<20	335	305	316	315	272	302	247	256	235	191	188	186	184	154	178
	20-34	972	944	990	933	972	939	892	913	911	963	890	888	846	916	899
	35+	103	107	118	110	105	107	92	87	120	99	103	116	123	128	123
	Place of birth															
	Hospital	1349	1299	1370	1286	1297	1292	1177	1213	1230	1219	1141	1157	1123	1162	1171
	Non-hospital	61	57	54	72	52	56	54	43	36	34	40	33	30	36	29
	Type of labour onset															
	Spontaneous	973	950	1007	898	873	865	736	709	702	682	634	608	558	539	580
	Induced	264	233	251	271	299	303	323	337	362	345	325	376	382	415	406
	No labour	173	173	166	189	177	180	172	210	202	226	222	206	213	244	214
	Method of birth															
	Normal vaginal	975	953	985	914	870	891	815	749	764	772	745	746	697	683	723
	Forceps	16	20	28	11	22	18	31	32	28	30	40	37	37	33	62
	Ventouse	41	39	49	68	57	61	53	66	65	53	44	59	60	67	57
	Caesarean	378	344	362	365	400	378	332	409	409	398	352	348	358	414	353
FIRST-TIME MOTHERS	**Total**	**407**	**402**	**432**	**440**	**419**	**455**	**413**	**441**	**437**	**387**	**388**	**389**	**407**	**398**	**450**
	Maternal age															
	<20	245	229	230	243	218	247	206	223	196	159	161	163	164	141	158
	20+	162	173	202	197	201	208	207	218	241	228	227	226	243	257	292
BABIES	**Total**	**1426**	**1367**	**1442**	**1379**	**1368**	**1363**	**1242**	**1270**	**1283**	**1271**	**1191**	**1203**	**1169**	**1216**	**1214**
	Stillborn	22	16	28	17	16	12	24	11	19	17	13	20	22	18	36
LIVE-BORN BABIES	**Total**	**1404**	**1351**	**1414**	**1362**	**1352**	**1351**	**1218**	**1259**	**1264**	**1254**	**1178**	**1183**	**1147**	**1198**	**1178**
	Plurality															
	Singleton	1375	1329	1381	1321	1314	1321	1196	1232	1231	1219	1158	1157	1119	1162	1150
	Multiple	29	22	33	41	38	30	22	27	33	35	20	26	28	36	28
	Birthweight (g)															
	<1500	39	26	36	38	36	32	41	37	34	45	29	27	29	42	39
	1500-2499	140	157	157	152	177	151	134	139	161	150	141	151	129	156	137
	2500+	1225	1168	1221	1172	1139	1168	1043	1083	1069	1059	1007	1005	989	1000	1002
	Gestational age (weeks)															
	<28	14	14	12	15	20	15	20	17	15	27	14	10	15	20	21
	28-36	191	173	179	179	200	184	177	178	188	168	182	187	166	178	160
	37+	1199	1164	1223	1168	1132	1152	1021	1064	1061	1059	982	986	966	1000	997

Note: 1. Counts shown in trends table may differ slightly to those in previous reports due to the ongoing data validation process.

Table 68. Trends in proportions for selected measures, NT Aboriginal mothers and babies, 2007–2021

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
								Percent								
ALL MOTHERS	**Maternal age**															
	<20	23.8	22.5	22.2	23.2	20.2	22.4	20.1	20.4	18.6	15.2	15.9	15.6	16.0	12.9	14.8
	20-34	68.9	69.6	69.5	68.7	72.1	69.7	72.5	72.7	72.0	76.9	75.4	74.6	73.4	76.5	74.9
	35+	7.3	7.9	8.3	8.1	7.8	7.9	7.5	6.9	9.5	7.9	8.7	9.7	10.7	10.7	10.3
	Place of birth															
	Hospital	95.7	95.8	96.2	94.7	96.1	95.8	95.6	96.6	97.2	97.3	96.6	97.2	97.4	97.0	97.6
	Non-hospital	4.3	4.2	3.8	5.3	3.9	4.2	4.4	3.4	2.8	2.7	3.4	2.8	2.6	3.0	2.4
	Type of labour onset															
	Spontaneous	69.0	70.1	70.7	66.1	64.7	64.2	59.8	56.4	55.5	54.4	53.7	51.1	48.4	45.0	48.3
	Induced	18.7	17.2	17.6	20.0	22.2	22.5	26.2	26.8	28.6	27.5	27.5	31.6	33.1	34.6	33.8
	No labour	12.3	12.8	11.7	13.9	13.1	13.4	14.0	16.7	16.0	18.0	18.8	17.3	18.5	20.4	17.8
	Method of birth															
	Normal vaginal	69.1	70.3	69.2	67.3	64.5	66.1	66.2	59.6	60.3	61.6	63.1	62.7	60.5	57.1	60.5
	Forceps	1.1	1.5	2.0	0.8	1.6	1.3	2.5	2.5	2.2	2.4	3.4	3.1	3.2	2.8	5.2
	Ventouse	2.9	2.9	3.4	5.0	4.2	4.5	4.3	5.3	5.1	4.2	3.7	5.0	5.2	5.6	4.8
	Caesarean	26.8	25.4	25.4	26.9	29.7	28.0	27.0	32.6	32.3	31.8	29.8	29.2	31.1	34.6	29.5
FIRST-TIME MOTHERS	**Maternal age**															
	<20	60.2	57.0	53.2	55.2	52.0	54.3	49.9	50.6	44.9	41.1	41.5	41.9	40.3	35.4	35.1
	20+	39.8	43.0	46.8	44.8	48.0	45.7	50.1	49.4	55.1	58.9	58.5	58.1	59.7	64.6	64.9
BABIES																
	Stillbirths	1.5	1.2	1.9	1.2	1.2	0.9	1.9	0.9	1.5	1.3	1.1	1.7	1.9	1.5	3.0
LIVE-BORN BABIES	**Plurality**															
	Singleton	97.9	98.4	97.7	97.0	97.2	97.8	98.2	97.9	97.4	97.2	98.3	97.8	97.6	97.0	97.6
	Multiple	2.1	1.6	2.3	3.0	2.8	2.2	1.8	2.1	2.6	2.8	1.7	2.2	2.4	3.0	2.4
	Birthweight (g)															
	<1500	2.8	1.9	2.5	2.8	2.7	2.4	3.4	2.9	2.7	3.6	2.5	2.3	2.5	3.5	3.3
	1500-2499	10.0	11.6	11.1	11.2	13.1	11.2	11.0	11.0	12.7	12.0	12.0	12.8	11.2	13.0	11.6
	2500+	87.3	86.5	86.4	86.0	84.2	86.5	85.6	86.0	84.6	84.4	85.6	85.0	86.2	83.5	85.1
	Gestational age (weeks)															
	<28	1.0	1.0	0.8	1.1	1.5	1.1	1.6	1.4	1.2	2.2	1.2	0.8	1.3	1.7	1.8
	28-36	13.6	12.8	12.7	13.1	14.8	13.6	14.5	14.1	14.9	13.4	15.4	15.8	14.5	14.9	13.6
	37+	85.4	86.2	86.5	85.8	83.7	85.3	83.8	84.5	83.9	84.4	83.4	83.3	84.2	83.5	84.6

Note: 1. Counts shown in trends table may differ slightly to those in previous reports due to the ongoing data validation process.

Table 69. Trends in numbers for selected measures, NT non-Aboriginal mothers and babies, 2007–2021

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Total fertility rate	1.9	1.9	1.8	1.8	1.9	1.9	1.9	1.8	1.8	1.8	1.7	1.6	1.6	1.6	1.6
								Number								
ALL MOTHERS	**Total**	**2247**	**2374**	**2349**	**2382**	**2448**	**2563**	**2700**	**2598**	**2625**	**2637**	**2550**	**2476**	**2329**	**2397**	**2541**
	Maternal age															
	<20	91	94	82	76	75	79	60	53	49	43	31	30	21	24	22
	20-34	1654	1800	1771	1784	1857	1974	2111	2006	2046	2021	1974	1855	1774	1728	1870
	35+	502	480	496	522	516	510	529	539	530	573	545	591	534	645	649
	Place of birth															
	Hospital	2199	2333	2297	2337	2393	2520	2645	2563	2581	2600	2504	2421	2268	2330	2471
	Non-hospital	48	41	52	45	55	43	55	35	44	37	46	55	61	67	70
	Type of labour onset															
	Spontaneous	1364	1471	1396	1426	1399	1504	1473	1355	1360	1306	1270	1153	1078	1013	1118
	Induced	482	512	555	564	613	616	706	766	757	813	763	827	806	848	928
	No labour	401	391	398	392	436	443	521	477	508	518	517	496	445	536	494
	Method of birth															
	Normal vaginal	1342	1447	1403	1412	1391	1495	1537	1452	1451	1527	1452	1412	1250	1211	1369
	Forceps	55	82	81	87	96	96	136	108	134	106	137	119	163	170	163
	Ventouse	141	157	145	161	146	160	147	161	160	164	143	147	171	171	161
	Caesarean	709	688	720	722	815	812	880	877	880	840	818	798	744	842	845
FIRST-TIME MOTHERS	**Total**	**989**	**1076**	**1012**	**1051**	**1096**	**1127**	**1247**	**1200**	**1161**	**1238**	**1171**	**1105**	**1094**	**1102**	**1211**
	Maternal age															
	<20	75	78	68	68	68	70	53	45	41	40	26	27	21	21	20
	20-34	763	852	825	831	875	915	1032	1000	974	1009	975	892	911	914	982
	35+	151	146	119	152	153	142	162	155	146	189	170	186	162	167	209
BABIES	**Total**	**2272**	**2400**	**2383**	**2414**	**2482**	**2595**	**2730**	**2634**	**2658**	**2669**	**2589**	**2511**	**2362**	**2430**	**2571**
	Stillborn	9	10	14	14	11	12	20	21	19	16	23	25	16	20	26
LIVE-BORN BABIES	**Total**	**2263**	**2390**	**2369**	**2400**	**2471**	**2583**	**2710**	**2613**	**2639**	**2653**	**2566**	**2486**	**2346**	**2410**	**2545**
	Pluralit y	2215	2342	2304	2337	2403	2519	2654	2546	2573	2589	2490	2421	2280	2344	2488
	Singleton															
	Multiple	48	48	65	63	68	64	56	67	66	64	76	65	66	66	57
	Birthweight (g)															
	<1500	19	20	13	26	28	17	19	16	20	11	23	22	20	24	21
	1500-2499	88	91	132	112	121	121	119	136	124	143	118	128	117	115	106
	2500+	2156	2279	2224	2262	2322	2445	2571	2461	2494	2499	2425	2336	2209	2271	2417
	Gestational age (weeks)															
	<28	6	7	5	10	10	6	11	6	5	6	15	7	8	11	13
	28-36	141	141	143	168	167	159	162	181	164	192	164	193	170	166	151
	37+	2116	2242	2221	2222	2294	2418	2537	2426	2470	2455	2387	2286	2168	2233	2381

Note: 1. Counts shown in trends table may differ slightly to those in previous reports due to the ongoing data validation process.

Table 70. Trends in proportions for selected measures, NT non-Aboriginal mothers and babies, 2007–2021

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
								Percent								
ALL MOTHERS	**Maternal age**															
	<20	4.0	4.0	3.5	3.2	3.1	3.1	2.2	2.0	1.9	1.6	1.2	1.2	0.9	1.0	0.9
	20-34	73.6	75.8	75.4	74.9	75.9	77.0	78.2	77.2	77.9	76.6	77.4	74.9	76.2	72.1	73.6
	35+	22.3	20.2	21.1	21.9	21.1	19.9	19.6	20.7	20.2	21.7	21.4	23.9	22.9	26.9	25.5
	Place of birth															
	Hospital	97.9	98.3	97.8	98.1	97.8	98.3	98.0	98.7	98.3	98.6	98.2	97.8	97.4	97.2	97.2
	Non-hospital	2.1	1.7	2.2	1.9	2.2	1.7	2.0	1.3	1.7	1.4	1.8	2.2	2.6	2.8	2.8
	Type of labour onset															
	Spontaneous	60.7	62.0	59.4	59.9	57.1	58.7	54.6	52.2	51.8	49.5	49.8	46.6	46.3	42.3	44.0
	Induced	21.5	21.6	23.6	23.7	25.0	24.0	26.1	29.5	28.8	30.8	29.9	33.4	34.6	35.4	36.5
	No labour	17.8	16.5	16.9	16.5	17.8	17.3	19.3	18.4	19.4	19.6	20.3	20.0	19.1	22.4	19.4
	Method of birth															
	Normal vaginal	59.7	61.0	59.7	59.3	56.8	58.3	56.9	55.9	55.3	57.9	56.9	57.0	53.7	50.6	53.9
	Forceps	2.4	3.5	3.4	3.7	3.9	3.7	5.0	4.2	5.1	4.0	5.4	4.8	7.0	7.1	6.4
	Ventouse	6.3	6.6	6.2	6.8	6.0	6.2	5.4	6.2	6.1	6.2	5.6	5.9	7.3	7.1	6.3
	Caesarean	31.6	29.0	30.7	30.3	33.3	31.7	32.6	33.8	33.5	31.9	32.1	32.2	32.0	35.2	33.3
FIRST-TIME MOTHERS	**Maternal age**															
	<20	7.6	7.2	6.7	6.5	6.2	6.2	4.3	3.8	3.5	3.2	2.2	2.4	1.9	1.9	1.7
	20-34	77.1	79.2	81.5	79.1	79.8	81.2	82.8	83.3	83.9	81.5	83.3	80.7	83.3	82.9	81.1
	35+	15.3	13.6	11.8	14.5	14.0	12.6	13.0	12.9	12.6	15.3	14.5	16.8	14.8	15.2	17.3
BABIES																
	Stillbirths	0.4	0.4	0.6	0.6	0.4	0.5	0.7	0.8	0.7	0.6	0.9	1.0	0.7	0.8	1.0
LIVE-BORN BABIES	**Plurality**															
	Singleton	97.9	98.0	97.3	97.4	97.2	97.5	97.9	97.4	97.5	97.6	97.0	97.4	97.2	97.3	97.8
	Multiple	2.1	2.0	2.7	2.6	2.8	2.5	2.1	2.6	2.5	2.4	3.0	2.6	2.8	2.7	2.2
	Birthweight (g)															
	<1500	0.8	0.8	0.5	1.1	1.1	0.7	0.7	0.6	0.8	0.4	0.9	0.9	0.9	1.0	0.8
	1500-2499	3.9	3.8	5.6	4.7	4.9	4.7	4.4	5.2	4.7	5.4	4.6	5.1	5.0	4.8	4.2
	2500+	95.3	95.4	93.9	94.3	94.0	94.7	94.9	94.2	94.5	94.2	94.5	94.0	94.2	94.2	95.0
	Gestational age (weeks)															
	<28	0.3	0.3	0.2	0.4	0.4	0.2	0.4	0.2	0.2	0.2	0.6	0.3	0.3	0.5	0.5
	28-36	6.2	5.9	6.0	7.0	6.8	6.2	6.0	6.9	6.2	7.2	6.4	7.8	7.2	6.9	5.9
	37+	93.5	93.8	93.8	92.6	92.8	93.6	93.6	92.8	93.6	92.5	93.0	92.0	92.4	92.7	93.6

Note: 1. Counts shown in trends table may differ slightly to those in previous reports due to the ongoing data validation process.

Table 71. Trends in numbers for selected measures, all NT mothers and babies, 2007–2021

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
	Total fertility rate	2.1	2.1	2.1	2.0	2.1	2.1	2.0	2.0	2.0	1.90	1.8	1.8	1.7	1.7	1.8
								Number								
ALL MOTHERS	**Total**	**3657**	**3730**	**3773**	**3740**	**3797**	**3911**	**3931**	**3854**	**3891**	**3890**	**3731**	**3666**	**3482**	**3595**	**3741**
	Maternal age															
	<20	426	399	398	391	347	381	307	309	284	234	219	216	205	178	200
	20-34	2626	2744	2761	2717	2829	2913	3003	2919	2957	2984	2864	2743	2620	2644	2769
	35+	605	587	614	632	621	617	621	626	650	672	648	707	657	773	772
	Place of birth															
	Hospital	3548	3632	3667	3623	3690	3812	3822	3776	3811	3819	3645	3578	3391	3492	3642
	Non-hospital	109	98	106	117	107	99	109	78	80	71	86	88	91	103	99
	Type of labour onset															
	Spontaneous	2337	2421	2403	2324	2272	2369	2209	2064	2062	1988	1904	1761	1636	1552	1698
	Induced	746	745	806	835	912	919	1029	1103	1119	1158	1088	1203	1188	1263	1334
	No labour	574	564	564	581	613	623	693	687	710	744	739	702	658	780	708
	Method of birth															
	Normal vaginal	2317	2400	2388	2326	2261	2386	2352	2201	2215	2299	2197	2158	1947	1894	2092
	Forceps	71	102	109	98	118	114	167	140	162	136	177	156	200	203	225
	Ventouse	182	196	194	229	203	221	200	227	225	217	187	206	231	238	218
	Caesarean	1087	1032	1082	1087	1215	1190	1212	1286	1289	1238	1170	1146	1102	1256	1198
FIRST-TIME MOTHERS	**Total**	**1396**	**1478**	**1444**	**1491**	**1515**	**1582**	**1660**	**1641**	**1598**	**1625**	**1559**	**1494**	**1501**	**1500**	**1661**
	Maternal age															
	<20	320	307	298	311	286	317	259	268	237	199	187	190	185	162	178
	20-34	920	1021	1019	1023	1071	1117	1233	1213	1206	1232	1198	1114	1146	1163	1270
	35+	156	150	127	157	158	148	168	160	155	194	174	190	170	175	213
BABIES	**Total**	**3698**	**3767**	**3825**	**3793**	**3850**	**3958**	**3972**	**3904**	**3941**	**3940**	**3780**	**3714**	**3531**	**3646**	**3785**
	Stillbirths	31	26	42	31	27	24	44	32	38	33	36	45	38	38	62
	Neonatal deaths	18	19	18	17	26	10	14	18	15	17	21	20	14	25	17
	Perinatal deaths	49	45	60	48	53	34	58	50	53	50	57	65	52	63	79
LIVE-BORN BABIES	**Total**	**3667**	**3741**	**3783**	**3762**	**3823**	**3934**	**3928**	**3872**	**3903**	**3907**	**3744**	**3669**	**3493**	**3608**	**3723**
	Plurality															
	Singleton	3590	3671	3685	3658	3717	3840	3850	3778	3804	3808	3648	3578	3399	3506	3638
	Multiple	77	70	98	104	106	94	78	94	99	99	96	91	94	102	85
	Birthweight (g)															
	<1500	58	46	49	64	64	49	60	53	54	56	52	49	49	66	60
	1500-2499	228	248	289	264	298	272	253	275	285	293	259	279	246	271	243
	2500+	3381	3447	3445	3434	3461	3613	3614	3544	3563	3558	3432	3341	3198	3271	3419
	Gestational age (weeks)															
	<28	20	21	17	25	30	21	31	23	20	33	29	17	23	31	34
	28-36	332	314	322	347	367	343	339	359	352	360	346	380	336	344	311
	37+	3315	3406	3444	3390	3426	3570	3558	3490	3531	3514	3369	3272	3134	3233	3378

Note: 1. Counts shown in trends table may differ slightly to those in previous reports due to the ongoing data validation process.

Table 72. Trends in proportions for selected measures, all NT mothers and babies, 2007–2021

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
								Percent								
ALL MOTHERS	**Maternal age**															
	<20	11.6	10.7	10.5	10.5	9.1	9.7	7.8	8.0	7.3	6.0	5.9	5.9	5.9	5.0	5.3
	20-34	71.8	73.6	73.2	72.6	74.5	74.5	76.4	75.7	76.0	76.7	76.8	74.8	75.2	73.5	74.0
	35+	16.5	15.7	16.3	16.9	16.4	15.8	15.8	16.2	16.7	17.3	17.4	19.3	18.9	21.5	20.6
	Place of birth															
	Hospital	97.0	97.4	97.2	96.9	97.2	97.5	97.2	98.0	97.9	98.2	97.7	97.6	97.4	97.1	97.4
	Non-hospital	3.0	2.6	2.8	3.1	2.8	2.5	2.8	2.0	2.1	1.8	2.3	2.4	2.6	2.9	2.6
	Type of labour onset															
	Spontaneous	63.9	64.9	63.7	62.1	59.8	60.6	56.2	53.6	53.0	51.1	51.0	48.0	47.0	43.2	45.4
	Induced	20.4	20.0	21.4	22.3	24.0	23.5	26.2	28.6	28.8	29.8	29.2	32.8	34.1	35.1	35.7
	No labour	15.7	15.1	14.9	15.5	16.1	15.9	17.6	17.8	18.2	19.1	19.8	19.1	18.9	21.7	18.9
	Method of birth															
	Normal vaginal	63.4	64.3	63.3	62.2	59.5	61.0	59.8	57.1	56.9	59.1	58.9	58.9	55.9	52.7	56.0
	Forceps	1.9	2.7	2.9	2.6	3.1	2.9	4.2	3.6	4.2	3.5	4.7	4.3	5.7	5.7	6.0
	Ventouse	5.0	5.3	5.1	6.1	5.3	5.7	5.1	5.9	5.8	5.6	5.0	5.6	6.6	6.6	5.8
	Caesarean	29.7	27.7	28.7	29.1	32.0	30.4	30.8	33.4	33.1	31.8	31.4	31.3	31.7	35.0	32.1
FIRST-TIME MOTHERS	**Maternal age**															
	<20	22.9	20.8	20.6	20.9	18.9	20.0	15.6	16.3	14.8	12.2	12.0	12.7	12.3	10.8	10.7
	20-34	65.9	69.1	70.6	68.6	70.7	70.6	74.3	73.9	75.5	75.8	76.8	74.6	76.3	77.5	76.5
	35+	11.2	10.1	8.8	10.5	10.4	9.4	10.1	9.8	9.7	11.9	11.2	12.7	11.3	11.7	12.8
BABIES																
	Stillbirths	0.8	0.7	1.1	0.8	0.7	0.6	1.1	0.8	1.0	0.8	1.0	1.2	1.1	1.0	1.6
	Neonatal deaths	0.5	0.5	0.5	0.5	0.4	0.7	0.3	0.4	0.5	0.4	0.5	0.6	0.6	0.4	0.7
	Perinatal deaths	1.3	1.2	1.6	1.3	1.4	0.9	1.5	1.3	1.3	1.3	1.5	1.8	1.5	1.7	2.1
LIVE-BORN BABIES	**Plurality**															
	Singleton	97.9	98.1	97.4	97.2	97.2	97.6	98.0	97.6	97.5	97.5	97.4	97.5	97.3	97.2	97.7
	Multiple	2.1	1.9	2.6	2.8	2.8	2.4	2.0	2.4	2.5	2.5	2.6	2.5	2.7	2.8	2.3
	Birthweight (g)															
	<1500	1.6	1.2	1.3	1.7	1.7	1.2	1.5	1.4	1.4	1.4	1.4	1.3	1.4	1.8	1.6
	1500-2499	6.2	6.6	7.6	7.0	7.8	6.9	6.4	7.1	7.3	7.5	6.9	7.6	7.0	7.5	6.5
	2500+	92.2	92.1	91.1	91.3	90.5	91.8	92.0	91.5	91.3	91.1	91.7	91.1	91.6	90.7	91.9
	Gestational age (weeks)															
	<28	0.5	0.6	0.4	0.7	0.8	0.5	0.8	0.6	0.5	0.8	0.8	0.5	0.7	0.9	0.9
	28-36	9.1	8.4	8.5	9.2	9.6	8.7	8.6	9.3	9.0	9.2	9.2	10.4	9.6	9.5	8.4
	37+	90.4	91.0	91.0	90.1	89.6	90.7	90.6	90.1	90.5	89.9	90.0	89.2	89.7	89.6	90.7

Note: 1. Counts shown in trends table may differ slightly to those in previous reports due to the ongoing data validation process.

Appendix C. Northern Territory Estimated Resident Population

Table 73. Northern Territory Estimated Resident Population, by Aboriginal status, age group, and sex, 2021

Age	Male			Female			Person
(years)	Aboriginal	Non-Aboriginal	Total	Aboriginal	Non-Aboriginal	Total	Total
0 - 4	3495	5679	9174	3256	5174	8430	17604
5 - 9	3982	5235	9217	3944	4904	8848	18065
10 - 14	4162	4685	8847	3908	4285	8193	17040
15 - 19	3094	4759	7853	3002	4290	7292	15145
20 - 24	2766	6341	9107	2334	5704	8038	17145
25 - 29	3010	8186	11196	3030	8438	11468	22664
30 - 34	3006	8653	11659	3235	8720	11955	23614
35 - 39	2811	7466	10277	2911	7511	10422	20699
40 - 44	2283	6325	8608	2549	6191	8740	17348
45 - 49	3284	4873	8157	3094	4751	7845	16002
50 - 54	1928	5993	7921	2247	5552	7799	15720
55 - 59	1485	5622	7107	1703	5035	6738	13845
60 - 64	1070	4853	5923	1405	4372	5777	11700
65 - 69	722	3820	4542	910	3293	4203	8745
70 - 74	360	2959	3319	579	2396	2975	6294
75 -79	187	1620	1807	247	1347	1594	3401
80-84	78	857	935	164	826	990	1925
85+	62	455	517	106	572	678	1195
Total	**37785**	**88381**	**126166**	**38624**	**83361**	**121985**	**248151**

Morris, L. (2022). Health District Population 1971_2021. http://internal.health.nt.gov.au/services/healthstatistics/statistics-analysis/Pages/default.aspx#demography.

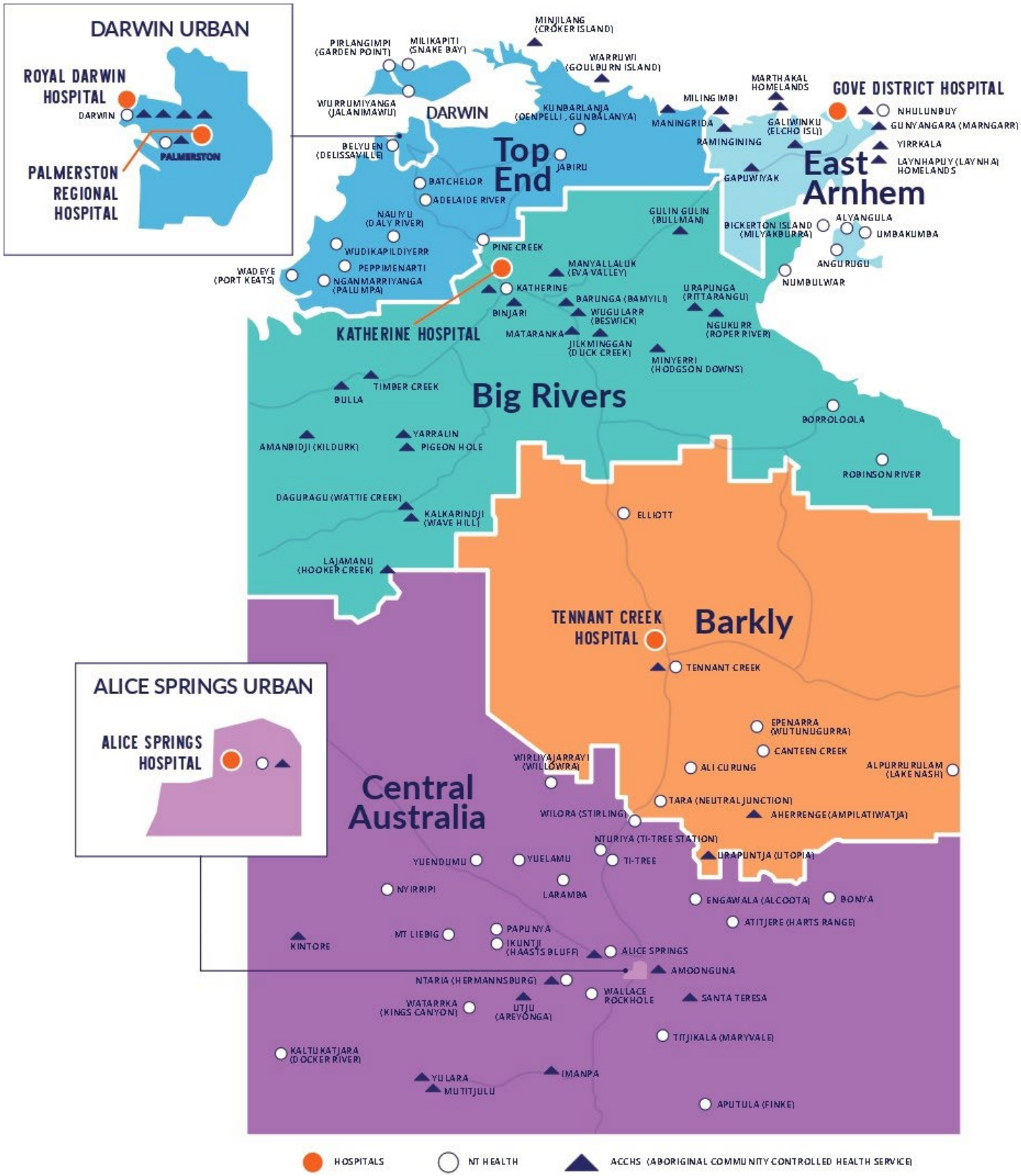
Table 74. Northern Territory Estimated Female Resident Population aged between 15-49 years, by Aboriginal status and age group, 2021

Age (years)	Aboriginal	Non-Aboriginal	Total
15 - 19	3002	4290	7292
20 - 24	2334	5704	8038
25 - 29	3030	8438	11468
30 - 34	3235	8720	11955
35 - 39	2911	7511	10422
40 - 44	2549	6191	8740
45 - 49	3094	4751	7845
Total	**20155**	**45605**	**65760**

Morris, L. (2022). Health District Population 1971_2021. http://internal.health.nt.gov.au/services/healthstatistics/statistics-analysis/Pages/default.aspx#demography.

Appendix D. Map of Northern Territory Regions

Source: NT Health 2021



4. Glossary

This section provides definitions for a selection of key perinatal terms.

Term	Definition
Age-specific fertility rate	The number of births per individual within a specific age interval during a specified time.
Antenatal	The period covering conception up to the time of birth.
Apgar score	Numerical score used to indicate the baby's condition at one minute and five minutes after birth. A score of 0, 1 or 2 is given for each of five characteristics: heart rate, breathing, colour, muscle tone and reflex irritability, and the total score is between 0 and 10.
Augmentation of labour	Intervention after the onset of spontaneous labour to assist the progress of labour.
Birth status	Status of the baby immediately after birth.
Birthweight	The first weight of a baby (stillborn or live-born) obtained after birth, measured to the nearest 5 grams and usually obtained within one hour of birth. Birthweight can be classified at the following levels Normal birthweight: between 2,500 and 4,499 grams. Low birthweight: less than 2,500 grams. High birthweight: 4,500 grams or more. Low weight births can be classified at the following levels: Very low birthweight: less than 1500 grams Extremely low birthweight: less than 1000 grams.
Born before arrival	The term used to describe deliveries which occurred before arrival to the health service or before the arrival of the midwife for planned homebirths.
Breech presentation	A fetal presentation in which the buttocks are at the opening of the womb.
Caesarean section	Operative birth by surgical incision through the abdominal wall and uterus. It is often divided into two sub-categories: Elective caesarean section: a caesarean section carried out as a planned procedure before the onset of labour or following the onset of spontaneous labour, when the decision was made before labour. It does not include caesarean section after failed trial of scar. Emergency caesarean section: a caesarean section required because of an emergency situation (e.g. obstructed labour, fetal distress/compromise). It is best described as 'when the caesarean section is performed having not been considered necessary previously'.
Epidural/Caudal	Analgesia or anaesthesia produced by injection of a local anaesthetic into the epidural space of the spinal cord or caudal canal.
Episiotomy:	An incision of the perineum and vagina to enlarge the vulval orifice.
Fetal death (stillbirth)	A child of at least 20 weeks gestation or with a birthweight of at least 400 grams at birth that exhibits no sign of respiration or heartbeat, or other sign of life, at birth.
Fetal death rate	The number of fetal deaths in a year per 1000 total births in that same year.
Forceps birth	Assisted vaginal birth using a metallic obstetric instrument.
First-time mother	Also called primiparous mother, refers to a woman who is giving birth for the first time.
Gestational age	The duration of a pregnancy in completed week, calculated from the date of the first day of a woman's last menstrual period to her baby's date of birth. Each birth can be categorised, according to fetal gestational age, into: Pre-term baby: A baby born before 37 completed weeks of gestation;

	Term baby: A baby born from 37 completed weeks up to 41 completed weeks of gestation; or Post-term baby: A baby born after 41 completed weeks of gestation.
Induction of labour	Intervention to stimulate the onset of labour.
Instrumental birth	Includes vaginal birth by forceps or ventouse (vacuum extraction).
Labour	The process by which the products of conception are expelled from the uterus via the birth canal.
Live birth	The complete expulsion or extraction from its mother of a baby, irrespective of duration of pregnancy, which after separation shows signs of life.
Malpresentation	When baby is not facing head-first down the birth canal as birth approaches.
Maternal age	Mother's age in completed years at the birth of her baby.
Mother's length of postnatal hospital stay	The number of days between the baby's date of birth and the separation date of the mother (from the hospital where the birth occurred). The interval is calculated by subtracting the date of the baby's birth from the date of separation.
Neonatal death	Death of a live-born baby within 28 days of birth.
Neonatal death rate	The neonatal deaths in a year per 1000 live births in that same year.
Normal vaginal birth	Birth without intervention in which the baby's head is the presenting part.
Parity	Number of previous pregnancies resulting in live births or stillbirths, excluding the current pregnancy.
Perinatal death	A fetal or neonatal death.
Perinatal death rate	The sum of fetal deaths (stillbirths) and neonatal deaths in a year per 1000 total births in that same year.
Perineal laceration (laceration)	A graze, laceration, rupture, or laceration of the perineal skin during delivery. Perineal lacerations can be classified as either 1st degree: considered to be slight or that involves fourchette, labia, vagina; 2nd degree: also involving pelvic floor, perineal muscles, or vaginal muscles; 3rd degree: also involving anal floor, rectovaginal septum, or sphincter; or 4th degree: also involving anal mucosa or rectal mucosa.
Perineal status	Status of the perineum after the birth. It may involve surgical suturing of perineal laceration (laceration) or episiotomy incision.
Plurality	The number of babies resulting from a pregnancy. According to plurality a pregnancy can be defined as either Singleton birth: only one baby born Multiple birth: more than one baby is born.
Presentation at birth	Presenting body part of the foetus/baby at birth.
Pudendal	Local anaesthetic to block the pudendal nerves.
Resuscitation of baby	Active measures taken shortly after birth to assist the baby's ventilation and heartbeat, or to treat depressed respiratory effort and to correct metabolic disturbances.
Spontaneous onset of labour	Onset of labour without intervention.
Stillbirth	A child of at least 20 weeks gestation or with a birthweight of at least 400 grams at birth that exhibits no sign of respiration or heartbeat, or other sign of life, at birth (fetal death)
Stillbirth rate	The number of stillbirths in a year per 1000 total births in that same year.
Teenage mother	Mother aged less than 20 years at the birth of her baby.
Total fertility rate	A hypothetical measure of the number of live births a woman would have if, throughout her reproductive years, she had children at the age-specific rates that were observed in any one year. The TFR is calculated by adding up all the age-specific fertility rates (ASFR), multiplying this sum by five (the width

	of the age-group interval), and then dividing by 1000. $TFR = 5 \times \sum(ASFR) = 5 \times \left(\frac{number\ of\ births\ to\ women\ aged\ 15-19}{number\ of\ women\ aged\ 15-19} + \cdots + \frac{number\ of\ births\ to\ women\ aged\ 45-49}{number\ of\ women\ aged\ 45-49}\right)$
Ventouse (Vacuum extraction) birth	Assisted birth using a suction cap applied to the baby's head.

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Chapter Three – Perspectives on the Northern Territory's Traffic Light Recall Reporting surveillance system for chronic disease management in remote primary health care services.

Evaluation of a Public Health Surveillance System

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Prologue

Rationale

This chapter aims to fulfil the MAE requirement to evaluate a public health surveillance system. I evaluated a chronic disease surveillance system, commonly referred to as the Traffic Light Recall Reporting surveillance system. The Northern Territory (NT) Health's Traffic Light Recall Reporting (TLRR) system comprises a suite of reports designed to guide and monitor primary health care (PHC) clinicians in providing chronic disease care and management across remote NT Health communities. As this system had never previously been evaluated, I was requested by the Health Statistics and Informatics unit to evaluate the system to ensure it is meeting its objectives and to identify potential strengthening strategies.

My role

I was the lead evaluator of this project. I designed and developed the research protocol which clarified the evaluation aims and objectives, I reviewed relevant literature and established the evaluation method. I presented the project proposal to the Executive Directors for Remote and Primary Health Care (PHC) services for Top End and Central Australia. These consultations were essential for securing support and gaining valuable guidance on how to conduct the survey respectfully within the realities of a low-resource setting.

I created and tested the survey tool and then collaborated with NT Health's Media and Communications team to promote the survey. I analysed survey data using descriptive statistics in STATA and conducted follow-up interviews with consenting participants.

From this analysis, I generated key findings and organised them by surveillance attribute and recurring themes relevant to the remote PHC context. I developed recommendations that included actionable suggestions and identified responsible stakeholders for each recommendation to build transparency and accountability. A lay summary of findings (Appendix G) was disseminated to stakeholders for feedback and further engagement and was also presented at the fortnightly Health Statistics and Informatics seminar series.

Lessons learned

One of the key lessons learnt during this project was the importance of clearly defining the evaluation objectives as they guided the structure of the survey and interviews, and helped ensure the analysis remained focused addressing the right questions.

Engaging stakeholders early was also invaluable, not only for gaining approval, but for receiving practical advice that shaped the study design. I developed skills in creating clear and focused presentations to support these engagements.

The United States of American Centers for Disease Control and Prevention **(**US CDC) surveillance system attributes[1] provided a strong framework for developing survey questions and analysing responses. However, I learned that some of the survey questions could have been constructed more accurately to elicit clear, succinct responses. This highlighted the need for thoughtful and well-designed piloted survey and interview tools. Similarly, this evaluation taught me the importance and intricate process of selecting clear, actionable recommendations from the evaluation findings that are relative to NT Health's organisational structure and relevant stakeholders.

On a technical side, I increased my proficiency in using the Research Electronic Data Capture (REDCap) for the survey creation, and STATA for data analysis. I learned how to clean and code datasets, handle missing data, analyse demographic characteristics of survey participants and generate visual outputs of data. This process strengthened my confidence in handling data, an area that I was previously unfamiliar with.

Conducting interviews helped refine my ability to write focused questions and maintain rapport while keeping the conversation aligned to the project's goals. This reinforced my interest in mixed-methods research. Overall, this project helped me consolidate my public health and epidemiology skills.

Public health impact

A key public impact of this evaluation is the development of a new strategic framework to guide the systematic integration of the TLRR surveillance system into NT Health's organisational structure for remote PHC services. By formalising the delivery of the surveillance system and its reports, this framework aims to support improved monitoring and management of chronic disease across NT Health remote PHC centres. The framework is built on four pillars; governance and integration; stakeholder collaboration; training and development; and transitioning the reports to online dashboards. For each pillar, the evaluation defines the roles and responsibilities of relevant stakeholders to ensure transparency and accountability, supporting continual improvement in the quality of chronic disease care within NT Health's remote PHC services.

Acknowledgements

First and foremost, this project is dedicated to remote Aboriginal communities across the Northern Territory. To work and learn in such culturally rich settings is one of profound

privilege. I'd also like to acknowledge the clinicians and wider employees of NT Health involved in remote primary health care service delivery for their hard work and dedication to remote primary health care. A very special thank you and acknowledgement to my field and academic supervisors – this project in particular, has been a process of navigating and blending so much content, and I am so grateful for the support and perseverance from Alyson, Amy and Kirsty who continuously provided invaluable teachings, and profound lessons in surveillance evaluation. Also, to the team at Health Statistics and Informatics for providing support and such useful feedback during the survey piloting stage – I appreciate you taking the time in supporting a student amongst your busy and demanding workloads.

Abstract

The Traffic Light Recall Reporting (TLRR) surveillance system supports chronic disease management in the Northern Territory's (NT) remote primary health care (PHC) services through four main Traffic Light Recall (TLR) reports. This evaluation aimed to assess whether the system was meeting its overall objectives and identify opportunities for improvement.

We evaluated surveillance attributes including data quality, timeliness, simplicity, representativeness, stability, acceptability and usefulness. A mixed-methods approach was used, including an online survey and interviews. Of the survey participants, we identified participants for structured interviews through purposive sampling. We analysed findings using descriptive statistics and content analysis.

A total of 80 staff completed the survey, representing remote NT Health PHC workforce across the NT. Findings showed that the Recall, Full List and Community Summary reports are the most frequently used and valued by clinicians for managing workloads and prioritising chronic disease care. Whilst the Trend report was the least known and utilised TLR report. Sixty two percent (n=38/61) of participants reported the TLR reports easy to use and read even though 92% (n=57/62) had not received any formal training or support regarding how to use and apply the reports in their daily work. Participants highlighted the need for standardised training, improved communication, a secure model of report distribution and for the surveillance system to become more systematically integrated within NT Health's remote service delivery processes.

This evaluation highlights that the TLRR surveillance system is achieving its intended purpose in assisting data driven chronic disease management, however, its full potential is limited by a lack of integration within routine remote PHC practice. Strengthening collaboration amongst governance structures and key stakeholders, while developing standardised training and support for clinicians are opportunities for embedding the surveillance system more deeply into primary health care provision. These improvements would increase the impact of the TLRR surveillance system in chronic disease care across remote NT communities.

Background

Primary health care services

Primary health care (PHC) is grounded in the principle that everyone has the right to the highest attainable standard of health that is free from distinction of race, religion, and political belief, or socioeconomic status.[2] Strong PHC systems that adopt a whole-of-society approach are associated with more equitable, efficient and effective health outcomes.[3] From health prevention to disease identification, management and rehabilitation, PHC's underlying philosophy and strategy ensures that health care is delivered in a way that is centred on people's needs, with respect to their preferences.[4]

Accessibility and affordability are central to PHC, and are particularly relevant to rural and remote Australia where significant and unacceptable health disparities persist.[5] The disparity is evident in Australia being consistently ranked in the Organisation for Economic Co-operation and Development (OECD) top ten countries for average life expectancy whilst at the same time, it also has one of the highest levels of regional disparity in life expectancy.[5]

Northern Territory context

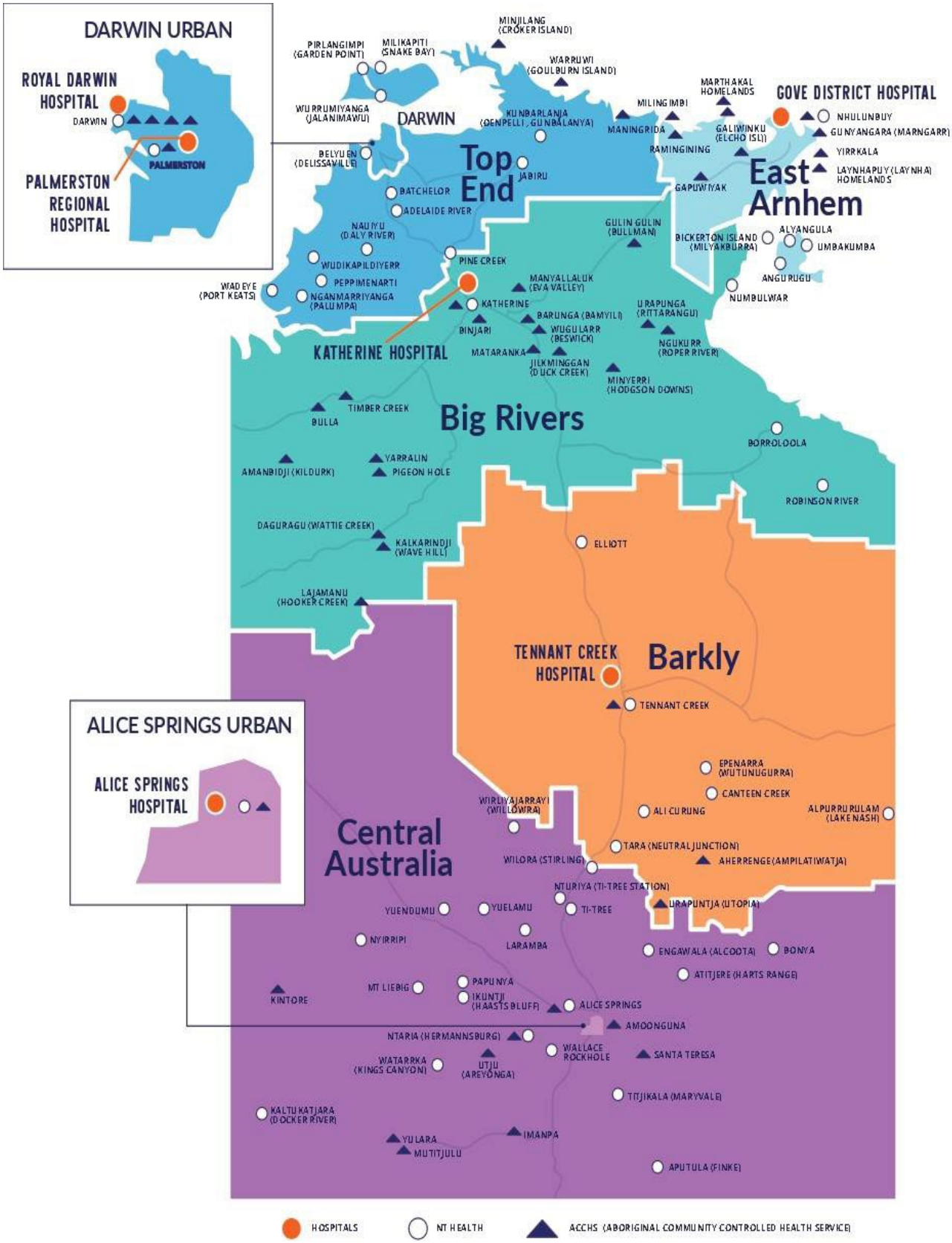
These disparities are most pronounced in the Northern Territory (NT), where a population of 233,000 is spread over 1.3 million square kilometres. Delivering equitable PHC services in this context remains an ongoing challenge, contributing to gaps in life expectancy, disease burden and health outcomes.[6] The NT is home to many remote communities of Aboriginal peoples, with 48.6% living very remote, 25.9% remote and 25.4% in outer regional locations.[7] Representing the oldest living continuous culture in human history, Aboriginal people place paramount importance on a harmonious balance between their individual connections with their body, mind and spirit, alongside their collective relationships to land, community and family.[8] Aboriginal Elders are central to the continuation of Aboriginal ways of being, knowing and doing.[9]

These principles are essential to understand in the delivery of culturally responsive and safe PHC, as is the understanding of previous and ongoing injustices Aboriginal people experience. Despite the strength, resilience, and continuity of one of the world's oldest living cultures, the ongoing impacts of colonisation, marginalisation, and dispossession continue to disadvantage Aboriginal people living in remote communities relative to other Australians. Unemployment, reduced access to appropriate health care services, limited education, food insecurity, substance abuse and inadequate housing and infrastructure, are recognised social determinants that impact the standard of health amongst remote Aboriginal people.[10]

These social determinants have and continue to contribute to the rise in chronic disease prevalence amongst remote communities, with ischaemic heart diseases, diabetes, chronic lower respiratory diseases, lung cancer and suicide reported as the top five leading causes of death of Aboriginal and Torres Strait Islander people.[11] Many of these diseases that are responsible for greater mortality and morbidity, would ordinarily be managed with involvement of specialists in urban Australian settings.[12] However, specialist outreach services are not always accessible and are more difficult to access for residents in remote areas. With view to the specific influence of remoteness, the management of chronic conditions needs a more planned and co-ordinated approach by routine primary health care staff to increase the benefits of visiting fly-in fly-out specialists and services.[13]

Remote PHC services across the NT (Figure 1) are typically characterised by geographical, professional and often social isolation for practitioners who are required to manage a full range of services across the lifespan with often limited resources.[14] With varied models of service delivery, PHC centres are often led by remote area nurses and Aboriginal health workers with extended clinical skills, with a General Practitioner (GP) service either through telehealth, onsite or via a regular outreach visiting service. A high degree of staff turnover, reliance on short-term agency staff, and vacancies in dedicated primary health care portfolios impact on the provision of PHC services.[14] These challenges are coupled with a high burden of acute care presentations, which can divert finite staff away from core primary health care activity. The result is reduced capacity and delivery of crucial primary health care prevention and management services. A 2023 report on primary health care key performance indicators in NT identified an average of 10.9 episodes of care per Aboriginal resident were provided in 2021, attesting to the significant workload provided by frontline primary health care staff.[15]

Figure 1. NT Health regions and service locations



Accessed: [Regional Health Service Home (nt.gov.au)]

Chronic disease management and Medicare funding

Despite the high need for PHC in remote communities, funding is not equivalent to the levels of PHC funding received by populations in non-remote communities. A 2022 study of the NT estimated that expenditure on GP services in very remote areas is only 57% of that in major cities.[16] While at the same time, residents from such remote areas in the NT are 50% more likely to be hospitalised than residents in non-remote areas.[16] A cornerstone of PHC funding in Australia is through Medicare, a fee-for-service funding model that reimburses GPs for services. With its aim to strengthen affordability and accessibility of PHC services, Medicare includes the Medicare Benefits Schedule (MBS) which allows people living with one or more chronic conditions to receive subsidised health services through a number of health care plans including a General Practitioner Management Plan (GPMP), Team Care Arrangement (TCA) and/or multidisciplinary case conference (MCC). In the context of funding for PHC in remote NT and the significant disease burden, it is important to investigate systems that may support and improve workflows and patient care.

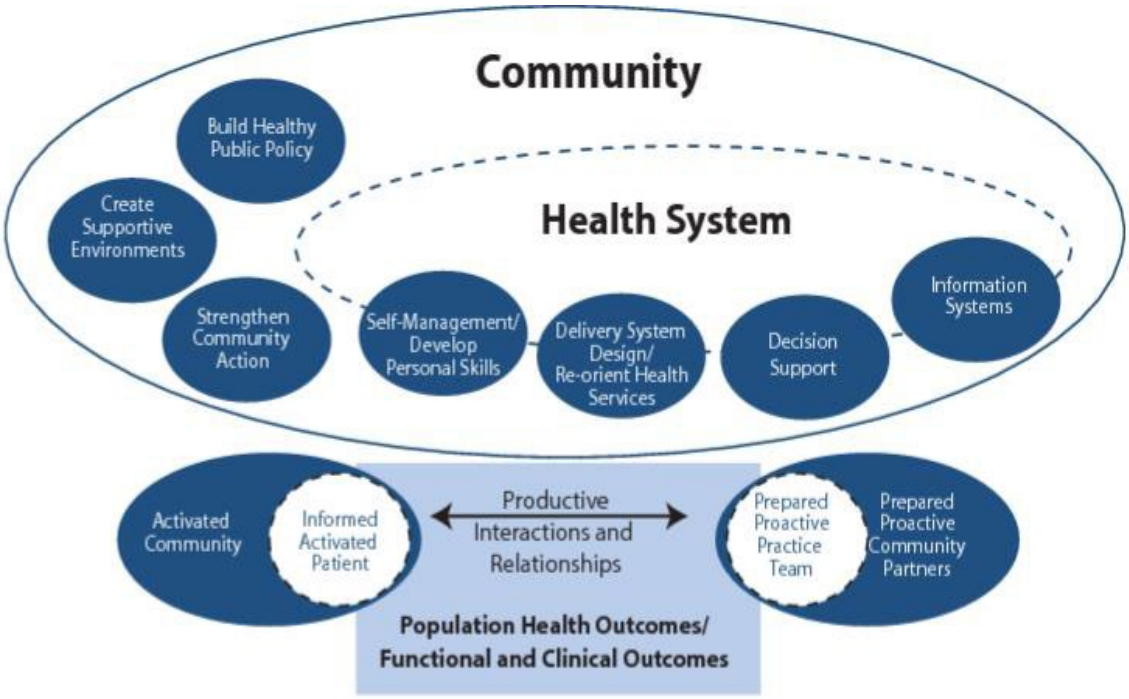
Key findings from the 2010-2021 NT Aboriginal Health Key Performance Indicators trend report demonstrated an increase in the proportion of current GP management plans for clients diagnosed with Type 2 diabetes (56.5% to 61.9%), and for clients diagnosed with coronary heart disease (56.4% to 61.5%).[15] The improvements in provision of services for those with chronic conditions are important, however programs that support preventive action have been identified as an ongoing gap.[17] To ensure a greater focus on chronic condition prevention and management is incorporated in PHC services, NT Health has introduced a suite of interventions aimed at continuous quality improvement in chronic conditions care.[17] These include the development of the Chronic Conditions Prevention and Management Strategy (CCPMS) 2010-2020[18], the introduction of the Primary Care Information System (PCIS) – an electronic health record that complies with the standard treatment manual for chronic conditions, and the implementation of structured care pathways (annual Care Plans) within PCIS.[17]

Public health surveillance of chronic disease

Following the CCPMs, the Chronic Condition Management Model (CCMM) was developed and implemented. Guided by the Ed Wagner's Chronic Care Model - a multifaceted framework aiming to deliver quality care to patients with a chronic disease (Figure 2), the CCMM devised the Traffic Light Recall Reporting surveillance system. The TLR reports provided by the surveillance system are public health surveillance tools for NT Health operated PHC and correctional services with the aim of providing timely reporting on clients and clinical data to support the prevention, early detection, and appropriate management of chronic conditions.

The reports are intended to inform chronic disease care and improve care with principles of safe, effective, patient-centred, efficient and equitable.

Figure 2. Ed Wagners Chronic Care Model.[19]



Accessed: The expanded Chronic Care Model: an integration of concepts and strategies from population health promotion and the Chronic Care Model - PubMed, January 2025.

Since the introduction of the Traffic Light Reports in 2012 there has been no formal evaluation of the surveillance system. The purpose of evaluating public health surveillance systems is to ensure that problems of public health importance are monitored effectively and efficiently,[20] while assessing the system's overall performance against core attributes including timeliness, sensitivity, specificity, data quality, acceptability, stability, and representativeness. Surveillance system evaluation(s) also aim to identify areas for improvement i.e. in design, resource allocation or operation, and ensures accountability and transparency within public health practice by promoting stakeholder engagement and accountability and fostering trust in the data being collected and reported. Similarly, it provides an opportunity to enhance preparedness, by identifying gaps in detection and response capacity, and support decision-making regarding continuing, modifying and/or discontinuing a surveillance system. Ultimately, public health surveillance systems ought to be evaluated periodically to ensure regular recommendations for improving the quality, usefulness and efficiency of the public health surveillance system.[20]

The following evaluation explores how this chronic disease public health surveillance operates across remote PHC centres in the NT. The evaluation is based on the perspective of clinicians and aims to ascertain how well the TLRR surveillance system operates to meet its main

purpose and objectives and provides recommendations to enhance the system contribution in remote PHC delivery.

Purpose of the evaluation

Aim

Evaluate the NT Health's surveillance system for chronic disease prevention and management implemented in remote NT Health primary health care services – the Traffic Light Recall Reporting (TLRR) surveillance system.

Surveillance evaluation objectives

The objectives of the evaluation were:

1. Describe the purpose of the TLRR surveillance system in public health surveillance and remote NT PHC management of chronic conditions.
2. Document the perspectives of key stakeholders engaged in the surveillance system based on a selection of surveillance system attributes to evaluate.
3. Identify continuous quality improvement opportunities to strengthen chronic disease surveillance in remote PHC centres by providing feedback to NT Health and relevant stakeholders.
4. Recommend improvements to enhance the surveillance system and that support remote PHC clinicians in using the reporting system to deliver chronic disease care and management across remote PHC centres.

Methodology

This project used a mixed methods approach in which qualitative and quantitative data were collected and analysed. Data was collected from a combination of data sources including open-ended and closed survey and interview questions amongst two main stakeholder groups, and a document review of each de-identified TLR reports.

Evaluation framework

This project was informed by the US Centers for Disease Control and Prevention (US CDC) framework and guidelines for Evaluating Public Health Surveillance Systems. Developed in 1988, these guidelines were devised to promote the best use of public health resources through the development of effective, and efficient public health surveillance systems.[20] The US CDC identified nine attributes of surveillance systems that can be assessed to gauge the overall performance of a surveillance system (Appendix F).[21] A selection of the surveillance

system attributes were identified as appropriate to assess and guide the evaluation of the TLR reporting surveillance system (Table 1).

Evaluated surveillance system attributes

The following table illustrates the method of assessment and collection that was required to evaluate the surveillance attributes.

Table 2. Surveillance System Attributes applied to the Traffic Light Recall Reporting Surveillance System.

Surveillance Attribute	Method of Assessment	Method of Collection
Data Quality	Clinician proficiency and training in using the reports and Primary Care Information System (PCIS). Clinicians allocated time for dedicated data entry and program work. Identified previous and/or current Continuous Quality Improvement (CQI) initiatives in PCIS support for clinicians.	Interview[1] Survey
Simplicity	Review methods of preparing and managing the data, including time required for this process. Assess clinician's perspective on ease of use and applying the reports during their clinical work. Identify opportunities for training staff re: using the reports.	Survey Interview[1] Review de-identified Traffic Light Recall Reports. Develop an operational flow diagram of the system.
Representativeness	Investigate barriers and facilitators in the accuracy of the patients' demographics and medical information. Review components within each of the reports that identify, classify and categorize chronic disease – are these sufficient and accurate?	Survey Interview[1] Review de-identified Traffic Light Recall Reports.
Stability	Identify who is responsible for the maintenance and consistency of the reports' distribution. Examine protocols in place during unexpected event occurrences i.e. system failures and its impact on data collection and report distribution. Review the mode of distribution of the reports is this vulnerable to delays, data security breach? Are the skills among the Department of Corporate and Digital Development (DCDD) unit transferrable or is this position/person dependent?	Interview[1]

Timeliness	Identify the suitability of the frequency the reports are emailed and updated. Examine the clinician's perspective on how the reports assist with workload timeliness and time management in chronic disease care. Investigate the flexibility and responsiveness of the system to clinician requests. Examine the systems process to produce the reports.	Survey Interview[1] Develop an operation flow diagram
Usefulness	What are the facilitators and barriers in the systems usefulness for clinicians?	Interview[1] Survey
Acceptability	Clinician awareness of each of the reports and perspective on how/whether each report supports their workload. Operational team perceptions on level of acceptability – is this informed and if so, how? Identify similarities and differences in how the reports are intended to be used with how they are used by clinicians. Review the availability of time relative to time required for reviewing and using the reports. Identify facilitators and barriers to the current format of the recall reports.	Interview[1] Survey

Note: Interview[1] involves structured interviews with both groups (survey participants and system managers).

Stakeholder Engagement

Stakeholder mapping identified two main stakeholder groups to engage in this evaluation. Group one included NT Health employed clinicians who are currently working across the 47 NT Health remote PHC centres. The second group included the surveillance system's main operational staff who have been involved in developing and managing the TLRR surveillance system and distributing the TLR reports.

The project was deliberately kept narrow to ensure timelines fitted within MAE deadlines, as such, the following more peripheral stakeholders were excluded from involvement in the evaluation:

- NT Government corrections facilities who receive the TLR reports.
- Community Controlled Aboriginal Health Services that do not use PCIS or the TLR reports.
- Remote primary health care clinicians employed by a non-government agency who are working within NT Health operated remote PHC centre.

Results of the evaluation, however, will be shared and available amongst broader stakeholder groups.

Sampling

The sampling method was primarily a convenience sampling approach. The survey was distributed to stakeholder group one via the report distribution email list. Additionally, we advertised the survey on the NT Health intranet site to clinicians, participation was voluntary. After completion of the survey, stakeholder group one participants were provided the opportunity to participate in a structured interview.

Participants from stakeholder group two were directly selected due to their involvement and experience in the TLRR surveillance system. Interviews conducted with this group occurred at the very beginning of the evaluation.

Data collection and sources

While the purpose of the TLRR surveillance system was briefly referenced in a 2021 Productivity Reform Case Study on *'Innovations in Care for Chronic Health Conditions,*[22] formal documentation describing the system was found to be limited. The evaluation, therefore draws on two key sources of literature including the Chronic Conditions Prevention Management Strategy[18] and the Chronic Conditions Management Model.[19] Additional insights were complemented by a review of the TLRR surveillance system's operational documents. This included reviewing each of the de-identified TLR reports, the surveillance system's data dictionary, pre-recorded TLR report education sessions and the online preventable chronic disease dashboards accessible on the NT Health intranet Health Statistics and Informatics webpage and Power BI reporting portal.

Data were collected from a combination of self-administered survey responses and stakeholder interviews. Structured interviews with the surveillance systems' operational staff were completed prior to the development of the survey. These interviews, in combination with a review of the system documentation, provided an understanding to the background, development, and rationale of the TLRR surveillance system. It also provided an overall outline of the purpose and intention of each of the TLR reports. Such interviews also provided an opportunity to ascertain the expectations, assumptions, and reflections of operational staff in view of the system's overall usefulness, timeliness, stability, data quality, acceptability and representativeness and also for each of the individual TLR reports.

A self-administered survey was delivered on the Research Electronic Data Capture (REDCap) database. Questions were based on the selected surveillance attributes (Table 1), review of system documentation and the preliminary interviews with operational staff. Demographic

characteristics collected included: Participants clinical position; NT Health region; employer and length of service working in remote PHC. The survey completion was estimated to take 5-10 minutes and included examples of each of the TLR's for participants to refer to if required. A participant information sheet was included as an attachment within the survey for participants to read with consent obtained through the participants' completion of the survey (Appendix A).

The survey was piloted and approved internally within the HSI branch prior to distribution via the clinician's NT Health email which aligned to the most recent updated email distribution list utilised by the surveillance system. It was also made accessible via the NT Health intranet home webpage. The survey was disseminated on the 6th of August 2024 with weekly reminders thereafter emailed including the link to the survey for a duration of five weeks. The survey was also mentioned during this time at the 2024 Continuous Quality Improvement Collaborative conference held in Darwin attended by remote PHC clinicians within the NT.

Survey participants were offered the opportunity for a follow up interview. Participant information sheets were created and provided to all interviewees to complete for confidentiality and informed consent purposes (Appendix B). Interview questions were devised based on key findings from the survey and provided an opportunity for respondents to share feedback and their reflections (Appendix C).

Data analysis and management

As this project was a mixed method study design, a combination of descriptive statistics and thematic analysis was applied during the analysis.

The quantitative data were analysed prior to the thematic analysis of the qualitative data. As such, findings from the interviews were used to expand understanding and informed the interpretation of the survey results.

Descriptive analysis was used to describe the survey participants, response rates and to present the main survey findings. Data were presented in numbers and proportions. The small sample number meant that a more complicated analysis was not appropriate.

Once imported into STATAv18 from REDCap, data were cleaned and labelled according to the survey question and the project's data dictionary terms (Appendix G). As each survey question aligned with a surveillance attribute, results were categorised by each attribute and cross-tabulated against a demographic characteristic. This included by NT Health region (i.e. Top End, Central Australia), length of service within remote PHC services and clinician type (i.e. Nurses, Aboriginal Health Workers and/or Practitioners, Medical Practitioners).

Thematic analysis was applied to the qualitative data which involved categorising interview responses and comments by the surveillance attribute being assessed and then were further grouped into categories specific to the components of the surveillance system being assessed.

Data from the two different interview groups was managed separately:

- Survey participants follow up interviews: Data were classified as either a facilitator or barrier within the following categories – Clinical purpose/application of the reports within the PHC context; training and support; open suggestions with each surveillance system attribute identified within these categories.
- Surveillance system staff interviews: Data were classified based on the selected surveillance attributes and categorised into the following – background and evolvement of the surveillance system; a description of the system and each of the TLR's purpose and operational processes involved; perceptions of how the system is received by clinicians; and a discussion regarding current and/or previous training in using the surveillance system and its' associated TLR's.

Partially complete survey responses remained in the dataset and were included in the participant total. Survey responses and questions that were partially answered and/or not answered at all, are recorded as "missing data". The count of missing data is not included in the denominator when calculating proportions.

Ethical and institutional approvals

This project received NT Primary Health Care and Remote Services directorate staff support. The project was also covered by the Australian National University (ANU) umbrella approval for MAE students via the *Variation – Human Ethics Protocol 2017/909, approved waiver of consent for use of data in research for Masters in Applied Epidemiology students for 'Surveillance in Public Health' projects:* 2017_909_Field variation approval letter_2022.pdf Full disclosure of this ethics waiver can be accessed here: Human Research Ethics Committee ANU.pdf.

Results

Description of the Traffic Light Recall Reporting surveillance system purpose

History of the development of Traffic Light Recall Reporting surveillance system

This evaluation identified that the Traffic Light Recall Reporting (TLRR) surveillance system was developed to improve information processes to enhance primary health care (PHC) services across remote NT Health PHC facilities. The TLRR surveillance system was initially devised in early to mid-2000 by a General Practitioner, Dr. Gary Sinclair, working in remote PHC in Central Australia. Recognising an opportunity to better utilise data from the Primary Clinical Information System (PCIS), Dr. Sinclair developed a system to extract and compile client data into a suite of Excel-based reports to support improvements in the management of chronic disease care in remote NT PHC centres.

During this time, NT Health released the Chronic Conditions Prevention Management Strategy (CCPMS) (2010 – 2020) in 2009 to provide a strategic framework for chronic disease care. The strategy included the Chronic Conditions Management Model (CCMM) which was introduced in 2012 to formalise and structure the TLRR surveillance system to facilitate data-driven approaches in routine clinical practice.[18] Over time, the system has developed the capability to produce multi-level reporting for chronic disease management ranging from clinical support at the client level, to broader operational reporting and analysis across NT Heath regions.

No formally defined objectives of the TLRR surveillance system were identified in the reviewed documentation. However, to capture the system's overall functions and purpose, the evaluation drew on recurrent themes from the literature review and interviews with surveillance system staff to identify a set of core objectives. These objectives reflect how the TLRR surveillance system supports chronic disease care and management across remote NT Health PHC centres.

Key objectives identified:

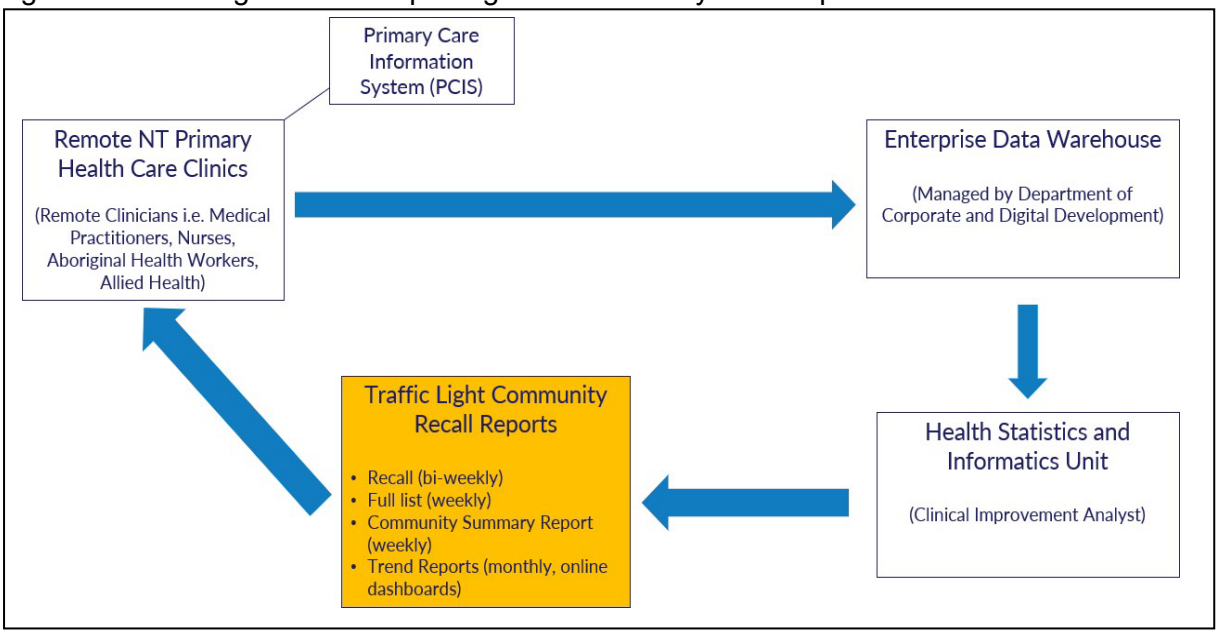
- Facilitate and support clinicians through actionable reporting to deliver timely and effective chronic disease prevention, early detection and management in remote NT Health PHC centres.
- Enable data-driven decision making to deliver multi-level reporting that informs care from individual patients to regional population health planning and optimise resource allocation across NT Health regions.

- Ensure patient-centred care is tailored to individual needs and facilitate equity by ensuring fair access to chronic disease care in remote, resource-limited PHC settings.
- Foster accountability through transparent monitoring of care outcomes to enhance patient safety through evidence-based clinical interventions.

Operational flow of the Traffic Light Recall Reporting surveillance system

In remote NT Health operated PHC centres, patient data is recorded in the electronic health record – Primary Care information System (PCIS), and uploaded on a nightly basis to a centralised data warehouse managed by the Department of Corporate and Digital Development (DCDD).[22] Data is then used to generate automated surveillance TLR reports, four of which are assessed in this evaluation. Three of the reports are routinely and automatically created and emailed to a list of remote PHC centre managers, and NT Health specific clinicians working in the PHC centres. The fourth report, the 'Trend' report, is updated monthly on the NT Health Power BI dashboard available to NT Health staff (and is similar to data in the 'Community Summary' report). Figure 3 outlines the system's operational processes involved for data collection, management, report production and distribution.

Figure 3. Traffic Light Recall Reporting Surveillance System's operational flowchart.



Source: *Evaluating the Traffic Light Recall Reporting Surveillance System project proposal, July 2024.*

Traffic Light Recall Reports

The four TLR reports illustrate the multi-levelled nature of the surveillance system. These reports vary from client-level reports to aggregated community-level data on chronic disease management. The 'Full List' and 'Recall' report are client-specific tools designed to assist frontline clinicians in delivering individualised care. The 'Trend' and 'Community Summary' report present similar data at the regional and community levels and provide a broader view of service delivery and performance on chronic disease indicators. As shown in Table 3, the

reports main audience differs depending on the purpose and level of data within each of the TLR's.

Table 3. Summary of the Traffic Light Recall Reports, NT Health 2025.

Report Name	Data and reporting level	Purpose	Target users
Trend Report	Aggregate (Regional/Community level)	Reports on chronic disease trends overtime and tracks changes in service delivery across the NT Health regions and communities.	Regional managers, policy makers, remote PHC centre managers.
Community Summary Report	Aggregate (Community level)	Snapshot of the current service delivery performance and key health indicators for chronic disease management for each community.	Remote PHC centre clinical managers.
Full List Report	Client-level	Identifies all clients with chronic conditions and reports on specific health screening outcomes.	Clinicians at remote PHC centres.
Recall Report	Client-level	Highlights clients due or overdue for care.	Clinicians at remote PHC centres.

Trend Report / Online Dashboard

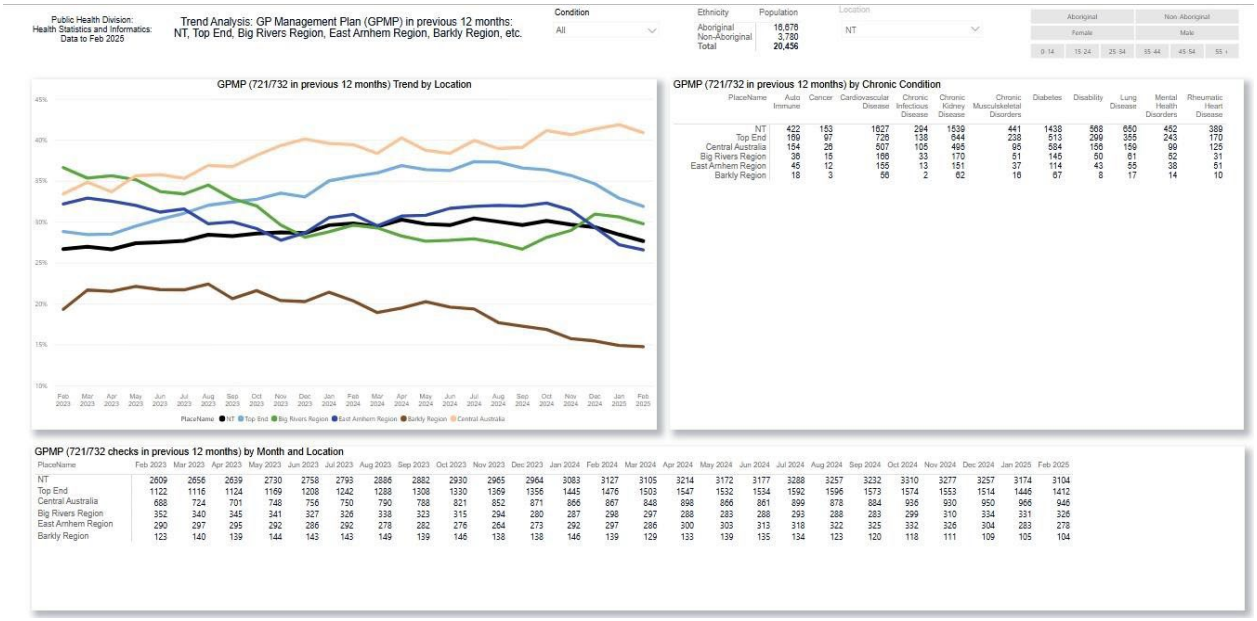
The 'Trend' report provides an overview of population level data for all NT Health clinics and is available through online dashboards. The indicators included in the report are chronic disease trends, screening outcomes including Adult Health Checks, STI testing, behavioural risk factors, Diabetes Management, CVD risk and GP Management Plans (Figure 4 and 5). The dashboards can be filtered by age group; sex; region and in some cases by health centre. Reporting by PHC centres enables comparison and benchmarking of performance across remote NT PHC centres. Similarly, the dashboards support Continuous Quality Improvement (CQI) staff and PHC centre managers to examine their clinic's performance and how the community and/or region they work in compares with other clinics. The rationale for data informed care at this level was described by one of the surveillance system's operative staff:

> *"Across the NT, we wanted to stimulate healthy competition but more importantly, stimulate healthy learning. Data is not ever about punishing or having a stick. Data should always be about the culture of learning for improvement and generating better outcomes." – Surveillance system staff.*

Figure 4. Trend Analysis: Chronic Conditions by NT Health Region

Data Source: *NT Health Power BI Reporting Portal; Chronic Conditions. NT Health Traffic Light Recall Reporting Surveillance system, accessed June 2024.*

Figure 5. Trend Analysis: GP Management Plan in previous 12 months by NT Health Region



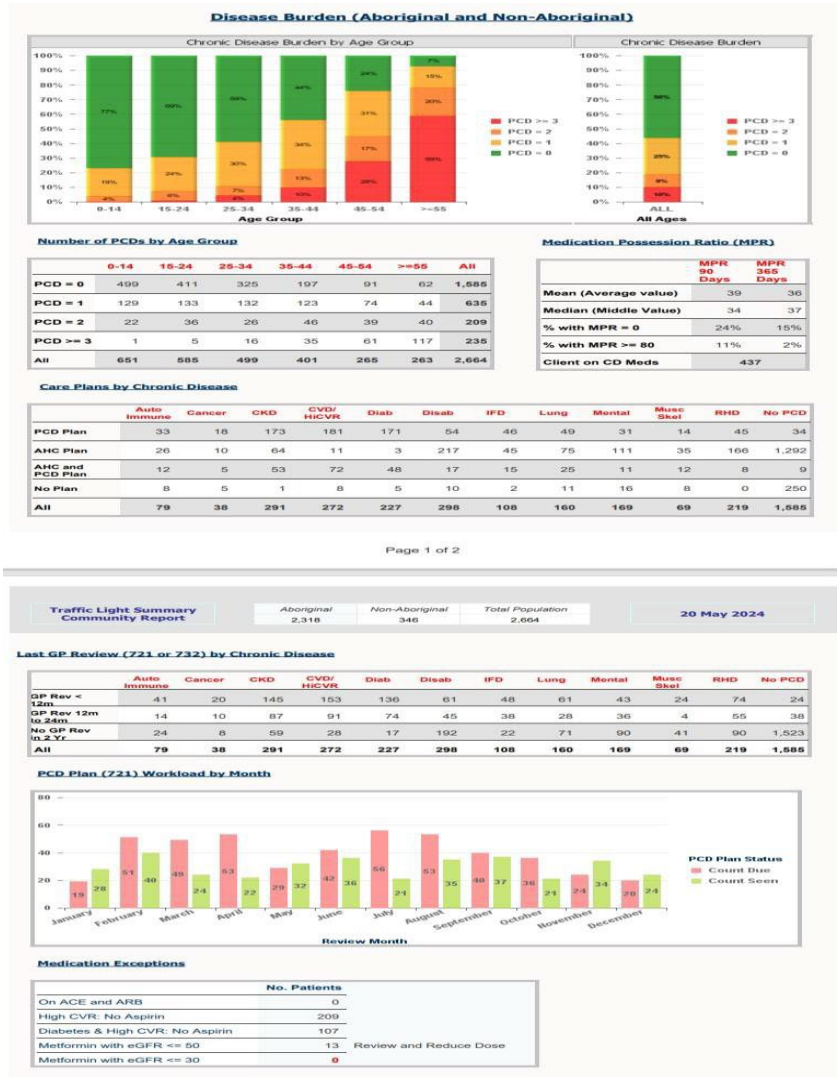
Data Source: *NT Health Power BI Reporting Portal; GP Management Plan for Chronic Disease management. NT Health Traffic Light Recall Reporting Surveillance system, accessed June 2024.*

Community Summary Report

The 'Community Summary' report is a detailed community level report provided via email to the relevant remote PHC centres. Distributed as a PDF document, this report provides a weekly summary of aggregated data regarding chronic disease burden by age group, care-

plans and medication possession ratio for the specified community. It allows PHC centres to review their workload by month as it reports the number of due and completed Preventable Chronic Disease (PCD) Care Plans. Contextual to individual communities, this report assists remote PHC clinical teams with determining targeted interventions and resource allocation for chronic disease care and management (Figure 6).

Figure 6. Community Summary Traffic Light Recall Report



Data Source: *Community Summary Traffic Light Report. Traffic Light Recall Reporting Surveillance System, accessed June 2024.*

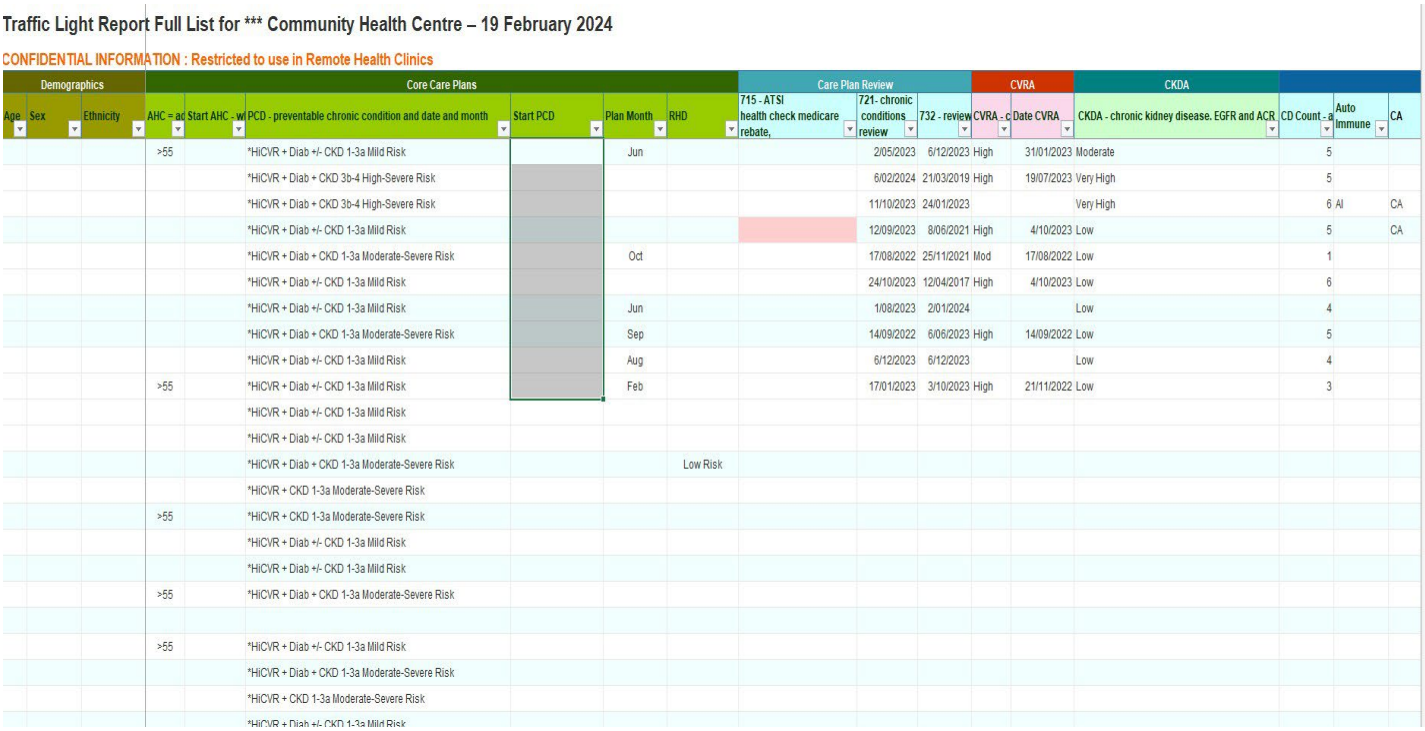
Full List Report

The ‘Full List’ report provides individual client-level data on chronic condition diagnoses, disease status, care plans, pathology results and other specific conditions identified during patient consultation and examination (Figure 7). This report is a tool for clinicians working directly with patients as it allows clinicians to develop a task list by filtering the report by the required service item. This core function of the report aims to improve time management by

assisting clinicians to prioritise and schedule their workload. Examples of how this report intends to be applied clinically are described by the following interviewee:

> *"The Full List report allows clinicians to develop a task list in very few mouse clicks that can help them direct their time in community…this is a very powerful tool you know, for example, if I have an optometrist coming to …… and they're coming to see all the diabetics, I can filter that list in less than 10 seconds to develop a list of patients who need an optometry review." – Surveillance system staff.*

Figure 7. De-identified Full List Traffic Light Recall Report



Traffic Light Report Full List for * Community Health Centre – 19 February 2024**

CONFIDENTIAL INFORMATION : Restricted to use in Remote Health Clinics

Demographics			Core Care Plans						Care Plan Review			CVRA		CKDA			
Age	Sex	Ethnicity	AHC = ac	Start AHC - w	PCD - preventable chronic condition and date and month	Start PCD	Plan Month	RHD	715 - ATSI health check medicare rebate,	721- chronic conditions review	732 - review	CVRA - c	Date CVRA	CKDA - chronic kidney disease. EGFR and ACR	CD Count - a	Auto Immune	CA
			>55		*HiCVR + Diab +/- CKD 1-3a Mild Risk		Jun			2/05/2023	6/12/2023	High	31/01/2023	Moderate	5		
					*HiCVR + Diab + CKD 3b-4 High-Severe Risk					6/02/2024	21/03/2019	High	19/07/2023	Very High	5		
					*HiCVR + Diab + CKD 3b-4 High-Severe Risk					11/10/2023	24/01/2023			Very High	6	AI	CA
					*HiCVR + Diab +/- CKD 1-3a Mild Risk					12/09/2023	8/06/2021	High	4/10/2023	Low	5		CA
					*HiCVR + Diab + CKD 1-3a Moderate-Severe Risk		Oct			17/08/2022	25/11/2021	Mod	17/08/2022	Low	1		
					*HiCVR + Diab +/- CKD 1-3a Mild Risk					24/10/2023	12/04/2017	High	4/10/2023	Low	6		
					*HiCVR + Diab +/- CKD 1-3a Mild Risk		Jun			1/08/2023	2/01/2024			Low	4		
					*HiCVR + Diab + CKD 1-3a Moderate-Severe Risk		Sep			14/09/2022	6/06/2023	High	14/09/2022	Low	5		
					*HiCVR + Diab +/- CKD 1-3a Mild Risk		Aug			6/12/2023	6/12/2023			Low	4		
			>55		*HiCVR + Diab +/- CKD 1-3a Mild Risk		Feb			17/01/2023	3/10/2023	High	21/11/2022	Low	3		
					*HiCVR + Diab +/- CKD 1-3a Mild Risk												
					*HiCVR + Diab +/- CKD 1-3a Mild Risk												
					*HiCVR + Diab + CKD 1-3a Moderate-Severe Risk			Low Risk									
					*HiCVR + CKD 1-3a Moderate-Severe Risk												
			>55		*HiCVR + CKD 1-3a Moderate-Severe Risk												
					*HiCVR + Diab +/- CKD 1-3a Mild Risk												
					*HiCVR + Diab +/- CKD 1-3a Mild Risk												
			>55		*HiCVR + Diab + CKD 1-3a Moderate-Severe Risk												
			>55		*HiCVR + Diab +/- CKD 1-3a Mild Risk												
					*HiCVR + Diab + CKD 1-3a Moderate-Severe Risk												
					*HiCVR + CKD 1-3a Moderate-Severe Risk												
					*HiCVR + Diab +/- CKD 1-3a Mild Risk												

Data source: *Traffic Light Full List Report. NT Health Traffic Light Recall Reporting Surveillance system, accessed June 2024.*

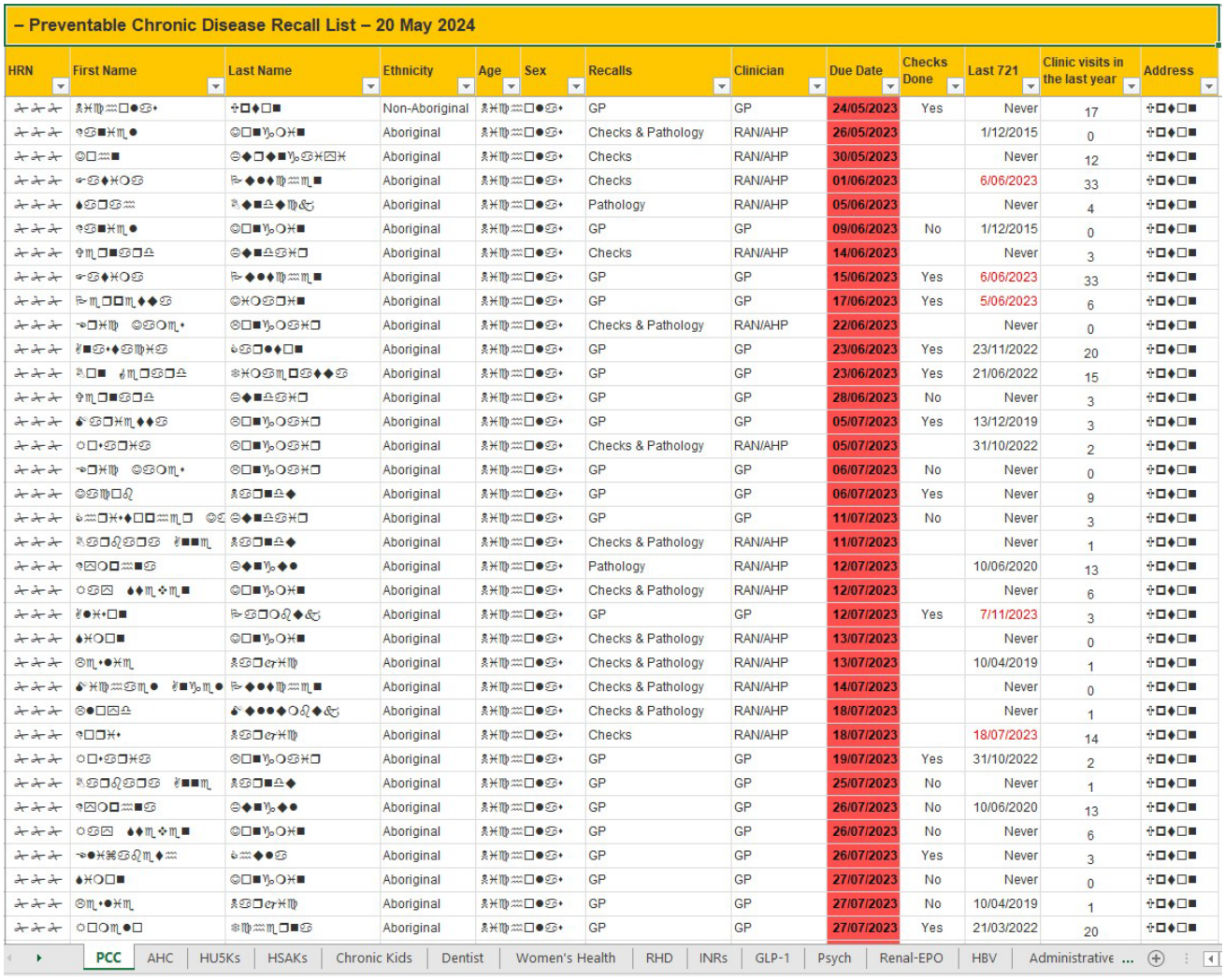
Recall Report List

The 'Recall' report is a refined version of the 'Full List' report and is tailored to meet the daily needs of clinicians. Data is categorised into program areas for tasks or 'recall' lists that outline due and/or overdue care (Figure 8).

By organising the data aligned to the PHC centres' service delivery model, the 'Recall' report supports clinicians within a program area (i.e. Child Health, Women's Health, Rheumatic Heart Disease, Chronic Disease) to review and prioritise the client that requires follow up care. The bi-weekly distribution is intended to support clinicians/centres to reflect on the progress during the week, and capture items that may be critical for weekend clinicians to follow-up i.e. specific

dates required for Rheumatic Heart Disease prophylaxis. This report is the most detailed list and are emailed to each PHC centre on a bi-weekly basis.

Figure 8. De-identified Traffic Light Recall Report



– Preventable Chronic Disease Recall List – 20 May 2024

HRN	First Name	Last Name	Ethnicity	Age	Sex	Recalls	Clinician	Due Date	Checks Done	Last 721	Clinic visits in the last year	Address
[illegible]	[illegible]	[illegible]	Non-Aboriginal	[illegible]	[illegible]	GP	GP	24/05/2023	Yes	Never	17	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks & Pathology	RAN/AHP	26/05/2023		1/12/2015	0	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks	RAN/AHP	30/05/2023		Never	12	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks	RAN/AHP	01/06/2023		6/06/2023	33	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Pathology	RAN/AHP	05/06/2023		Never	4	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	09/06/2023	No	1/12/2015	0	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks	RAN/AHP	14/06/2023		Never	3	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	15/06/2023	Yes	6/06/2023	33	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	17/06/2023	Yes	5/06/2023	6	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks & Pathology	RAN/AHP	22/06/2023		Never	0	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	23/06/2023	Yes	23/11/2022	20	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	23/06/2023	Yes	21/06/2022	15	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	28/06/2023	No	Never	3	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	05/07/2023	Yes	13/12/2019	3	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks & Pathology	RAN/AHP	05/07/2023		31/10/2022	2	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	06/07/2023	No	Never	0	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	06/07/2023	Yes	Never	9	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	11/07/2023	No	Never	3	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks & Pathology	RAN/AHP	11/07/2023		Never	1	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Pathology	RAN/AHP	12/07/2023		10/06/2020	13	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks & Pathology	RAN/AHP	12/07/2023		Never	6	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	12/07/2023	Yes	7/11/2023	3	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks & Pathology	RAN/AHP	13/07/2023		Never	0	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks & Pathology	RAN/AHP	13/07/2023		10/04/2019	1	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks & Pathology	RAN/AHP	14/07/2023		Never	0	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks & Pathology	RAN/AHP	18/07/2023		Never	1	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	Checks	RAN/AHP	18/07/2023		18/07/2023	14	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	19/07/2023	Yes	31/10/2022	2	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	25/07/2023	No	Never	1	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	26/07/2023	No	10/06/2020	13	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	26/07/2023	No	Never	6	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	26/07/2023	Yes	Never	3	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	27/07/2023	No	Never	0	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	27/07/2023	No	10/04/2019	1	[illegible]
[illegible]	[illegible]	[illegible]	Aboriginal	[illegible]	[illegible]	GP	GP	27/07/2023	Yes	21/03/2022	20	[illegible]

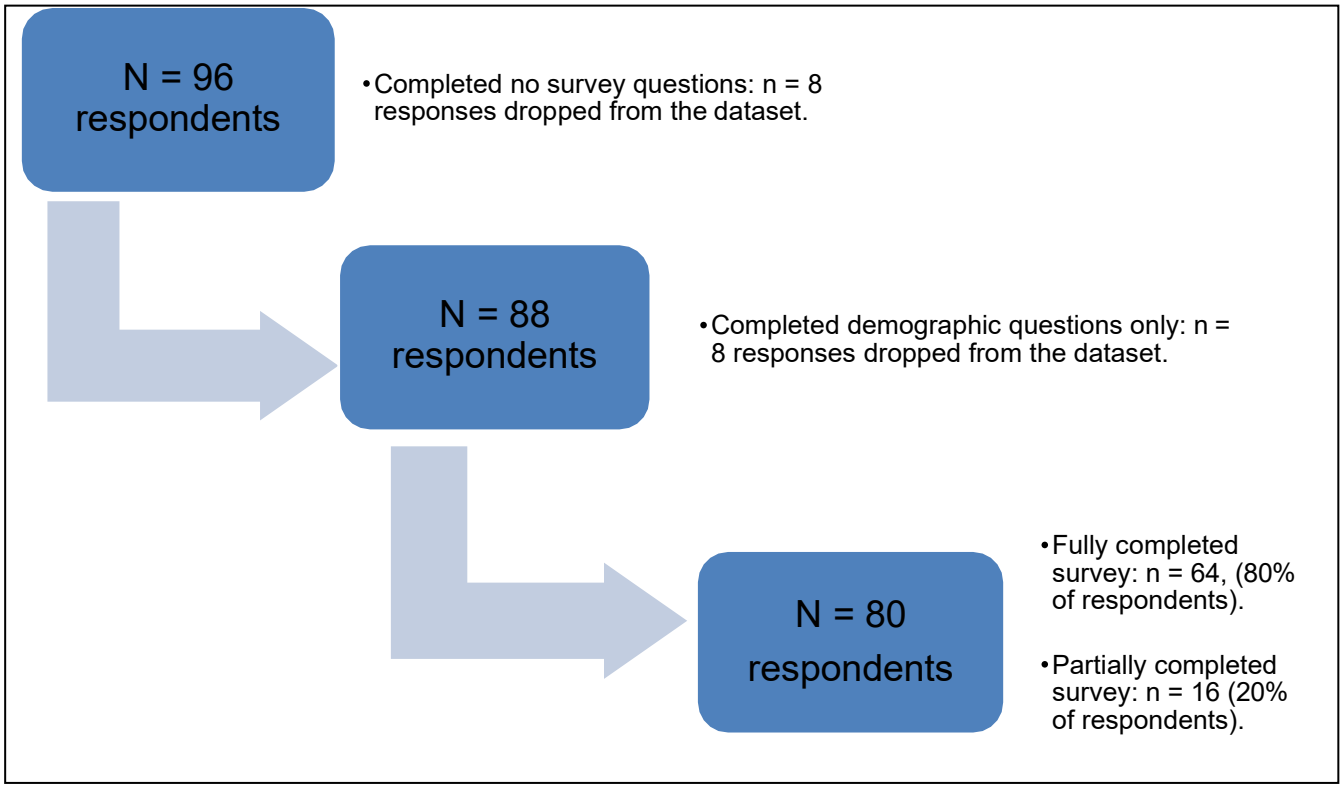
PCC | AHC | HU5Ks | HSAKs | Chronic Kids | Dentist | Women's Health | RHD | INRs | GLP-1 | Psych | Renal-EPO | HBV | Administrative ...

Data source: *Traffic Light Recall Report. NT Health Traffic Light Recall Reporting Surveillance system, accessed June 2024.*

Survey responses

The survey received a total of 96 responses from 441 clinicians that were emailed an invitation to participate in the study with an attached hyperlink to the survey. Of the 96 survey participants, 8 were completely incomplete and another 8 only included completed demographic questions, these 16 surveys were deleted from the analysed dataset. This meant a remaining 80 survey participants were included in the analysis which included a combination of completed surveys and partially completed. In total the survey had a response rate of 18% (n=80/441) (Figure 9).

Figure 9. Number of survey respondents and the removal of incomplete surveys '*Evaluating the TLR reporting surveillance system'* survey.



Of the 80 responses received, including complete and partially complete surveys, 16 participants agreed to a follow up interview with a total of 5 interviews completed via TEAMS. Nurses and Medical Officers represented the highest proportion of survey participants 59% (n=47) and 25% (n=20), respectively. Seventy-five percent (n=60) of participants had worked 6 years or more in remote PHC, while 24% (n=19) of participants worked 5 years or less in remote PHC. Across the NT, the greatest proportion of participants were from clinics in the Top End region 71% (n=57) compared to Central Australia 19% (n=15) (Table 4).

Table 4. Demographic characteristics of survey participants.

Demographic Characteristics	***N (N=80)***	***%***
Clinician Position		
Nurse[1]	47	59
Aboriginal Health Worker &/or Practitioner	8	10
Medical Officer	20	25
Allied Health	5	6
Region		
Top End[2]	57	71
Central Australia	15	19
Missing Data	8	10
Length of service working in remote PHC centre		
5 years or less	19	24
6 years or more	60	75
Missing data	1	1

Note: [1]Nurse inclusive of (Clinical Nurse Managers, Midwives, Nurse Outreach Specialists and Remote Area Nurses). [2]Top End (inclusive of Big Rivers and East Arnhem region).
Source: *Evaluating the Traffic Light Recall Reporting Surveillance System Survey, NT Health 2024*.

Results by surveillance attribute

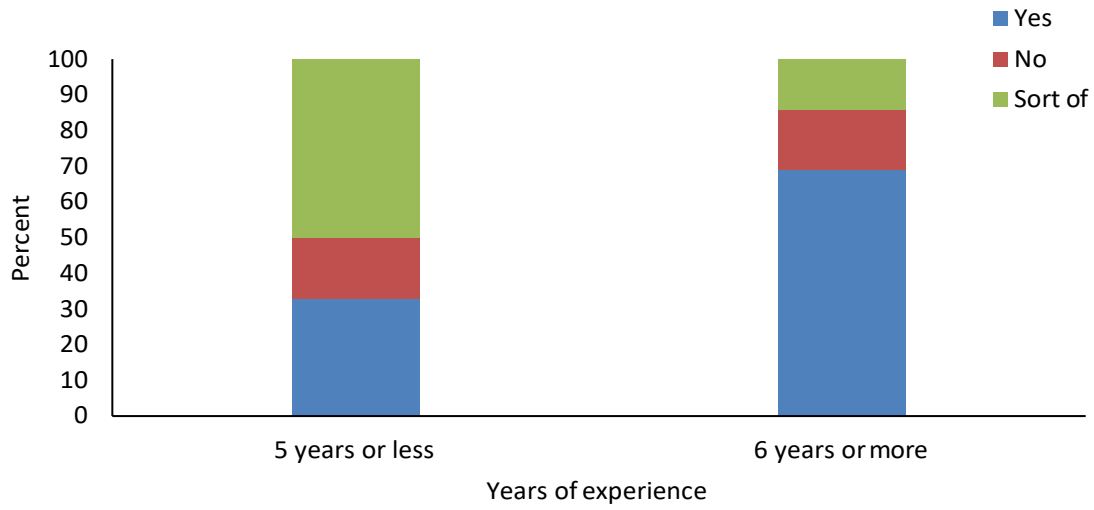
This section illustrates findings from the survey participants and follow up interviews, based on the evaluation surveillance system attribute (Table 1). It aims to highlight a combination of facilitators and barriers to using the TLRR surveillance system that were identified by PHC clinicians and surveillance system staff.

Simplicity

The TLR reports are intended to support clinicians in the management of chronic disease. Usability, however, varies based on clinician's familiarity with the format of TLR reports and technical proficiency particularly with Excel-based reports. Whilst there is a combination of format styles across the four TLR reports, associated findings discussed in the following are predominantly related to the Excel format of the 'Full List' and 'Recall' report – two of the reports most intended to support clinicians with daily client level chronic disease care and management.

Among survey participants who answered the question on simplicity (N=61): 62% (n=38) stated 'Yes' indicating they found the reports easy to use; 21% (n=13) responded 'Sort of'; and 16% (n=10) reported 'No'. Participants who had 6 years or more experience in a remote PHC centres were more likely to answer that the reports were 'easy to use' (69%, n=33/48) compared with participants who had 5 years of less experience (Figure 10).

Figure 10. Simplicity[1] of the Traffic Light Recall Reports by years of experience in remote PHC, NT Health 2024.



Note: 1. Simplicity[1] evaluated in the survey question "Overall, do you find the Traffic Light Recall Reports easy to read and use?"
2. Missing data n=20.

In addition to years of experience, minimal to no formal training on how to use the TLR reports was also found to be a significant factor influencing the ease and usability of the TLR reports. Fifty-five percent (n=44/80) of survey participants reported not having received any formal training on how to use the TLR reports and apply them in their clinical practice. Comments from survey data (n=7) and follow up interviews (n=4) highlighted the lack of structured training as a barrier in the ease of use, and effective application of the TLR reports among clinicians:

> *"Filtering can be quite difficult... skills around managing Excel aren't really shared by a lot of the workforce... and if people don't feel comfortable with it, then you'll find that they just don't do it..." – Interview survey participant.*
>
> *… "The Excel TLR for Chronic Disease is too busy. If you don't know how to use Excel and filtering, then it will be hard to use." – Survey participant.*

Although a few short instructional videos (approximately 5-minutes in length) have been developed for clinicians, participants noted that the absence of a standardised induction process and/or comprehensive user guide leaves clinicians without any consistent direction on how to understand and/or apply the TLR reports effectively:

> *"There's not really that much instruction about how to maintain, manage, delete." – Interview survey participant.*

> *"I would like regular training and support... If we are meant to use these reports, then they should be more user friendly and there could be ongoing education support to encourage and motivate staff." – Survey participant.*

Surveillance system staff also acknowledged the lack of co-ordinated training attributed to the limited number of surveillance system staff members, and partly to the siloed nature of remote PHC services within NT Health which limits opportunities for collaboration and shared learning:

> *"I suppose you know, that's the thing about training, we're all a bit siloed. You know, we all kind of do our own things and don't talk to each other and don't, you know, cooperate very well "– Surveillance system staff.*

> *…."So it'd be nice, but we probably don't really have an opportunity to do orientation, like there's only myself and '…..' really doing this. So, it's hard for either of us to orientate a whole lot of staff that are coming in and a lot are agency staff." – Surveillance system staff.*

Stability

The system itself was described by participants as reliable, with few interruptions in data extraction or report generation. However, several operational and structural issues that were identified raise concerns about the systems' long-term stability and sustainability.

A key vulnerability is the heavy reliance on a single surveillance system staff member to manage the email distribution of the TLR reports. High staff turnover across remote PHC services means report recipients frequently change, creating a risk that reports may not reach the right clinicians – potentially undermining timely patient care and co-ordination:

> *"If someone leaves and their email disappears, the whole report falls over for that clinic." – Surveillance system staff.*

> *"It's an enormous administrative burden to maintain the email distribution list because of staff turnover." – Surveillance system staff.*

Further concerns were raised about the security risk from the surveillance systems' practice of emailing confidential patient information. While a transition to secure online dashboard is currently underway, at the time of this evaluation reports were still distributed internally via email.

The evaluation also identified that there is also no feedback mechanism to confirm whether the reports are being received, opened and/or used by intended recipients:

> *"With the emailed reports, you just kind of send them out into the ether, and you know, hope that somebody's reading them and somebody finds them useful. And like I say,*

we don't get a lot of feedback, but some of the like, you know, you do talk to people sometimes and they say, oh yeah, the reports are excellent." – Surveillance system staff.

"The reports get lost in the thousands of emails that are sent." – Survey participant.

Other areas of instability were identified in the limited staffing and insecure funding within the surveillance system. Currently, a single team member supports 47 PHC centres and approximately 30,000 patients. Surveillance staff also reported inconsistent support from the Department of Corporate and Digital Development (DCDD) which operates the Data Warehouse and was perceived to prioritise funding submissions over clinical support:

"Our data provider's priority is funding submissions, not clinician support, which complicates stable operational support." – Surveillance system staff.

"Just last Monday, the Data Warehouse hadn't finished data loading until mid-morning, causing reports with missing data, and many calls to our team." – Surveillance system staff.

Timeliness

The surveillance system's automated data extraction and frequency of report generation and distribution was identified to be aligned with the intended purpose of each of the TLR reports. Survey data (N=80) showed that 23% (n=18) of participants indicated the 'Recall' report was most frequently used daily. The 'Full List' report was most accessed weekly, 43% (n=34). Distributed weekly, the 'Community Summary' report, was most frequently used on monthly basis, 31% (n=25). The 'Trend' report, which provides monthly population-level data, was most often reported as "rarely" 23% (n=18) or "never" used, 39% (n=31). This variation in usage suggests that the reports are generally used in ways that reflect their clinical relevance and intended function to support clinicians working in remote PHC centres. For example, the more frequently used bi-weekly 'Recall' report and weekly 'Full List' report are the TLR reports most intended to support clinicians in day-to-day patient care and task prioritisation.

Qualitative feedback, however, revealed that the volume and format of emailed TLR reports may hinder their timely use. Participants reported that the length and complexity of the TLR reports' content – particularly when delivered via unfiltered email attachments can be difficult to navigate, especially in busy clinical environments:

"It's just better to have real time data as in straight from the system rather than an Excel spreadsheet that then has to be manually maintained and saved." – Interview survey participant.

Data Quality and Representativeness

Notably, 77% (n=51/66) of participants correctly identified PCIS as the data source used to generate the TLR reports, while 15% (n=10/66) were unsure, and 8% (n=5/66) identified other clinical information systems such as Acacia or Communicare. Although 87% (n=53/61) reported receiving formal PCIS training, there was considerable variation in the perceptions of the quality, and usefulness of this training. Many participants viewed PCIS training as overly basic and inadequate for supporting technical data entry and management required for effective chronic disease care planning and co-ordination:

> *"PCIS training is poor, poor, poor – it's just the basics, how to log on, open patient visits, so we rely on experienced longer-term staff to teach new staff and of course they [are] short on the ground these days." – Interviewed survey participant.*

> *"PCIS training is mostly useless. The shortcuts and things we need to know are much more complex than PCIS basic training." – Survey response.*

> *"Feedback I get from junior doctors is the PCIS training doesn't prepare them." – Surveillance system staff.*

While most participants selected that the TLR reports provided accurate data, concerns about data validity were not uncommon. These concerns centred on inconsistent or incorrect data entry in PCIS – particularly regarding patient classification, care-plan location and diagnostic status. As the TLR reports draw directly from PCIS entries, inaccurate and/or incomplete data entry compromises both the quality and representativeness of the reports which was highlighted by the following participants:

> *"Well, the only time you're gonna get a mismatch is data in, data out – right down to residency status or the careplan whoever put the careplan on….if a careplan is sitting in Daly River and the client isn't there…that's going to affect the reports and KPIs.." – Interviewed survey participant.*

> *"In PCIS – people need to understand what's a "Visitor", what's a "Resident", making sure careplans sit under the correct health centre – otherwise you don't generate accurate data or appropriate recalls…all that sort of stuff." – Interviewed survey participant.*

> *"We only pick up problems of patients with the status of confirmed, but they might have a status of probable or something. If clinicians ask why the patient isn't in the report it's because we're not picking it up because the clinician has documented on PCIS as probable." – Surveillance system staff.*

Acceptability and Usefulness

Survey results showed a high level of awareness for each of the TLR reports, particularly the 'Community Summary' report with 92% (n=73/79) of survey participants indicating strong familiarity. Eighty four percent (n=66/79) and 87% (n=69/79) accounted for participant awareness of the 'Recall' report and 'Full List' report, respectively. Fewer participants, 37% (n=29/79) were aware of the 'Trend' report.

Although these findings indicate a baseline level of engagement, qualitative data highlighted that the TLRR surveillance system is not sufficiently embedded or integrated within NT Health at an organisation level and that there is greater emphasis on resources allocated to acute care services in remote PHC settings:

> *"I don't think it's discussed in forums. There's a real need for a public health approach and it's not really that at the moment. I'll be honest. Like every meeting… lot of them are sort of a much more acute focus. I think that's part of it. I don't think it's ingrained enough." – Interview survey participant.*

> *"I think it's not embedded about the importance of it as well as it could be and that may be management level, it may be governance, whatever. But I think I feel like it's not driven and the people that are sort of sending it out aren't necessarily embedded there. I think there is some bit of a mismatch." – Interview survey participant.*

> *"If people don't know about them, they don't know how good they are." – Interview survey participant.*

Participants also highlighted considerable variability in clinician engagement and understanding of the TLR reports which they suggested was influenced by factors such as the clinician role, experience and familiarity in delivering remote PHC in NT Health PHC centres. Limited orientation and training resources for new clinicians, as well as minimal protected time for program planning were highlighted:

> *"But that's what they were initially designed for - those half days, so that you could get time to look at your program area and organise it." – Interview survey participant.*

> *"Can't keep asking staff to do more when we don't increase their resources or capacity to do it." – Interview survey participant.*

> *"I think that possibly some of the actual clinicians that just do clinical work purely with no program work, probably don't use it as much… that doesn't mean it's a really bad tool. It's just that we need to allow people to have that time to do that." – Interview survey participant.*

Despite these challenges, the TLR reports were described as useful tools for chronic disease management, patient prioritisation, program planning and public health education, especially in the context of high staff turnover and staffing shortages:

> *"Need to have the information still there given the high turnover of staff in certain places." – Interview survey participant.*

> *"People find the reports really useful in chronic disease, supporting them to get people in for check." – Survey response.*

Summary of findings

Overall, these findings suggest that the TLRR surveillance system is supporting the management of chronic disease care in remote PHC services. However, there is a clear opportunity to strengthen the uptake of the TLR reports among non-users and new clinicians.

The simplicity and usability of the TLR reports appears to be strongly influenced by the clinician's length of experience in remote PHC centres, and their technical proficiency in using PCIS, Excel and the internal NT Health dashboard portal. The absence of structured, consistent training and support for clinicians highlights an opportunity for improvement and collaboration amongst key stakeholders within NT Health remote PHC services.

While the automated data extraction and report generation processes of the surveillance system demonstrate technical stability, a number of operational challenges were identified. These include insecure report distribution methods, lack of a feedback mechanism, and an over-reliance on limited staffing and funding. Collectively, these issues pose risk to the system's long-term reliability, and capacity for ongoing improvement. Findings also suggest that while report production and distribution are timely, the mode of delivery and format may impact timely use amongst clinicians. The current transition of the TLR reports to an online, real-time dashboard that commenced during this evaluation, is expected to improve both accessibility and utility of the TLR reports within the clinical setting.

Clinician proficiency in data entry and management in PCIS was identified as a key determinant of the TLR report's data accuracy and completeness. Enhanced user support and resources for PCIS data entry, combined with periodical audits of data through a random selection of PHC service sites, would be beneficial to measure consistency and completeness overtime. Similarly, the lack of dedicated, protected time for program planning further limits clinicians' ability to perform effective data entry and management, which is essential for quality program planning to ensure the provision of accurate chronic disease care.

To enhance uptake, usability and long-term sustainability of the TLRR surveillance system and its associated reports, efforts must focus on embedding the surveillance system into NT

Health's operational service pathways for remote PHC services. Strengthening collaboration and shared accountability among key stakeholders – including surveillance system staff, remote PHC clinicians, PCIS staff, clinician educators and executive management – is essential to improve data quality, facilitate effective training and ultimately, ensure the surveillance system is providing high quality, actionable data to support clinicians in delivering chronic disease care.

Recommendations for Continuous Quality Improvement of the Traffic Light Recall reporting surveillance system

For the purpose of comprehensive PHC in the NT, Continuous Quality Improvement (CQI) activity is regarded as an ongoing process of identifying strengths and gaps in health service systems to improve upon, and test and review changes to increase efficiency, safety and overall improvement in patient and staff satisfaction.[23] Funded since 2009, the NT CQI strategy aims to support sustainable, long term health service improvement through embedding CQI across all remote PHC's in the NT, ensuring that it is core business for each PHC centre and staff member.[23]

Findings from this evaluation have identified and recommended opportunities for CQI initiatives to ensure that the TLRR surveillance system is not just functional but being utilised in a systematic way by PHC services. A systemic approach would ensure the TLR reports are embedded as critical tools of PHC delivery, recognising their contribution to improve clients' chronic disease management and their role in public health surveillance for chronic disease.

The evaluation recommendations in Table 5 are summarised under 3 broad areas that require attention include:

1. Review of the distribution mode and format of TLR reports.
2. Enhance the training and support of clinicians in understanding and applying the TLR surveillance system and its associated TLR reports in the clinical setting.
3. Strengthen the integration of the surveillance system within NT Health's organisational processes.

The evaluations' recommended actions, specifying the stakeholder responsible for implementation, and the intended outcomes within these three broad areas are defined in Table 5. By recognising and describing the role of each stakeholder highlights the need that to implement these recommendations effectively, shared accountability and collaboration is essential.

Similarly, to ensure sustained effectiveness and relevance of the recommendations outlined, it is advised that the TLRR surveillance system is periodically re-evaluated every 3–5 years to

assess the progress and implementation of the recommendations of this evaluation and identify any emerging challenges and opportunities for system improvement. An independent evaluation would also be beneficial to ensure objectivity and completeness.

Table 5. Summary of recommendations for Continuous Quality Improvement Opportunities

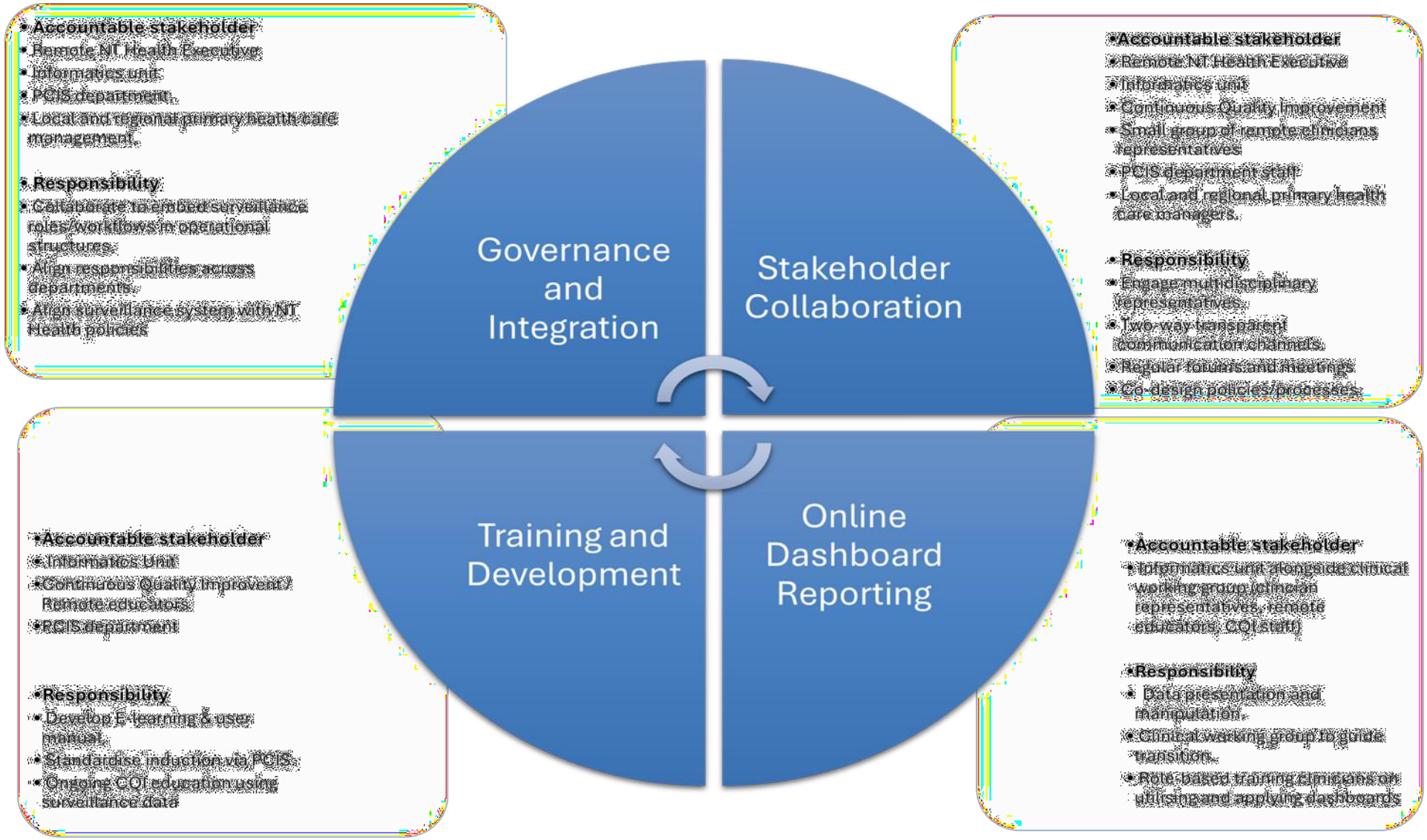
Opportunity	Recommendation	Stakeholder responsible	Expected outcome
1. Traffic Light Recall Reports: *Data format and mode of distribution of the TLR Reports.*	• Transition Traffic Light Recall reports to online dashboards in collaboration with a clinical working group. • Collaboration throughout remote PHC services to inform staff aware of the changes followed by education and support on how to access and utilise the online reporting replacement.	• Surveillance system staff to transition each of the TLR reports to an online dashboard. • Collaboration amongst surveillance system staff and clinical representatives including: CQI staff and a small number of clinicians representatives including nurses, allied health, Aboriginal health workers and medical practitioners.	• Real time data is secure, confidential and easily accessible for clinicians to manage. • A large volume of data presented and manipulated with varying degrees of specificity via an online portal that has the option to sort, filter and generate into a printable document as required. • Clinicians are able to review and filter the data during patient consults. • Clinicians can access the portal as required rather than reliance on report access via scheduled emails.
2. Training and Support	• Development of an E-learning package to be included in the PHC remote induction/orientation week for clinicians commencing employment in remote PHC services to provide:	• E-learning and user manual guide: Developed by the surveillance system operation's team in collaboration with nurse educators who then provide the orientation and induction for remote health clinicians.	• Clinicians are equipped with the foundational and fundamental skills and knowledge in understanding the TLRR surveillance system and applying its associated reports in their work.

	1. Overview of the TLRR surveillance system contextual to remote NT PHC (i.e. structure of PHC centres, discussion of health programs and the expected primary health care approach). 2. Outlines and discusses each Traffic Light Recall reports, their role and application in the clinical setting with examples of clinical application. • Develop a Traffic Light Recall report user manual guide for clinicians to refer to in practice regarding how to use and apply the surveillance system and each of the Traffic Light Recall reports to PHC programs i.e. chronic disease management, Rheumatic Heart Disease.	• Input from CQI staff, nurse educators, experienced medical and nursing clinicians, and clinic managers to collaborate on the content, structure and format with varying degrees of involvement. However, surveillance system operations' team, CQI representatives and nurse educators across the NT Health PHC centre regions would be most appropriate to take the lead in the development and roll out of this recommendation. • PCIS training review required of PCIS staff, remote PHC nurse educators and surveillance system team to collaborate and evaluate whether PCIS training is meeting requirements to support and prepare clinicians with proficient data entry and management skills when working remote.	• Improved transparency and communication between clinicians, educators and the system's operation team. • Strengthened approach and emphasis on delivering primary health care using the TLR Reports. • PCIS training and support satisfies the data extraction requirements of the Traffic Light Recall reporting surveillance system and prepares and supports clinicians adequately to ensure quality and accurate data entry and management.

	• Review the structure and content of PCIS training that is currently provided to clinicians and evaluate whether this is satisfying clinician requirements for clinical practice preparedness. • Review data entry requirements via PCIS that then influences the data extracted and generated into the Traffic Light Recall reports to ensure data quality and accurate representativeness.	• PCIS data entry review to occur between surveillance system and PCIS staff collaboration.	
3. Strengthen integration of the surveillance system within NT Health's organisational processes	• Identify executive and management meetings/forums for surveillance staff to collaborate with to strengthen data-driven quality care and service delivery in remote PHC. • Review and standardize PHC program delivery structures, including allocating protected weekly time for clinicians' program review. • Foster ongoing collaboration between surveillance operations team and	• Remote executive directors for remote PHC practice, regional and local management across all NT Health regions. • Develop an interdisciplinary group of stakeholder representatives to ensure consistency of communication and accountability of roles and responsibilities i.e. PCIS department, surveillance system	• Increased awareness and understanding of the system among clinicians, leading to better utilization. • Stronger integration of surveillance data into organisational decision-making and service planning. • Standardized program delivery and protected time for clinicians to engage in quality improvement activities.

	management to embed the system in service delivery planning and prioritization. • Promote transparency and constructive communication among stakeholders to support positive reception of reports, boosting staff morale and proactive chronic disease care.	team, management, remote nurse educators and CQI members.	• Enhanced alignment between surveillance data and PHC service delivery, improving prioritization and planning. • Improved staff morale, constructive use of surveillance data, and increased proactivity in chronic disease management.

Figure 11. System Framework: Collaborative integration of the Traffic Light Recall Reporting surveillance system, NT Health 2024.



Limitations

The main limitation of this evaluation was the small sample size and missing data. The low response rate (18%) undoubtedly posed limits on the scope and variety of feedback that was obtained, as the survey participants were mostly users of TLR, rather than representing non-users. In effort to increase the sample size, the survey was emailed on a weekly basis over a six-week period to the target audience with additional advertising and survey access via the internal NT Health intranet page. The survey was also shared at the '*2024 Continuous Quality Improvement Collaborative: Empowering Communities for Child Health*' conference via a QR code, enabling remote PHC clinicians to participate.

The degree of advertising could have been strengthened by contacting remote PHC centre managers to discuss the survey and request that staff are informed at the morning clinic meeting, however discussions prior to dissemination were only conducted with executive directors in remote primary health care for Top End and Central Australia. Similarly, the survey was distributed to NT Health employees only, which excludes a large proportion of clinicians who are employed by an external agency. Whilst 96 respondents conducted the survey overall, 16 of those were excluded from the analysis due to a high amount of incomplete data within the survey responses (Figure 9).

The evaluator identified that two components were included in the question '*Do you find the Traffic Light Recall reports easy to read and use'* which made it difficult to differentiate by the surveillance attribute during the analysis. Similarly, the structure and wording of the survey questions, overall, elicited broad responses which created variations in how the response(s) could be interpreted. This posed limitations on eliciting direct correlations between the participants perspective and the surveillance systems' core objectives for evaluation.

Conclusion

In remote PHC practice, time is a precious resource for clinicians who are frequently presented with an often-unsurmountable workload in the limited working hours of remote PHC centres. As identified in this evaluation, the TLRR surveillance system aims to support and facilitate clinicians delivering chronic disease PHC programs and overall, was found to be a valuable tool amongst clinicians who are aware, and comfortable in using the system reports.

Importantly, the evaluation identified a clear opportunity for NT Health to systemically embed the surveillance system across remote NT Health PHC services. Achieving this, however, requires collaboration across all levels of service delivery including frontline clinicians, PCIS staff, TLRR surveillance system staff, local and regional management and senior executive for remote PHC services. Rather than allowing the surveillance system to continue functioning as a standalone tool, this evaluation highly recommends a more integrated and transparent model

where reporting, CQI, clinical practice and executive oversight are aligned through shared accountability and consistent collaboration. The need for such an approach was highlighted by the following participant:

> *"I think we're doing more but outcomes aren't improving at the rate we're increasing the workload" – Interviewed survey participant.*

While implementing such system change may seem idealistic given the resource constraints of remote NT Health PHC settings, it is imperative for those living with and/or at risk of chronic disease in remote communities. As a leading provider in remote PHC, NT Health has both the opportunity and responsibility to reflect on current practices and embed changes that improve service quality. These changes are best guided by principles of equity, transparency, efficiency and sustainability to ensure that change is not only achievable, but meaningful for those who it is intended to support.

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Literature Review

Population Intervention Comparison Outcome (PICO) Framework:

Population	Remote NT Health primary health care communities including clinicians and patients with/or at risk of chronic disease
Intervention	Traffic Light Recall Reporting surveillance system for chronic disease prevention and management
Comparison	No direct comparison.
Outcome	Overall effectiveness of the Traffic Light Recall Reporting surveillance system in supporting clinicians in chronic disease care, quality improvement opportunities.

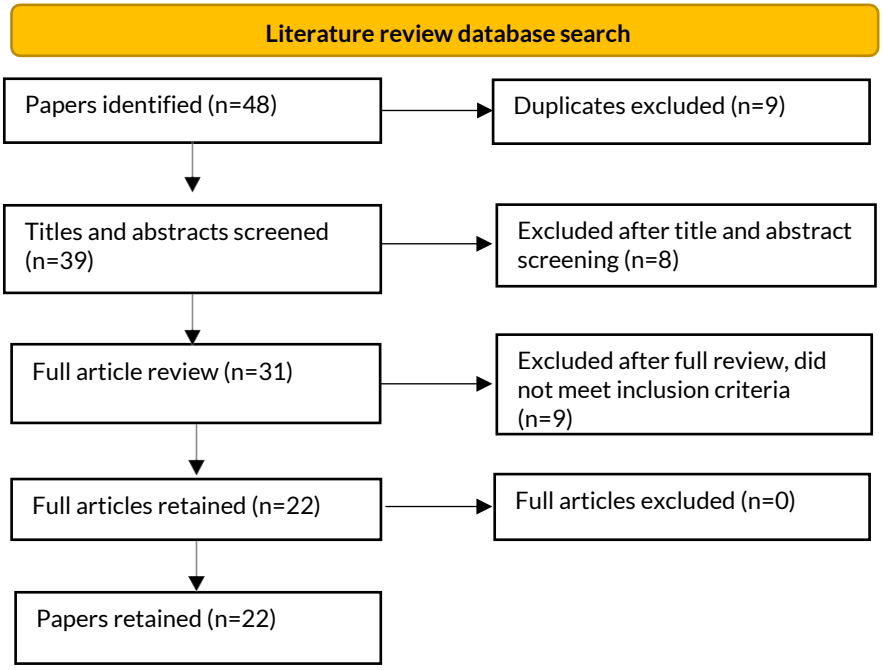
PICO Question:

"In remote NT primary health care communities, how effective is the Traffic Light Recall Reporting Surveillance system in supporting clinicians in chronic disease care and management, and what opportunities are there for continuous quality improvement opportunities?"

Literature Search process:

Databases searched	PubMed, CINAHL, EBSCO, relevant government websites (internal NT Health policy and guidelines, US Centre for Disease Control, World Health Organization).
Search period	From [2005 – 2025].
Search terms	"Traffic light recall", "chronic disease" "remote primary health care" "primary health care" "Indigenous health" "chronic disease management" "evaluation guidelines" "Norther Territory remote" "primary health care" "surveillance attributes" "continuous quality improvement"

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart:



Appendices

Appendix A. Participant information sheet and Consent Form for remote PHC clinicians.

Evaluating the Chronic Condition Community Traffic Light Recall System in remote NT Primary Health Care centres

A quality improvement assessment of a primary health care approach to support the prevention and management of chronic conditions in remote Aboriginal communities of the NT.

Participant Information

As an NT Health employee working in a NT remote primary health care centre you have been invited to participate in this voluntary survey. This survey contains 14 questions and will take up to five minutes to complete.

Please read through the following information before agreeing to participate.

Aim

We plan to evaluate NT Health's reporting system for chronic disease prevention and management, implemented in remote NT Health primary health care services – the **Community Traffic Light Recall Reporting System**.

Findings from the evaluation aim to contribute to continuous quality improvement in supporting frontline clinical staff working in chronic disease prevention and management across remote Aboriginal communities of the NT.

The four traffic light system reports that we would like your thoughts on include:

- *Recall List* (bi-weekly report)
- *Full List* (weekly report)
- *Traffic Light Community Summary Report* (weekly report)
- *Trend Report* (online dashboard)

The **Community Traffic Light Recall Reporting System** includes four reports:

- *Recall List* – bi-weekly report, identifies people who, in accordance with their health care-plan and risk factors, are overdue for care.
- *Full List* – weekly report for clinicians detailing the person's chronic condition diagnoses, pathology results, key risk factors, care plans and examination findings.

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- *Traffic Light Community Summary Report* – weekly report for primary health care centre managers and clinicians that compares service performance against chronic conditions program targets and chronic disease key performance indicators.
- *Trend Report* – are online dashboard reports viewable to anyone on the NT Health network and are updated monthly.

Findings

A summary of the findings will be distributed to participants and key stakeholders in NT health via approved publication and/or presentations. Findings will also aim to provide quality improvement opportunities to strengthen chronic disease surveillance in remote primary health care.

Evaluation Team

The principal researcher – Sarah Sim, is an Epidemiology Scholar at the NT Department of Health at the Health Statistics and Informatics (HSI) branch. Sarah previously has worked as a Child Health Nurse Specialist across remote communities in the Northern Territory, Torres Strait Islands and Far North Queensland.

Sarah will be supported by:

- Dr Alyson Wright: NT Health
- Rus Nasir: NT Health and a descendant of the Djugan/Yawuru people
- Kirsty Nicols: The Australian National University and a proud Muran and Kungarakun woman from the Northern Territory
- Dr Amy Parry: The Australian National University

Ethics

This project is supported and approved by the NT Executive Director of Strategy, Planning and Reform for Public and Primary Health Care and is approved through ANU's ethics' committee via an umbrella approval for MAE students via a: *Variation – Human Ethics Protocol 2017/909, approved waiver of consent for use of data in research for Masters in Applied Epidemiology students for 'Surveillance in Public Health' projects:* 2017_909_Field variation approval letter_2022.pdf Full disclosure of this ethics waiver can be accessed here: Human Research Ethics Committee ANU.pdf.

If you have any concern with this project please contact Dr Alyson Wright (Alyson.wright@nt.gov.au) or Dr Amy Parry (amy.parry@anu.edu.au) or the ANU human ethics team (human.ethics.officer@anu.edu.au).

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Data Security

The research team only, will have access to the data and it will be locked on a password protected computer for a period of five years.

Personal participant details will be de-identified unless otherwise specified by participants themselves and are not required to answer any questions that they feel may compromise their identity. Incomplete data will be included in the results unless participants request for it to be deleted.

Participation is voluntary, you may decline and/or withdraw at any time.

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Appendix B. Participation Information Sheet and Consent Form – Surveillance System Operations team.

Evaluation of the Chronic Condition Community Traffic Light Recall System in remote NT Primary Health Care centres

A quality improvement assessment of a primary health care approach to support the prevention and management of chronic conditions in remote Aboriginal communities of the NT.

Participant Information

You have been invited to participate in this voluntary interview as you are identified as an NT Health employee involved in the development and management of the Community Traffic Light Recall System. Please allow up to 90 minutes for this interview.

Please read through the following information before agreeing to participate.

Aim

We plan to evaluate NT Health's reporting system for chronic disease prevention and management, implemented in remote NT Health primary health care services – the **Community Traffic Light Recall Reporting System.**

Findings from the evaluation aim to contribute to continuous quality improvement in supporting frontline clinical staff working in chronic disease prevention and management across remote Aboriginal communities of the NT.

The four traffic light system reports that we would like your thoughts on include:

- *Recall List (bi-weekly report)*
- *Full List* (weekly report)
- *Traffic Light Community Summary Report* (weekly report
- *Trend Report* (online dashboard)

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Appendix C. Participation Information Sheet and Consent Form – Survey respondent follow up interviews.

Evaluating the Chronic Condition Community Traffic Light Recall System in remote NT Primary Health Care centres

An investigation of a primary health care approach to support the prevention and management of chronic conditions in remote Aboriginal communities of the NT

Participant Information

You have been invited to participate in this voluntary interview as you are identified as an NT Health employee working in a NT remote primary health care centre. Please allow up to 60 minutes for this interview.

Please read through the following information before agreeing to participate.

Aim

We plan to evaluate NT Health's reporting system for chronic disease prevention and management, implemented in remote NT Health primary health care services – the **Community Traffic Light Recall Reporting System**.

Findings from the evaluation aim to contribute to continuous quality improvement in supporting frontline clinical staff working in chronic disease prevention and management across remote Aboriginal communities of the NT.

The four traffic light system reports that we would like your thoughts on include:

- *Recall List (bi-weekly report)*
- *Full List* (weekly report)
- *Traffic Light Community Summary Report* (weekly report
- *Trend Report* (online dashboard)

The **Community Traffic Light Recall Reporting System** includes four reports:

- *Recall List* – *bi*-weekly report, identifies people who, in accordance with their health care-plan and risk factors, are overdue for care.
- *Full List* – weekly report for clinicians detailing the person's chronic condition diagnoses, pathology results, key risk factors, care plans and examination findings.

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- *Traffic Light Community Summary Report* – weekly report for primary health care centre managers and clinicians that compares service performance against chronic conditions program targets and chronic disease key performance indicators.
- *Trend Report* – are online dashboard reports viewable to anyone on the NT Health network and are updated monthly.

Findings

A summary of the findings will be distributed to participants and key stakeholders in NT health via approved publication and/or presentations. Findings will also aim to provide quality improvement opportunities to strengthen chronic disease surveillance in remote primary health care.

Evaluation Team

The principal researcher – Sarah Sim, is an Epidemiology Scholar at the NT Department of Health at the Health Statistics and Informatics (HSI) branch. Sarah previously has worked as a Child Health Nurse Specialist across remote communities in the Northern Territory, Torres Strait Islands and Far North Queensland.

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Data Security

The research team only, will have access to the data and it will be locked on a password protected computer for a period of five years.

Personal participant details will be de-identified unless otherwise specified by participants themselves and are not required to answer any questions that they feel may compromise their identity. Participation is voluntary, you may decline and/or withdraw at any time.

Consent

If you have read the information above and agree to participate, please tick the box below.

☐ Yes, I agree to take part

Full name: _____

Date: _____

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Appendix D. Consent to Audio or Video Recording and Transcription.

CONSENT TO AUDIO- OR VIDEO RECORDING & TRANSCRIPTION

Project: Evaluation of the Chronic Condition Community Traffic Light Recall Report System

Research Team: Sarah Sim, Dr. Alyson Wright, Dr. Amy Parry, Rus Nasir and Kirsty Nichols

This study involves the audio or video recording of your interview with the researcher. Neither your name nor any other identifying information will be associated with the audio or audio recording or the transcript. Only the research team will be able to listen (view) to the recordings. Recordings will be saved on an NT health password protected computer.

Recordings will be transcribed by the researcher and erased once the transcriptions are checked for accuracy. Transcripts of your interview may be reproduced in whole or in part for use in presentations or written products that result from this study. Neither your name nor any other identifying information (such as your voice or picture) will be used in presentations or in written products resulting from the study.

By signing this form, I am allowing the researcher to audio or video tape me as part of this research. I also understand that this consent for recording is effective until the following date: 01/12/2025. Following this date the recording transcripts will be destroyed.

Participant's Signature: _____Date:_____

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Appendix E: Summary of interview and focus group questions.

Follow-up interview questions with survey participants

1. Can you tell me a bit about your current role in PHC?
2. Can you tell me about how you and the clinics you work in use the TL reports?
3. What are the most important parts of the reports for your work? Why?
4. How does the timing of the reports being sent to you suit your workload? Have there been times when they have not been emailed, how did this affect your work?
5. How do you find the reports impacting the effectiveness of chronic disease health care in the community that you are working in?
6. Lots of our survey respondents have worked a long time with NT Health. We think that more long term employees are more familiar with the Traffic Light reports than those who have come to agency in the last 1-3 years? Would you agree and what thoughts do you have on this? How can we support (training, system improvements) more junior staff to engage with/use the reports?
7. Most survey participants reported that they haven't had any training or support on TLR? Is this a barrier to using reports and what training would help support clinicians to use the TLR?
8. What type of clinical support do you receive in applying and using the reports (CQI staff, data analyst – who create the reports).
9. In the survey its noted you attended x PCIS training – can you tell me about this training – what was good, and what could be improved?
10. Do the reports align with your client and community data in PCIS? What improvements would you suggest to enhance data quality?
11. We saw from the results that less respondents are engaging with the dashboards than the other reports? Do you have any ideas on why this is the case?
    - The Informatics team who are responsible for the TLR are working to move all the TLR to dashboard, what are your thoughts on this?
12. What general comments / feedback would you like to share with us? What suggestions do you have to improve the reports?

Interview Questions with Traffic Light Recall Reporting Surveillance System Operations staff

1. What has been your role in the development of TLR used by primary health care?
2. Can you tell me the origins of the TLR and why they were implemented in NT Primary Health Care.
3. What do you think is the purpose of the TLRs and how should they be used?
4. How should clinical teams engage with each of the 4 TLR reports and what are their collective and individual objectives?
5. In your clinical view, please describe the purpose of each of the four reports with an example of how the reports should be used in the context of chronic disease prevention and management.
    i. Traffic Light Community Summary Report
    ii. Full List
    iii. Recall List
    iv. Trend Report
6. How was the reporting schedule developed?
7. What is the rationale behind the frequency that the reports are sent to staff?
8. Do you know if staff have received the reports? If yes, how?
9. Can the reports be sent outside of routine reporting times and do you respond to clinicians request for data?
10. Is there evidence between the reports to show that staff are using the reports for their clinical practice?
11. What have you seen work to support clinical teams make use of the reporting system?
12. Who is the data dictionary for the recall reporting system made available to?
13. Do you receive feedback communication between PHC about the reports and if so what type and how often?
14. What are the main challenges to the completeness of data i.e. incomplete health checks and is there a way of reviewing the level of completeness?
15. Please outline who is responsible for maintaining the system and the consistency of the reports, is this person or position dependent? What happens when the data analyst (main person) is on leave?
16. What plans are in place for when unexpected events occur i.e. system failures, does this delay the distribution of the reports?

17. Are there any systems in place to review validity of the data, and if so what are they?

18. Please describe the CQI role in regard to the reporting system

19. Please describe any training that is available for staff in using each of the four reports. Are you aware if PCIS training mentions how clinical input translates to reporting systems?

20. Could you please describe the methods of managing the data i.e. time spent on the transfer, entering, editing, storing and backing up data and those methods for preparation i.e. time spent on analysis and to prepare data for dissemination.

21. Are there any other means of distribution other than the email list and how often is the email list updated

22. What are the barriers and facilitators occur maintaining accurate demographic population data? Are there any current measures that address the barriers for the accuracy of the reports in regard to the demographic data reflected in the reports?

23. What are the future opportunities for the TLR and what are the barriers to these opportunities

24. Who else do you recommend I speak with about this evaluation?

Appendix F. General and specific definitions of the surveillance attributes based on the Centre of Disease Control guidelines.[24]

Attribute	General Description
Acceptability*	Reflects how willing organizations and people are to participate in the system
Simplicity*	Reflects the ease of operation within the system
Representativeness*	Whether the system accurately represents and describes the population and/or event under surveillance
Flexibility	Whether the system can adapt to changing situations
Stability*	Reflects how reliable and available the system is
Timeliness*	Examines the speed at which it operates to meet its purpose i.e. generation of reports, early detection of disease.
Usefulness*	Whether the system is effective in accomplishing its objectives
Data Quality*	Reflects the validity and completeness of the data included in the system.
Sensitivity	Refers to how well the system captures the proportion of cases of diseases detected by the system
Positive predictive Value	Refers to the number of reported cases to meet the case definition

Note: *attributes were selected to be assessed in this evaluation.

Appendix G. Lay Summary: Evaluation of the Traffic Light Recall Reporting Surveillance System: *Current Perspectives on chronic disease management in Northern Territory remote primary health care services.*

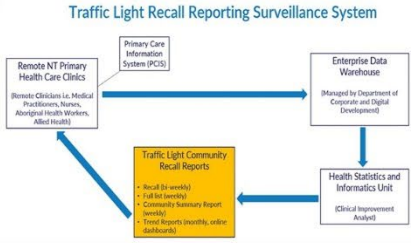
Public Health Surveillance for Remote Northern Territory Communities Process

Primary health care clinicians enter patient data via the Primary Care Information System (PCIS).

Data is uploaded every night to the Enterprise Data Warehouse – managed by Department of Corporate and Digital Development.

Data is collated and generated into the Traffic Light Recall Reports by the Clinical Improvement Analyst at Health Statistics Informatics Unit.

The reports are distributed via email to the appropriate primary health care centre(s) and clinicians.



Surveillance System's Traffic Light Recall Reports

- **Recall List** – bi-weekly report, identifies people who, in accordance with their health care-plan and risk factors, are overdue for care.
- **Full List** – weekly report for clinicians detailing the person's chronic condition diagnoses, pathology results, key risk factors, care plans and examination findings.
- **Traffic Light Community Summary Report** – weekly report for primary health care centre managers and clinicians that compares service performance against chronic conditions program targets and chronic disease key performance indicators.
- **Trend Report** – online dashboard reports viewable to anyone on the NT Health network and are updated monthly.

Objectives of the Traffic Light Recall Reporting Surveillance Evaluation

Evaluation objectives:

1. Describe the purpose of the reporting system in public health surveillance and primary health care's management of chronic conditions.
2. Evaluate clinician perspectives on the facilitators and barriers in using the Traffic Light Recall Reports for screening, prevention and management of chronic conditions.
3. Identify continuous quality improvement opportunities to strengthen chronic disease surveillance in remote primary health care by providing feedback and recommendations on key findings based on the surveillance attributes.

Evaluation Study Design and Study Population

Study Design: Mixed Methods

- Combines both **quantitative** (survey) and **qualitative** (interview) approaches.
- Focus: Identify intended purpose of the system and how clinicians use and experience the Traffic Light Recall Reporting system.

Study Population

- **Stakeholder Group 1**:
  - NT Health-employed clinicians in remote PHC i.e. Nurses, Medical Officers and Aboriginal Health Workers, Allied Health.
- **Stakeholder Group 2**:
  - NT Health staff involved in the surveillance system development, management, and delivery of Traffic Light Recall Reports.
- ***Excluded from study population***:
  - NT correctional facilities
  - Community Controlled Aboriginal Health Services
  - Non-government-employed clinical staff in NT Health centres

Evaluation data sources

- We asked a variety of questions:
  - *What is the purpose of the surveillance system?*
  - *Are the reports easy to use?*
  - *Are they accurate and timely?*
  - *Are clinicians well supported in using the reports?*
  - *Do the reports support and help clinicians in chronic disease care and management?*
- Online survey distributed to NT Health clinicians working in remote primary health care centers.
- Structured interviews completed with surveillance system staff and survey participants who volunteered to be interviewed.

REDCap Evaluating the Chronic Condition Community Traffic Light Recall Reporting System in remote NT Primary Health Care centres

Survey results and demographics

- Total of 80 participants completed the online survey.
- A total of six interviews with surveillance staff (n=2) and survey participants (n=4) were completed.

Figure 1. Participant demographic characteristics 'Survey: *Evaluating the Traffic Light Recall Reporting Surveillance System*, NT Health 2024.

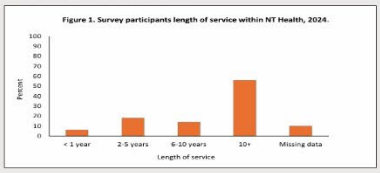


Table 1. Demographic characteristics 'Survey: *Evaluating the Traffic Light Recall Reporting Surveillance System*, NT Health 2024.

Survey Demographic Characteristics	n	%
Clinician Position		
Nurse[1]	47	59
Aboriginal Health Worker &/or Practitioner	8	10
Medical Officer	20	25
Allied Health	5	6
Region		
Top End[2]	57	71
Central Australia	15	19
Length of service in a remote primary health care centre		
5 years or less	19	24
6 years or more	60	75
Missing data	1	1
Total	80	100

Key findings – what's working well

1. The Traffic Light Recall Reports are helpful for clinicians:
   - The most frequently used reports are the Recall Report and Full List Report.
   - The reports help clinicians prioritise care, support chronic disease care planning and organise their workload in monitoring and completing due and overdue recalls.
   - The reports can be useful for teaching a public health approach.

"Oh it's a really good tool, they like it and it gives them good information." – Participant 4.

2. Automated data extraction and distribution:
   - The reports are automatically generated from PCIS data.
   - Minimal technical breakdowns / delayed distribution was identified.
   - Distribution of the reports align well with their intended use (i.e. weekly full list report, bi-weekly recall report).

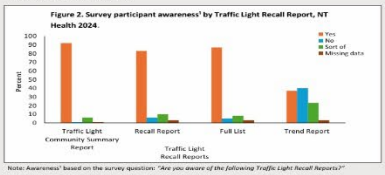
"People find the reports really useful in chronic disease, supporting them to get people in for check." – Survey response.

"Need to have the information still there given the high turnover of staff in certain places." – Participant 4.

Key findings – what's working well

3. Widespread awareness of the reports:
   - 80-92% of survey participants know of the main reports.
   - ≥50% of survey respondents reported YES to each of the Traffic Light Recall Reports satisfying their main objective in the clinical setting.

Figure 2. Participant survey response 'Survey: *Evaluating the Traffic Light Recall Reporting Surveillance System*, NT Health 2024.



Note: Awareness' based on the survey question: *"Are you aware of the following Traffic Light Recall Reports?"*

Key findings – what needs improvement

1. Training and support.
   - No standardised user manual guide for clinicians on how to use and apply the reports.
   - Lack of structured orientation and/or continuous support regarding the surveillance system and its reports for clinicians in remote primary health care.
   - Many clinicians are not equipped with required skills to use the reports i.e. excel filtering and data literacy.
   - PCIS training during orientation is too basic and not providing clinicians with the necessary skills for data entry and management for chronic disease care.
   - While 62% (38/61) respondents found the Traffic Light Reports easy to read and use 87% (33/38) who responded yes – had a length of service in remote PHC for ≥ 6 years and 10% (4/38) who reported no – had a length of service in remote PHC for ≤ 5 years.

"The skills around managing Excel aren't really skills that are shared by a lot of the workforce. And if people don't feel comfortable with it, then you'll find that they just don't do it, you know." – Participant 4

"There's not really that much instruction about how to maintain, manage, delete." – Participant 5.

"If we are meant to use these reports, then they should be more user friendly and there could be an ongoing education support to encourage and motivate staff." – Survey respondent.

Key findings – what needs improvement

3. Surveillance system needs to be embedded and driven in NT Health remote primary health care services.

- Insufficient processes to facilitate transparent communication and sustainable quality improvement across key stakeholders including:
  - ❑ Remote based and outreach clinician representatives across disciplines.
  - ❑ Surveillance system staff members.
  - ❑ Primary health care managers – across all levels.
  - ❑ PCIS staff involved in training and development for remote induction.
  - ❑ Continuous Quality Improvement staff / educators across disciplines.
- Potential disconnect between the reality and practicalities of the remote primary health care setting and NT Health policy decisions remote PHC services.
- No consistent or standardised protected time for program planning for clinicians.

"I think it's not embedded about the importance of it as well as it could be and that may be management level, it may be governance, whatever. But I think I feel like it's not driven and the people that are sort of sending it out aren't necessarily embedded there. I think there is some bit of a mismatch." – Participant 3.

"...I guess we all work a bit siloed" – Participant 2.

"Can't keep asking staff to do more when we don't increase their resources or capacity to do it" – Participant 4.

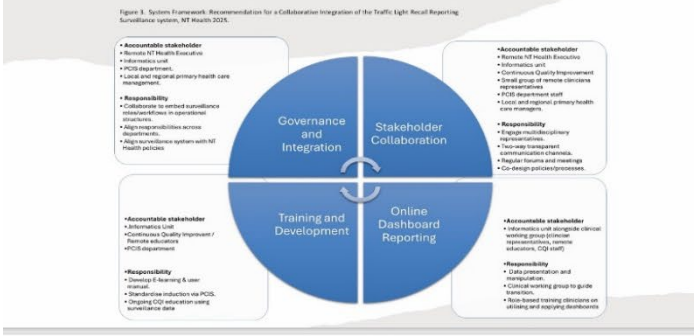
Recommended opportunities for improvement

Support and training

Improve report access

Start communicating and collaborating

Recommended stakeholder roles and responsibilities



For any further information please feel free to contact the research team at Health Statistics and Informatics and Australian National University:

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6. Northern Territory Department of Health. NT Primary Health Care Data Collection Annual Report 2021. Darwin: NT Health; 2022.

Appendix H: Data Dictionary: *NT Health's Traffic Light Recall Reporting surveillance system:* TLR Data Dictionary.pdf

Chapter Four – A single imported case of measles and the subsequent outbreak response, Darwin, Northern Territory, January 2025

Respond to Acute Public Health Threat or Outbreak

Prologue

Rationale

Measles is a highly contagious viral, airborne disease that can lead to severe complications and death and therefore a rapid, co-ordinated response is required to contain further transmission. Population groups most vulnerable to serious complications of a measles infection include those who are immunocompromised, pregnant and under 5 years of age. This chapter describes the outbreak response and investigation to a single measles notification that occurred in Darwin in January 2025, and the key strengths and limitations that were identified during the response, to inform future public health response and surveillance processes.

My role

I was a member of the Outbreak Investigation team and worked with public health staff at Darwin's Centre for Disease Control (CDC) unit to support contact tracing over the course of the outbreak response. This involved working across a range of public health databases and electronic platforms to prioritise contacts and identify the necessary actions and control strategies. Following the outbreak, I was responsible for summarising the investigation in a report published in the Darwin's quarterly CDC Disease Bulletin. This process involved reviewing the systems and processes that occurred during the outbreak response, a descriptive analysis of the data and a cost-analysis of the staff resources incurred during the response. On behalf of Darwin CDC, I presented the outbreak response at the Communicable Diseases and Immunisation Conference held in Adelaide, June 2025.

Lessons Learned

This investigation gave me real world experience in applying the 10 steps of an outbreak investigation. I learnt the processes involved in identifying and confirming the index case and procedures required for contact tracing in a public health unit. I built further skills in the Research Electronic Database Capture (REDCap) as a tool for recording and managing surveillance data and learnt the advantage of following the Series of National Guidelines (SoNG) whilst interviewing contacts to ensure consistency in data collection and public health response information regarding measles. When contacting the public, I learnt that it is important to approach this conversation clearly and calmly to avoid unnecessary misperceptions. Similarly, I observed and learnt the importance of public health education and communicating with the media to disseminate timely information to inform the wider public of the measles notification, exposure sites and information regarding measles and vaccinations

with recommendations. I was allocated the responsibility of reporting the outbreak investigation in the monthly CDC bulletin and conducted a cost analysis of staff resources incurred during the outbreak response, both opportunities of which allowed me to advance my learning and skills in scientific writing.

Public health impact

In January 2025, Darwin's CDC public health unit executed a timely public health response to the single measles notification. Measles, a highly infectious notifiable disease requires a rapid response to prevent widespread outbreaks. The team promptly confirmed the case and likely source of infection, identified a list of contacts, implemented isolation control measures and provided vaccinations where needed. This rapid containment protected vulnerable populations including immunocompromised, unvaccinated individuals, and young children. The effective management of the case also prevented potential strain and financial costs on local healthcare facilities. Similarly, it contributed to strengthening community trust in public health services through transparent and timely communication, which was frequently shared to the public via situational reports and media briefings throughout the outbreak investigation. This response offered an invaluable opportunity for targeted public health messaging to provide education on measles and reinforce the importance of maintaining high vaccination coverage.

Acknowledgements

A sincere and big thank you to the outbreak response team and staff at Darwin CDC: Anthony Draper, Dr. Hayley Dyke, Jerry Chen, Dhanya Kachapilly Louis, Rob Baird, Kevin Freeman, Kimberly McMahon, Gina Majid, Jane Porter, Isabel Ngere and Dr. Vicki Krause. Thank you for taking the time to teach, guide and share your expertise and experiences – I am very grateful and have learnt a lot. Similarly, an extended thank you and acknowledgement to both supervisors - Alyson and Amy, your subtle yet always profound and helpful guidance and comments are very appreciated, I have and continue to learn so much from the both of you!

Abstract

Measles is a highly contagious viral airborne disease, typically presenting with high fever, cough, conjunctivitis, and a maculopapular rash. No longer endemic in Australia, imported cases of measles do occur with a single case regarded as a public health emergency.

In January 2025, a returned traveller with measles was notified to the Centre for Disease Control (CDC) in Darwin, Northern Territory (NT); the first case in the NT since 2019 to be notified. An outbreak team followed national public health response guidelines. We interviewed the case to determine travel history, infectious period, potential contacts, and provided isolation advice. The electronic database, Research Electronic Data Capture (REDCap), was used for contact tracing to record contact details, vaccination status, and

past infection history.

A total of 162 contacts were identified. We successfully contacted and completed follow up for 94% (n=153/162) of contacts. Of the total 162 contacts, 84% (n=136/162) were considered immune to measles. Of those immune, 90% (123/136) had received two doses of the measles-containing vaccine; 7% (n=9/136) were born before 1966; and 3% (n=4/136) reported a previous measles infection as a child. During the response, 90% (n=146/162) of contacts were provided advice only with no further action required, and 2% (n=4/162) were provided the measles-mumps-rubella (MMR) containing vaccine. Only one contact received normal human immunoglobulin (NHIG). The contact tracing was completed by eight staff over a total of 12 hours on a weekend. We calculated the human resource cost for this outbreak response to be approximately AUD$7,300. No further cases of measles were reported in the NT in the two months following this case notification.

This outbreak response highlights how high immunisation rates and a rapid, co-ordinated response using familiar electronic management systems, and staff preparedness training are crucial in preventing the onward transmission of measles.

Chapter format: The remainder of this chapter will be presented as the full report.

A single imported case of measles and the subsequent outbreak response, Darwin, Northern Territory, January 2025

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Abstract

Measles is a highly contagious viral airborne disease, typically presenting with high fever, cough, conjunctivitis, and a maculopapular rash. No longer endemic in Australia, imported cases of measles do occur with a single case regarded as a public health emergency.

In January 2025, a returned traveller with measles was notified to the Centre for Disease Control (CDC) in Darwin, Northern Territory (NT); the first case in the NT since 2019 to be notified. An outbreak team followed national public health response guidelines. We interviewed the case to determine travel history, infectious period, potential contacts, and provided isolation advice. The electronic database, Research Electronic Data Capture (REDCap), was used for contact tracing to record contact details, vaccination status, and past infection history.

A total of 162 contacts were identified. We successfully contacted and completed follow up for 94% (153/162) of contacts. Of the total 162 contacts, 84% (136/162) were considered to be immune to measles. Of those immune, 90% (123/136) had received 2 doses of the measles-containing vaccine; 7% (9/136) were born before 1966; and 3% (4/136) reported a previous measles infection as a child. During the response, 90% (146/162) of contacts were provided advice only with no further action required, and 2% (4/162) were provided the measles-mumps-rubella (MMR) containing vaccine. Only 1 contact received normal human immunoglobulin (NHIG). The contact tracing was completed by 8 staff over a total of 12 hours on a weekend. We calculated the human resource cost for this outbreak response to be approximately $7,300. No further cases of measles were reported in the NT in the 2 months following this case notification.

This outbreak response highlights how high immunisation rates and a rapid, co-ordinated response using familiar electronic management systems, and staff preparedness training are crucial in preventing the onward transmission of measles.

Keywords: *measles, outbreaks, contact tracing, REDCap, Northern Territory, vaccination.*

Background

Measles is caused by a paramyxovirus from the Morbillivirus genus. It is a highly contagious viral, airborne disease that can lead to severe complications and death.[1] Measles virus infects the respiratory tract, and typical symptoms of patients include high fever, coryza, cough, conjunctivitis and a widespread maculopapular

rash. Populations most vulnerable to serious complications of measles infection include those who are pregnant, those under 5 years of age or those who are immunocompromised.[2] Before the global introduction of the measles- containing vaccine in 1963, and subsequent mass vaccination programs, more than 2 million people died from the measles virus annually.[3] With the introduction of the Expanded Programme on Immunisation (EPI) implemented by the World Health Organization (WHO) in 1974, there has been a dramatic reduction of measles cases with increased vaccine uptake.[3] However, despite the availability of a safe and cost-effective vaccine, measles still remains a leading cause of death among young children in developing countries, with an estimated 107,500 children under 5 years of age dying from measles in 2023.[2]

Measles is a notifiable disease across all states and territories in Australia, with a single case regarded as an outbreak, requiring urgent public health response and surveillance.[4] In 2014, the World Health Organization declared measles eliminated in Australia because it had not been endemic for several years.[5] The Communicable Disease Network Australia (CDNA) has developed a Series of National Guidelines (SoNG) to provide best practice and nationally consistent guidance for notifiable disease events. The CDNA Measles SoNG provides the public health response and management required during an outbreak involving; isolating infectious people, identifying their contacts, providing post-exposure prophylaxis and implementing appropriate education and exclusions as required.[4]

The measles-containing vaccines used in Australia are; measles-mumps-rubella (MMR) which is a live attenuated vaccine recommended for children at 12 months of age; and the measles-mumps-rubella-varicella (MMRV) recommended at 18 months of age.[5] People born before 1966 are generally considered to be immune to measles due to the likelihood of a measles infection as a child.[4] Vaccine immunogenicity and effectiveness of measles-containing vaccines is high; an overall vaccine effectiveness of 96% for 1 dose, and 99% for 2 doses.[6] Therefore people are considered to be 'measles immune' if they were born before 1966, have had documented measles in the past or have received 2 doses of a measles-containing vaccine. However, 95% vaccination coverage is required in the population to ensure herd immunity, due to the measles virus' extremely infectious nature, and subsequent high reproduction number (R_0) in a population susceptible to measles (i.e. those non-immune).[6]

For non-immune individuals exposed to cases of measles there is a narrow window of opportunity to give measles prophylaxis in the post-exposure period of 6 days (144 hours) with best results when given within 3 days (72 hours).[4] Most non-immune exposed individuals should receive MMR (or in some circumstances MMRV) however, for some individuals who are unable to receive the measles-containing vaccine, normal human immunoglobulin (NHIG) is recommended. These individuals include the immunocompromised of all ages, non-immune pregnant mothers and babies born to non-immune mothers from birth to 5 months of age, and for babies 6 to 18 months depending on any doses of measles-containing vaccine they have received, and the timing of post exposure as guided by the CDNA Measles SoNG.[4]

In the Northern Territory (NT), the last measles outbreak occurred in 2019 (Figure 1) with 23 cases total notified, 20 of whom acquired their disease in the NT. The incidence rate for measles in the NT for 2019 was 11[7] per 100,000 which was 16 times greater than the national rate.[7] Over 1,200 contacts were traced to contain this

outbreak.[7] Previous studies have shown that effective public health outbreak responses are resource intensive with most cost attributed to staff related activities i.e. interviewing cases, contact tracing and arranging testing and/or post-exposure prophylaxis.[7] Between 2020 and 2024 there were no measles cases notified in the NT, likely due to the COVID-19 pandemic and subsequent reduced international travel.

The most recent notification of a measles case occurred in January 2025 with an overseas born, NT resident returning from international travel with no documentation or recall of being measles vaccinated. The case presented to the hospital emergency department and was discharged home, presenting 2 days later with a rash. The case was admitted overnight, tested for measles and discharged home the following day with a subsequent positive result to measles. We describe the public health response to this notification

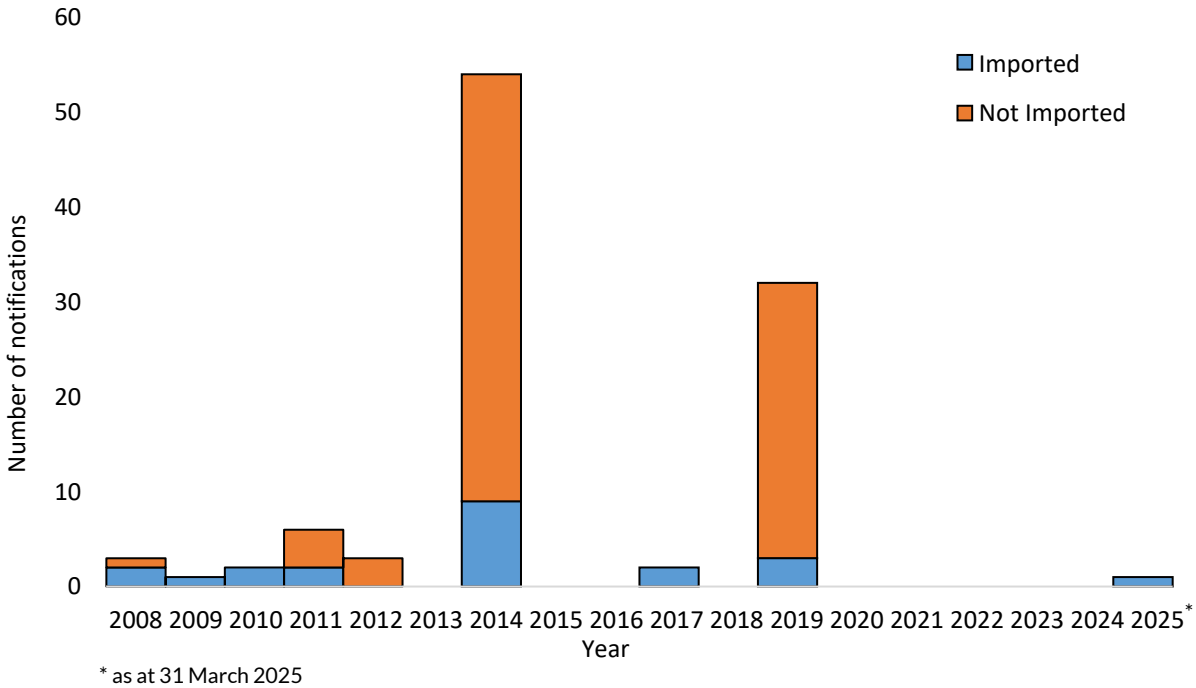
Methods

Outbreak response

The measles index case was confirmed through laboratory definitive evidence, meeting the current national measles case definition defined by the CDNA Measles SoNG.[4] An outbreak management team was formed to respond to the reported case of measles.

The index case was interviewed to determine travel history, infectious period, potential contacts and provided with isolation advice. A timeline of the case movements and contact interventions was devised based on the CDNA Measles SoNG and the NT Centre for Disease Control (CDC) disease reckoner, which calculated a timeframe of dates for the potential development of symptoms in contacts, and the dates of exposure sites for contacts. This enabled prompt collaboration with Cairns Public Health Unit and the National Incident Room in response to the case's interstate movements while infectious.

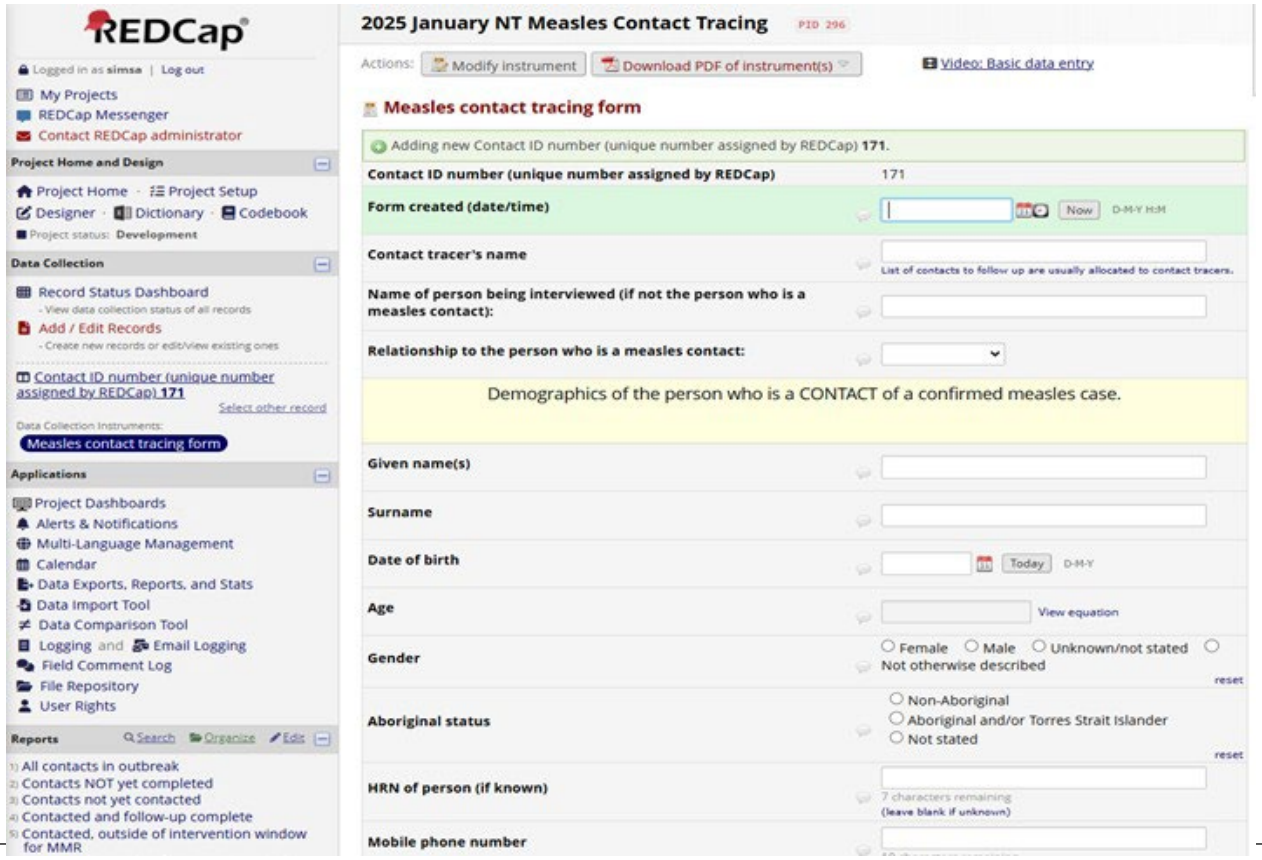
Figure 1. Number of measles notifications from 2008 to 31 March 2025 by imported/not imported case, Darwin, Northern Territory



Contacts were also identified as per the CDNA Measles SoNG guideline definition; as anyone who had or may have shared the same enclosed area for any length of time with the infectious case.[4] Contacts were grouped according to where the case had visited during the infectious period i.e. emergency department, snack bar, workplace, and family barbeque. We classified any person who was at these locations 30 minutes before, and 30 minutes after the case visited as a potential contact. Identified locations were asked to provide Darwin NT CDC with lists of names and contact details for contacts who were present at the nominated times i.e. hospital's Infection Prevention and Control department to provide contacts lists for the case's workplace management team.

Contact tracing was conducted and managed using REDCap (Research Electronic Data Capture) database – a secure web base application for developing and managing online surveys and databases, and the Telstra Integrated Messaging (TIM) system – a rapid, automatic broadcast notification system for two-way short message service (SMS). TIM was used to send SMS to all identified contacts asking them to contact Darwin NT CDC. To distribute the workload, members of the outbreak team were allocated groups of contacts to actively telephone while at the same time receive incoming calls. During telephone calls with contacts a standardised questionnaire was administered via REDCap (Figure 2), with information collected on demographic details, susceptibility to infection, identification of further contacts, and public health advice.

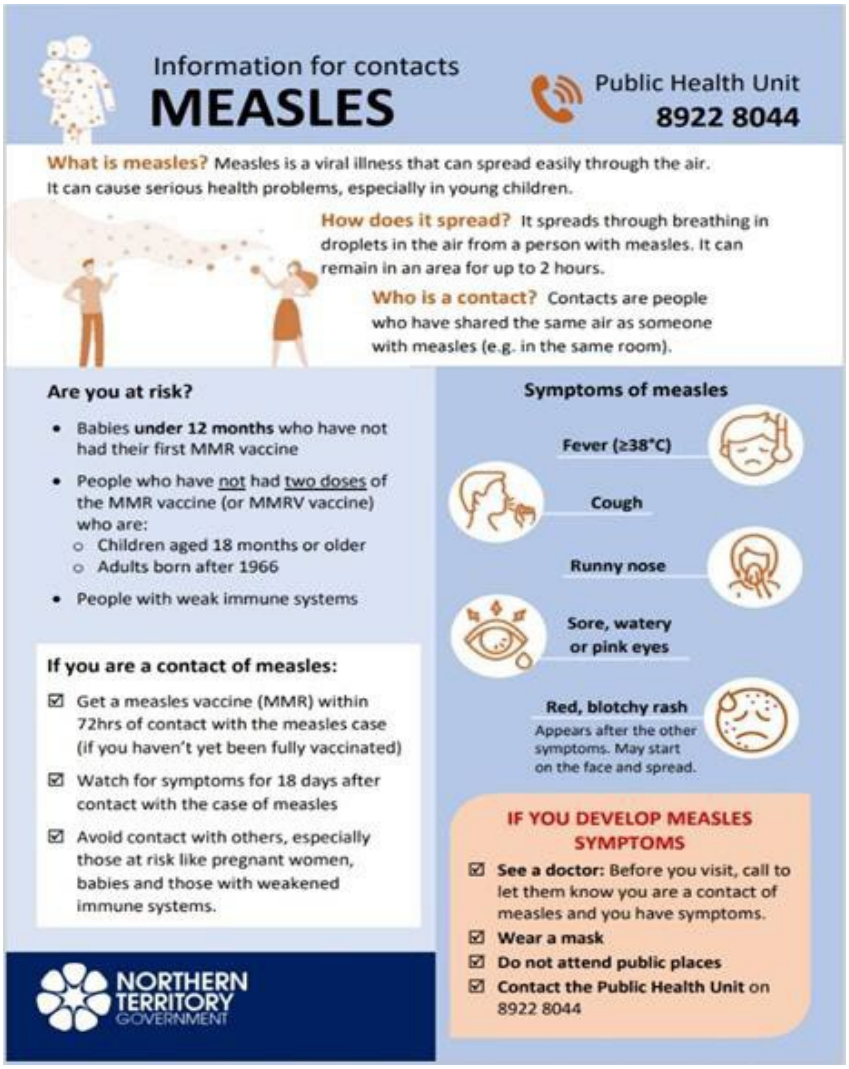
Figure 2. Screenshot of REDCap – Measles questionnaire during contact tracing



Depending on the response to the questionnaire, contacts were categorised into groups to assist with organising and prioritising the outbreak response: (1) suspected cases, (2) contacts requiring post-exposure prophylaxis, (3) contacts waiting for call back, (4) contacts unable to contact/lost to follow-up, and (5) contacts whose follow-up was complete. For telephone calls unanswered, a second text message was sent asking people to call Darwin NT CDC with an attached hyperlink to the NT Health measles factsheet (Figure 3)

Vaccination history of contacts was obtained from the Australian Immunisation Register (AIR) where possible and prepopulated to identify susceptible contacts.[8] Contacts who were considered to be susceptible to measles infection were advised to receive post-exposure prophylaxis. The provision of MMR, MMRV or NHIG was delivered at health clinics or NT CDCs according to the CDNA Measles SoNG.[4] Vaccinations and immunoglobulin was supplied by the Royal Darwin Hospital Pharmacy, co-ordinated by the immunisation staff members of the outbreak team. The CDNA Measles SoNG guidelines outline the eligibility criteria for post-exposure prophylaxis and time of first exposure to infectious case.

Figure 3. Measles factsheet – information for contacts, NT Health


Information for contacts
MEASLES
Public Health Unit
8922 8044
What is measles? Measles is a viral illness that can spread easily through the air. It can cause serious health problems, especially in young children.
How does it spread? It spreads through breathing in droplets in the air from a person with measles. It can remain in an area for up to 2 hours.
Who is a contact? Contacts are people who have shared the same air as someone with measles (e.g. in the same room).
Are you at risk?
Babies under 12 months who have not had their first MMR vaccine
People who have not had two doses of the MMR vaccine (or MMRV vaccine) who are:
Children aged 18 months or older
Adults born after 1966
People with weak immune systems
If you are a contact of measles:
Get a measles vaccine (MMR) within 72hrs of contact with the measles case (if you haven't yet been fully vaccinated)
Watch for symptoms for 18 days after contact with the case of measles
Avoid contact with others, especially those at risk like pregnant women, babies and those with weakened immune systems.
NORTHERN TERRITORY GOVERNMENT
Symptoms of measles
Fever (≥38°C)
Cough
Runny nose
Sore, watery or pink eyes
Red, blotchy rash
Appears after the other symptoms. May start on the face and spread.
IF YOU DEVELOP MEASLES SYMPTOMS
See a doctor: Before you visit, call to let them know you are a contact of measles and you have symptoms.
Wear a mask
Do not attend public places
Contact the Public Health Unit on 8922 8044

Data Analysis

Data from REDCap was extracted and descriptive statistical analysis was conducted using Microsoft Excel 2016 and STATAv18. We calculated frequencies and proportions for variables including vaccination status, contact tracing, and testing outcomes.

A cost analysis was calculated retrospectively to describe the staff costs of this measles outbreak response, with Darwin NT CDC staff members' hourly rate and hours worked during theoutbreak summed. While the immediate response occurred over 4 days, surveillance and remaining follow up continued up until the final date of the potential period of development of symptoms in contacts, however these follow up days were excluded from the cost analysis. Laboratory time and testing costs were not included.

Laboratory

Measles virus polymerase chain reaction (PCR) testing on clinical samples was performed at Territory Pathology, with genotyping performed at the Victorian Infectious Diseases Reference Laboratory (VIDRL).

Results

A total of 162 contacts were identified during the measles outbreak. We successfully contacted and completed follow up for 94% (153/162) of contacts identified. Of the 162 contacts overall, 84% (136/162) were defined as immune to measles with 90% (123/136) confirmed to have received 2 doses of the measles-containing vaccine; 7% (9/136) were born before 1966; and 3% (4/136) reported a previous measles infection as a child.

During the response, 90% (146/162) of contacts were provided advice only, with no further action required, 6% (9/162) were uncontactable and lost to follow up and 2% (4/162) were provided the MMR vaccine. Only 1 contact received NHIG (1/162). Testing for measles was advised and carried out for 1 contact (1/162), and a recommendation to receive the MMR vaccine given for 1 contact (1/162). Of the 9 contacts who were uncontactable or lost to follow-up, 4 were identified as having received 2 doses of the measles-containing vaccine according to their medical records; 1 had a record of only 1 dose of the MMR vaccine and 4 had no documented history of receiving a measles-containing vaccine in the medical records accessed by contact tracing staff. Outcomes resulting from public health actions are summarised in Table 1.

Table 1. Outcome summary of public health actions for contacts identified during measles outbreak response, Darwin, NT January 2025 (n=162)

Outcome	n	%
No further action – advice only	146	90
Uncontactable / lost to follow up Given	9	5
MMR[1] at CDC[2]	4	2
Advised to get MMR[1] vaccine	1	1
Given NHIG[3] at CDC	1	1
Testing for measles arranged / advised	1	1
Total	**162**	**100%**

Note: 1. Measles Mumps Rubella
2. NT Centre for Disease Control

3. Normal human immunoglobulin

There were 5 contact locations identified within the NT during the response. Contacts were ascertained from the 2 presentations to the emergency department which accounted for 78% (127/162) of identified contacts, while additional locations the case had visited when infectious included: household 9% (14/162); workplace 6% (9/162); local snack bar 2% (4/162) and a social gathering 5% (8/162).

The outbreak response took place over a weekend with a total of 8 staff including 1 medical officer, 4 nurses, 2 epidemiologists and 1 Master of Applied Epidemiology (MAE) student, working a cumulative 88 hours overtime over a total of 4 days. We estimated the measles outbreak response to have cost approximately $7,300 in Darwin NT CDC staff resources alone.

Appropriate infection prevention was undertaken when a measles diagnosis was suspected on admission to hospital. Laboratory testing reported the measles genotype D8 with sequence matching strains circulating in Indonesia, re-affirming it as an imported case. There were no secondary cases identified and no further cases notified in the NT as of 31 March 2025.

Discussion

In January 2025, a single case of measles occurred in the NT with a total of 162 contacts identified, of whom 153 (94%) were contacted and given public health advice and actions completed. There were no subsequent cases from this event. The response occurred over a weekend, with the estimated cost for performing this public health response estimated at $7300.

During previous measles outbreaks, Darwin NT CDC used NetEpi as their contact tracing database, however in February 2021 it was decommissioned by the Commonwealth. The NT CDC replaced it with REDCap and incorporated the same recording fields used in NetEpi. As part of the CDC's routine public health surveillance activities, REDCap is used daily, enhancing staff familiarity and proficiency during an outbreak response. Associated policy guidelines and procedure manuals regarding public health surveillance and response to measles is saved on a cloud-based platform (SharePoint) and made accessible to staff to support professional development, and practical guidance during an outbreak response. Following the outbreak response in 2017, regular measles response training for staff was introduced to ensure staff are adequately prepared during a measles outbreak. Our success with this approach supports an evaluation conducted by Hunter New England Health NSW in 2008 on health service capacity to manage protracted public health emergencies, which identified and recommended that staff should be familiar in their routine work with data systems that will be used during an outbreak response.[9]

To inform public health responses during an outbreak response, timely and accurate data collection is needed to inform public health responses, however during public health emergencies, staff and resources on the ground are often stressed which can impact the quality, usefulness, and completeness of collected data.[10] Data extracted from REDCap during this outbreak revealed missing data due to incomplete documentation during contact tracing. To address this challenge, implementing standardised tools to facilitate the collection of essential and consistent data entry has proven effective, such as WHO's disease-specific Outbreak Toolkits that recommend data elements for data collection, reporting and use.[11] Similarly, piloting data collection tools, and training staff in response preparedness can contribute to improving overall data quality.

Darwin NT CDC retrieved contact lists from the hospital's Infection Prevention and Control (IPC) unit. This facilitated and expanded contact tracing and also highlighted an opportunity for both units

to review and streamline the timeliness of current processes for future outbreak responses. It was noted that some contact details in the medical records accessed during contact tracing were either incorrect or outdated. Routine documentation is a legal obligation and crucial for the continuity of patient care, with pubic hospital systems recommended to maintain up-to-date documentation including contact information in patient medical records.[12]

The estimated cost of this outbreak response for 1 case was $7,300 compared to $2,433 per case investigated during an outbreak in Sydney in 2011 that culminated in 26 measles cases being notified.[13] The higher cost we observed may well represent some economy of scale and efficiency that Sydney gained in their case responses over time. However, the cost of responding to a measles case was identified as far less than the cost of hospitalisations as occurred in Sydney or any potential Intensive Care Unit (ICU) admission in Australia, that can occur with measles with an average daily cost ranging from $966 to $5381 per day.[14] Also, not calculated here are those costs associated with potential loss of activity, loss of income and other costs that may be associated with serious illness and care giving.

Globally, measles cases have been increasing with a number of notable outbreaks recently occurring across the United States and European regions.[15] Strict travel restrictions imposed during the COVID-19 pandemic reduced the number of imported cases in Australia, however there have been an increasing number of internationally imported measles cases occurring across states and territories, with local transmission occurring in New South Wales and Victoria, and isolated instances occurring in Western Australia, South Australia and the Northern Territory in the first quarter of this year.[16] Setbacks in immunisation services following the pandemic have also contributed to this increase. To achieve herd immunity for infectious diseases like measles, national coverage needs to be high to prevent transmission. Australia's national vaccination coverage target for all vaccines is 95%.[17] Currently, the fully vaccinated coverage rate in Australian children 5 years of age is 93.76%, while the coverage rate for measles specifically in 2023 was 96.4%.[18] In 2023 coverage of the dose 2 of the measles-containing-vaccine for children aged 24 months of age varied across regions in the NT (81% to ≥95%).[19] It is difficult to estimate coverage of measles immunity for the population 5 years and older who were born after 1966. We do know there are under-vaccinated groups such as Australian adults born between 1966 and 1994 who were initially only recommended 1 dose of the measles-containing vaccine who were later targeted for a recommended 2nd dose in a catch- up program which they may or may not have received. Additionally, there are NT residents and citizens born overseas who may not have been offered or obtained a 2-dose schedule of a measles-containing vaccine.

The global resurgence in measles and regular international travel into Australia increases the risk of local transmission and highlights the need to improve and ensure timely and more complete vaccine uptake.[15] In response to this current resurgence of measles, public health and primary care services across Australia's jurisdictions are frequently updating and disseminating measles health alerts, educational resources and following the CDNA Measles SoNG regarding the diagnosis and management of measles to prevent sustained local transmission. As demonstrated by Darwin NT CDC, an efficient and timely public health response to a single imported case of measles is a priority and needed to prevent ongoing transmission of the virus. Key factors contributing to this systematic public health response included laboratory timeliness for positive PCR notification, staff preparedness training in measles response, accessibility to online resources and staff

familiarity with electronic management systems (i.e. REDCap, TIM).

Conclusion

This measles outbreak response highlights the importance of a rapid, co-ordinated response and herd immunity. The response was critical to preventing transmission of measles, and subsequent outbreak containment, and highlighted the value of using familiar online databases, accessible staff resources and preparedness training. This overall preparedness facilitated a co-ordinated approach within only a small outbreak management team of 8 staff members and reduced costs.

The use of low-cost technologies such as TIMs, also proved to be effective for the efficiency of contact tracing activities and was advantageous in providing a simple method for distributing public health information. With structured and streamlined outbreak response infrastructure, this measles outbreak investigation reinforces the crucial role public health surveillance and response plays in an effective and efficient measles outbreak response. This outbreak investigation is a timely reminder of the need for high childhood vaccination coverage as well as the need for catch-up vaccination in other groups that are non-immune. It reminds all travellers of the need for measles immunity and reinforces the importance of maintaining herd immunity as a most effective public health strategy in maintaining measles elimination in Australia.

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Chapter Five – Health profile of 5–15-year-old Aboriginal children living in a remote community with access to a NT Health primary health care centre

Conduct and Design an Epidemiological Project.

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1. Prologue

1.1. Rationale

This chapter aims to fulfil the MAE requirement to design and conduct an epidemiology project using routine collected health data. The conception of the study was a response to a previously identified gap in knowledge regarding health service utilisation and preventative health care among Aboriginal children 5-15 years living in remote Northern Territory (NT) communities. While primary health care programs for younger children 0-5 years are supported through the Healthy Under 5 Kids Partnering Families (HU5K-PF), structured programs for older children remain limited and unclear following NT Health's 2015 evaluation of the Healthy School Aged Kids (HSAK) program. By examining patterns of health service utilisation including age-specific health programs, clinical presentations, screening coverage and key health outcomes in 2024, this project aims to provide important insight to support child health policy and practice in remote NT Health primary health care centres.

1.2. My role

For this project, I was responsible for developing the research question, study design and analysis. Prior to conducting the research, I collaborated with key stakeholders within NT Health including operational PHC staff. I completed a literature review for this study and then prepared a project proposal for submission to the Menzies School of Health Research and obtained ethics approval from the Human Research Ethics Committee (HREC). I managed a large dataset that was provided in multiple Excel documents which contained routinely collected data from the Primary Care Information System (PCIS). During this process, I categorised and extracted International Classification of Primary (ICPC) codes pertaining to the selected screening and health outcomes, completed extensive data cleaning and merging of up to five datasets with regular review by my field supervisor and clinical data analysist within the Health Statistics and Informatics unit to ensure no data was lost and/or incorrectly coded. I applied descriptive statistics, a logistic regression and other statistical tests including Pearsons Chi Squared test to analyse health service utilisation, screening coverage and incidence of selected health outcomes. Outcomes were also stratified by age group, sex and NT Health region. Results were summarised and illustrated through tables and figures presented in this chapter.

1.3. Lessons learned

This project has been invaluable in teaching me patience and perseverance when working across various separate datasets that are essential to different aspects of the study. I

learned the importance of the need and benefit to thoroughly understand the data provided, to ensure it aligns with the data request. Similarly, I learnt the sheer importance of ensuring data is thoroughly cleaned and coded prior to merging datasets and commencing analysis. Throughout this process, I have significantly strengthened my coding skills in STATA, discovering new techniques and functions I had not previously used. Similarly, it enhanced my proficiency in descriptive statistics and was a great learning opportunity to apply and understand the benefit of statistical tests.

Beyond the technical skills I have acquired, this project emphasised the importance of how epidemiology is instrumental in identifying public health issues and determining the relevant data to synthesise findings to inform public health change. Having previously worked in remote child health programs for children aged 0-5 years, I was learnt the need and benefit to approach data with both neutrality and a broader population health perspective, while also drawing on my clinical skills and understanding of remote settings. This integration of analytical, public health and clinical perspectives has been a profound learning experience that has highlighted how epidemiology can translate data into meaningful insights and actionable recommendations for those it is intended to support.

1.4. Public health impact

This project provides an important insight to the public health needs of Aboriginal children aged 5-15 years living in remote NT communities. Despite frequent presentations to remote primary health care (PHC) centres, the analysis identified inconsistent coverage of preventative health assessments including the Healthy School Aged Kids (HSAK) and Medicare Benefit Schedule 715 assessments. These gaps in service delivery reduce the potential for early detection and management of conditions such as ear disease and anaemia, the two most commonly recorded health outcomes identified in this study and both of which carry long-term implications for a child's learning, development and overall wellbeing. Building on longstanding concerns highlighted in the 2015 HSAK Evaluation by NT Health[12], this study quantifies patterns of health service utilisation including general presentations, uptake of health assessments and incidence of key health outcomes, highlighting where opportunities are being missed within existing remote NT PHC services. These findings also reinforce the importance of working in partnership with families and communities to ensure health programs are responsive to local needs, and more effective in supporting the health and wellbeing of Aboriginal children in remote NT communities.

1.5. Acknowledgements

This project firstly acknowledges Aboriginal children, families and communities across remote the Northern Territory and NT Health staff working in remote PHC services. I would sincerely like to thank Dr Alyson Wright – your mentorship as a field supervisor throughout this project has been very helpful despite your busy workload and am very grateful for sharing your expertise and guidance in navigating large datasets and mentorship in applied epidemiology. Thank you to Dr Amy Parry for your sound guidance, clarification and support with study design concepts. I'm very grateful to the both of you for always making the time to teach, guide and find some humour amongst MAE requirements and deadlines. Thank you to Peter Nihill for frequently answering emails to clarify questions on data and care plans, I'm very grateful for you taking the time to share your expertise in PCIS. To operational PHC staff – thank you for providing such useful information and guidance in the early stages of the study design.

1. Abstract

Regular preventative health care assessments are essential to improving long-term outcomes for Aboriginal children living in remote NT communities.[14] However, the extent to which Aboriginal children aged 5-15 years of age utilise health services and preventative screening programs within NT Health remote primary health care centres (PHC) is unclear. This study aimed to explore and describe patterns of health service utilisation, screening activity and key health outcomes among Aboriginal children 5-15 years attending remote NT Health PHC centres in 2024.

Routinely collected data from NT Health's Primary Care Information System (PCIS) were analysed for children who attended a remote NT PHC centre during 2024. Data reported included the number of overall presentations per child, uptake of the Healthy School Aged Kids and Medicare Benefit Schedule (MBS) 715 health assessments, selected screening activities and the incidence of ear, cardiac, growth and nutrition related conditions. Data were stratified by age group, sex and NT Health region.

Among 3593 children in the study population, the average number of face-to-face presentations per child in 2024 was 6.1 (SD 6.4), with a median of 5 (IQR 2-9). Five children recorded having greater than 50 face-to-face presentations in 2024. Younger children (5-9 years) were more likely to receive preventative health assessments than older children (14-15 years). Coverage of HSAK and MBS 715 health assessments was variable, with an overall higher uptake of HSAK assessments, and greater likelihood of having a completed MBS 715 assessment with a completed HSAK assessment. The incidence of health outcomes including ear infections and anaemia was common, with a significantly higher incidence, 11% (n=160/1388), of ear infections identified in the younger 5–9 year old age group. Regional and demographic differences across screening activity and health outcomes highlighted potential gaps in service delivery and potential missed opportunities for early detection and prevention across remote NT PHC centres.

Despite high levels of health service utilisation, findings suggest that frequent presentations alone may not ensure consistent preventative care and the provision of targeted health programs for young Aboriginal children in remote NT communities. Structural challenges for remote PHC settings, including workforce capacity, resource limitations and integration of the HSAK and 715 health assessments were identified as persisting factors, influencing limitations in the delivery of preventative care. Strengthening age-appropriate, structured preventative programs that collaborate and integrate community perspective to be locally responsive, may support more consistent and effective health care for Aboriginal children in remote NT communities.

2. Background

2.1. Health and wellbeing of Aboriginal children aged 5-15 years

The phase of life between 5-15 years is a pivotal and unique stage for establishing good foundations for health.[1] During this time, young people are experiencing rapid cognitive, psychosocial and physical growth and development, which profoundly influences how they think, feel, make decisions, and interact with the world around them. This stage of development is also associated with increasing autonomy in health and social decision-making, reduced reliance on primary caregivers, and a greater vulnerability to peer influences and risk taking behaviour.[2] Such changes also pose challenges for health care services to effectively engage with this age-group to ensure their health needs are met. Health programs, however that are modelled on youth-centred and youth-friendly initiatives delivered by clinicians who are appropriately trained and motivated to work with this age-group, are regarded as most effective and beneficial.[3] Similarly, youth-friendly approaches that are culturally safe and responsively designed to appropriately meet the needs of young Aboriginal and Torres Strait Islander children and adolescents, have also been found more effective. One example of this is seen in the *'Deadly Choices'* initiative, a preventative health program designed to educate and empower Aboriginal and Torres Strait Islander communities in making healthy choices for themselves and their families.[4] In the Northern Territory (NT), partnerships between *'Deadly Choices'* and health services such as Miwatj Health Aboriginal Corporation in East Arnhem have been working to strengthen youth engagement, chronic disease prevention, and health promotion through health checks and education that are youth-focused, culturally safe and community led.[5] A 2013 evaluation of the *Deadly Choices* initiative in South East Queensland, identified the program as successful in improving self-efficacy, knowledge, attitudes and a number of health behaviours among Aboriginal and Torres Strait Islander people.[6] Similarly, the evaluation found the *Deadly Choices* program to have a positive influence in empowering participants to be positive role models in the community through reshaping their health choices, physical activity and lifestyle.[6]

This model of adolescent health-care service delivery is particularly relevant for primary health care (PHC) services in remote communities of the Northern Territory (NT), where delivering equitable care across a population of 233,000, spread over 1.3 million square kilometres remains an ongoing challenge.[7] Factors of remoteness and limited access to care have been associated with a higher disease burden and poorer health outcomes among Aboriginal children.[8] Despite efforts to improve health outcomes, chronic infections such as acute otitis media are endemic in some remote Aboriginal communities with rates greater than three times the global rates reported by the World Health Organization.[9] In 2023, the NT had the highest

prevalence rates of Rheumatic Heart Disease, with 3170.8 per 100,000 cases.[10] Aboriginal and Torres Strait Islander children aged 5-14 years had a significantly higher prevalence of RHD with 537.2 per 100,000 cases, compared to other Australians in this age group with a prevalence of 45.9 per 100,000.[10]

Such health outcomes among 5–15-year-old Aboriginal children in the NT occur within settings whereby remote PHC services are predominantly facing workforce shortages, high staff turnover, and limited resources with few clinicians specifically trained or comfortable in delivering adolescent health care. These constraints, collectively, contribute to an inconsistent and inequitable delivery of routine preventative primary health care for this age group. Examining how Aboriginal children 5-15 years of age utilise remote NT PHC services, the extent of screening coverage and associated health outcomes, is essential in identifying opportunities for remote PHC services to strengthen models of care to better support the health and wellbeing needs of this age group.

2.2. Challenges to screening and healthcare services for Aboriginal school aged children

Across Australia, the health and wellbeing of school-aged children have long been supported through dedicated school screening programs. Historically, school-based screening commenced nationally in the early 1900's, although in the NT such programs were not implemented until the 1970's.[11] Such programs were designed to improve the health of children living in remote communities across the NT through screening, surveillance, health promotion and education in collaboration with health and education staff, children, families and the wider community.[12]

In 1998, a joint agreement between NT Health and Department of Education was formed for the development and implementation of the Healthy School Aged Kids program (HSAK).[13] Expanding on school health screening items, the HSAK program was intended to include three core components: (1) school and community-based health promotion; (2) integration with other community services and programs for school-aged children (i.e. youth groups); and, (3) child health checks (preventative health assessments).[14] Its design was informed by the '*World Health Organization's 'Health Promoting Schools Framework',* which emphasises the role of health in supporting a child's learning, and the importance of partnerships between schools, health services, communities and families.[15]

The HSAK program has been evaluated on several occasions with the most recent evaluation in 2015. This evaluation highlighted key issues, including low and inconsistent screening coverage, variable access, and limited clarity regarding the shared responsibility of NT Health and Department of Education in providing the program.[16] Weaknesses in data management,

reporting and accountability were also noted, contributing to a fragmentation of health service delivery between schools and PHC centres.

The evaluation also described an overlap of health assessments between the Healthy School Aged Kids (HSAK) assessment and the Medicare Benefit Schedule (MBS) item 715 Aboriginal and Torres Strait Islander health check. While both assessments aim to support age tailored health assessments to support early detection and management of health conditions, their similar scope and role was found at times to create duplication and confusion among health staff and families.[16] Although the intent was for these programs to operate in a complementary manner, it remains unclear whether this model of care is consistently implemented across remote NT PHC centres.

Overall, these challenges highlight potential fragmentation in health service delivery for school-aged children, which appears to have occurred with limited consultation or collaboration with communities and families. Since the 2015 evaluation, it remains unclear how Aboriginal children aged 5-15 years are utilising remote NT Health PHC services, the coverage of screening activities, and associated health outcomes. To identify opportunities to strengthen health service delivery to promote and support the health and wellbeing of Aboriginal children 5-15 years in remote NT communities, this study examined and describes patterns of health service utilisation, including the uptake of the Healthy School Aged Kids (HSAK) assessment and MBS 715 health checks, coverage of key screening activities for ear, cardiac, growth and nutrition, and the incidence of related health outcomes.

3. Study Design and Methodology

3.1. Study design

This study is a cross-sectional, descriptive analysis of clinical health service utilisation, screening activities and incidence of selected health conditions among Aboriginal children aged 5-15 years attending NT Health primary health care centres during 2024.

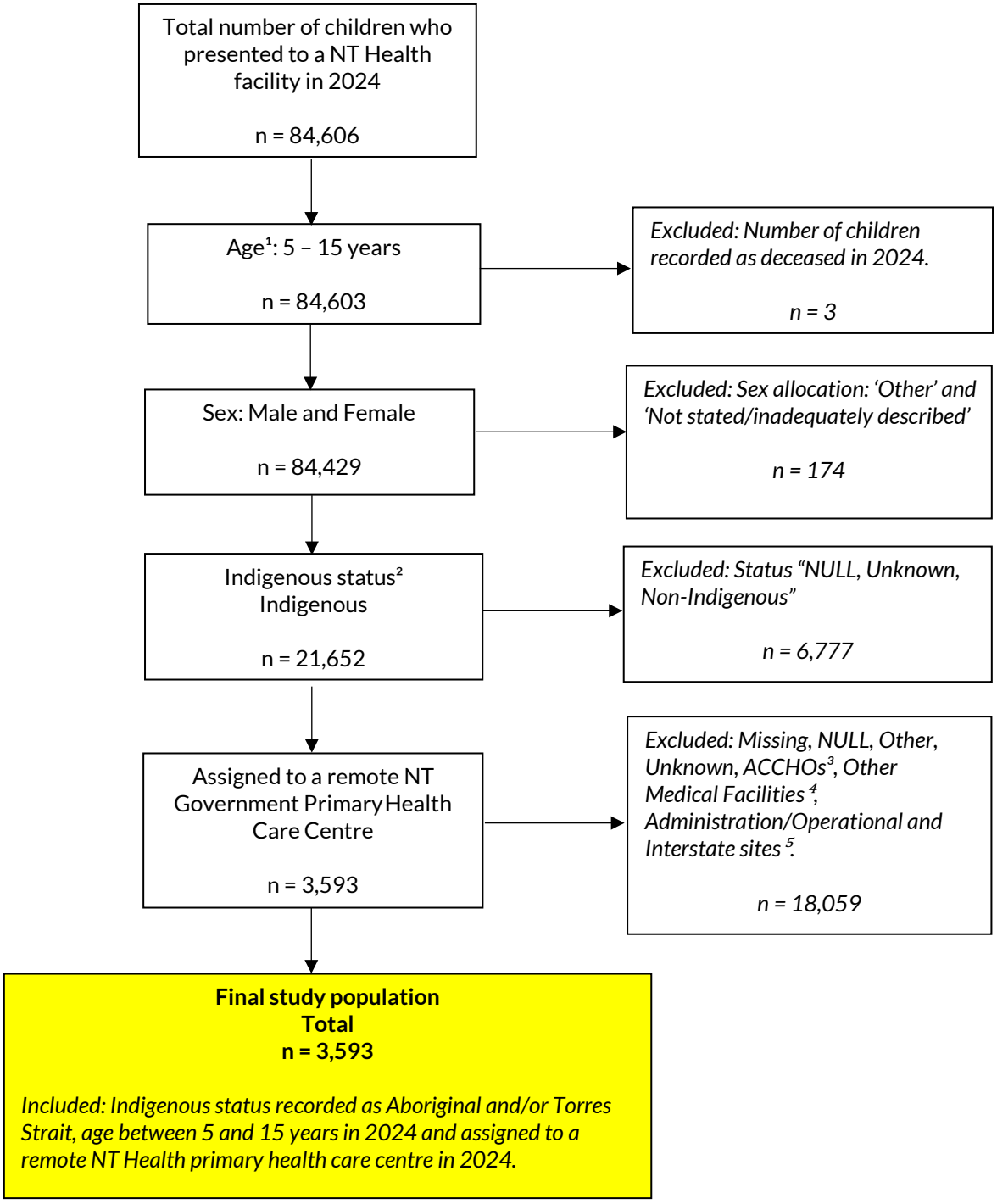
3.2. Study population

The initial population included all children aged 5-15 years who accessed any NT Health service in 2024, including remote PHC centres, urban health clinics and hospitals. This population was identified from administrative client records and represents all children who have ever accessed the NT public health system during this time. From this source population, the study cohort was defined using the following inclusion criteria: children with a recorded Aboriginal and/or Torres Strait Islander status, aged 5-15 years at any point during 2024, assigned to a remote NT Health PHC centre as their usual health service, and with at least one face-face clinical event recorded in the Primary Care Information System (PCIS) during 2024.

Children were excluded from the study population if Indigenous status was missing, not stated and/or recorded as non-Indigenous; aged < 5 or > 15 years in 2024; had sex recorded as ‘Other’ or ‘Not stated/inadequately described’; assigned to a non-NT Health facility as their usual health care provider (Appendix A); or if they only had an administrative and/or non-visit encounter recorded in PCIS.

After applying the above criteria, the final study cohort included 3593 children who had at least one recorded face-face PHC event at a remote NT health PHC centre in 2024. This cohort forms the basis of all analyses of health assessment uptake, screening coverage and incidence of selected health conditions in 2024 (Figure 1).

Figure 1. Flowchart of study population selection, NT Health, 2024.



Note:
Age-range[1]: Calculated using end of year inclusion date 31/12/2024.
Indigenous status[2]: Inclusive of Aboriginal and/or Torres Strait Islander.
ACCHOs[3]: Incudes some urban, regional and remote Aboriginal Community Controlled Health Organisations (not representative of all in the NT) see Appendix A.
Other Medical Facilities[4]: Includes regional hospitals, dental clinics, general practice. See appendix.
Administration/Operational: Clients allocated with an administrative label.
Interstate sites[5]: Includes ACCHOs and government health facilities interstate.

3.3. Data sources

This study used routinely collected data from NT Health's Primary Care Information System (PCIS) to capture clinical presentation information from remote NT Health PHC centres, including service items recording health assessments, screening activities and health outcomes. Additional data were drawn from the Medicare Benefit Schedule (MBS) item numbers recorded in PCIS, with particular focus on the 715 item which relates to Indigenous health assessments completed by medical practitioners.[17]

The International Classification of Primary Care (ICPC) coding system was used to categorise screening and health outcomes documented during the clinical presentation[18] (Appendix B). The Central Australian Rural Practitioners Association (CARPA) Standard Treatment Manual informed the clinical categorisation of health conditions diagnoses and details of screening outcome activities[19] (Appendix D).

Data cleaning was performed to ensure the accuracy and relevance of records for the study population. Records were excluded if Indigenous status was missing, had incomplete demographic information, or the age fell outside the 5–15-year range during 2024. Only records for which the individual's usual primary care provider was recorded as a remote NT Health PHC centre were included (Appendix A).

3.4. Study outcomes and case definitions

To extract data that only represented a face-face presentation of a child/study participant to the PHC centre, data that contained the service item description 'Visit Consultation' were only included. The 'Non-visit Consultation' service item that represents non-face-to-face and non-clinical activity on PCIS were not included.

The study reports on three main outcomes: health assessments, screening and health outcomes, each of which aim to provide a complementary perspective on child health service utilisation and the conditions identified through that utilisation. The three categories are described in the following:

Health Assessments

A child/study participant was defined as having a Healthy School Aged Kids (HSAK) assessment if they had a recorded HSAK-specific service items (Appendix E) in their health care records in PCIS in 2024. Similarly, participants were considered to have received an MBS 715 health assessment if a corresponding MBS 715 item was documented in their PCIS records.

Screening

The study examines three key screening categories: ear, cardiac and growth and nutrition. These screening domains were chosen to provide a broad overview of child health and preventative care activities delivered through remote PHC centres. Some ICPC codes within the cardiac and growth and nutrition screening domains were included to provide a comprehensive view of potential screening activities across the cohort, capturing routine, opportunistic and more specialised encounters (e.g. echocardiograms and/or specific diabetes testing) rather than solely representing less specialised, routine screening activities such as general weight assessments and/or ear assessments.

The screening domains were chosen as they reflect key health priorities among Aboriginal children 5-15 years in remote NT communities.[20] For example, the high prevalence of otitis media among Aboriginal children, which is often associated with hearing loss, delayed language development and reduced educational engagement highlights the importance of examining the coverage of ear screening to ensure timely identification and management of ear conditions.[21] Similarly, a review of cardiac screening addresses the elevated risk of acute rheumatic fever and rheumatic heart disease known to occur among Aboriginal children, enabling early detection and intervention to prevent long term complications.[22] Growth and nutrition screening assessments are also key indicators for child health as they provide insight to patterns of undernutrition, anaemia and emerging risk factors for obesity and Type 2 diabetes.[23]

For each child, relevant screening ICPC codes (Appendix C) corresponding to each domain were extracted from their clinical presentation information. A child was considered ‘ever screened’ in a given domain if at least one corresponding screening activity was recorded during 2024. Details of the ICPC codes and categorisation process for screening activities are provided in Appendix C.

Other screening domains including skin, respiratory, development, mental health, hearing, vision, dental, renal and reproductive categories, while integral to comprehensive child health care, were not included in this study.

Health Outcomes

Health outcomes were categorised into the same three pre-defined domains: ear, cardiac, and growth and nutrition. For each child, relevant ICPC diagnosis codes recorded during clinical presentations were analysed (Appendix D). A child was considered ‘ever diagnosed’ in a domain if at least one corresponding diagnosis was recorded during 2024.

The subcategories within each domain (Table 1) represent the specific health outcomes reviewed in this study. Ear conditions included acute otitis media, otitis media and ear perforations; while cardiac conditions included rheumatic heart disease, acute rheumatic fever

and Sydenham's Chorea. Growth and nutrition related conditions included anaemia, growth faltering, underweight, obesity, type 2 diabetes, pre-diabetes and weight loss. These outcomes were selected as they reflect clinically significant conditions for Aboriginal children aged 5-15 years, and correspond with priority screening areas outlined in the HSAK program (Appendix E) and CARPA, the clinical procedure manual, which guides preventative and diagnostic practices in remote PHC centres.[19] Focusing on these outcome domains and subcategories enables the exploration of the relationship between screening coverage and key health conditions that are central to the health of this age group.

Table 1. Categorisation of health outcomes by domain and subcategory for Aboriginal children 5-15 years attending remote NT PHC centres, 2024.

Health outcome categories	**Health outcome subcategories**
Ear	• Acute otitis media • Otitis Media • Ear perforation
Cardiac	• Rheumatic Heart Disease • Acute Rheumatic Fever • Sydenham's Chorea
Growth and Nutrition	• Anaemia • Growth faltering • Type 2 diabetes • Underweight • Obesity • Pre-Diabetes • Weight loss

3.5. Data management

Records with missing, unknown, or incomplete information for key demographic variables – including Indigenous status, age, sex or assigned PHC centre – were excluded from the analysis (Figure 1). This approach ensured data integrity and allowed accurate definition and stratification of the study population.

To maintain confidentiality and comply with NT Health data reporting governance requirements, small cell sizes were managed carefully. Counts of less than five (n=<5) were not reported explicitly, instead these values were either suppressed or aggregated into broader categories. Proportions based on fewer than five individuals were also not presented.

3.6. Data analysis

Descriptive statistics were used to summarise health service utilisation, screening coverage and incidence of specific health outcomes. Numbers and proportions were calculated for each outcome and data were stratified by age groups (5-9, 10-13, 14-15 years), sex (male, female)

and NT Health regions (Top End, Barkly, Big Rivers, Central Australia, East Arnhem). To describe the overall health service utilisation, the total number of face-to-face clinical presentations per child to a remote NT PHC centre in 2024 was calculated. Measures of central tendency and dispersion, including the mean, median and interquartile range (IQR) were reported to describe the distribution of clinical presentations per child to a remote PHC centre during 2024. Descriptive comparisons of categorical variables across demographic characteristics were examined using chi-squared tests, with statistical significance set at p value <0.05. Multivariable logistic regression was applied specifically to examine factors associated with clinical presentations adjusting for sex, age group and NT Health region. Results from logistic regression are presented as adjusted odds ratio (OR) with 95% confidence intervals (CI). An OR >1 indicates a higher odd of the outcome compared to the reference group, while OR<1, indicates lower odds. Chi-squared tests were used to examine differences across demographic variables. All analyses were undertaken in Stata version 18.

3.7. Ethical and institutional approvals

Support and approval by the First Nations Health and Wellbeing Division of NT Health, was obtained prior to submitting an ethics application. This study was conducted with approval from the Human Research Ethics Committee (HREC) of the Northern Territory Department of Health and Menzies School of Health Research (Reference Number: HREC 2025-5106).

All data were handled in accordance with ethical guidelines for research involving Aboriginal and Torres Strait Islander people. This included secure management of NT health datasets, adherence to CARPA clinical guidelines in defining health outcomes, and suppression of small cell sizes to protect privacy and maintain confidentiality. Remote communities were categorised into broader NT Health regions as to prevent any disclosure or naming of individual communities. Analyses and interpretation were framed to respect principles of cultural sensitivity ensuring that findings are relevant and supportive of Aboriginal child health priorities.

4. Results

4.1. Study participants and health service utilisation

In 2024, a total of 3593 Aboriginal children aged 5-15 years were assigned to a remote NT Health PHC centre. Forty-eight percent (n=1742/3593) of the study population were females, while 52% (n=1851/3593) were males. Across NT Health regions, the highest proportion of children represented in the study population were in Top End and Central Australia 45% (n=1613/3593) and 27% (n=983/3593), respectively.

Across the study population, the average number of face-to-face presentations per child in 2024 was 6.1 (SD 6.4), with a median of 5 (IQR 2-9). Five children recorded having greater than 50 face-to-face presentations in 2024. Upon case review, these five children had at least one chronic condition that required regular treatment, clinical review, and assessments. Of all children in the study, 88% (n=3162/3593) had at least one recorded face-face clinical presentation during the year. A smaller proportion of the population, 12% (n=432/3593) had no record of clinical presentations during the study period (Table 2).

Similar presentation coverage was recorded by sex, 49% (n=1561/3162) females and 51% (n=1601/3162) males presenting at least once to a remote NT Health centre in 2024. By age group, 10-13-year-olds were 41% (OR 0.59, 95% CI 0.47-0.75, p<0.001) and 14-15-year-olds 56% (OR 0.44, CI 0.33-0.58, p<0.001) less likely to have at least one presentation to a clinic than youngest age group 5-9-year-olds.

Presentation coverage varied by region from highest at 91% (n=1469/1613) in Top End and to lowest at 82% (n=222/270) in East Arnhem. Children in East Arnhem were 56% less likely to present than children in Top End (0R 0.44, 95% CI 0.30-0.62, p<0.001), while children in Central Australia were 48% less likely (OR 0.52, 95% CI 0.41-0.67, p<0.001). Presentations of children in Big Rivers was not statistically different from Top End (OR 0.94, 95% CI 0.63-1.40, p=0.748) (Table 2).

Table 2. Demographic characteristics and coverage of clinical presentations among Indigenous children aged 5-15 years assigned to a remote NT Health PHC centre, NT 2024.

Demographic Characteristics	Total study population, n (%)	Children with ≥1 episode of care in 2024, n (%)	Adjusted OR (95% CI) *	p-value
Total	**3593 (100%)**	**3162 (88%)**	–	–
Sex				
Female	1742 (48%)	1561 (49%)	1.00	–
Male	1851 (52%)	1601 (51%)	0.73 (0.59-0.89)	0.003
Age				
5-9 years	1534 (43%)	1402 (44%)	1.00	–
10-13 years	1388 (39%)	1202 (38%)	0.59 (0.47- 0.75)	<0.001
14-15 years	671 (19%)	558 (18%)	0.44 (0.33-0.58)	<0.001
NT Health Region[1]				
Top End	1613 (45%)	1469 (46%)	1.00	–
Central Australia	983 (27%)	834 (26%)	0.52 (0.41-0.67)	<0.001

Barkly	378 (11%)	321 (10%)	0.52 (0.37-0.72)	<0.001
Big Rivers	349 (10%)	316 (10%)	0.94 (0.63 – 1.4)	0.748
East Arnhem	270 (8%)	222 (7%)	0.43 (0.30 – 0.62)	<0.001

Note: *Adjusted for sex, age group and NT Health region.
† p-value <0.05 considered significant
Percentages calculated by column.
NT Health Regions[1]: Classified by remote NT Health PHC centre locations in the Northern Territory (Appendix A).

Healthy School Aged Kids (HSAK) Health Assessments

In 2024, 47% (n=1685/3593) of Aboriginal children aged 5–15 years received a HSAK health assessment, while 53% (n=1908/3593) had no recorded HSAK health assessment. Coverage differed by sex, with 51% (n=880/1742) of females slightly more likely to have a recorded HSAK assessment compared to males, 43% (n=805/1851) (Pearson χ^2 = 17.79, p = 0.001). HSAK coverage also varied by age group: 5–9 years (51%, n=776/1534), 10-13 years (49%, n= 681/1388) and 14–15 years (34%, n=228/671) (Pearson χ^2 = 55.96 p = 0.001). Differences were observed in HSAK coverage by NT Health region, with the highest proportion recorded in Top End (54%, n=872/1613), Central Australia (42%, n=409/983) and East Arnhem (42%, n=114/270). While Barkly recorded the lowest proportion, 35% (n=131/378) (Pearson χ^2 = 69.95, p = 0.001).

MBS Item 715 Health Assessments

In 2024, 23% (n=835/3593) of Aboriginal children aged 5-15 years attending remote NT Health PHC centres in 2024 had a 715-health assessment, while 77% (n=2758/3593) had no record of a completed annual health assessment. There was a statistically significant difference in coverage by sex, 25% females (n=433/1742) and 22% (n=402/1851) of males receiving the assessment (Pearson χ^2 = 8.99, p = 0.011).

Coverage also varied significantly across age groups (Pearson χ^2= 30.98, p = <0.0001), with the highest coverage among children aged 5-9 years at 26% (n=400/1534), followed by 22% (n=312/1388) among 10–13 years and 18% (n=123/671) in 14–15 years.

Similarly, regional variation in MBS 715 coverage was evident (Pearson χ^2= 108.16, p= <0.0001), with the highest assessment coverage in Top End 26% of children (n=418/1613) and lowest coverage in the Barkly at 10% of children (n=38/378).

Overlap of HSAK and MBS 715 Health Assessments

Overall, 49% (n=1756/3593) of children had at least one health assessment recorded (HSAK or MBS 715). Analysis of the overlap of the HSAK and MBS 715 health assessments showed among children without a HSAK assessment (N=1908), only 4% (n=71/1908) had a documented MBS 715 assessment, while the remaining 96% (n=1837/1908) had neither health assessments. In contrast, among children with a HSAK assessment (N=1685), 45%

(n=764/1685) had a recorded MBS 715 assessment, while 55% (n=921/1685) had a HSAK assessment only.

4.2. Screening coverage

In 2024, 67% (n=2391/3593) of Aboriginal children aged 5-15 years attending a remote PHC centre had at least one screening activity recorded in a key health domain – ear, cardiac and/or growth and nutrition – while 33% (n=1202/3593) had no recorded screening activity in any of these areas. Screening coverage varied notably between screening categories: ear screening was recorded for 39% (n=1389/3593) of children, cardiac screening was recorded for 8% (n=279/3593) of children, and growth and nutrition had the highest level of coverage at 57% (n=2065/3593) (Table 3). Variability in screening uptake was observed across both demographic and geographical stratification, with younger children and certain NT Health regions demonstrating higher rates of screening activity across the screening domains (e.g. Barkly and the 5–9-year-old-age group

Table 3. Screening coverage of Aboriginal children aged 5-15 years attending a remote NT Health primary health care centre, by demographic characteristics, NT Health 2024.

Screening Categories	Ear Screening		Growth and Nutrition Screening		Cardiac Screening		
	Screened	**Not Screened**	**Screened**	**Not Screened**	**Screened**	**Not Screened**	**Total**
Total	**1,389 (39%)**	**2,204 (61%)**	**2,065 (57%)**	**1,528 (43%)**	**279 (8%)**	**3,314 (92%)**	**3593 (100%)**
Demographic Characteristics							
Sex							
Female	708 (41%)	1,034 (59%)	1,018 (58%)	724 (42%)	134 (8%)	1,608 (92%)	**1,742**
Male	681 (37%)	1,170 (63%)	1,047 (57%)	804 (43%)	145 (8%)	1,706 (92%)	**1,851**
Age							
5-9 years	773 (50%)	761 (50%)	1,043 (68%)	491 (32%)	114 (7%)	1,420 (93%)	**1,534**
10-13 years	436 (31%)	952 (69%)	749 (54%)	639 (46%)	103 (7%)	1,285 (93%)	**1,388**
14-15 years	180 (27%)	491 (73%)	273 (41%)	398 (59%)	62(9%)	609 (91%)	**671**
NT Health Region							
Top End	698 (43%)	915 (57%)	940 (58%)	673 (42%)	134 (8%)	1,479 (92%)	**1,613**
Central Australia	343 (35%)	640 (65%)	541 (55%)	442 (45%)	76 (8%)	907 (92%)	**983**
Barkly	106 (28%)	272 (72%)	200 (53%)	178 (47%)	23 (6%)	355 (94%)	**378**
Big Rivers	151 (43%)	198 (57%)	227 (65%)	122 (35%)	25 (7%)	324 (93%)	**349**
East Arnhem	91 (34%)	179 (66%)	157 (58%)	113 (42%)	21 (8%)	249 (92%)	**270**

4.3. Incidence of key health outcomes

The following section presents the overall incidence of key health outcomes for the study population. The health outcomes reviewed include types of ear disease, cardiac conditions and growth and nutrition related conditions, including metabolic and haematological diagnoses, such as type two diabetes and iron deficient anaemia. The outcomes reflect whether a child was ever diagnosed with the specific health condition during 2024; however, children must have undergone relevant screening for a condition to be detected and recorded. Although higher screening coverage increases the likelihood of detecting a condition, the relationship was not uniform. For example, despite relatively high coverage of growth and nutrition screening 57% (n=2065/3593), only 5% (n=197/3593) of children were recorded with a growth and nutrition related condition. Whilst, ear screening was lower, 39% (n=1389/3593) but ear conditions were the most frequently recorded outcome out of the three domains, 15% (n=542/3593) followed by growth or nutrition related conditions 5% (n=197/3593) and cardiac conditions 3% (n=108/3593) (Table 4).

Table 4. Incidence of health outcomes among Aboriginal children 5-15 years attending remote NT Health PHC centres, 2024.

Health Outcome (N=3593)	Yes (n %)	No (n %)
Ear	**542 (15%)**	**3051 (85%)**
Acute otitis media	311 (9%)	3282 (91%)
Otitis Media	78 (2%)	3515 (98%)
Ear perforation	163 (4)	3430 (95%)
Growth and Nutrition	**197 (5%)**	**3396 (95%)**
Anaemia	93 (3%)	3500 (97%)
Growth faltering	41 (1%)	3552 (99%)
Type 2 diabetes	14 (0.4%)	3579 (99%)
Underweight	6 (0.2%)	3587 (99.8%)
Obesity	2 (0.06%)	3591 (99.9%)
Pre-Diabetes	1 (0.03%)	3592 (99.97%)
Weight loss	1 (0.03%)	3592 (99.97%)
Cardiac	**108 (3%)**	**3035 (97%)**
Rheumatic Heart Disease	69 (2%)	3035 (98%)
Acute Rheumatic Fever	35 (1%)	3126 (99%)
Sydenham's Chorea	4 (0.1%)	3157 (99.9%)

4.3.1. Incidence of key health outcomes by age, sex, and NT Health region

To examine variation across demographic and geographical groups, the overall incidence for ear, cardiac and growth and nutrition conditions was stratified by age, sex and NT Health regions. Subcategories of specific health conditions was not stratified due to small numbers in some conditions (for example: obesity, pre-diabetes, weight loss, Sydenham's Chorea).

Age and sex

Ear conditions were significantly more common in younger children, with 22% (n=338/1534) of children aged 5-9 years with a least one recorded ear condition, compared to 11% (n=160/1388) of children aged 10-13 years and 6% (n=44/671) aged 14-15 years (Pearson χ^2: 109.63, p= <0.0001). Ear conditions were slightly more common among females, 16% (n=284/1742) compared with 14% (n=258/1851) (Pearson χ^2: 3.92, p= <0.048). There was no significant variation in cardiac conditions by age group (Pearson χ^2: 1.42, p= <0.491). The highest proportion of cardiac conditions was among 14–15-year-olds 3% (n=18/671) compared with the 10–13-year-old and 5–9-year-old age groups who both had <2%. Cardiac conditions were not different by sex with 2% in both females (n=38/1742) and males (n=40/1851) (Pearson χ^2: 0.0018, p= <0.96).Growth and nutrition related conditions were slightly more common in the age group 14–15 years at 6% (n=42/671), followed by 5% in both the 5–9 year-old age group (n=84/1534) and 10–13 year-old age group (n=71/1388). This difference was not statistically significant (Pearson χ^2: 1.14, p= <0.56). Similarly, growth and nutrition related conditions were more common in females, 6% (n=113/1742) compared to males, 10% (n=84/851) (Pearson χ^2: 6.58, p= <0.010).

NT Health Region

Ear health conditions varied slightly by NT Health region with no significant association. The highest proportion of children with a recorded ear condition was in East Arnhem 17% (n=46/270) followed by Big Rivers 16% (n=56/349), Top End 15% (n=248/1613) and Central Australia 14% (n=143/983). The lowest recorded was 13% (n=49/378) in the Barkly region (Pearson χ^2: 2.71, p= <0.60), which also had the lowest ear screening results. Cardiac conditions were relatively consistent across NT Health regions with no significant association (Pearson χ^2: 3.90, p= <0.41), ranging from 2-3% across all NT regions. The highest proportion of children recorded with a cardiac condition was in Barkly, 3% (n=13/378) followed by 2% across the remaining regions, Big Rivers (n=7/349), Central Australia (n=23/983), East Arnhem (n=5/270) and Top End (n=30/1613). The highest incidence of outcomes in growth and nutrition were observed in Top End at 7% (n=109/1613), compared to 5% in Big Rivers (n=18/349) and Central Australia (n=49/983), and 3% in Barkly (n=12/378) and East Arnhem (n=9/270) (Pearson χ^2: 11.89, p= <0.018).

5. Discussion

This study identified a high level of health service utilisation among Aboriginal children aged 5-15 years attending remote NT Health PHC centres in 2024, with a median of 5 presentations per child. Although the rate of contact with remote PHC services was high, coverage of structured health assessments and routine screening activities was limited and uneven. Overall, less than half of children (49%, n=1756/3593) received at least one health assessment recorded (HSAK or MBS 715) in 2024. While the uptake of the HSAK assessment was higher than MBS 715 assessments, a completed HSAK assessment increased the likelihood of a completed MBS 715 assessment, suggesting that these activities are complementary, and that children who have received a structured HSAK assessment are more likely to be reviewed by a medical practitioner and have a completed MBS 715 assessment.

The relatively lower uptake of MBS 715 assessments likely reflects limited availability of medical practitioners in remote PHC centres, where health services are predominantly staffed by nurses and Aboriginal Health Workers and/or Practitioners. Similarly, the high rate of presentations per child in 2024 highlights limited capacity and a missed opportunity of health services to leverage existing contact of children attending PHC centres to complete age-specific health assessments such as the HSAK and MBS 715 assessments. These findings align with the 2015 HSAK evaluation which also identified gaps in program prioritisation, clarity, integration and consistent implementation.[16] Strengthening workforce capacity and refining the model of delivery of these two health assessments could improve uptake of the MBS 715 assessment and integration of the HSAK and MBS 715 health assessments for this age group.

Overall, 67% (n=2391/3593) of Aboriginal children 5-15 years had at least one recorded screening activity in any of the ear, cardiac and growth and nutrition screening domains, while 33% (n=1202/3593) had no recorded screening activity in any of these areas. The higher coverage of growth and nutrition screening 57% (n=2065/3593) may reflect the relative ease of these screening activities, compared to the lower coverage of cardiac screening 8% (n=279/3593), which requires more specialised screening.

The higher rate of screening activity compared to completed HSAK and MBS 715 health assessments further suggests that although children are utilising health services, comprehensive completion of targeted preventative health assessments for this age group remain suboptimal. This is consistent with the health outcomes identified in the study, where an ongoing burden of ill health among Aboriginal children aged 5-15 years was evident. Conditions related to ear health, growth and nutrition and cardiac were present, with acute otitis media and anaemia the most recorded. The higher incidence of acute otitis media compared to otitis media suggests potential delays in identification or follow up, highlighting gaps in early detection and management of ear conditions.

Although the proportion of children with recorded acute rheumatic fever (ARF) and rheumatic heart disease (RHD) was low, the presence of these two cardiac conditions reflects persistent inequities linked to social and environmental determinants of health including over-crowding, housing infrastructure and access to clean water.[22] These findings are consistent with national evidence in which ARF and RHD remain diseases of poverty, and emphasize the need for sustainable, locally responsive prevention programs targeting both underlying determinants of health and clinical care.[22]

This is particularly important in remote NT PHC settings, where workforce instability and resource limitations compound these challenges. Staff shortages, constrained resources, geographical isolation, and a reliance of fly-in-fly out specialist service models can limit the capacity for remote PHC services to prioritise and deliver sustainable preventative health programs. Workforce turnover is particularly pronounced, with a recent study of Aboriginal Community Controlled Health Services in the Northern Territory and Western Australia (2017-2019) reporting an annual clinical staff turnover rate exceeding 151% and 81% at the organisational staff level.[24] For non-Aboriginal clinical staff, the mean annual turnover rate was 162% compared to 81% of Aboriginal clinical staff,[24] highlighting the likelihood of Aboriginal staff providing a more stable and sustainable health service that is more culturally responsive to community needs. This finding also underscores the importance of growing and supporting a local Aboriginal clinical workforce. Initiatives such as the First Nations Health Worker Traineeship Program, developed by the National Aboriginal Community Controlled Health Organization (NACCHO), demonstrate how training and employment opportunities for Aboriginal and Torres Strait Islander people in remote PHC services can enhance sustainability and cultural safety of health services.[25]

This study was designed with the intention of sharing results with remote Aboriginal communities to enable local interpretation, provide insight into the patterns of health service utilisation, health outcomes, and guide recommendations from a cultural and community perspective. While time constraints limited this engagement, findings within this study emphasise the ongoing need for future work to prioritise active collaboration with communities to co-design strategies that strengthen preventative health assessments that align with community needs and priorities to better support the health and wellbeing of Aboriginal children aged 5-15 years living in remote NT communities.

6. Limitations

The dataset obtained for this study included the population of children who have visited a NT Health facility during 2024 captured by PCIS. This provides a comprehensive overview of health service utilisation among remote NT Health PHC centres. However, it did not capture Aboriginal children who received care exclusively from Aboriginal Community Controlled

Organisations (ACCHO's) of which such data is strictly governed and was not available in the timeframes of this project. Consequently, the analysis represents only a subset of Aboriginal children in remote NT and results should not be extrapolated to NT population or other populations more broadly (limited external validity).

The study results may also have been influenced by reporting biases, including clinician and administrative practices, under-reporting and/or incomplete data entry. These factors could lead to an underestimation of `both screening and incidence of health outcomes and that the true extent of preventative care delivery and burden of ill health among the study cohort could be higher than reported. Similarly, if a child's health centre and demographic details are not regularly updated, the record may reflect the original allocation rather than their current locality, which could have influenced whether and how they were captured in the study.

Despite these limitations, the study used routinely collected data which allowed for population-level analysis, providing insights into patterns of health service utilisation, screening activity and incidence of particular health outcomes. The analysis of screening activities and health outcomes has enabled identification of gaps in preventative care for this population, and highlighted areas for targeted improvements that are contextual to remote NT Health PHC services.

7. Conclusion

Improving the health and wellbeing of Aboriginal children in the Northern Territory (NT) remains a critical priority and reflects the need for sustainable, holistic, and culturally responsive preventative health care programs in remote NT PHC centres. Despite the high level of health service utilisation among Aboriginal children aged 5-15 years identified in this study, the delivery and uptake of age-appropriate comprehensive preventative health assessments and routine screening was found to be limited and uneven. Ongoing challenges in the operational context of remote NT PHC centres including workforce instability, staff shortages, geographic isolation and limited resources constrain the consistent delivery of equitable and sustainable preventative health programs. Subsequent health outcomes identified in the study underscore these findings, with preventable conditions such as acute otitis media, anaemia and the ongoing presence of acute rheumatic fever and rheumatic heart disease. Such burden of disease reflects the significant influence of limited health resources in remote settings and broader social and environmental determinants of health, in which factors such as overcrowding and housing infrastructure continue to impact the health of Aboriginal children aged 5-15 years in remote NT communities.[26]

By providing important insights into recent patterns of health service utilisation and associated health outcomes among Aboriginal children aged 5-15 years attending remote NT Health PHC

centres, this study emphasises the need for collaboration with leaders and families in remote NT communities to co-design preventative programs that align with local priorities and needs. A formal report will be published from this study and made accessible for remote PHC operational staff, including policy and project officers within NT Health to guide program planning, inform local consultation, and support initiatives that strengthen preventative care programs to support and improve the health and wellbeing of Aboriginal children in remote NT communities.

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9. Appendices

Appendix A – List of remote NT Health Primary Health Care Centres, NT Health 2024

Clinic_ Name	EDW Clinic Code	Trend District Name	EDW District Name
Adelaide River Community Health Centre	0001	Top End West	Top End
Ali Curung Community Health Centre	0047	Barkly	Barkly
Alpurrurulam Community Health Centre	0048	Barkly	Barkly
Alyangula Community Health Centre	0022	East Arnhem South	East Arnhem
Amunturrngu Community Health Centre	0034	CA Central	Central Australia
Angurugu Community Health Centre	0020	East Arnhem South	East Arnhem
Aputula Community Health Centre	0030	CA South	Central Australia
Atitjere Community Health Centre	0041	CA North	Central Australia
Batchelor Community Health Centre	0002	Top End West	Top End
Belyuen Community Health Centre	0003	Top End Central	Top End
Bonya Community Health Centre	0053	CA North	Central Australia
Borroloola Community Health Centre	0393	Big Rivers	Big Rivers
Canteen Creek Community Health Centre	0049	Barkly	Barkly
Elliott Community Health Centre	0028	Barkly	Barkly
Engawala Community Health Centre	0042	CA North	Central Australia
Epenarra Community Health Centre	0050	Barkly	Barkly
Gunbalanya Community Health Centre	0019	West Arnhem	Top End
Ikuntji Community Health Centre	0035	CA Central	Central Australia
Julanimawu (Nguiu) Community Health Centre	0007	Top End Central	Top End
Laramba Community Health Centre	0043	CA North	Central Australia
Milikapiti Community Health Centre	0006	Top End Central	Top End
Milyakburra Community Health Centre	0023	East Arnhem South	East Arnhem
Nauiyu (Daly River) Community Health Centre	0018	Top End West	Top End
Ntaria (Hermannsburg) Community Health Centre	0029	CA South	Central Australia
Numbulwar Community Health Centre	0024	Big Rivers	Big Rivers
Nyirripi Community Health Centre	0037	CA Central	Central Australia
Nganmarriyanga Community Health Centre	0008	Top End West	Top End
Papunya Community Health Centre	0036	CA Central	Central Australia
Peppimenarti Community Health Centre	0014	Top End West	Top End
Pine Creek Community Health Centre	0026	Big Rivers	Big Rivers
Pirlangimpi Community Health Centre	0009	Top End Central	Top End
Pmara Jutunta Community Health Centre	0045	CA North	Central Australia
Robinson River Community Health Centre	0025	Big Rivers	Big Rivers
Tara Community Health Centre	0051	Barkly	Barkly
Ti Tree Community Health Centre	0052	CA North	Central Australia
Titjikala Community Health Centre	0031	CA South	Central Australia
Umbakumba Community Health Centre	0021	East Arnhem South	East Arnhem
Wadeye Community Health Centre	0015	Top End West	Top End
Wallace Rockhole Community Health Centre	0033	CA South	Central Australia
Watarrka Community Health Centre	0054	CA South	Central Australia
Willowra Community Health Centre	0040	CA North	Central Australia
Wilora Community Health Centre	0046	CA North	Central Australia
Yuelamu Community Health Centre	0039	CA Central	Central Australia
Yuendumu Community Health Centre	0038	CA Central	Central Australia

Appendix B International Classification of Primary Care Codes and Definitions

ICPC-2 – English

International Classification of Primary Care – 2nd Edition

Wonca International Classification Committee (WICC)

Process codes

-30	Medical Exam/Eval-Complete
-31	Medical Examination/Health Evaluation-Partial/Pre-op check
-32	Sensitivity Test
-33	Microbiological/Immunological Test
-34	Blood Test
-35	Urine Test
-36	Faeces Test
-37	Histological/Exfoliative Cytology
-38	Other Laboratory Test NEC
-39	Physical Function Test
-40	Diagnostic Endoscopy
-41	Diagnostic Radiology/Imaging
-42	Electrical Tracings
-43	Other Diagnostic Procedures
-44	Preventive Imunisations/Medications
-45	Observe/Educate/Advice/Diet
-46	Consult with Primary Care Provider
-47	Consultation with Specialist
-48	Clarification/Discuss Patient's RFE
-49	Other Preventive Procedures
-50	Medicat-Script/Reqst/Renew/Inject
-51	Incise/Drain/Flush/Aspirate
-52	Excise/Remove/Biopsy/Destruction/Debride
-53	Instrument/Catheter/Intubate/Dilate
-54	Repair/Fixate-Suture/Cast/Prosthetic
-55	Local Injection/Infiltration
-56	Dress/Press/Compress/Tamponade
-57	Physical Medicine/Rehabilitation
-58	Therapeutic Counselling/Listening
-59	Other Therapeutic Procedure NEC
-60	Results Tests/Procedures
-61	Results Exam/Test/Record
-62	Administrative Procedure
-63	Follow-up Encounter Unspecified
-64	Encounter Initiated by Provider
-65	Encounter Initiated third person
-66	Refer to Other Provider (EXCL. M.D.)
-67	Referral to Physician/Specialist/Clinic/Hospital
-68	Other Referrals NEC
-69	Other Reason for Encounter NEC

General and Unspecified — A

A01	Pain general/multiple sites
A02	Chills
A03	Fever
A04	Weakness/tiredness general
A05	Feeling ill
A06	Fainting/syncope
A07	Coma
A08	Swelling
A09	Sweating problem
A10	Bleeding/haemorrhage NOS
A11	Chest pain NOS
A13	Concern/fear medical treatment
A16	Irritable infant
A18	Concern about appearance
A20	Euthanasia request/discussion
A21	Risk factor for malignancy
A23	Risk factor NOS
A25	Fear of death/dying
A26	Fear of cancer NOS
A27	Fear of other disease NOS
A28	Limited function/disability NOS
A29	General symptom/complaint other
A70	Tuberculosis
A71	Measles
A72	Chickenpox
A73	Malaria
A74	Rubella
A75	Infectious mononucleosis
A76	Viral exanthem other
A77	Viral disease other/NOS
A78	Infectious disease other/NOS
A79	Malignancy NOS
A80	Trauma/injury NOS
A81	Multiple trauma/injuries
A82	Secondary effect of trauma
A84	Poisoning by medical agent
A85	Adverse effect medical agent
A86	Toxic effect non-medicinal substance
A87	Complication of medical treatment
A88	Adverse effect physical factor
A89	Effect prosthetic device
A90	Congenital anomaly OS/multiple
A91	Abnormal result investigation NOS
A92	Allergy/allergic reaction NOS
A93	Premature newborn
A94	Perinatal morbidity other
A95	Perinatal mortality
A96	Death
A97	No disease
A98	Health maintenance/prevention
A99	General disease NOS

Blood, Blood Forming Organs and Immune Mechanism — B

B02	Lymph gland(s) enlarged/painful
B04	Blood symptom/complaint
B25	Fear of aids/HIV
B26	Fear cancer blood/lymph
B27	Fear blood/lymph disease other
B28	Limited function/disability
B29	Sympt/complt lymph/immune other
B70	Lymphadenitis acute
B71	Lymphadenitis non-specific
B72	Hodgkin's disease/lymphoma
B73	Leukaemia
B74	Malignant neoplasm blood other
B75	Benign/unspecified neoplasm blood
B76	Ruptured spleen traumatic
B77	Injury blood/lymph/spleen other
B78	Hereditary haemolytic anaemia
B79	Congen.anom. blood/lymph other
B80	Iron deficiency anaemia
B81	Anaemia, Vitamin B12/folate def.
B82	Anaemia other/unspecified
B83	Purpura/coagulation defect
B84	Unexplained abnormal white cells
B87	Splenomegaly
B90	HIV-infection/aids
B99	Blood/lymph/spleen disease other

PROCESS CODES

SYMPTOMS/COMPLAINTS

INFECTIONS

NEOPLASMS

INJURIES

CONGENITAL ANOMALIES

OTHER DIAGNOSES

Digestive — D

D01	Abdominal pain/cramps general
D02	Abdominal pain epigastric
D03	Heartburn
D04	Rectal/anal pain
D05	Perianal itching
D06	Abdominal pain localized other
D07	Dyspepsia/indigestion
D08	Flatulence/gas/belching
D09	Nausea
D10	Vomiting
D11	Diarrhoea
D12	Constipation
D13	Jaundice
D14	Haematemesis/vomiting blood
D15	Melaena
D16	Rectal bleeding
D17	Incontinence of bowel
D18	Change faeces/bowel movements
D19	Teeth/gum symptom/complaint
D20	Mouth/tongue/lip symptom/complt.
D21	Swallowing problem
D23	Hepatomegaly
D24	Abdominal mass NOS
D25	Abdominal distension
D26	Fear of cancer of digestive system
D27	Fear of digestive disease other
D28	Limited function/disability (d)
D29	Digestive symptom/complaint other
D70	Gastrointestinal infection
D71	Mumps
D72	Viral hepatitis
D73	Gastroenteritis presumed infection
D74	Malignant neoplasm stomach
D75	Malignant neoplasm colon/rectum
D76	Malignant neoplasm pancreas
D77	Malig. neoplasm digest other/NOS
D78	Neoplasm digest benign/uncertain
D79	Foreign body digestive system
D80	Injury digestive system other
D81	Congen. anomaly digestive system
D82	Teeth/gum disease
D83	Mouth/tongue/lip disease
D84	Oesophagus disease
D85	Duodenal ulcer
D86	Peptic ulcer other
D87	Stomach function disorder
D88	Appendicitis
D89	Inguinal hernia
D90	Hiatus hernia
D91	Abdominal hernia other
D92	Diverticular disease
D93	Irritable bowel syndrome
D94	Chronic enteritis/ulcerative colitis
D95	Anal fissure/perianal abscess
D96	Worms/other parasites
D97	Liver disease NOS
D98	Cholecystitis/cholelithiasis
D99	Disease digestive system, other

Eye — F

F01	Eye pain
F02	Red eye
F03	Eye discharge
F04	Visual floaters/spots
F05	Visual disturbance other
F13	Eye sensation abnormal
F14	Eye movements abnormal
F15	Eye appearance abnormal
F16	Eyelid symptom/complaint
F17	Glasses symptom/complaint
F18	Contact lens symptom/complaint
F27	Fear of eye disease
F28	Limited function/disability (f)
F29	Eye symptom/complaint other
F70	Conjunctivitis infectious
F71	Conjunctivitis allergic
F72	Blepharitis/stye/chalazion
F73	Eye infection/inflammation other
F74	Neoplasm of eye/adnexa
F75	Contusion/haemorrhage eye
F76	Foreign body in eye
F79	Injury eye other
F80	Blocked lacrimal duct of infant
F81	Congenital anomaly eye other
F82	Detached retina
F83	Retinopathy
F84	Macular degeneration
F85	Corneal ulcer
F86	Trachoma
F91	Refractive error
F92	Cataract
F93	Glaucoma
F94	Blindness
F95	Strabismus
F99	Eye/adnexa disease, other

Ear — H

H01	Ear pain/earache
H02	Hearing complaint
H03	Tinnitus, ringing/buzzing ear
H04	Ear discharge
H05	Bleeding ear
H13	Plugged feeling ear
H15	Concern with appearance of ears
H27	Fear of ear disease
H28	Limited function/disability ear
H29	Ear symptom/complaint other
H70	Otitis externa
H71	Acute otitis media/myringitis
H72	Serous otitis media
H73	Eustachian salpingitis
H74	Chronic otitis media
H75	Neoplasm of ear
H76	Foreign body in ear
H77	Perforation ear drum
H78	Superficial injury of ear
H79	Ear injury other
H80	Congenital anomaly of ear
H81	Excessive ear wax
H82	Vertiginous syndrome
H83	Otosclerosis
H84	Presbyacusis
H85	Acoustic trauma
H86	Deafness
H99	Ear/mastoid disease, other

Cardiovascular — K

K01	Heart pain
K02	Pressure/tightness of heart
K03	Cardiovascular pain NOS
K04	Palpitations/awareness of heart
K05	Irregular heartbeat other
K06	Prominent veins
K07	Swollen ankles/oedema
K22	Risk factor cardiovascular disease
K24	Fear of heart disease
K25	Fear of hypertension
K27	Fear cardiovascular disease other
K28	Limited function/disability (k)
K29	Cardiovascular sympt./complt. other
K70	Infection of circulatory system
K71	Rheumatic fever/heart disease
K72	Neoplasm cardiovascular
K73	Congenital anomaly cardiovascular
K74	Ischaemic heart disease w. angina
K75	Acute myocardial infarction
K76	Ischaemic heart disease w/o angina
K77	Heart failure
K78	Atrial fibrillation/flutter
K79	Paroxysmal tachycardia
K80	Cardiac arrhythmia NOS
K81	Heart/arterial murmur NOS
K82	Pulmonary heart disease
K83	Heart valve disease NOS
K84	Heart disease other
K85	Elevated blood pressure
K86	Hypertension uncomplicated
K87	Hypertension complicated
K88	Postural hypotension
K89	Transient cerebral ischaemia
K90	Stroke/cerebrovascular accident
K91	Cerebrovascular disease
K92	Atherosclerosis/PVD
K93	Pulmonary embolism
K94	Phlebitis/thrombophlebitis
K95	Varicose veins of leg
K96	Haemorrhoids
K99	Cardiovascular disease other

Musculoskeletal — L

L01	Neck symptom/complain
L02	Back symptom/complaint
L03	Low back symptom/complaint
L04	Chest symptom/complaint
L05	Flank/axilla symptom/complaint
L07	Jaw symptom/complaint
L08	Shoulder symptom/complaint
L09	Arm symptom/complaint
L10	Elbow symptom/complaint
L11	Wrist symptom/complaint
L12	Hand/finger symptom/complaint
L13	Hip symptom/complaint
L14	Leg/thigh symptom/complaint
L15	Knee symptom/complaint
L16	Ankle symptom/complaint
L17	Foot/toe symptom/complaint
L18	Muscle pain
L19	Muscle symptom/complaint NOS
L20	Joint symptom/complaint NOS
L26	Fear of cancer musculoskeletal
L27	Fear musculoskeletal disease other
L28	Limited function/disability (l)
L29	Sympt/complt. Musculoskeletal other
L70	Infections musculoskeletal system
L71	Malignant neoplasm musculoskeletal
L72	Fracture: radius/ulna
L73	Fracture: tibia/fibula
L74	Fracture: hand/foot bone
L75	Fracture: femur
L76	Fracture: other
L77	Sprain/strain of ankle
L78	Sprain/strain of knee
L79	Sprain/strain of joint NOS
L80	Dislocation/subluxation
L81	Injury musculoskeletal NOS
L82	Congenital anomaly musculoskeletal
L83	Neck syndrome
L84	Back syndrome w/o radiating pain
L85	Acquired deformity of spine
L86	Back syndrome with radiating pain
L87	Bursitis/tendinitis/synovitis NOS
L88	Rheumatoid/seropositive arthritis
L89	Osteoarthrosis of hip
L90	Osteoarthrosis of knee
L91	Osteoarthrosis other
L92	Shoulder syndrome
L93	Tennis elbow
L94	Osteochondrosis
L95	Osteoporosis
L96	Acute internal damage knee
L97	Neoplasm benign/unspec musculo.
L98	Acquired deformity of limb
L99	Musculoskeletal disease, other

Neurological — N

N01	Headache
N03	Pain face
N04	Restless legs
N05	Tingling fingers/feet/toes
N06	Sensation disturbance other
N07	Convulsion/seizure
N08	Abnormal involuntary movements
N16	Disturbance of smell/taste
N17	Vertigo/dizziness
N18	Paralysis/weakness
N19	Speech disorder
N26	Fear cancer neurological system
N27	Fear of neurological disease other
N28	Limited function/disability (n)
N29	Neurological symptom/complt. other
N70	Poliomyelitis
N71	Meningitis/encephalitis
N72	Tetanus
N73	Neurological infection other
N74	Malignant neoplasm nervous system
N75	Benign neoplasm nervous system
N76	Neoplasm nervous system unspec.
N79	Concussion
N80	Head injury other
N81	Injury nervous system other
N85	Congenital anomaly neurological
N86	Multiple sclerosis
N87	Parkinsonism
N88	Epilepsy
N89	Migraine
N90	Cluster headache
N91	Facial paralysis/bell's palsy
N92	Trigeminal neuralgia
N93	Carpal tunnel syndrome
N94	Peripheral neuritis/neuropathy
N95	Tension headache
N99	Neurological disease, other

Psychological P

P01 Feeling anxious/nervous/tense
P02 Acute stress reaction
P03 Feeling depressed
P04 Feeling/behaving irritable/angry
P05 Senility, feeling/behaving old
P06 Sleep disturbance
P07 Sexual desire reduced
P08 Sexual fulfilment reduced
P09 Sexual preference concern
P10 Stammering/stuttering/tic
P11 Eating problem in child
P12 Bedwetting/enuresis
P13 Encopresis/bowel training problem
P15 Chronic alcohol abuse
P16 Acute alcohol abuse
P17 Tobacco abuse
P18 Medication abuse
P19 Drug abuse
P20 Memory disturbance
P22 Child behaviour symptom/complaint
P23 Adolescent behav. Symptom/complt.
P24 Specific learning problem
P25 Phase of life problem adult
P27 Fear of mental disorder
P28 Limited function/disability (p)
P29 Psychological symptom/complt other
P70 Dementia
P71 Organic psychosis other
P72 Schizophrenia
P73 Affective psychosis
P74 Anxiety disorder/anxiety state
P75 Somatization disorder
P76 Depressive disorder
P77 Suicide/suicide attempt
P78 Neuraesthenia/surmenage
P79 Phobia/compulsive disorder
P80 Personality disorder
P81 Hyperkinetic disorder
P82 Post-traumatic stress disorder
P85 Mental retardation
P86 Anorexia nervosa/bulimia
P98 Psychosis NOS/other
P99 Psychological disorders, other

Respiratory R

R01 Pain respiratory system
R02 Shortness of breath/dyspnoea
R03 Wheezing
R04 Breathing problem, other
R05 Cough
R06 Nose bleed/epistaxis
R07 Sneezing/nasal congestion
R08 Nose symptom/complaint other
R09 Sinus symptom/complaint
R21 Throat symptom/complaint
R23 Voice symptom/complaint
R24 Haemoptysis
R25 Sputum/phlegm abnormal
R26 Fear of cancer respiratory system
R27 Fear of respiratory disease, other
R28 Limited function/disability (r)
R29 Respiratory symptom/complaint oth.
R71 Whooping cough
R72 Strep throat
R73 Boil/abscess nose
R74 Upper respiratory infection acute
R75 Sinusitis acute/chronic
R76 Tonsillitis acute
R77 Larynqitis/tracheitis acute
R78 Acute bronchitis/bronchiolitis
R79 Chronic bronchitis
R80 Influenza
R81 Pneumonia
R82 Pleurisy/pleural effusion
R83 Respiratory infection other
R84 Maliqnant neoplasm bronchus/lunq
R85 Malinant neoplasm respiratory, other
R86 Benign neoplasm respiratory
R87 Foreign body nose/larynx/bronch
R88 Injury respiratory other
R89 Congenital anomaly respiratory
R90 Hypertrophy tonsils/adenoids
R92 Neoplasm respiratory unspecified
R95 Chronic obstructive pulmonary dis
R96 Asthma
R97 Allergic rhinitis
R98 Hyperventilation syndrome
R99 Respiratory disease other

PROCESS CODES
SYMPTOMS/COMPLAINTS
INFECTIONS
NEOPLASMS
INJURIES
CONGENITAL ANOMALIES
OTHER DIAGNOSES

Skin S

S01 Pain/tenderness of skin
S02 Pruritus
S03 Warts
S04 Lump/swelling localized
S05 Lumps/swellings generalized
S06 Rash localized
S07 Rash generalized
S08 Skin colour change
S09 Infected finger/toe
S10 Boil/carbuncle
S11 Skin infection post-traumatic
S12 Insect bite/sting
S13 Animal/human bite
S14 Burn/scald
S15 Foreign body in skin
S16 Bruise/contusion
S17 Abrasion/scratch/blister
S18 Laceration/cut
S19 Skin injury other
S20 Corn/callosity
S21 Skin texture symptom/complaint
S22 Nail symptom/complaint
S23 Hair loss/baldness
S24 Hair/scalp symptom/complaint
S26 Fear of cancer of skin
S27 Fear of skin disease other
S28 Limited function/disability (s)
S29 Skin symptom/complaint other
S70 Herpes zoster
S71 Herpes simplex
S72 Scabies/other acariasis
S73 Pediculosis/skin infestation other
S74 Dermatophytosis
S75 Moniliasis/candidiasis skin
S76 Skin infection other
S77 Malignant neoplasm of skin
S78 Lipoma
S79 Neoplasm skin benign/unspecified
S80 Solar keratosis/sunburn
S81 Haemanqioma/lymphanqioma
S82 Naevus/mole
S83 Congenital skin anomaly other
S84 Impetigo
S85 Pilonidal cyst/fistula
S86 Dermatitis seborrhoeic
S87 Dermatitis/atopic eczema
S88 Dermatitis contact/allergic
S89 Diaper rash
S90 Pityriasis rosea
S91 Psoriasis
S92 Sweat gland disease
S93 Sebaceous cyst
S94 Ingrowing nail
S95 Molluscum contagiosum
S96 Acne
S97 Chronic ulcer skin
S98 Urticaria
S99 Skin disease, other

Endocrine/Metabolic and Nutritional T

T01 Excessive thirst
T02 Excessive appetite
T03 Loss of appetite
T04 Feeding problem of infant/child
T05 Feeding problem of adult
T07 Weight gain
T08 Weight loss
T10 Growth delay
T11 Dehydration
T26 Fear of cancer of endocrine system
T27 Fear endocrine/metabolic dis other
T28 Limited function/disability (t)
T29 Endocrine/met./sympt/complt other
T70 Endocrine infection
T71 Malignant neoplasm thyroid
T72 Benign neoplasm thyroid
T73 Neoplasm endocrine oth/unspecified
T78 Thyroglossal duct/cyst
T80 Congenital anom endocrine/metab.
T81 Goitre
T82 Obesity
T83 Overweight
T85 Hyperthyroidism/thyrotoxicosis
T86 Hypothyroidism/myxoedema
T87 Hypoglycaemia
T89 Diabetes insulin dependent
T90 Diabetes non-insulin dependent
T91 Vitamin/nutritional deficiency
T92 Gout
T93 Lipid disorder
T99 Endocrine/metab/nutrit. dis. other

Urological U

U01 Dysuria/painful urination
U02 Urinary frequency/urgency
U04 Incontinence urine
U05 Urination problems other
U06 Haematuria
U07 Urine symptom/complaint other
U08 Urinary retention
U13 Bladder symptom/complaint other
U14 Kidney symptom/complaint
U26 Fear of cancer of urinary system
U27 Fear of urinary disease other
U28 Limited function/disability urinary
U29 Urinary symptom/complaint other
U70 Pyelonephritis/pyelitis
U71 Cystitis/urinary infection other
U72 Urethritis
U75 Malignant neoplasm of kidney
U76 Malignant neoplasm of bladder
U77 Maliqnant neoplasm urinary other
U78 Benign neoplasm urinary tract
U79 Neoplasm urinary tract NOS
U80 Injury urinary tract
U85 Congenital anomaly urinary tract
U88 Glomerulonephritis/nephrosis
U90 Orthostatic albumin./proteinuria
U95 Urinary calculus
U98 Abnormal urine test NOS
U99 Urinary disease, other

Pregnancy, Childbearing, Family Planning W

W01 Question of pregnancy
W02 Fear of pregnancy
W03 Antepartum bleeding
W05 Pregnancy vomiting/nausea
W10 Contraception postcoital
W11 Contraception oral
W12 Contraception intrauterine
W13 Sterilization
W14 Contraception other
W15 Infertility/subfertility
W17 Post-partum bleeding
W18 Post-partum symptom/complaint oth.
W19 Breast/lactation symptom/complaint
W21 Concern body image in pregnancy
W27 Fear complications of pregnancy
W28 Limited function/disability (w)
W29 Pregnancy symptom/complaint other
W70 Puerperal infection/sepsis
W71 Infection complicating pregnancy
W72 Maliqnant neoplasm relate to preq.
W73 Benign/unspec. neoplasm/pregnancy
W75 Injury complicating pregnancy
W76 Congenital anomaly complicate preq.
W78 Pregnancy
W79 Unwanted pregnancy
W80 Ectopic pregnancy
W81 Toxaemia of pregnancy
W82 Abortion spontaneous
W83 Abortion induced
W84 Pregnancy high risk
W85 Gestational diabetes
W90 Uncomplicate labour/delivery live
W91 Uncomplicate labour/delivery still
W92 Complicate labour/ delivery livebirth
W93 Complicate labour/delivery stillbirth
W94 Puerperal mastitis
W95 Breast disorder in pregnancy other
W96 Complications of puerperium other
W99 Disorder pregnancy/delivery, other

Female Genital X

X01 Genital pain female
X02 Menstrual pain
X03 Intermenstrual pain
X04 Painful intercourse female
X05 Menstruation absent/scanty
X06 Menstruation excessive
X07 Menstruation irregular/frequent
X08 Intermenstrual bleeding
X09 Premenstrual symptom/complaint
X10 Postponement of menstruation
X11 Menopausal symptom/complaint
X12 Postmenopausal bleeding
X13 Postcoital bleeding
X14 Vaginal discharge
X15 Vaginal symptom/complaint other
X16 Vulval symptom/complaint
X17 Pelvis symptom/complaint female
X18 Breast pain female
X19 Breast lump/mass female
X20 Nipple symptom/complaint female
X21 Breast symptom/complt. female other
X22 Concern breast appearance female
X23 Fear sexually transmitted disease (f)
X24 Fear of sexual dysfunction female
X25 Fear of genital cancer female
X26 Fear of breast cancer female
X27 Fear genital/breast disease other (f)
X28 Limited function/disability (x)
X29 Genital symptom/complt female oth.
X70 Syphilis female
X71 Gonorrhoea female
X72 Genital candidiasis female
X73 Genital trichomoniasis female
X74 Pelvic inflammatory disease
X75 Maliqnant neoplasm cervix
X76 Maliqnant neoplasm breast female
X77 Malignant neoplasm genital other (f)
X78 Fibromyoma uterus
X79 Benign neoplasm breast female
X80 Benign neoplasm female genital
X81 Genital neoplasm oth/unspecied (f)
X82 Injury genital female
X83 Congenital anomaly genital female
X84 Vaginitis/vulvitis NOS
X85 Cervical disease NOS
X86 Abnormal cervix smear
X87 Uterovaginal prolapse
X88 Fibrocystic disease breast
X89 Premenstrual tension syndrome
X90 Genital herpes female
X91 Condylomata acuminata female
X92 Chlamydia infection genital (f)
X99 Genital disease female, other

Male Genital Y

Y01 Pain in penis
Y02 Pain in testis/scrotum
Y03 Urethral discharge
Y04 Penis symptom/complaint other
Y05 Scrotum/testis sympt/complt. other
Y06 Prostate symptom/complaint
Y07 Impotence NOS
Y08 Sexual function sympt./complt.(m)
Y10 Infertility/subfertility male
Y13 Sterilization male
Y14 Family planning male other
Y16 Breast symptom/complaint male
Y24 Fear of sexual dysfunction male
Y25 Fear sexually transmitted dis. male
Y26 Fear of genital cancer male
Y27 Fear of genital disease male other
Y28 Limited function/disability (y)
Y29 Genital sympt./complt.male other
Y70 Syphilis male
Y71 Gonorrhoea male
Y72 Genital herpes male
Y73 Prostatitis/seminal vesiculitis
Y74 Orchitis/epididymitis
Y75 Balanitis
Y76 Condylomata acuminata male
Y77 Maliqnant neoplasm prostate
Y78 Malign neoplasm male genital other
Y79 Benign/unspec. neoplasm gen. (m)
Y80 Injury male genital
Y81 Phimosis/redundant prepuce
Y82 Hypospadias
Y83 Undescended testicle
Y84 Congenital genl anomaly (m) other
Y85 Benign prostatic hypertrophy
Y86 Hydrocoele
Y99 Genital disease male, other

Social Problems Z

Z01 Poverty/financial problem
Z02 Food/water problem
Z03 Housing/neighbourhood problem
Z04 Social cultural problem
Z05 Work problem
Z06 Unemployment problem
Z07 Education problem
Z08 Social welfare problem
Z09 Legal problem
Z10 Health care system problem
Z11 Compliance/being ill problem
Z12 Relationship problem with partner
Z13 Partner's behaviour problem
Z14 Partner illness problem
Z15 Loss/death of partner problem
Z16 Relationship problem with child
Z18 Illness problem with child
Z19 Loss/death of child problem
Z20 Relationship prob. parent/family
Z21 Behaviour problem parent/family
Z22 Illness problem parent/family
Z23 Loss/death parent/family member
Z24 Relationship problem friend
Z25 Assault/harmful event problem
Z27 Fear of a social problem
Z28 Limited function/disability (z)
Z29 Social problem NOS

Abbreviations

Anom	anomaly
behav.	behaviour
bronch.	bronchus
complicat.	complication
congen.	congenital
dis.	disease
eval.	evaluation
exam.	examination
gen.	genital
malig.	malignant
metab.	metabolic
musculo.	musculoskeletal
NEC	not elsewhere classified
NOS	not otherwise specified
nutrit.	nutrition
oth	other
preg.	pregnancy
prob.	problem
RFE	reason for encounter
sympt.	symptom
unspec.	unspecified
w	with
w/o	without

Appendix C Classification of screening outcomes by Internation Classification of Primary Care code and definition, NT Health 2024.

Screening Category	ICPC Code	ICPC definition
EAR		
	H30001	Check up;complete;ear
	H31001	Check up;partial;ear
	H31002	Exam;partial;ear
	H30002	Exam;complete;ear
	H63001	Encounter;follow-up;ear
CARDIAC		
	A44J98	Medication;prevention;rheumatic
	K42002	Electrocardiogram
	K41001	Echocardiography
	K47002	Consult;cardiologist
	K31007	Check up;partial;cardiovascular
	K67002	Referral;cardiologist
	K63001	Encounter;follow-up;cardiovas
	K31001	Check up;blood pressure
GROWTH AND NUTRITION		
	T46002	Consult;dietitian/nutritionist
	A66016	Referral;dietitian/nutritionis
	A31030	Check up;height/weight
	T46003	Consult;diabetes educator
	T31005	Check up;diabetes
	T46002	Consult;dietitian/nutritionist
	A66016	Referral;dietitian/nutritionis
	A31030	Check up;height/weight
	T46003	Consult;diabetes educator

	T31005	Check up;diabetes
	T46002	Consult;dietitian/nutritionist
	A66016	Referral;dietitian/nutritionis

Appendix D Classification of health outcomes by International Classification of Primary Care code and definition, NT Health 2024.

Health Outcome Category	Subcategory	Definition	CARPA definition / diagnosis guideline.[19]	ICPC Code	ICPC definition
EAR					
	AOM	Acute Otitis Media	Ear drum bulge, red, no hole.	H71002	Otitis media; acute
				H99008	Infection;ear
				H71020	Otitis media acute; no perforation
	OME	Otitis Media Effusion	Fluid/pus behind ear drum.		
				H71003	Otitis media
				H72005	Otitis media (with); effusion
	Perforation	Dry and or chronic suppurative otitis media	Hole in ear drum, dry and/or discharge pus (includes both).		
				H77002	Perforation;ear drum
CARDIAC					
	ARF	Acute Rheumatic Fever	Two common presentations for ARF: Fever, sore joint/s, heart problems unwell, swollen joint/s (arthritis) § May be single joint — knee, ankle, elbow, wrist are common. Maybe several joints or move from 1 joint to another over days Can be history of recent injury, but still need to exclude ARF. Also consider joint infection (p369), other arthritis, bone infection (p306) ◦ Heart problems (carditis) ▪ New heart murmur ▪ Signs of heart failure — shortness of breath, fast pulse (p422) ◦ Often no history of recent sore throat •	K71003	Rheumatic fever

			Movement sickness (chorea) ◦ Fidgety movements that can't be controlled but go away when asleep § Usually one side of body, but can be both sides ◦ Often mood swings ◦ No fever ◦ Sometimes heart problems (carditis) — often not obvious.[19]		
	ARF			K71022	Rheumatic fever;acute
	RHD	Rheumatic Heart Disease	1. Clinical DiagnosisHistory of Acute Rheumatic Fever (ARF) based on the Jones criteria (fever, joint inflammation, chorea, etc.)Presence of cardiac murmur consistent with mitral or aortic valve involvementSymptoms such as shortness of breath, fatigue, palpitations (in advanced cases)Physical examination findings: valve murmurs, signs of heart failure 2. Echocardiographic Diagnosis (Gold Standard): Detection of valvular abnormalities typical of RHD:Mitral valve: leaflet thickening, restricted mobility, pathological mitral regurgitation (MR), mitral stenosis (MS)Aortic valve: leaflet thickening, restricted mobility, pathological aortic regurgitation (AR) Definite RHD criteria:Pathological MR with at least two morphological features of RHD on mitral valveMitral stenosis with mean gradient ≥4 mmHgPathological AR with at least two morphological features of RHD on aortic valve Borderline RHD criteria:Morphological changes without pathological regurgitation or stenosisPathological MR or AR alone without other morphological changes 3. Supporting Diagnostic CriteriaEvidence of previous group A Streptococcus infectionPresence of chorea, arthritis, or other manifestations of ARFPositive laboratory	K71J98	Rheumatic Heart (P2); Moderate

			markers (e.g., elevated ESR, CRP, ASO titers).[19]		
	RHD			K71002	Disease;rheumatic heart
	RHD			K71J99	Rheumatic Heart (P3); Mild
	RHD			K71J95	Rheumatic Heart (P4); Inactive
	RHD			K71J96	Rheumatic heart; Prophylaxis
	RHD			K71J97	Rheumatic Heart (P1); Severe
	Chorea	Chorea Sydenhams	Clinical Features: Involuntary, rapid, irregular, purposeless movements of the face, hands, and feet (chorea) Movements are non-rhythmic and flowing, often worsening with stress and disappearing during sleep Hypotonia (muscle weakness), motor impersistence (difficulty sustaining voluntary muscle contraction) Behavioral and psychiatric symptoms such as emotional lability, irritability, anxiety, or obsessive-compulsive symptoms can occur.	K71023	Chorea
	Chorea			K71001	Chorea;Sydenham
GROWTH AND NUTRITION					
	Growth faltering	Underweight: BMI-for-age below the 5th percentile. <18.5 BMI	Identified abnormal growth not growing as expected according to WHO growth chart - loss of weight, malnutrition, recent weight loss.	T08004	Loss (of);weight
	Growth faltering			T29022	Underweight
	Growth faltering			T10J99	Growth Faltering
	Growth faltering			T91015	Malnutrition
	Normal growth	Healthy Weight: BMI-for-age between the 5th and 85th	Growth tracking normally for age along growth chart.	T08007	Problem;weight loss

		percentiles. 18.5 - 24.9 BMI			
	Overweight	Overweight : BMI-for-age between the 85th and 95th percentiles. 25 - 29.9 overweight	Growth tracking above 85th percentile for age along growth chart.	T10008	Poor;weight gain;infant
				A31003	Assessment;normal growth
				T83001	Overweight
				T07002	Increased;weight
				T83002	Fat (BMI 25-30)
	Obese	Obesity: BMI-for-age at or above the 95th percentile. BMI 35 -	Growth tracking above 95th percentile for age along growth chart.	T82001	Excessive;weight (BMI>30)
	Diabetes	Pre-Diabetes	Fasting venous BGL 5.5-6.9 or random 5.5 - 11.0. Not HB1ac for <15 years.	A91011	Pre-diabetes
		Diabetes	Fasting venous BGL >7 or random >11.1 BGL.	T90019	Hyperglycaemia (diabetic)
				T89003	Diabetes;juvenile onset
				T90009	Diabetes;Type 2
	Anaemia	Anaemia; iron deficiency. Haemacue tested (finger prick)	5-7 years: <115Hb 8-11 years: <119Hb 12-15 years male:<125 12-15 years female: <118.	B80002	Anaemia;iron deficiency
				B82005	Anaemia

Appendix E Healthy School Aged Kids Health assessment care plan service items

Care Plan	Care Plan started	Group	Item
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	BMI (Body Mass Index) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Check Immunisation Status - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Check Relationship Details - HSAK Check

HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Consent Obtained (for GPMP/TCA/AHC/CHC)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Dental Check - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Developmental and Education Assessment - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Deworm - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Ear Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Family/Carer Concerns
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Haemoglobin - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Health; Advice/Education
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Height - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	HSAK Check (Annual) Clinical Assessment
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Referral - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Reproductive Check - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Review Allergies
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Review Family History
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Review PMHx/Problems
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Review Social History/Situation
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Skin Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	SNAPE HSAK (Brief Intervention)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Trachoma Check - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Urine Test - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) Clinical Items	Weight (wt) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) RMP Items	Chest Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) RMP Items	Complete Medicare Billing for HSAK
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) RMP Items	Consent Obtained (for GPMP/TCA/AHC/CHC)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) RMP Items	Heart Check (by Doctor) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) RMP Items	HSAK Check (Annual) RMP Assessment
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) RMP Items	Review Allergies
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) RMP Items	Review Medication(s)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) RMP Items	Review PMHx/Problems
HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) RMP Items	RMP HSAK Check (Annual Review)

HSAK (5-14yrs) Healthy School Aged Kids Care Plan	15/02/2016	HSAK Check (Annual) RMP Items	Urine Test - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	BMI (Body Mass Index) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Check Immunisation Status - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Check Relationship Details - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Consent Obtained (for GPMP/TCA/AHC/CHC)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Dental Check - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Developmental and Education Assessment - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Deworm - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Ear Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Eye/Vision Test (Visual Acuity)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Family/Carer Concerns
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Haemoglobin - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Health; Advice/Education
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Height - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	HSAK Family Present
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Medication; Advice/Education
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Referral - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Reproductive Check - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Review Allergies
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Review Family History
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Review PMHx/Problems
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Review Social History/Situation
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Skin Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Sleep Assessment - HSAK 5-14yrs
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	SNAPE HSAK (Brief Intervention)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Urine Test - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Waist Circumference to Height Ratio
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-9 yrs) Clinical Items	Weight (wt) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	BMI (Body Mass Index) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Check Immunisation Status - HSAK Check

HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Check Relationship Details - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Consent Obtained (for GPMP/TCA/AHC/CHC)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Dental Check - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Developmental and Education Assessment - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Deworm - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Ear Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Eye/Vision Test (Visual Acuity)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Family/Carer Concerns
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Haemoglobin - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Health; Advice/Education
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Height - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	HSAK Family Present
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	HSAK Overweight/Obese/Diabetes Risk Assessment
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Medication; Advice/Education
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Referral - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Reproductive Check - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Review Allergies
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Review Family History
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Review PMHx/Problems
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Review Social History/Situation
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Skin Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Sleep Assessment - HSAK 5-14yrs
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	SNAPE HSAK (Brief Intervention)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Urine Test - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Waist Circumference to Height Ratio
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (10-13 yrs) Clinical Items	Weight (wt) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	BMI (Body Mass Index) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Check Immunisation Status - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Check Relationship Details - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Consent Obtained (for GPMP/TCA/AHC/CHC)

HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Dental Check - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Developmental and Education Assessment - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Deworm - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Ear Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Explanation of limits of confidentiality
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Eye/Vision Test (Visual Acuity)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Family/Carer Concerns
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Haemoglobin - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Health; Advice/Education
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Height - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	HSAK Family Present
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	HSAK Overweight/Obese/Diabetes Risk Assessment
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Medication; Advice/Education
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Referral - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Reproductive Check - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Review Allergies
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Review Family History
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Review PMHx/Problems
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Review Social History/Situation
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Skin Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Sleep Assessment - HSAK 5-14yrs
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	SNAPE HSAK (Brief Intervention)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Urine Test - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Waist Circumference to Height Ratio
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) Clinical Items	Weight (wt) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-13 yrs) RMP Items	Chest Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-13 yrs) RMP Items	Complete Medicare Billing for HSAK
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-13 yrs) RMP Items	Consent Obtained (for GPMP/TCA/AHC/CHC)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-13 yrs) RMP Items	Heart Check (by Doctor) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-13 yrs) RMP Items	Review Allergies

HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-13 yrs) RMP Items	Review Medication(s)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-13 yrs) RMP Items	Review PMHx/Problems
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-13 yrs) RMP Items	RMP HSAK Check (Annual Review)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (5-13 yrs) RMP Items	Trachoma Check - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) RMP Items	Chest Examination - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) RMP Items	Complete Medicare Billing for HSAK
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) RMP Items	Consent Obtained (for GPMP/TCA/AHC/CHC)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) RMP Items	Explanation of limits of confidentiality
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) RMP Items	Heart Check (by Doctor) - HSAK Check
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) RMP Items	Review Allergies
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) RMP Items	Review Medication(s)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) RMP Items	Review PMHx/Problems
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) RMP Items	RMP HSAK Check (Annual Review)
HSAK (5-14yrs) Healthy School Aged Kids Care Plan - 2020	13/10/2020	HSAK Check (14 yrs) RMP Items	Trachoma Check - HSAK Check

Chapter Six – Teaching Activities

Lessons from the Field and Teaching First Year MAE students

Prologue

Rationale

Participating in teaching activities and developing skills in teaching is a minor competency required by the MAE program.

My role

For the teaching competency I participated in multiple activities. Teaching activities included delivery and participation in Lessons from the Field (LFF) and teaching of first year Master of Applied Epidemiology (MAE) students.

For my LFF teaching session, I delivered a 60-minute lesson on 'Collaborative Practice and Stakeholder Engagement: *Translating Public Health Policy and Quality Improvement Initiatives in Community Settings.'* For this activity, I chose the topic, delivered teaching material and through TEAMS delivered the teaching session. This topic was selected as an extension to the findings identified in my evaluation of the Traffic Light Recall Reporting surveillance system that I found particularly interesting and important to discuss. The style of teaching was based through providing students a case scenario (Appendix A) with recommended pre-reading and relative materials i.e. de-identified Traffic Light Recall Reports. The case scenario also included questions that students were to consider and prepare for to discuss in the lesson. During the session I delivered a PowerPoint presentation (Appendix B) which combined teaching the core objectives and combining the theme of the case scenario. Additionally, I participated in each of the sessions provided by fellow MAE students within our allocated group (n=5). This involved completing any pre-reading requirements and actively participating in the session i.e. contributing ideas, answering allocated questions.

For the teaching of first year MAE students, I worked in a group to develop a lesson on '*Syphilis in priority and sub-populations*' of which I focused on '*Women with health and social complexities'* (Appendix F). During this session, I taught and facilitated first years to learn and appreciate how social and behavioural determinants of health can influence syphilis infections amongst this population group. In a small group we focused on the social determinants of health including homelessness, unstable employment, inadequate access to healthcare and education regarding sexual health education. Additional factors including domestical and family violence and illicit drug use were also discussed.

The second session for teaching first years, involved presenting on '*How to Survive the MAE'*. For this presentation we conveyed tips and tricks for first year students that were identified by our MAE cohort as useful. These items included recommendations for accessing different

services via ANU i.e. academic skills services, biostatistics support. We also discussed ways to manage the high workload including time management skills, asking questions early, self-care and the importance of reaching out and supporting fellow MAE students within the cohort.

Lessons learned

During this minor competency overall, I found that developing succinct learning objectives and outcomes important and very helpful in structuring the lesson plan and content. Similarly, I devised a lesson plan outline to ensure that the session was structured, and therefore conducive to effective learning.

During the syphilis discussion with first year students, I learnt the importance of navigating the students' background and level of understanding and awareness regarding the topic. I had found that there were varying levels of knowledge regarding social determinants of health, so it was important to respond sensitively to the varying levels of knowledge to ensure students didn't feel excluded from the discussion. The importance of sharing experiences and ways to navigate the MAE for the first-year students highlighted the importance of cohort cohesion and the benefit of this for an enriching MAE experience.

This minor competency was also a good lesson for strengthening my time management skills and prioritising deadlines within the workload of major competencies. Convening with students across different time-zones (interstate and international) required effective team-work skills, specifically flexibility, adaptability and co-operation, all of which were conducive in creating a supportive, encouraging group to teach and learn from.

Public health impact

The LFF teaching session aimed to increase awareness in the importance of collaborative practice when translating public health policy(s) to practice with special interest to the remote setting in the Northern Territory. It emphasised the importance of transparent stakeholder engagement and how this can be a profound factor in the effectiveness of implementing public health policy changes.

In regard to teaching first year students, presenting on the varying degrees of consideration during a syphilis outbreak response is a timely and useful topic for first year MAE students. Our cohort covered a range of different areas to consider with our group focusing on sub-populations and minority groups. This was very useful to increase knowledge and awareness of what and how social and behavioural factors can have a profound influence on the groups discussed.

By providing a session on '*How to Survive the MAE'* encourages fellow colleagues and potentially emerging public health employees to be mindful and aware of the advantage in collaboration and supporting each other.

Acknowledgements

Special thank you to my fellow LFF and Teaching First Year colleagues – Gemma Delvin, Edura Jalil, Clare Kinnear, Alison Brown, Kwendy Cavanagh, Holly Gibbons, Edura Jalil and Nadine Hunt. And of course, an extended and very special thank you to the remaining MAE cohort – an incredible group to work and learn with!

Appendices

Appendix A. Lessons from the Field, May 2025.

Case scenario

Welcome to the Northern Territory! Your field placement for the MAE is at NT Health's Health Statistics and Informatics Branch in Darwin.

Background to your allocated additional project:

Across the NT there are 47 remote primary health care (PHC) centres operated by NT health. Given the vast geography of the territory a lot of these centres are only accessible via aircraft. *See map attached.*

Within these PHC centres clinicians i.e. Aboriginal Health Workers, nurses and doctors deliver a range of primary health programs including chronic disease care, rheumatic heart disease and child health.

Data for key health outcomes within these program areas are collected and reported on for each PHC centre through the NT Health's Traffic Light Recall Report Surveillance System.

This system is operated and managed by the Clinical Analytics Unit within NT Health's Health Statistics and Informatics Branch. Monthly reports are then made available to clinicians delivering the program in the respective remote communities who use this data to organise and manage their workload i.e. identify patients who are due and/ or overdue for health checks. *See recall list attached.*

This year the Clinical Analytics Unit proposes a project involving transitioning hard copy versions of the Traffic Light Recall Reports (that are emailed to staff) to online dashboards, allowing clinicians to access real-time data via the online internal NT health homepage.

However, before any changes to the reporting format can be implemented, approval from the Chief Health Officer is required **who really values stakeholder and community engagement**.

As part of your role as the MAE student based at Health Statistics and Informatics, you are required to follow up on the following actions for this project and discuss your findings at the next meeting:

1. Identify key stakeholders who you would like to collaborate with and why?
2. What are the possible advantages and disadvantages to changing the format and mode of distribution of the reports?
3. What strategies will be useful in approaching, facilitating and sustaining stakeholder engagement?

The meeting will be held on **the 6th May 3pm ACDT via TEAMS.**

Link already emailed – thanks Gemma!

See you then!

Sarah

Appendix B. Structure of Lesson Plan

Structure of Lesson Plan

1. Send out case study with attached map and recall list (contextual to casestudy)

2. Journal article '**At the grass roots level it's about sitting down and talking': exploring quality improvement through case studies with high-improving Aboriginal and Torres Strait Islander primary healthcare services factors that contribute to successful Continuous Quality Improvement**' sent with case study toread.

3. PowerPoint presentation, each member discusses what they identified and then I discuss lessons learnt during this experience.

4. Summary / take home messages.

Appendix C. Pre-reading materials

Lessons from the Field resources: Larkins et al. - 2019 - 'At the grass roots level it's about sitting down .pdf

Appendix D. Lessons from the Field – Teaching presentation

Stakeholder Engagement & Collaborative Practice

Translating public health policy and quality improvement initiatives in remote community settings.



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NORTHERN TERRITORY GOVERNMENT

Acknowledgement of Country

Agenda

- Learning objectives and outcomes
- Background
- Case scenario: meeting discussion
- Outcomes in practice
- Summary

Learning Objectives

- Describe the role of effective stakeholder engagement and collaboration when translating policy into practice with a focus on remote community health settings.
- Review the format, functionality and utility of epidemiological data in providing key health information appropriate to the setting.
- Identify implementation strategies to ensure sustainable and streamlined collaboration between policy unit and operational health services and centres.

Learning Outcomes

- Understand the importance of community collaboration and stakeholder engagement in delivering effective care and public health programs.
- Recognize the need to contextualize the format and mode of distribution of epidemiological data to clinician and community needs and priorities.
- Identify practical strategies for initiating and facilitating sustainable collaboration and stakeholder engagement.

Background

- Northern Territory – unique vast geography and settlement pattern.
- Population of 233,00 spread over 1.3 million square kilometers.
- Delivering equitable primary health care services to remote communities remains an ongoing challenge.
- Measurable impacts on population health metrics – life expectancy, disease burden and health outcomes.

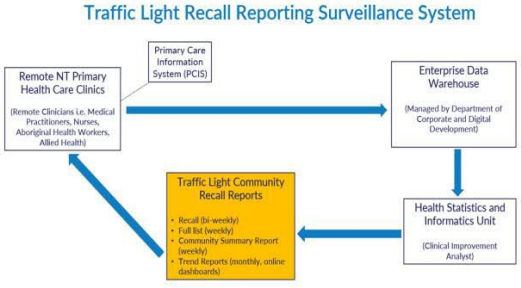
Remote communities

- Across the Northern Territory – remote communities are home to Aboriginal people:
  - 48.6% very remote; 25.9% remote; 25.4% outer regional.
- Representing oldest living continuous culture in Australia
- Aboriginal people place paramount importance on harmonious balance between their connection with:
  - Body, mind and spirit
  - Family, community and land.

Public Health Surveillance Reporting

- 47 primary health centres operated by NT Health in remote settings.
- Provide a variety of primary health programs (chronic disease, child health) and emergency presentations.
- Public health surveillance achieved through the Traffic Light Recall Reporting Surveillance System:
  - Aims to support and facilitate clinicians and policy decisions with the management and care of health outcomes i.e. chronic disease through the Traffic Light Recall Reports.

Public Health Surveillance Reporting for Remote Settings



Case Scenario

Meeting Discussion

1. Identify key stakeholders who you would like to collaborate with and why?
2. What are the possible advantages and disadvantages to changing the format of the reports?
3. What strategies will be useful in approaching, facilitating and sustaining stakeholder engagement?

Outcomes in practice

Outcomes

1. Identify key stakeholder groups – interview / survey / working group parties:

- Executive director(s) for Remote Primary Health Care: Top End and Central Australia
- Regional and local site Primary Health Care Centre managers with Aboriginal representatives
- All clinicians employed by NT Health in remote primary health care
- First Nations Health and Wellbeing Division
- Health statistics staff – clinical analyst and management of the surveillance system

Rationale:

- Understand the perspective of frontline clinicians, management and surveillance system operational staff regarding the surveillance system and transition of reports.
- Identify gaps in collaboration between policy and practice i.e. amongst the identified stakeholder groups.
- Facilitated identifying opportunities for engagement regarding translating policy changes to practice i.e. working group parties with a variety of staff representatives.

Outcomes

2. What are the possible advantages and disadvantages to changing the format and mode of distribution of the reports?

- Advantages:
  - Real-time data
  - Confidential - accessible via secure online platform rather than via generic emails.
  - Can be accessed and manipulated easily when seeing a patient.
  - Varying degrees of information – broad population level to specific blood levels / results.
  - Less overwhelming amount of emails for staff who are limited / have no protected administration time.
- Disadvantages:
  - Clinicians untrained in how to navigate and apply dashboards to clinical work (data literacy limited)
  - No plan for training / introducing the dashboard to clinicians
  - Dashboard will need to include the ability to print hardcopy for outreach or have appropriate technology to support clinicians to provide community based-care.

Outcomes

3. What strategies will be useful in approaching, facilitating and sustaining stakeholder engagement?

- Approach
  Project proposal outlining:
  - Background and context
  - Aims and objectives
  - Methodology
  - Timeline
  - Plan for dissemination* i.e. training dates
- Facilitate
  - Interviews
  - Survey
  - Working group parties with key representatives on the development of the dashboard
- Sustainability
  - Regular forums and meetings amongst stakeholders regarding public health surveillance
  - Consistent information sharing across the varied levels i.e. troubleshooting for continuous quality improvement

Thank you

Appendix E. Survey evaluation of LFF

https://s.surveyplanet.com/1jj9918l