# Evaluation of the AMIHS program using administrative datasets: a technical report

**HUMANCAPITAL**
Alliance
*Creating workforce solutions*

**MURAWIN**
PROFESSIONAL SERVICES

## About this report

This Technical Report was prepared by Human Capital Alliance and Murawin under the guidance of a structured governance arrangement, a Cultural Reference Group and an Evaluation Advisory Committee. The report was commissioned by the NSW Ministry of Health.

We would like to thank the dedicated members of the Cultural Reference Group, Evaluation Advisory Committee and NSW Ministry of Health, whose support and assistance throughout the evaluation has been invaluable.

## Suggested citation

Bin Jalaludin, Chong, S. and Ridoutt, L. (2019) *Technical Report: Evaluation of the AMIHS program using administrative datasets*. NSW Ministry of Health, Sydney.

# ACRONYMS AND ABBREVIATIONS

ACCHS        Aboriginal Community Controlled Health Services

AHW          Aboriginal Health Worker

AMDC         NSW AMIHS Data Collection

AMIHS        Aboriginal Maternal and Infant Health Service

AMS          Aboriginal Medical Service

CEE          Centre for Epidemiology and Evidence

CI           Confidence intervals

HCA          Human Capital Alliance

IRSED        Index of Relative Socio-Economic Disadvantage

LHD          Local Health District

MCHR         Maternal and Child Health Register

PDC          NSW Perinatal Data Collection

# CONTENTS

# A.  EXECUTIVE SUMMARY

## Background

The Aboriginal Maternal and Infant Health Service (AMIHS) is a NSW Health funded maternity service for Aboriginal families that aims to improve health outcomes for mothers and babies. AMIHS uses a continuity of care model in which Aboriginal Health Workers (AHWs) and midwives work together and with other services to provide high quality antenatal and postnatal care. Some of the essential elements of the AMIHS Service Delivery Model (NSW Health, reviewed 2014) include:

- being accessible, flexible and mobile
- working with other services to provide integrated care for women and families
- being involved in community development and health promotion activities
- supporting women and families to transition from AMIHS to child and family health services.

An evaluation of AMIHS was published in 2005.

This second evaluation commenced in 2016 and was conducted over the course of 2016-18. The evaluation used a mixed methods design, drawing on information from both existing and new data sources. The evaluation has had six interrelated components:

- a review of program documentation;
- a self-administered survey of AMIHS managers;
- qualitative interviews with key stakeholders;
- case studies of AMIHS sites;
- quantitative analysis of routinely collected administrative data; and
- an economic evaluation.

This technical report outlines the methods and the results for **the quantitative analysis of administrative data**. Specific objectives for this component of the evaluation were:

> **Objective 1: Estimate the reach of the AMIHS program**
> **Objective 2: Identify the factors that influence AMIHS program reach**
> **Objective 3: Determine the impact of AMIHS on maternal and infant health outcomes**

## Method

For the analysis of program reach two separate approaches were taken:

- Simple descriptive analyses for all AMIHS service sites (Objective 1)
- Regression analysis of AMDC data to identify factors influencing reach (Objective 2)

Similarly, two separate study designs were employed in the analysis of impact of AMIHS on health outcomes, which because of multiple cohort possibilities lead to six separate types of statistical analyses. The two study designs were:

- Retrospective cohort study design (Objective 3)
- Interrupted time series regression study design (Objective 3)

Two routinely collected administrative health datasets were used to undertake all the above investigations. The two datasets used were:

- The NSW AMIHS Data Collection (AMDC) - This dataset includes records of Aboriginal births in NSW. Data were made available from 2012 to 2016.
- Maternal Child Health Register (MCHR) – The MCHR comprises of records of nine different data collections including the Perinatal Data Collection, NSW Perinatal Death Review database, and Registry of Births, Deaths and Marriages (RBDM). An enhanced reporting of Aboriginality (ERA) variable is available in the MCHR through the linkage of the datasets, thus providing a larger and more accurate Aboriginal population for inclusion in the analysis. Data were available for the period 1 January 1994 – 31 December 2015.

A summary of the research designs and data sources used is provided below:

| Objective | Research design | AMDC data | MHCR data |
|---|---|:---:|:---:|
| **Objective 1: Estimate reach of AMIHS** | Mathematical calculation and descriptive comparison | * | |
| **Objective 2: Identify the factors that influence AMIHS reach** | Regression analysis | * | |
| **Objective 3: Determine the impact of AMIHS on maternal and infant health outcomes** | Retrospective assessment of outcomes in 'Exposed' and 'Control' groups (two analyses with different control group populations) | * | |
| | Retrospective pre-post AMIHS program evaluation (two analyses with different AMIHS service site cohorts) | | * |
| | Interrupted time series analysis (two analyses with different AMIHS service site cohorts) | | * |

A detailed description of the method including variables investigated and the statistical analyses undertaken is provided in the body of the report.

# Results of quantitative analysis of administrative data

## Reach of the AMIHS program

According to AMDC data, the current AMIHS Program footprint means that 82% of all Aboriginal babies born could have received the service. That is, four out of every five eligible mothers of Aboriginal babies born in NSW, could have accessed AMIHS support.

Based on AMDC data, between 2012 and 2016, 51% of eligible women accepted the service offer and received antenatal support. It is estimated that this represents 41% of mothers of Aboriginal babies in NSW.

## Factors influencing reach

The predictors of the mother of an Aboriginal baby being 'Offered and accepting' the AMIHS Program were:

1. Younger women more likely to accept AMIHS (almost twice as likely as older groups)
2. Aboriginal mother more likely to accept AMIHS (over twice as likely)
3. Mothers with previous pregnancies more likely to accept AMIHS (between 1 and 20% more likely)
4. Mothers whose antenatal visit is early in pregnancy more likely to accept AMIHS (10-20% more likely)
5. Mothers who smoke during pregnancy more likely to accept AMIHS (17-30% more likely)

The strongest predictors of accepting an offer of AMIHS support were maternal age and Aboriginality of the mother, with younger mothers almost twice as likely (compared to older mothers) and Aboriginal women more than twice as likely (compared to non-Aboriginal women) to participate in AMIHS. The population that accepts AMIHS is entirely in keeping with the AMIHS Program model and its equity ambitions.

## Outcomes of the AMIHS Program

### *Early access to and use of antenatal services*

There is comparatively strong evidence that associates mothers of babies who have accessed an AMIHS service with earlier use of antenatal services when compared with mothers who have not been exposed to AMIHS. The 'exposed' vs 'control' comparison using AMDC data where the control or 'unexposed' population is women who were not offered AMIHS, suggests that AMIHS mothers are 20% more likely to have their first antenatal visit before 14 weeks gestation. Additionally, other analyses found initial evidence that receiving AMIHS is associated with early engagement with antenatal care.

Not only do AMIHS mothers access antenatal services earlier, but also more frequently. On average, AMIHS mothers who have delivered full-term babies have received an average of 9.1 antenatal visits, almost equal to the visits of mothers who were 'offered and declined' an AMIHS service but significantly more than mothers 'not offered' the AMIHS service (average of 8 visits). When confounding factors are taken into account, mothers who have received an AMIHS service are likely to have 2% more antenatal visits than mothers who were 'offered and declined' and 8% more visits than mothers who were 'not offered' an AMIHS service even though eligible.

That the AMIHS program was able to demonstrate evidence of an impact on antenatal service access (timing and extent) should not surprise, since this is the most common type of impact identified in most other evaluations and investigations of similar interventions.

## *Smoking during pregnancy*

Smoking during pregnancy is a major risk factor for pregnancy complications and poor birth outcomes. Reducing smoking in pregnancy is an important 'intermediate' outcome that can improve Aboriginal maternal and infant health. Moderate evidence was obtained, particularly from the interrupted time series analysis, that AMIHS exposure is associated with a modest decrease in smoking at any time during pregnancy. This finding is consistent with some studies that have identified a decrease in mothers smoking from a specific intervention (Panaretto, et al., 2005) but otherwise such an impact has not been widely reported.

## *Breastfeeding at hospital discharge*

Another important intermediate outcome is that mothers are breastfeeding fully or partially at the time of discharge from hospital. There was little evidence to indicate mothers of babies who have received AMIHS support are any more likely to breast feed than mothers not involved in an AMIHS service.

## *Health outcomes of the baby*

Unlike the above 'intermediate' outcomes, low birth weight, preterm birth and small for gestational age baby are all 'endpoint' health outcomes. Apart from the one analysis of the comparison between mothers who were offered and accepted an AMIHS service and mothers who were not offered an AMIHS service (which suggested a substantial positive program impact), there was no evidence that preterm birth incidence decreased with AMIHS exposure and there is inconclusive evidence that AMIHS is associated with a decrease in small for gestational age babies.

In the case of low birth weight, babies of mothers who had accepted AMIHS service were 50% less likely to be low birth weight compared to babies of mothers not offered an AMIHS service. The time series analyses also indicated a possible trend in reduction in low birth weight babies associated with the AMIHS intervention.

### Differences between AMIHS service types

There were five AMIHS service types identified through analysis of the Manager Survey data. Service type was analysed for any effect on reach and outcomes. There was a significant difference between service types in their association with reach. The 'Midwife and home visiting' and 'AMIHS type' service types were most associated with women accepting the AMIHS program. These service types have a home visiting component in common. There is an association between the 'AHW-led and home visiting' service type and early access to antenatal care. There is little evidence of variation between AMIHS service types for other health outcomes investigated, although one sensitivity analysis for only Aboriginal mothers showed some service types had an effect on smoking cessation.

## Conclusion

**Overall the AMIHS Program is servicing the intended target population.** The AMIHS model targets young pregnant women having Aboriginal babies, Aboriginal women, mothers smoking and mothers living in disadvantaged socio-economic circumstances. All of these characteristics are associated with the population who have been offered and accepted an AMIHS service, with the exception of disadvantage, where the pattern of association is not clear.

Not only is the right population using AMIHS, but also **the reach of the Program is noteworthy**, both in proportional terms (within the AMIHS catchment areas) and absolute terms within the total population of Aboriginal babies born in NSW.

**Women who attended AMIHS had better outcomes than women 'not offered' AMIHS.** The most consistent and conspicuous differences in baby and mother outcomes were identified from a comparative analysis of the outcomes of Aboriginal babies from mothers who were 'offered and accepted' an AMIHS service with babies from mothers 'not offered' the AMIHS service. Arguably this is the most appropriate and powerful of all the analyses undertaken since the two populations being compared, 'offered and accepted' and 'not offered', are very much alike. The results of other forms of outcome analysis are less clear.

**The clearest difference in outcomes associated with AMIHS is in regard to antenatal service access and use.** Across most forms of analysis mothers who are offered and accept the AMIHS service are more likely to access antenatal services earlier, and to use those services more often.

**Some encouraging signs were detected regarding trends in mothers' smoking.** There is moderate evidence that AMIHS may be contributing to a population level decline in smoking in pregnancy among mothers of Aboriginal babies.

**There is a possibility that some AMIHS service types are more conducive to achieving reach** and more consistent use of the service (earlier and more antenatal contacts). It is not obvious how this might translate into other baby outcomes or what this means for future investment. This should be explored further.

# B.   INTRODUCTION

## Size and nature of the health issue

Over the past 20 years, there have been important improvements in Aboriginal maternal and infant health in NSW. These include increased access to early antenatal care, declines in risk factors such as smoking in pregnancy and teenage pregnancy, and improved birth outcomes.

From 2001 to 2017 the proportion of Aboriginal mothers commencing antenatal care before 14 weeks gestation increased from 46.1% to 68.1% and the proportion commencing before 20 weeks increased from 64.7% to 83.9% (CEE, 2019). Over the same period, the proportion of Aboriginal mothers aged 19 years and under decreased from 20.8% to 12.3% and smoking in pregnancy for Aboriginal mothers declined from 59.0% to 42.4% (CEE, 2019). In addition, rates of low birth weight (less than 2,500 grams) and perinatal mortality have improved. In 2017, the rate of perinatal mortality for babies born to Aboriginal mothers was 12.7 per 1,000 births compared to 18.2 per 1,000 births in 2001 (CEE, 2019). From 2001 to 2017, the proportion of low birth weight babies born to Aboriginal mothers decreased from 13.5% to 11.1% (CEE, 2019).

However, significant inequities between Aboriginal and non-Aboriginal populations remain. In 2017 in NSW, 42.4% of Aboriginal mothers smoked during pregnancy compared to 7.2% of non-Aboriginal mothers and 12.3% of Aboriginal mothers were aged 19 years and under compared to 1.5% of non-Aboriginal mothers (CEE, 2019). Aboriginal mothers also continue to experience poorer birth outcomes than non-Aboriginal mothers. In 2017, the rate of perinatal mortality among babies born to Aboriginal mothers was 12.7 per 1,000 births compared to 8.2 per 1,000 births among babies born to non-Aboriginal mothers (CEE, 2019). Similarly, 11.1% of babies born to Aboriginal mothers were low birth weight, compared to 6.5% of babies born to non-Aboriginal mothers, and 11.7% of Aboriginal babies were born prematurely (less than 37 weeks gestation) compared to 7.2% of non-Aboriginal babies (CEE, 2019).

Despite these disparities, little is known about the kinds of programs and services that are effective in improving the health and wellbeing of Aboriginal mothers and babies. Recent reviews have found a growing number of studies evaluating such programs and services.

While these studies tend to report positive participant outcomes, their true effectiveness is uncertain due to poor study quality (Jongen et al., 2014; Kildea and Van Wagner, 2013). Examples of methodological limitations of conducted studies include small numbers, short-term evaluation data and a lack of comparison data (Bywood, Raven and Erny-Albrecht, 2015). There is therefore a need to conduct rigorous impact evaluation of initiatives seeking to improve the health of Aboriginal mothers and babies (Brock, Charlton, and Yeatman, 2014).

# Description of the program

The Aboriginal Maternal and Infant Health Service (AMIHS) is a NSW Health funded maternity service for Aboriginal families that aims to improve health outcomes for mothers and babies.

AMIHS uses a continuity-of-care model in which Aboriginal health workers and midwives work together and with other services to provide high quality antenatal and postnatal care. Care starts as early as possible in pregnancy and continues through pregnancy and after the baby is born. The length of time postnatal care is provided varies but can be up to eight weeks postpartum.

The AMIHS Service Delivery Model (NSW Health, reviewed 2014) outlines the principles, objectives and essential elements of the AMIHS program. Some of the essential elements of the AMIHS service model when implemented in full include:

- Being accessible, flexible and mobile – to ensure AMIHS is accessible to local communities, services are adapted to the local needs and context, and are provided in a range of locations including in women's homes, community health centres, Aboriginal Community Controlled Health Services (ACCHS), antenatal clinics, and child and family health centres. Transport is also provided to support women accessing AMIHS and other services to which they are referred.
- Working with other services to provide integrated care for women and families – this includes the local ACCHS (where that is not the actual service provider), mainstream maternity services and other government and non-government services.
- Being involved in community development and health promotion activities – these are led by the Aboriginal health worker and are conducted with local Aboriginal community members and organisations.
- Supporting women and families to transition from AMIHS to child and family health services –strategies include clear referral processes and shared visits in the antenatal and postnatal periods (midwife, Aboriginal health worker and child and family health nurse).

Most AMIHS services are delivered by local health districts (LHDs) through public maternity and community health services, and some are delivered by ACCHS. LHDs and ACCHSs are given a certain level of autonomy in how they implement and adapt the program to meet local needs.

The NSW Ministry of Health coordinates and supports the implementation of AMIHS at a state level, this includes:

- Developing and reviewing program guidelines (for example the Service Delivery Model and Workforce and Recruitment Plan).

- Funding a Training Support Unit (TSU) to provide specific education and training for AMIHS staff[1] (this is additional to the core training and development provided by LHDs/ ACCHSs that deliver AMIHS).
- Monitoring and evaluating the program, including annual reporting and routine data collection through the AMIHS Data Collection (AMDC) reporting system.
- Coordinating an AMIHS and BSF network to communicate information to and between services across the state.
- Providing education and training opportunities based on areas of identified need such as smoking and alcohol cessation, breastfeeding support and trauma informed care.
- Offering an annual exchange visit program, which supports AMIHS teams visiting and learning from other AMIHS sites across the state.

In most areas where AMIHS is provided there is a range of alternative maternity services on offer. This can include mainstream antenatal clinics and case load midwifery/team midwifery provided by public hospitals, GP shared care (by private providers or through an ACCHS) or private obstetricians. Several LHDs also offer antenatal and postnatal outreach services for mothers and families based on the needs of the local population (accessing both Aboriginal and non-Aboriginal populations). In addition, there are a number of Commonwealth funded maternal and infant health programs such as New Directions Mothers and Babies Services and the Australian Nurse-Family Partnership Program[2]. These programs are mostly delivered by ACCHS and sometimes by LHDs. The presence of these different programs can confound the ability to attribute changed maternal and infant outcomes to a specific service, including to AMIHS.

AMIHS was initially funded in 2000/01 and, following an action-research evaluation, was expanded in 2008/09. Funding is provided to LHDs and ACCHSs, who undertake local planning to determine where AMIHS is delivered. This means that the number and location of AMIHS sites can change over time based on community needs.

A survey of AMIHS managers conducted for this evaluation found that 12 AMIHS sites were established in 2000/01 and a further 35 sites were established following funding enhancement in 2008/09. In 2017, there were 46 AMIHS sites delivering services to Aboriginal families in over 80 locations in NSW.

# Rationale for the evaluation

An evaluation of AMIHS was published in 2005. The findings suggested that AMIHS was achieving its goal of providing improved and culturally appropriate antenatal and postnatal care for mothers of Aboriginal babies and their families. The evaluation also identified ways in which the program could be strengthened. However, the evaluation design had some

---

[1] The TSU also supports the Building Strong Foundations for Aboriginal Children, Families and Communities Program (BSF), a child and family health service for Aboriginal families in NSW.
[2] http://www.health.gov.au/internet/main/publishing.nsf/Content/indigenous-maternal-health-lp

limitations, such as inadequate control of potential confounders in analyses of program impacts.

Following the 2005 AMIHS evaluation, the program was enhanced to increase access to antenatal care, reduce levels of antenatal smoking and improve uptake of child and family health services. Smoking during pregnancy is the most common preventable risk factor for pregnancy complications and is associated with poor perinatal outcomes such as low birth weight, preterm birth, small for gestational age and perinatal death (Cnattingius, 2004).

Ongoing evaluation of AMIHS is required to investigate whether its objectives are being met, identify ways in which the program can be improved, and contribute to what is known about programs designed to improve Aboriginal maternal and infant health outcomes. Understanding the impact and value of programs like AMIHS is essential to improving the health outcomes of Aboriginal people.

# Current evaluation

Over the course of 2016-18, the AMIHS program has been evaluated using a mixed methods design, drawing on information from both existing and new data sources. The evaluation has had six interrelated components:

- a review of program documentation;
- a self-administered survey of AMIHS managers;
- qualitative interviews with key stakeholders;
- case studies of AMIHS sites;
- quantitative analysis of routinely collected administrative data; and
- an economic evaluation.

The aims of the evaluation are to:

1. describe AMIHS program implementation;
2. explore stakeholder experiences and perspectives of the AMIHS program;
3. investigate AMIHS program reach and its impact on Aboriginal maternal and infant health outcomes; and
4. investigate the costs of implementing AMIHS and undertake an economic evaluation.

The evaluation was reviewed and approved by two ethics committees:

- Aboriginal Health & Medical Research Council (AH&MRC) Research Ethics Committee, Reference: 1223/16
- Population and Health Services Research Ethics Committee (PHSREC), Reference: HREC/16/CIPHS/35.

This technical report outlines the methods and the results for **Aim 3**, which is evaluating the program reach and the impact of the AMIHS program on Aboriginal maternal and infant health outcomes.

Specific objectives for Aim 3 of the evaluation are to:

> **Objective 1: Estimate the reach of the AMIHS program**
> **Objective 2: Identify the factors that influence AMIHS program reach**
> **Objective 3: Determine the impact of AMIHS on maternal and infant health outcomes**

This technical report addresses each of those objectives and is divided into the following sections:

- Section B presents the methods
- Sections C, D and E present the results for Objectives 1, 2 and 3 respectively
- Section F presents a discussion of the results and commentary on the method.

# C.  METHODS

## Study design

Routinely collected administrative health datasets were used to investigate the AMIHS program reach and impact on health outcomes.

For the analysis of reach two separate approaches were taken:

- Simple mathematical calculation and descriptive comparison undertaken for all AMIHS service sites (Objective 1)
- Regression analysis of AMDC data – factors influencing program reach (Objective 2)

Similarly, two separate study designs were employed in the analysis of impact of AMIHS on health outcomes leading to six separate types of statistical analyses. The two study designs were:

- Retrospective cohort study design (Objective 3)
- Interrupted time series regression study design (Objective 3)

These two study designs are briefly described below.

### Retrospective cohort study design

A retrospective cohort study is a longitudinal cohort study where a cohort of individuals that share a common exposure factor is compared to another group of equivalent individuals not exposed to that factor, to determine the factor's influence on certain expected or desired health outcomes (Mann, 2003). Retrospective cohort studies are fundamentally the same as 'prospective' cohort studies, the basis of much current medical research, except the data are already collected as part of existing or archived records and can immediately be analysed to determine the relative risk of the cohort compared to the control group.

Like prospective cohort studies, retrospective cohort studies classify study participants based on whether they were ***exposed*** or not to the factor of interest during a specific time frame (El-Masri, 2014). The 'factor of interest' in this evaluation to which participants were exposed was attendance at an AMIHS service.

Both kinds of cohort studies, retrospective and prospective, share the same starting point (considering data from *before* the occurrence of the outcome). A way of understanding the study design is shown below (Figure 1).
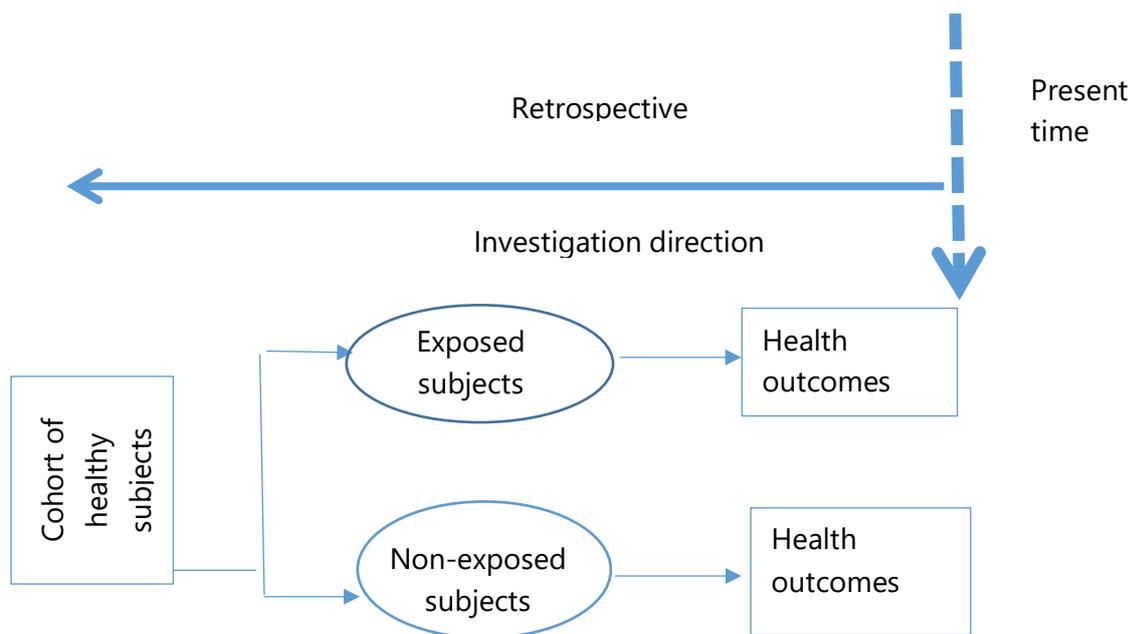
**Figure 1: Outline of Retrospective cohort design**

## Interrupted time series design

Interrupted time series analysis (ITS) was used to examine the change in trend (slope and intercept) in the selected outcome variables from pre to post-AMIHS implementation. Additionally, a separate time series of all births in NSW where the baby was Aboriginal but did not live in an area with an AMIHS site at the time of birth was also conducted. The design approach is illustrated in Figure 2.
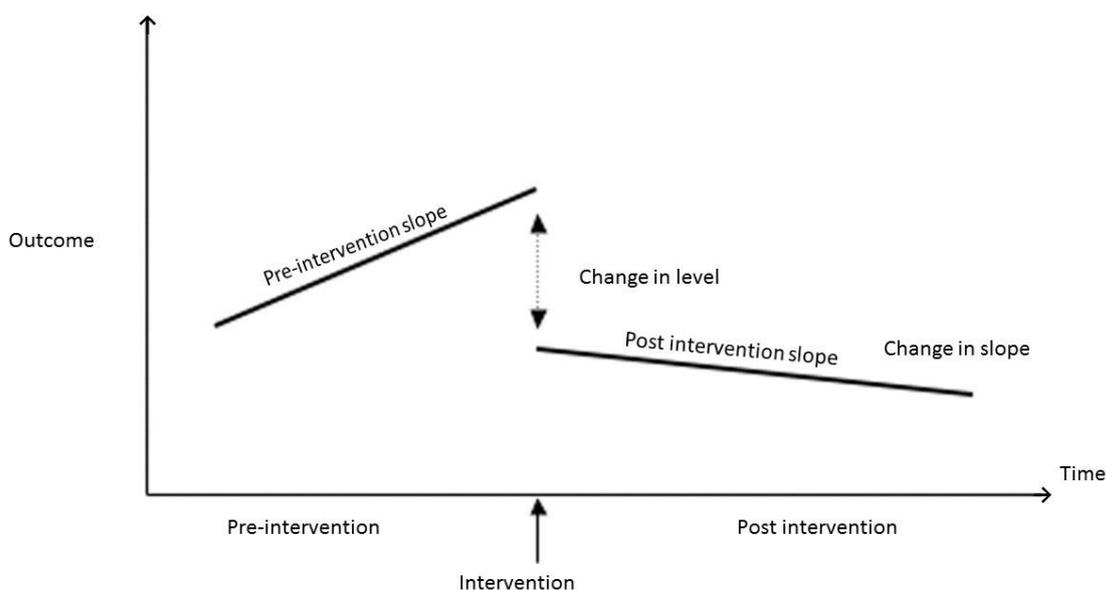


**Figure 2: Example of Interrupted time series analysis**

In ITS, data are collected at multiple time points before and after an intervention to detect whether the intervention had a significantly greater effect than any underlying secular trend (Bernal, et al., 2016). Some argue that in situations where randomisation is not possible the ITS method is the strongest quasi-experimental research design (Penfold and Zhang, 2013).

# Data sources

There were two sources of routinely collected administrative data that were interrogated for the research, both of which are datasets maintained by the NSW Ministry of Health.

## NSW AMIHS Data Collection (AMDC)

This dataset includes records of Aboriginal births in NSW. The data base was established through an AMIHS extract from the former ObstetriX maternity data system used by most LHDs with an AMIHS site. Data are available from 2012.

The AMDC holds the same fields that are held in the Perinatal Data Collection (PDC[3]) plus additional fields relating to: referral to, and uptake of, AMIHS; and referral to, and attendance at, an early childhood health service.

PDC items are sourced directly from the PDC, whereas AMIHS administrative data items that are not held in the PDC are sourced from local patient information systems. The AMDC is based on the date of birth of the baby.

The NSW Ministry of Health has advised that the AMDC may not include all Aboriginal births recorded in the PDC. The reasons for this are outlined below.

- Two LHDs used data collection systems that were not linked to the AMDC. Aboriginal births in these LHDs were recorded in the PDC but not in the AMDC.

- The AMDC extract was drawn from public hospitals only; the PDC includes births in public and private hospitals (though the number of Aboriginal births in private hospitals is low).

- To support annual reporting requirements, data was extracted into the AMDC in September for the previous financial year. As PDC data cleaning continues for a longer period, additional Aboriginal births may be identified that are not recorded in the AMDC.

## Maternal Child Health Register (MCHR)

The MCHR is a public health register containing de-identified records of children and young people aged up to 16 years and women aged 12 to 55 years in NSW. The MCHR was established under the Public Health and Diseases Registers provisions of the NSW Public Health Act 2010 and was approved by the NSW Chief Health Officer on 10th January 2014. The MCHR comprises of records of the following data collections: NSW Admitted Patient Data

---

[3] See https://www1.health.nsw.gov.au/pds/ActivePDSDocuments/PD2015_025.pdf for details of variables in the PDC.

Collection, NSW Emergency Department Data Collection, NSW Perinatal Data Collection (PDC), NSW Register of Congenital Conditions, NSW Perinatal Death Review database, NSW Notifiable Conditions Information Management System, Registry of Births, Deaths and Marriages (RBDM) death registrations and the Australian Coordinating Registry Cause of Death Unit Record File (COD URF). An enhanced reporting of Aboriginality (ERA) variable is available in the MCHR through the linkage of the aforementioned datasets, thus providing a larger and more accurate Aboriginal population for inclusion in the analysis. The Aboriginal Health and Medical Research Council Ethics Committee has approved the use of the MCHR and ERA for, among other things, measurement and monitoring of outcomes of specific population health interventions (approval number 935/13).

The MCHR comprises of the same fields that are held in the PDC and these are linked with the NSW administrative datasets described above (the PDC is a population-based data collection which covers all births in NSW public and private hospitals, as well as home births in NSW). The PDC includes fields describing: the socio-demographic characteristics of the mother and baby (consistently available from 1991 onwards), including the Aboriginal status of the mother and the baby (prior to 2011 this information was available for the mother only); the health outcomes and health behaviours (including health seeking behaviours) of the mother during the antenatal period; the nature of the labour and the delivery; the condition of the baby at birth; and health procedures provided to the baby postpartum). The collection is based on the date of birth of the baby.

The MCHR holds data for the period 1 January 1994 – 31 December 2015. The period of available data for each dataset in the MCHR varies depending on the source. The MCHR data custodian is the Director, Epidemiology and Biostatistics, Centre for Epidemiology and Evidence, NSW Ministry of Health. However, custodians of the individual datasets that form the MCHR retain control of the release of de-identified linked records to project investigators.

## Study cohorts

### *Study population from AMDC data*

The study population included all babies born to women who were **eligible** to receive the AMIHS service (pregnant women who gave birth to an Aboriginal baby and lived in an **AMIHS catchment area** at the time of their pregnancy) during the years 2012 to 2016. This population included babies whether their mother received an AMIHS service or not. The definition of AMIHS catchment areas and actual postcodes used is provided in Appendix 2. The following exclusion criteria were applied to the AMDC data prior to analysis:

1. Residential postcodes located outside NSW.

2. Residential postcodes located outside the AMIHS catchment areas.

3. Records reporting more than 20 previous pregnancies.

4. Women who were offered and accepted AMIHS before conception or after birth.

Further exclusion criteria were applied for specific outcomes as follows:

5. Preterm babies were excluded when analysing the number of antenatal visits.

6. Multiple births were excluded when analysing small for gestational age.

7. Birth weight falling outside the guidelines of Australian national birthweight percentiles by sex and gestational age were excluded when exploring small for gestational age and low birth weight (Dobbins *et al., 2012*).

The impact on the study cohort of exclusion criteria are illustrated in the flow chart on the next page. Notes to the flow chart include the following:

Note A – Unrealistic records includes:

- Women who were offered and accepted AMIHS before conception or after birth
- Records reporting more than 20 previous pregnancies

Note B – Antenatal visit exclusions include:

- Preterm births
- Missing gestational age
- Did not attend antenatal visit

Note C – First pregnancy antenatal visit exclusions include:

- Preterm births
- Missing gestational age
- Did not attend antenatal visit
- Not the first pregnancy

Note D – Small for gestational age exclusions include:

- Multiple births
- Birth weight falling outside the guidelines

Note E – Low birth weight exclusions include:

- Multiple births
- Birth weight falling outside the guidelines

Note F – Quit smoking exclusions include:

- Do not smoke in first half of pregnancy
- Missing value in both 1st and 2nd half pregnancy

All Aboriginal babies recorded in the AMDC July 2012 to December 2016: n=20334

Aboriginal babies born in AMIHS catchment postcodes: n=16,542

Excluding unrealistic records: n=183 (see Note A)

At least 7 antenatal visits
Exclusion: n=2,000 (See Note B)

After excluding criteria above: n=14,359

At least 10 antenatal visits first pregnancy
Exclusion: n=11,411 (See Note C)

After excluding criteria above: n=4,948

Preterm
Exclusion: n=15
Missing gestational age

After excluding criteria above: n=16,344

1st antenatal visit before 14 weeks gestation
Exclusion: n=177
-No antenatal visits

After excluding criteria above: n=16,182

Small for gestational age
Exclusion: n=752 (See Note D)

After excluding criteria above: n=15,607

Low birth weight
Exclusion: n=752 (See Note E)

After excluding criteria above: n=15,607

Quit smoking in second half or pregnancy
Exclusion: n=9538 (See Note F)

After excluding criteria above: n=6,821

Breast-feeding at discharge: n=16,359

**FLOW CHART A: DEMONSTRATING EXCLUSION CRITERIA EFFECTS**

### *Study population from MCHR data*

The MCHR dataset includes all Aboriginal and non-Aboriginal babies born in NSW between 1994 and 2015.

All Aboriginal births (based on enhanced reporting of Aboriginality) were categorised into two cohorts depending on when the AMIHS clinics were established. One group of AMIHS clinics (N=11) was established between 2000 (n=1) and 2001 (n=10) (**2001 Cohort**) and a second group of clinics (N=33) was established between 2008 (n=23) and 2009 (n=10) (**2008-09 Cohort**).

The women in these two cohorts were further categorised into three groups as follows:

1. women who gave birth before the establishment of the clinics (**Pre-AMIHS period**)

2. women who gave birth in the years the clinics were being established (**Implementation AMIHS period**)
3. women who gave birth after the establishment of the clinics (**Post-AMIHS period**).

As only one clinic was established in 2000, births in 2000 were included in the 'Pre-AMIHS period' category.

In all analyses, birth records were excluded where:

1. maternal residential postcodes were located outside NSW

2. postcodes were recorded for AMIHS program established in both 2000/2001 and 2008/2009 (postcodes 2259, 2321, 2322, 2441, 2450, 2765, 2828; n=2,882).

## Outcomes and covariates

The impact of the AMIHS program using AMDC data was evaluated for the following outcomes:

a. at least seven antenatal visits (or at least 10 visits among women in their first pregnancy)
b. first antenatal visit <14 weeks gestation
c. preterm birth (<37 weeks gestation)
d. low birth weight (<2,500 grams)
e. small for gestational age (singletons with a birth weight below the 10th percentile of Australian national gestational age- and sex-specific birth weight percentiles)
f. smoking cessation during pregnancy (smoked in the first half of pregnancy but not in the second half of pregnancy)
g. fully breastfeeding on discharge from hospital (baby is breastfed or receiving expressed breastmilk and not receiving infant formula when discharged from hospital)

Using the MHCR data, the following health outcomes were evaluated:

- First antenatal visit <14 weeks gestation[4]
- Preterm birth (<37 weeks gestation)
- Low birth weight (<2,500 grams)
- Small for gestational age (singletons with a birth weight below the 10th percentile of Australian national gestational age- and sex-specific birth weight percentiles)
- Ever smoked during pregnancy (smoked in the first half of pregnancy and/or in the second half of pregnancy)
- Perinatal death (still births and deaths within 28 days of birth)

The outcomes for Objectives 2 and 3 were also evaluated with multivariable logistic regression models. These regression models adjusted for variables (or covariates) that could have effects on the outcomes independent of the AMIHS program or were potential confounders. The covariates that were included in the analyses included:

1. maternal age (≤19 years, 20-34 years, 35+ years)
2. mother's Aboriginality (Yes/No)
3. number of previous pregnancies greater than 20 weeks gestation (0, 1-2, 3+)
4. gestational week at first antenatal visit (No antenatal visits, 1-13 weeks, 14-19 weeks, 20+ weeks)
5. last birth by caesarean section (Yes/No or 1st pregnancy)
6. maternal diabetes (Yes/No)
7. gestational diabetes (Yes/No)
8. maternal chronic hypertension (Yes/No)
9. gestational hypertension (Yes/No)
10. smoking during first half of pregnancy (Yes/No)
11. smoking during second half of pregnancy (Yes/No)
12. any smoking during pregnancy (Yes/No)
13. AMIHS service type (Higher ratio midwives & clinic, AHW-led & home visiting, AMIHS-type, Higher ratio of AHW & outreach, Higher ratio midwives & home visiting)
14. year of baby's birth
15. area socio-economic status (quintiles of Index of Relative Socio-Economic Disadvantage)

---

[4] In relation to the PDC variable "Duration of pregnancy (weeks) at first antenatal visit" there was a substantial change in the definition of "Antenatal visit" in 2011. The definition changed from "the first contact with any clinician for antenatal care" to the more comprehensive definition of contact "at first comprehensive booking or assessment by clinician". Because this new question more specifically defines the type of visit that is reported as antenatal care, the proportion of mothers who 'commenced' antenatal care in 2011 is lower than in previous years. CEE (2019) *HealthStats NSW*

Where one of the above variables was considered an outcome in a model, then it was not included as a covariate in that same model.

## Statistical analyses

The statistical methods that were used for each of the objectives are presented in this section.

### *Objective 1: Simple descriptive comparison undertaken for all AMIHS service sites - Reach*

The AMDC data was used to calculate the reach of the AMIHS program. Every birth in the AMDC dataset includes one of the following descriptions regarding use of the AMIHS program: 'offered and accepted', 'offered and declined' or 'not offered'. Reach was measured in the following two ways:

- proportion of eligible women who were **offered** AMIHS

    Numerator: number of Aboriginal births for which the mother (1) lived in an area with an AMIHS site at the time of birth AND (2) was offered AMIHS at any stage during the antenatal period.

    Denominator: number of Aboriginal births for which the mother lived in an area with an AMIHS site at the time of birth.

- proportion of eligible women who **accepted** AMIHS

    Numerator: number of Aboriginal births for which the mother (1) lived in an area with an AMIHS site at the time of birth AND (2) attended an AMIHS site at any stage during the antenatal period.

    Denominator: number of Aboriginal births for which the mother lived in an area with an AMIHS site at the time of birth.

For each of the two measures of reach, a descriptive analysis (means, frequencies, cross-tabulations) was conducted to determine associations between whether the AMIHS program was offered and accepted and maternal socio-demographic characteristics, antenatal factors and AMIHS service types. Descriptive analyses were conducted for each predominant AMIHS service type identified through earlier evaluation components (see Appendix 3 for service type definitions).

### *Objective 2: Regression analysis of AMDC data – factors influencing program reach*

The AMDC was used to determine associations between AMIHS attendance and a range of client, health service and temporal factors. Following descriptive analyses (means, frequencies, cross-tabulations) and single variable logistic regression models, multi-level logistic regression models were constructed to identify predictors of AMIHS attendance.

A range of client, health service and temporal factors were investigated, including: maternal age (≤19 years, 20-34 years, 35+ years); mother's Aboriginality (Yes/No); area socio-economic status (based on the Index of Relative Socio-Economic Disadvantage (IRSED) of mother's

residential postcode and categorised into quintiles)[5]; number of previous pregnancies greater than 20 weeks gestation (0, 1-2, 3+); last birth by caesarean section (Yes/No or 1st pregnancy); gestational diabetes (Yes/No); gestational hypertension (Yes/No); smoking during first and second half of pregnancy(Yes/No); AMIHS service type; year of baby's birth[6] and women's LHD of residence.

As women living within an LHD may share similar characteristics, multi-level logistic regression models were used to account for area-level clustering. In each model, the significant predictors of being offered and accepting the AMIHS program was compared to those women who were offered and declined the AMIHS program or were not offered the AMIHS program at all. Only maternal socio-demographic and antenatal characteristics significant (p-value <.05) in univariate multi-level logistic regression models were included in the multivariable multi-level logistic regression model. The type 3 p-value indicates if there is an overall significant association between maternal socio-demographic and antenatal characteristics and whether the AMIHS program was offered and accepted. The SAS procedure GLIMMIX was used to fit the multi-level logistic regression models. Results are presented as odds ratios (ORs) with accompanying p-values and 95% CIs.

### Objective 3: Cross-sectional assessment of outcomes in 'exposed' and 'control' groups

The impact of the AMIHS program, using AMDC data, on selected outcomes was investigated for two groups as follows:

> Eligible women who attended an AMIHS site (**exposed / treatment group**): Aboriginal births in NSW for which the mother (1) attended an AMIHS site at any stage in the antenatal period AND (2) satisfied the outcome criteria.

> Eligible women who did not attend an AMIHS site (**unexposed / non-treatment group**): Aboriginal births in NSW for which the mother (1) lived in an area with an AMIHS site at the time of birth AND (2) did not attend an AMIHS site at any stage in the antenatal period AND (3) satisfied the outcome criteria.

The analysis is described in Figure 3.

---

[5] The 1996, 2001, 2006 and 2011 Index of Relative Socio-Economic Disadvantage (IRSED) at the postcode level was used in the analyses as a measure of area deprivation. The IRSED was created by the Australian Bureau of Statistics to compare social and economic disadvantage across geographical areas in Australia. The IRSED is derived from Census variables such as, do not speak English well, do not own a car, long-term health condition or disability and need assistance with core activities, separated or divorced, single parent, do not have internet connection, low income and educational attainment, high unemployment, and people working in unskilled occupations. The IRSED has a mean score of 1,000 and standard deviation of 100. The IRSED was categorised into quintiles for the analyses using the postcodes in the AMIHS catchment areas.

[6] Year of birth is a proxy measure to allow for any trends in data as the Program matures and as other, non-program factors, potentially have an influence.
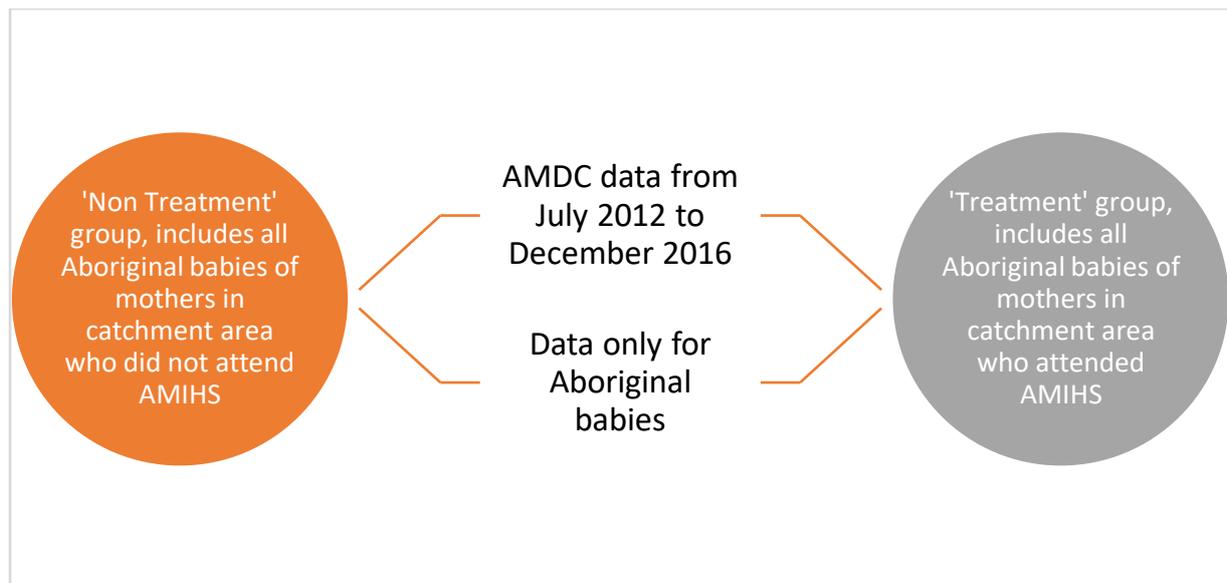
**Figure 3: Overview of the cross-sectional evaluation research analysis**

This cross-sectional analysis used the AMDC dataset (using subjects only from AMIHS catchment areas) and two separate analyses were conducted (referred to as Analysis 1 and Analysis 2) using two differently defined control or "non-treatment" comparator groups:

> Analysis 1 compares women who attended AMIHS ('treatment') with a 'control' group who did not attend AMIHS (declined the offer or were not offered the program at all) ('control').

> Analysis 2 compares women who attended AMIHS ('treatment') with those who were not offered the program at all ('control').

A descriptive analysis (means, frequencies, cross-tabulations) was first conducted. Multi-level logistic regression models were then constructed to determine associations between the AMIHS program and outcomes. All multi-level logistic regression analyses were adjusted for the same set of covariates that were shown in previous analysis to be potentially influential on participation in the service (year of birth, maternal age-group, Aboriginal mother, IRSED, number of previous pregnancies, previous birth by caesarean section, maternal diabetes, gestational diabetes, maternal hypertension, gestational hypertension, smoked in the first half of pregnancy, smoked in the second half of pregnancy and AMIHS service type). The SAS procedure GLIMMIX was used to fit the multi-level logistic regression models. Results are presented as odds ratios (ORs) with accompanying p-values and 95% CIs.

## *Objective 3: Retrospective pre-post analysis of outcomes*

The pre-post AMIHS program evaluation analysed MCHR data to determine whether there was a change in Aboriginal maternal and infant health outcomes in the period following implementation of the AMIHS program (post-AMIHS period) compared to the period prior to the implementation of the AMIHS program (pre-AMIHS period). The design is illustrated in Figure 4. The MCHR dataset goes from 1994 to 2015. All Aboriginal births were categorised into two cohorts (the 2001 Cohort and the 2008-09 Cohort).

All Aboriginal babies born in designated catchment area

All Aboriginal babies born in designated catchment area

Pre-Program - years prior to Program commencement at the service site

Post-Program - years after implementation

Selected outcome measures

Selected outcome measures
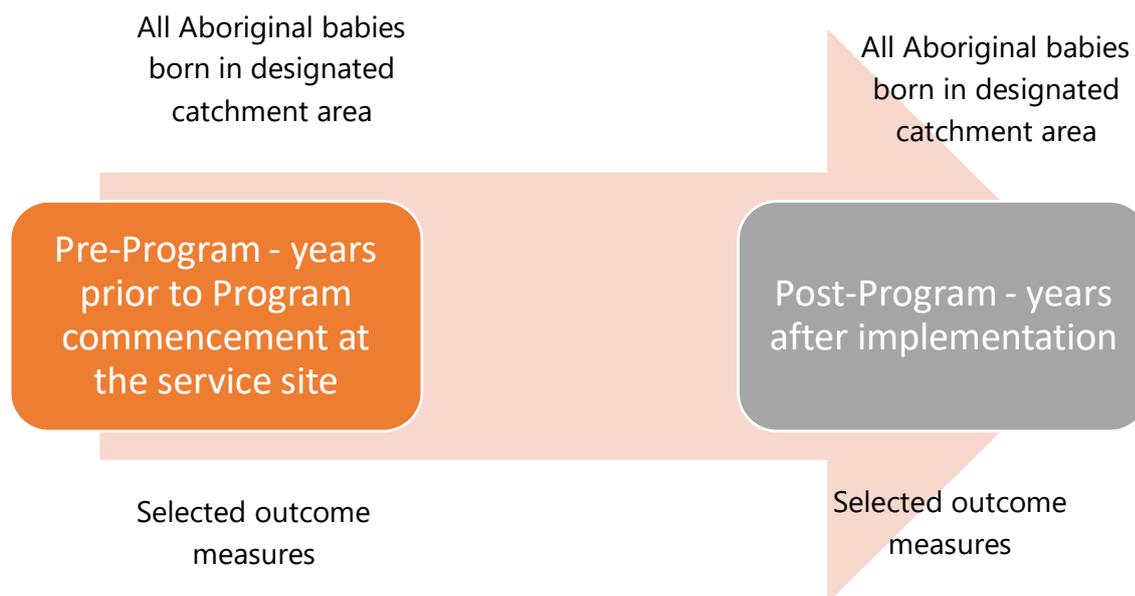
**Figure 4: Overview of simple Pre- Post-Implementation design**

Initial descriptive data analysis consisted of cross-tabulations between maternal socio-demographic and antenatal characteristics and implementation of the AMIHS program implementation (Pre-AMIHS and Post-AMIHS periods) for each of the two cohorts. Following the descriptive analysis, a multi-level multivariable logistic regression analysis was conducted to determine associations between the AMIHS program implementation (Pre-AMIHS and Post-AMIHS periods) and outcomes. Separate models were constructed for each of the two cohorts. All models were adjusted for the following set of covariates (maternal age-group, mother's Aboriginality, IRSED, number of previous pregnancies >20 weeks gestation, previous birth by caesarean section, maternal diabetes, gestational diabetes, maternal hypertension and gestational hypertension). Adjustment was also made for the covariates 'gestational week at first antenatal visit' and 'any smoking during pregnancy', but not of course where the outcome variable was the time of the first antenatal visit or smoking during pregnancy. The SAS procedure GLIMMIX was used to fit the multi-level logistic regression models. The results are presented for three separate models: 2001 Cohort, 2008-09 Cohort and a combined 2001 and 2008-09 cohort. ORs with accompanying p-values and 95% CIs are presented.

***Objective 3: Times series assessment of outcomes in 'before' and 'after' groups***

The MCHR dataset was used to conduct ITS analyses. For each of the six outcome variables, Poisson ITS analysis was used to examine the change in trend before and after AMIHS was established. To assess the fit of the model, the Chi-squared goodness-of-fit tests were used. When the Poisson model was inappropriate due to over-dispersion, the negative binomial model was used. In the Poisson models, the total number of births was included as an offset. To capture long-term trends over time, time was categorised into three-month periods (quarters) from the first quarter of 1994 to the last quarter of 2015 and included in the models. To account for the presence of autocorrelation, autoregressive parameters were included in

the models. An indicator variable was used to define the period when the AMIHS was established, with a value of zero given to the time before AMIHS was established and a value of one given to the time during the AMIHS establishment period and after AMIHS was established.

Like the retrospective pre-post analysis, there are two models of ITS analyses *viz.* a 2001 Cohort (areas where services commenced in 2001 and 2001 was considered as the establishment period) and a 2008-09 Cohort (areas where services commenced in 2008 or 2009 and where these two years were considered as the establishment period).

Given the AMIHS program and its impact on outcome can take a long time to establish and achieve the desired outcomes, only three main parameters are considered in each model. The first parameter (Pre-intervention trend or slope) estimates the change in outcome associated with each quarter before AMIHS was established. The second parameter (Post-intervention trend or slope) estimates the change in outcome associated with each quarter after AMIHS was established, and the third parameter (change in trend from pre- to post- implementation) estimates the change in trend in outcome associated with each quarter after AMIHS was established, compared with the quarterly trend before AMIHS was established.

To examine whether the residuals follow the independence assumption, the autocorrelation function (ACF) and partial autocorrelation function (PACF) were plotted and further verified with the Ljung-Box up to 24 lags. All ITS models were conducted using the SAS Proc GENMOD. ACF and PACF were conducted using Proc AUTOREG and Ljung-Box statistics was conducted using Proc ARIMA. Results are presented as risk ratios (also known as relative risks) (RR) together with their 95% confidence intervals. Where the RR is greater than 1, then the trend indicates an increasing likelihood of an outcome occurring (and the opposite for a trend RR of less than 1). A p-value of less than 0.05 indicates the trend obtained is statistically significant.

# D.  OBJECTIVE 1 - SERVICE REACH RESULTS

## Aboriginal babies born in NSW

For the period July 2012 to December 2016, the AMDC includes records for 20,334[7] Aboriginal births in NSW. Of these, 20,151 births had a maternal postcode of residence in NSW. There were 14 births recorded in the AMDC where the baby's Indigenous status was recorded as non-Indigenous (Table 1) and these births were excluded from all further analyses.

**Table 1: Indigenous status of mothers and babies with a maternal postcode of residence in NSW, AMDC 2012-2016**

| | Mother's Indigenous status | | | | | |
|---|---|---|---|---|---|---|
| Baby's Indigenous status | Aboriginal | Torres Strait Islander | Aboriginal and Torres Strait Islander | Neither Aboriginal or Torres Strait Islander | Not stated | Total |
| Aboriginal | 12,521 | 20 | 128 | 6,675 | 26 | 19,370 |
| Torres Strait Islander | 16 | 84 | 10 | 193 | 0 | 303 |
| Aboriginal and Torres Strait Islander | 167 | 20 | 111 | 166 | 0 | 464 |
| None of the above | 2 | 0 | 0 | 12 | 0 | 14 |
| **Total** | **12,706** | **124** | **249** | **7,046** | **26** | **20,151** |

## Results of reach analysis

### State-wide reach of AMIHS

There were 16,542 Aboriginal babies whose mothers lived in an AMIHS catchment area. This means the 'potential reach' of the AMIHS program was to 82.1% of the total number of Aboriginal babies born in that period in NSW (n=20,151). The socio-demographic and pregnancy characteristics of the mothers of the 16,542 babies are presented in Table 2. Data collection for 2012 commenced on 1st July and therefore there are data for only six months for 2012.

Most women were in the 20-34-year age-group and about a third of the women were non-Aboriginal. About 55% of women had their first antenatal visit by 14 weeks of gestation and about 1% of mothers did not make any antenatal visits. More women reported smoking in the

---

[7] To provide a perspective on the relative quality of the AMDC data, the total number of Aboriginal births recorded in the PDC for the same period is 25,027 (HealthStats NSW)

first half of pregnancy (42%) than in the second half of pregnancy (37%). Just over 6% of women had gestational diabetes mellitus.

**Table 2: Socio-demographic and pregnancy characteristics of mothers giving birth to Aboriginal babies in the AMIHS catchment area (N=16,542)**

| Socio-demographic & pregnancy characteristics of mothers of Aboriginal babies | Frequency | % of total Aboriginal babies born in catchment area |
|---|---|---|
| **Year of birth** | | |
| **2012** | 1,770 | 10.7 |
| **2013** | 3,888 | 23.5 |
| **2014** | 4,009 | 24.2 |
| **2015** | 3,703 | 22.4 |
| **2016** | 3,172 | 19.2 |
| **Maternal age-group (years)** | | |
| **<=19** | 2,156 | 13.0 |
| **20-34** | 12,817 | 77.5 |
| **35+** | 1,569 | 9.5 |
| **Aboriginal mother** | | |
| **No** | 5,561 | 33.6 |
| **Yes** | 10,981 | 66.4 |
| **Index of Relative Socioeconomic Disadvantaged** | | |
| **Missing** | 2 | 0.01 |
| **Most disadvantaged** | 3,274 | 19.8 |
| **Second disadvantaged** | 3,316 | 20.1 |
| **Third disadvantaged** | 3,370 | 20.4 |
| **Fourth disadvantaged** | 3,255 | 19.7 |
| **Least disadvantaged** | 3,325 | 20.1 |
| **Gestational age at first antenatal visit (weeks)** | | |
| **Missing** | 1 | 0.01 |
| **No antenatal visits** | 186 | 1.1 |
| **1-13** | 9158 | 55.4 |
| **14-19** | 3472 | 21.0 |
| **20+** | 3725 | 22.5 |
| | | |
| **Number of previous pregnancies** | | |
| **Missing** | 2,672 | 16.2 |
| **0** | 2,984 | 18.0 |

| Socio-demographic & pregnancy characteristics of mothers of Aboriginal babies | Frequency | % of total Aboriginal babies born in catchment area |
|---|---|---|
| **1-2** | 7,328 | 44.3 |
| **3+** | 3,558 | 21.5 |
| **Maternal hepatitis B surface antigen positive** | | |
| **No/Not stated** | 16,477 | 99.6 |
| **Yes** | 65 | 0.4 |
| **Maternal diabetes** | | |
| **No/Not stated** | 16,367 | 98.94 |
| **Yes** | 175 | 1.06 |
| **Maternal chronic hypertension** | | |
| **No/Not stated** | 16,403 | 99.2 |
| **Yes** | 139 | 0.8 |
| **Gestational diabetes** | | |
| **No/Not stated** | 15,525 | 93.9 |
| **Yes** | 1,017 | 6.2 |
| **Gestational hypertension** | | |
| **No/Not stated** | 15,903 | 96.1 |
| **Yes** | 639 | 3.9 |
| **Smoked during first half of pregnancy** | | |
| **Missing** | 92 | 0.6 |
| **No** | 9,541 | 57.7 |
| **Yes** | 6,909 | 41.8 |
| **Smoked during second half of pregnancy** | | |
| **Missing** | 11 | 0.1 |
| **No** | 10,395 | 62.9 |
| **Yes** | 6,136 | 37.1 |

The majority of women (89%; 14,514) in the AMIHS catchment areas were 'offered' the program. The AMIHS offer is usually made and recorded at the first comprehensive antenatal visit (booking in), which may be completed by an AMIHS midwife or a midwife at a hospital antenatal clinic. It is acknowledged that the amount of information about AMIHS given to women may differ between sites. If offers were extended to 89% of the 82% within NSW who had Aboriginal babies in an AMIHS catchment area, this equates to 73% of the mothers of all NSW Aboriginal babies having been offered the AMIHS Program.

Just over 50% (n=8,222) of mothers in the AMIHS catchment areas accepted the AMIHS program (See Figure 5). Based on AMDC records, it is estimated that 41% of all Aboriginal

babies born in NSW during the designated period were through an AMIHS service. Thirty-eight per cent were 'offered and declined' the service. It is considered by site level managers that this may over-estimate actual declines (and therefore under-estimate uptake), since this may also be recorded when a woman accepts AMIHS but:

- AMIHS cannot be provided because the service is at capacity
- there is no AMIHS site in the woman's local area
- the referral does not reach the AMIHS site, the referral is therefore not followed up and the AMIHS service is not provided
- there are only a few AMIHS occasions of service (i.e. the woman accesses other maternity care)
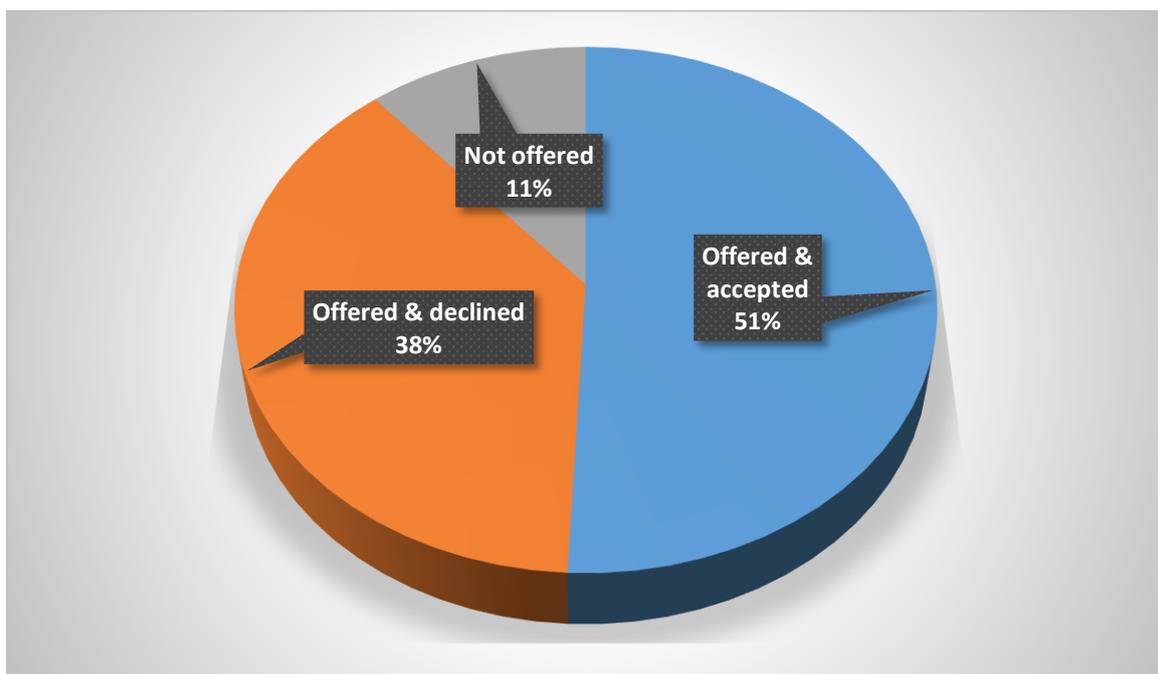


**Figure 5: Distribution of mothers in the AMIHS catchment areas by offer and acceptance status for the AMIHS Program (*Source: AMDC data, 2012-2016*)**

The proportion of mothers who were not offered the AMIHS program (just over one in ten) while small is worth noting (over 1,800 babies). Site level Program managers were asked to comment on the 'AMIHS not offered' numbers and offered the following possible circumstances for 'non-offer':

- there is no AMIHS service in the locality
- the midwife assumes the woman is not Aboriginal (question about Aboriginality is not asked)
- the midwife does not have a good understanding of all local services available

The actual reach of the AMIHS program, if it was offered to 100% of all eligible mothers, could be closer to 57% if those not offered the service accessed AMIHS in similar proportions to the rest of the population.

## Service type level reach

There were five different types of AMIHS service identified through a cluster analysis of manager survey data (see Appendix 3) where all 44 active sites were differentiated into 'service types'. The distribution of Aboriginal babies born by AMIHS service types (N = 16,359) was as follows:

**Table 3: Distribution of Aboriginal babies by AMIHS service types**

| Service type | N | % |
|---|---|---|
| Midwife & clinic-based | 5,593 | 34.8 |
| AHW-led & home visiting | 3,394 | 21.1 |
| AMIHS-type | 3,214 | 20.0 |
| AHW & outreach | 2,156 | 13.4 |
| Midwife & home visiting | 1,694 | 10.6 |
| Total | 16,359 | |

*Source: AMDC, 2012-2016, Manager Survey, 2017*

Differences in offer and acceptance between service types is significant (p<0.0001). Of the five AMIHS service types, the 'Higher ratio midwives & home visiting' service type had the highest offer and acceptance rate (see Figure 6).
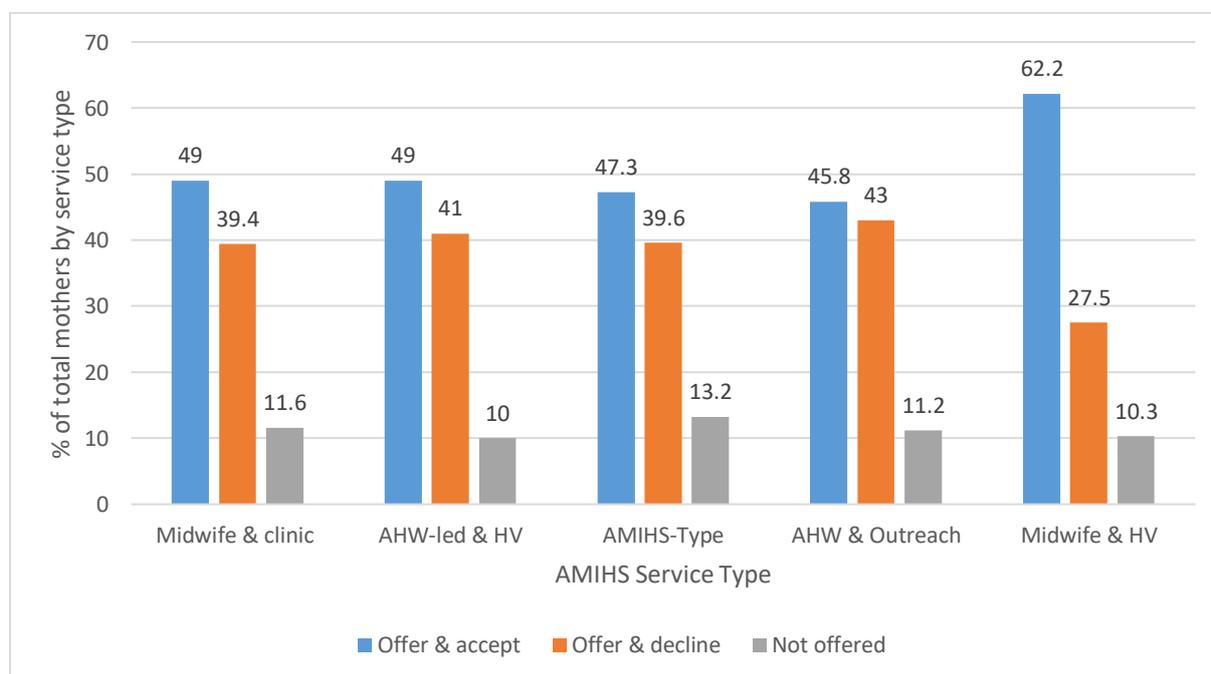


**Figure 6: Distribution of Aboriginal births by AMIHS service type (Source: AMDC, 2012-2016, Manager Survey, 2017)**

# E.   OBJECTIVE 2 - FACTORS INFLUENCING AMIHS REACH

A combination of descriptive analyses, univariate regression and multivariable regression analyses were conducted to explore factors associated with participation in AMIHS. Tables 4, 5, 6 and 7 provide results of preliminary analyses. Table 8 provides the results of the final multivariable regression model with adjusted odds ratios.

## Characteristics of mothers who accepted the AMIHS Program offer

Tables 4 and 5 present descriptive data by whether AMIHS was offered to mothers of Aboriginal babies and if the offer was accepted. Characteristics most associated (statistically significantly) with accepting the AMIHS were:

- Age - a higher proportion (60%) of women aged 19 years or less accepted AMIHS, compared to women aged between 20 and 34 years (49%) and women aged 35 years or more (45%) (p <.0001)
- Aboriginality - 57% of Aboriginal mothers accepted AMIHS compared to 37% of non-Aboriginal mothers (p < 0.0001)
- Living in a disadvantaged area – in the three most disadvantaged areas, 53-55% of women accepted AMIHS compared to 41- 48% of women living in more advantaged areas (p<0.0001)
- Any smoking during pregnancy – 56% of women who smoked at any time during pregnancy accepted an AMIHS offer compared to 46-47% of women who did not smoke during pregnancy (p < 0.0001)

**Table 4: Maternal socio-demographic characteristics by whether AMIHS program was offered**

| | | AMIHS program offer and acceptance status | | |
|---|---|---|---|---|
| **Characteristics of mother** | **Total** | **Offered and accepted** N=8,222 (%) | **Offered and declined** N=6,292 (%) | **Not offered** N=1,845 (%) |
| **Maternal age-group (years)** | | | | |
| **<19** | 2,125 | 1,266 (59.6) | 602 (28.3) | 257 (12.1) |
| **20-34** | 12,678 | 6,260 (49.4) | 5,037 (39.7) | 1,381 (10.9) |
| **35+** | 1,556 | 696 (44.7) (8.5) | 653 (42.0) (10.4) | 207 (13.3) (11.2) |

| Characteristics of mother | Total | AMIHS program offer and acceptance status | | |
|---|---|---|---|---|
| | | Offered and accepted N=8,222 (%) | Offered and declined N=6,292 (%) | Not offered N=1,845 (%) |
| **Chi-square, p-value** | <.0001 | | | |
| **Aboriginal mother** | | | | |
| **No** | 5,521 | 2,033 (36.8) | 2,836 (51.4) | 652 (11.8) |
| **Yes** | 10,838 | 6,189 (57.1) | 3,456 (31.9) | 1,193 (11.1) |
| **Chi-square, p-value** | <.0001 | | | |
| **IRSED (missing=2)** | | | | |
| **Most disadvantaged** | 3,213 | 1,766 (55.0) | 1,063 (33.1) | 384 (12.0) |
| **Second disadvantaged** | 3,282 | 1,727 (52.6) | 1,115 (34.0) | 440 (13.4) |
| **Third disadvantaged** | 3,344 | 1,826 (54.60) | 1,221 (36.5) | 297 (8.9) |
| **Fourth disadvantaged** | 3,218 | 1,327 (41.2) | 1,479 (46.0) | 412 (12.8) |
| **Least disadvantaged** | 3,300 | 1,575 (47.7) | 1,413 (42.8) | 312 (9.5) |
| **Chi-square, p-value** | <.0001 | | | |

*Source: AMDC 2012-2016*

**Table 5: Maternal antenatal characteristics by whether AMIHS program was offered**

| Characteristics of mother | Total | AMIHS program offer and acceptance status | | |
|---|---|---|---|---|
| | | Offered and accepted N=8,222 (%) | Offered and declined N=6,292 (%) | Not offered N=1,845 (%) |
| **Number of previous pregnancies** | | | | |
| **0** | 5,598 | 2,827 (50.5) | 2,142 (38.3) | 629 (11.2) |
| **1-2** | 7,248 | 3,560 (49.1) | 2,948 (40.7) | 740 (10.2) |
| **3+** | 3,513 | 1,835 (52.2) | 1,202 (34.2) | 476 (13.6) |
| **Chi-square, p-value** | <.0001 | | | |
| **Gestational age at first antenatal visit (weeks) (missing=1)** | | | | |
| **No antenatal visits** | 172 | 13 (7.6) | 27 (15.7) | 132 (76.7) |
| **1-13** | 9,060 | 4721 (52.1) | 3482 (38.4) | 857 (9.5) |
| **14-19** | 3,444 | 1672 (48.9) | 1417 (41.1) | 355 (10.3) |

| Characteristics of mother | Total | AMIHS program offer and acceptance status | | |
|---|---|---|---|---|
| | | Offered and accepted N=8,222 (%) | Offered and declined N=6,292 (%) | Not offered N=1,845 (%) |
| **20+** | 3,682 | 1816 (49.3) | 1365 (37.1) | 501 (16.6) |
| **Chi-square, p-value** | <.0001 | | | |
| **Last birth by caesarean section** | | | | |
| **No or first pregnancy** | 11,521 | 5,781 (50.2) | 4,488 (39.0) | 1,252 (10.9) |
| **Yes** | 2,188 | 1,083 (49.5) | 834 (38.1) | 271 (12.4) |
| **Not stated** | 2,650 | 1,358 (51.3) | 970 (36.6) | 322 (12.2) |
| **Chi-square, p-value** | 0.043 | | | |
| **Maternal diabetes** | | | | |
| **No/Not stated** | 16,185 | 8,142 (50.3) | 6,227 (38.5) | 1,816 (11.2) |
| **Yes** | 174 | 80 (46.0) | 65 (37.4) | 29 (16.7) |
| **Chi-square, p-value** | 0.0733 | | | |
| **Maternal chronic hypertension** | | | | |
| **No/Not stated** | 16,220 | 8,151 (50.3) | 6,236 (38.5) | 1,833 (11.3) |
| **Yes** | 139 | 71 (51.1) | 56 (40.3) | 12 (8.6) |
| **Chi-square, p-value** | 0.6035 | | | |
| **Gestational diabetes** | | | | |
| **No/Not stated** | 15,350 | 7,729 (50.4) | 5,879 (38.3) | 1,742 (11.4) |
| **Yes** | 1,009 | 493 (48.9) | 413 (40.9) | 103 (10.2) |
| **Chi-square, p-value** | 0.2003 | | | |
| **Gestational hypertension** | | | | |
| **No/Not stated** | 15,730 | 7,921 (50.4) | 6,032 (38.4) | 1,777 (11.3) |
| **Yes** | 629 | 301 (47.9) | 260 41.3) | 68 10.8) |
| **Chi-square, p-value** | 0.3191 | | | |
| **Smoked during first half of pregnancy (missing=79)** | | | | |
| **No** | 9455 | 4,390 (46.4) | 4,119 (43.6) | 946 (10.0) |
| **Yes** | 6825 | 3,804 (55.7) | 2,165 (31.7) | 856 (12.5) |
| **Chi-square, p-value** | <.0001 | | | |
| | | | | |

| Characteristics of mother | Total | AMIHS program offer and acceptance status | | |
|---|---|---|---|---|
| | | **Offered and accepted** **N=8,222** **(%)** | **Offered and declined** **N=6,292** **(%)** | **Not offered** **N=1,845** **(%)** |
| **Smoked during second half of pregnancy (missing=11)** | | | | |
| **No** | 10,296 | 4,812 (46.74) | 4,412 (42.9) | 1,072 (10.4) |
| **Yes** | 6,052 | 3,408 (56.31) | 1,876 (31.0) | 768 (12.70) |
| **Chi-square, p-value** | <.0001 | | | |

*Source: AMDC 2012-2016*

# Characteristics of mothers by AMIHS service types

The following two tables (Tables 6 and 7) present data on the characteristics of the mother and baby populations in each of the AMIHS service types. There were minimal differences found in the socio-demographic and pregnancy characteristics of mothers by the AMIHS service types. Although in some characteristics the p-values denote statistical significance, the absolute differences are small and may not be important from a service delivery point of view. For instance, in the case of the Aboriginality of the mother, none of the service type populations vary by more than 1-2% from the proportion for all Aboriginal mothers in all AMIHS catchment areas combined. There are two exceptions to the above the first of which is illustrated in Figure 7.
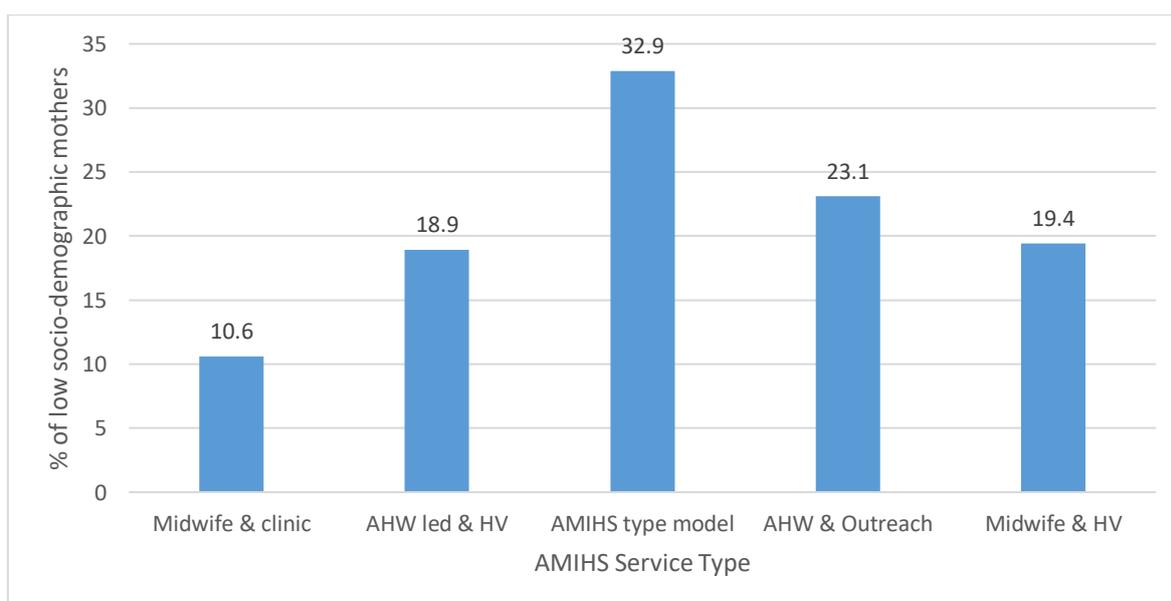


Figure 7: Percentage of disadvantaged mothers (two most disadvantaged IRSED categories) resident in AMIHS program catchment areas by AMIHS service type (*Source: AMDC 2012-2016*)

**Table 6: Maternal socio-demographic characteristics by AMIHS service type**

| Characteristic | Total | Midwife & clinic | AHW-led and home visiting | AMIHS-type | AHW & outreach | Midwife & home visiting |
|---|---|---|---|---|---|---|
| | | N=5,593 | N=3,394 | N=3,214 | N=2,156 | N=1,694 |
| **Maternal age-group (years)** | | | | | | |
| **<=19** | 2,078 | 692 (12.4) | 464 (13.7) | 441 (13.7) | 250 (11.6) | 231 (13.6) |
| **20-34** | 12,447 | 4,355 (77.9) | 2,614 (77.0) | 2,434 (75.7) | 1,716 (79.6) | 1,328 (78.4) |
| **35+** | 1,526 | 546 (9.8) | 316 (9.3) | 339 (10.6) | 190 (8.8) | 135 (8.0) |
| **Chi-square, p-value** | | | | 0.113 | | |
| **Aboriginal mother** | | | | | | |
| **No** | 5,442 | 1,987 (35.5) | 1,154 (34.0) | 1,052 (32.7) | 681 (31.6) | 568 (33.5) |
| **Yes** | 10,609 | 3,606 (64.5) | 2,240 (66.0) | 2,162 (67.3) | 1,475 (68.4) | 1,126 (66.5) |
| **Chi-square, p-value** | | | | 0.0086 | | |
| **IRSED (Missing=2)** | | | | | | |
| **Most disadvantaged** | 3,117 | 592 (10.6) | 642 (18.9) | 1,056 (32.9) | 498 (23.1) | 329 (19.4) |
| **Second disadvantaged** | 3,172 | 555 (9.9) | 1,061 (31.3) | 712 (22.2) | 316 (14.7) | 528 (31.2) |
| **Third disadvantaged** | 3,326 | 1,091 (19.5) | 1,099 (32.4) | 687 (21.4) | 354 (16.4) | 95 (5.6) |
| **Fourth disadvantaged** | 3,188 | 1379 (24.7) | 254 (7.5) | 263 (8.3) | 830 (38.5) | 462 (27.3) |
| **Least disadvantaged** | 3,246 | 1976 (35.3) | 338 (10.0) | 496 (15.4) | 158 (7.3) | 278 (16.4) |
| **Chi-square, p-value** | | | | <.0001 | | |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

*Source: AMDC 2012-2016*

**Table 7: Maternal antenatal history by AMIHS service type**

| | Total | Midwife & clinic | Aboriginal - led & home visiting | AMIHS- type | AHW & Outreach | Midwife & home visiting |
|---|---|---|---|---|---|---|
| | | N=5,593 | N=3,394 | N=3,214 | N=2,156 | N=1,694 |
| **Number of previous pregnancies** | | | | | | |
| **0** | 5,496 | 2,006 (35.9) | 1,165 (34.3) | 1,097 (34.1) | 678 (31.5) | 550 (32.5) |
| **1-2** | 7,117 | 2,482 (44.4) | 1,501 (44.2) | 1,397 (43.5) | 957 (44.4) | 780 (46.0) |
| **3+** | 3,438 | 1,105 (19.8) | 728 (21.5) | 720 (22.4) | 521 (24.2) | 364 (21.5) |
| **Chi-square, p-value** | 0.0003 | | | | | |
| **Gestational age at first antenatal visit (weeks) (missing=1)** | | | | | | |
| **No antenatal visits** | 172 | 54 (1.0) | 31 (0.9) | 49 (1.5) | 25 (1.2) | 13 (0.8) |
| **1-13** | 9,539 | 3228 (57.7) | 2330 (68.7) | 1576 (49.0) | 1265 (58.4) | 1140 (67.3) |
| **14-19** | 2,757 | 1025 (18.3) | 496 (14.6) | 686 (21.3) | 352 (16.3) | 198 (11.7) |
| **20+** | 3,591 | 1285 (23.0) | 537 (15.8) | 903 (28.1) | 523 (24.2) | 343 (20.3) |
| **Chi-square, p-value** | <.0001 | | | | | |
| **Last birth by caesarean section** | | | | | | |
| **No or 1st pregnancy** | 11,315 | 3,930 (70.3) | 2,391 (70.5) | 2,229 (69.4) | 1,555 (72.1) | 1,210 (71.4) |
| **Yes** | 2,148 | 716 (12.8) | 448 (13.2) | 453 (14.1) | 303 (14.1) | 228 (13.5) |
| **Not stated** | 2,588 | 947 (16.93) | 555 (16.4) | 532 (16.6) | 298 (13.8) | 256 (15.1) |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| | Total | Midwife & clinic | Aboriginal - led & home visiting | AMIHS-type | AHW & Outreach | Midwife & home visiting |
|---|---|---|---|---|---|---|
| **Chi-square, p-value** | 0.0439 | | | | | |
| **Maternal diabetes** | | | | | | |
| **No/Not stated** | 15,878 | 5,533 (98.9) | 3,357 (98.9) | 3,180 (98.9) | 2,128 (98.7) | 1,680 (99.2) |
| **Yes** | 173 | 60 (1.1) | 37 (1.1) | 34 (1.1) | 28 (1.3) | 14 (0.8) |
| **Chi-square, p-value** | 0.7420 | | | | | |
| **Maternal hypertension** | | | | | | |
| **No/Not stated** | 15,914 | 5,549 (99.2) | 3,358 (98.9) | 3,193 (99.4) | 2,136 (99.1) | 1,678 (99.1) |
| **Yes** | 137 | 44 (0.8) | 36 (1.1) | 21 (0.7) | 20 (0.9) | 16 (0.9) |
| **Chi-square, p-value** | 0.4292 | | | | | |
| **Gestational diabetes** | | | | | | |
| **No/Not stated** | 15,070 | 5184(92.7) | 3204 (94.4) | 3033 (94.4) | 2049 (95.0) | 1600 (94.5) |
| **Yes** | 981 | 409 (7.3) | 190 (5.6) | 181 (5.6) | 107 (5.0) | 94 (5.6) |
| **Chi-square, p-value** | 0.0002 | | | | | |
| **Gestational hypertension** | | | | | | |
| **No/Not stated** | 15,438 | 5,421 (96.9) | 3,260 (96.1) | 3,062 (95.3) | 2,074 (96.2) | 1,621 (95.7) |
| **Yes** | 613 | 172 (3.1) | 134 (4.0) | 152 (4.7) | 82 (3.8) | 73 (4.3) |
| **Chi-square, p-value** | 0.0020 | | | | | |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| | Total | Midwife & clinic | Aboriginal - led & home visiting | AMIHS-type | AHW & Outreach | Midwife & home visiting |
|---|---|---|---|---|---|---|
| **Smoking during first half of pregnancy (missing=79)** | | | | | | |
| **No** | 9,298 | 3,273 (58.9) | 2,048 (60.5) | 1,841 (57.6) | 1,195 (55.7) | 941 (55.8) |
| **Yes** | 6,676 | 2,285 (41.1) | 1,337 (39.5) | 1,355 (42.4) | 952 (44.3) | 747 (44.3) |
| **Chi-square, p-value** | 0.0009 | | | | | |
| **Smoking during second half of pregnancy (missing=11)** | | | | | | |
| **No** | 10,118 | 3,521 (63.0) | 2,207 (65.0) | 2043 (63.6) | 1,324 (61.4) | 1,023 (60.5) |
| **Yes** | 5,922 | 2,067 (37.0) | 1,187 (35.0) | 1168 (36.4) | 831 (38.6) | 669 (39.5) |
| **Chi-square, p-value** | 0.0096 | | | | | |

*Source: AMDC 2012-2016*

The 'AMIHS-type' service model seems to be associated with a much more disadvantaged population.

The second exception is in relation to gestational age at which the mother presents for the first antenatal visit. On average, across all AMIHS catchment areas, 59% of mothers present ≤13 weeks of gestation. By AMIHS service type though, this varies from 49% to 69% as shown in Figure 8.
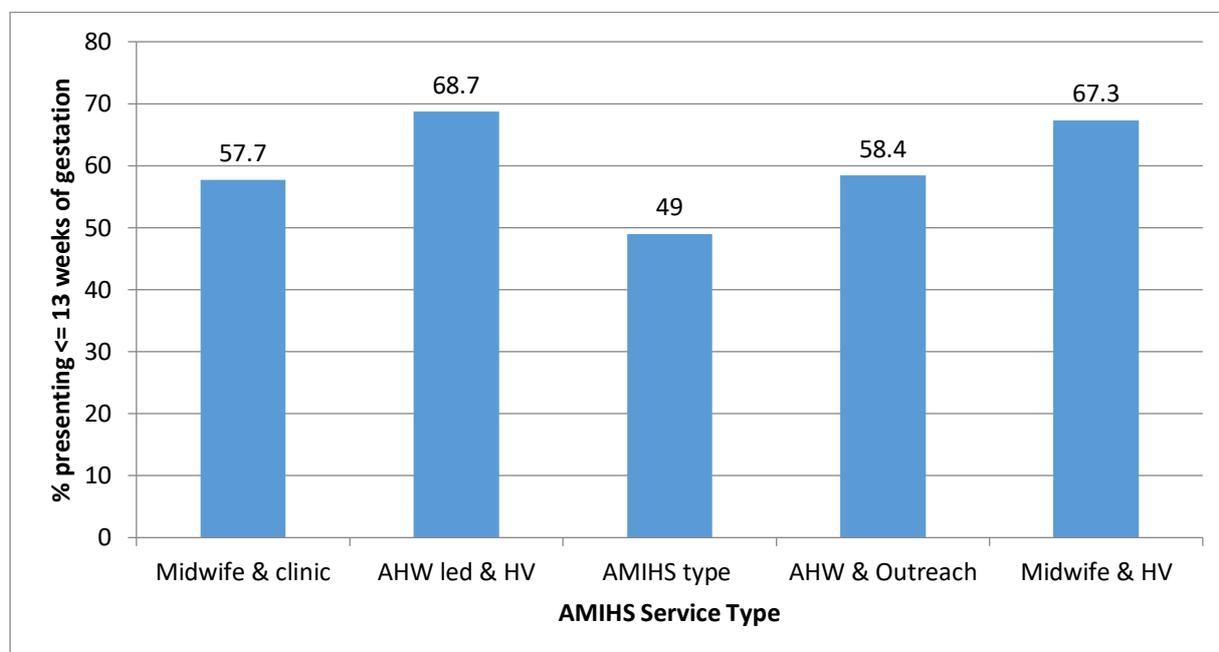


**Figure 8: Percentage of mothers in the population in AMIHS program catchment areas by AMIHS service type (*Source: AMDC 2012-2016*)**

# Associations between maternal socio-demographic and antenatal characteristics and service offer

For this analysis we are aiming to identify factors that influence (or predict) women who accepted the AMIHS program compared to women who were offered the program and declined or who were not offered the program at all. A regression analysis allows us to identify these factors and to assess the independent contribution of each of these factors. Descriptive analysis does not allow us to identify the independent contribution of one factor relative to other factors. In this section the degree of association between characteristics and a service offer and acceptance is described in terms of an odds ratio.

An odds ratio (OR) is a measure of association between an exposure and an outcome (Szumilas, 2010). The OR represents the odds that an outcome (AMIHS offer and acceptance) will occur given a particular exposure (a particular characteristic in this instance), compared to the odds of the outcome occurring in the absence of that exposure. The odds ratio can be used to compare the magnitude of various risk factors for that outcome as follows:

> OR=1 Exposure does not affect odds of outcome

OR>1 Exposure associated with higher odds of outcome

OR<1 Exposure associated with lower odds of outcome

The significant predictors of AMIHS acceptance from the final multi-level regression model are presented in Table 8. Factors associated with increased AMIHS offer and acceptance were as follows:

- Compared to women aged <=19 years, women aged 20-34 years (OR=0.63; 95% CI = 0.56-0.70) and women aged more than 34 years (OR=0.48; 95% CI=0.40-0.56) (p<0.0001) were less likely to accept an AMIHS service. This means that younger women were between one and a half and two times more likely to accept an AMIHS service offer.
- Compared to non-Aboriginal mothers of Aboriginal babies, mothers who were Aboriginal were more likely to accept an AMIHS offer (OR = 2.35; CI = 2.18-2.52, p < 0.0001). AMIHS acceptors were over two times more likely to be Aboriginal women than non-Aboriginal women
- Compared to mothers in their first pregnancy, mothers with three or more previous pregnancies (OR = 1.19; 95% CI = 1.07-1.32, p = 0.002) were more likely to accept an AMIHS offer. This means that women in their third or more pregnancy were almost 20% more likely to accept an AMIHS service than women who were pregnant for the first time
- Compared to women who were =>20 weeks gestation at their first antenatal visit, women who were 14-19 weeks gestation at their first antenatal visit were about 25% more likely to accept an AMIHS service (OR = 1.24; 95% CI=1.11-1.38; p < 0.0001)
- Mothers who smoked during pregnancy (OR = 1.29; 95% CI=1.15-1.32; p<0.0001 for the first half of pregnancy and OR = 1.17; 95% CI=1.04-1.32; p=0.010 for the second half of pregnancy) were more likely to accept an AMIHS offer. Compared to women who did not smoke during pregnancy, women who smoked were between 17% and 29% more likely to accept an AMIHS service.

These findings strongly indicate that the population being offered and accepting the AMIHS service is that which is intended to be targeted as per the underlying service model. As an equity-based program, AMIHS is reaching more young and Aboriginal mothers and smokers. While the relationship between AMIHS acceptance and level of disadvantage is less clear (it is significant but in an ill-defined way), based on the data in Table 4 it appears more users of AMIHS services are in lower disadvantaged groups than non-users.

All maternal socio-demographic and antenatal characteristics that were significant in the univariate models remained significant in the multivariable model.

*Evaluation of the AMIHS program using administrative datasets: a technical report*

**Table 8: Associations between socio-demographic and antenatal characteristics and whether AMIHS program was offered and accepted from final regression model**

| Variable | Odds Ratio | 95% CI | Type3, p-value | Interpretive comment |
|---|---|---|---|---|
| **Year of birth** | | | significant, p=0.0002 | Women in 2014 and 2015 less likely to accept AMIHS than women in 2016 |
| 2012 | 0.96 | 0.84-1.09 | | |
| 2013 | 0.96 | 0.86-1.057 | | |
| 2014 | 0.84 | 0.76-0.94 | | |
| 2015 | 0.81 | 0.73-0.90 | | |
| 2016 | 1 | | | |
| **Maternal age-group (years)** | | | Significant, p<.0001 | Younger women more likely to accept AMIHS than older women |
| <=19 | 1 | | | |
| 20-34 | 0.63 | 0.56-0.70 | | |
| 35+ | 0.48 | 0.40-0.56 | | |
| **Aboriginal mother** | | | Significant, p<.0001 | Aboriginal mothers much more likely to accept AMIHS than non-Aboriginal mothers |
| Yes | 2.35 | 2.18-2.52 | | |
| No | 1 | | | |
| **Index of Relative Socio-economic Disadvantage** | | | Significant, p<.0001 | There is an association between socio-economic status and AMIHS participation. However, the direction of the relationship is unclear |
| Most disadvantaged | 1.01 | 0.88-1.16 | | |
| Second disadvantaged | 0.92 | 0.81-1.04 | | |

| Variable | Odds Ratio | 95% CI | Type3, p-value | Interpretive comment |
|---|---|---|---|---|
| Third disadvantaged | 1.08 | 0.95-1.22 | | |
| Fourth disadvantaged | 0.72 | 0.64-0.81 | | |
| Least disadvantaged | 1 | | | |
| **Number of previous pregnancies** | | | **Significant, p=0.002** | **Mothers with three or more previous pregnancies more likely to accept AMIHS** |
| 0 | 1 | | | |
| 1-2 | 1.01 | 0.93-1.10 | | |
| 3+ | 1.19 | 1.07-1.32 | | |
| **Gestational age at first antenatal visit (weeks)** | | | **Significant, p<.0001** | **Mothers whose antenatal visit is early in pregnancy more likely to accept AMIHS** |
| No antenatal visits | 0.07 | 0.04-0.12 | | |
| 1-13 | 1.11 | 1.01-1.21 | | |
| 14-19 | 1.24 | 1.11-1.38 | | |
| 20+ | 1 | | | |
| **Smoked during the first half of pregnancy** | | | **Significant, p<.0001** | **Mothers who smoke during the first half of pregnancy more likely to accept AMIHS than mothers who did not smoke** |
| No | 1 | | | |
| Yes | 1.29 | 1.15-1.32 | | |
| **Smoked during the second half of pregnancy** | | | **Significant, p=0.010** | **Mothers who smoke during the second half of pregnancy more likely to accept AMIHS** |
| No | 1 | | | |

| Variable | Odds Ratio | 95% CI | Type3, p-value | Interpretive comment |
|---|---|---|---|---|
| Yes | 1.17 | 1.04-1.32 | | |

*Source: AMDC 2012-2016*

A sensitivity analysis was undertaken to see if the associations between antenatal characteristics and whether the AMIHS program was offered and accepted were the same for the population of Aboriginal mothers only. Given the high propensity of Aboriginal mothers to accept an AMIHS service offer, it is not unexpected that there were virtually no changes in significance or the odds ratios of these analyses when compared to all eligible women. Because there was no added value from this analysis the data are not shown in this report.

When comparing AMIHS service types, the 'Midwife & home visiting' and the 'AMIHS-type' service types were associated with greater likelihood of women being offered and accepting the AMIHS program compared to the 'Midwife & clinic' service type (Table 9). The 'Midwife & home visiting' service type in particular was almost twice as likely to have mothers accepting an offer of AMIHS compared to the 'Midwife & clinic' service type. These results are in contrast to the raw/unadjusted reach figures provided in Figure 9 which showed the 'AHW-led & home visiting' service type to have the highest reach and the 'AMIHS-type' to have the lowest. After adjusting for covariates, the relative odds of service type influencing service acceptance is somewhat reversed, although the 'Midwife & home visiting' type retains a strong influence.

**Table 9: Associations between AMIHS service type and whether AMIHS program was offered and accepted from the final regression model (after adjusting for covariates)**

| AMIHS service type | Odds Ratio | 95% CI |
|---|---|---|
| **Significant, p<0.0001** | | |
| Midwife & clinic | 1 | |
| AHW-led & home visiting | 1.04 | 0.93-1.17 |
| AMIHS-type | 1.18 | 1.04-1.35 |
| AHW & outreach | 0.88 | 0.77-1.02 |
| Midwife & home visiting | 1.72 | 1.51-1.95 |

*Source: AMDC 2012-2016*

# F.  OBJECTIVE 3 - PROGRAM EFFECT ON OUTCOMES

## Retrospective assessment of outcomes in 'Treatment' and 'Control' groups

Two separate multi-level logistic regression analyses were conducted (referred to as Analysis 1 and Analysis 2 in Table 10) to determine associations between the AMIHS program and outcomes.

Analysis 1 compares women who were in the AMIHS program ('treatment') with a single 'control' group of those who were not in the AMIHS program (declined the offer or were not offered the program). AMIHS participation was not statistically significantly associated with improvements in any of the seven outcomes investigated, and the only significant difference indicated that the women not in the AMIHS Program were associated with lower odds of their babies having a small for gestational age outcome (OR = 0.87; 95% CI = 0.78-0.96). It is worth noting though that if the analysis of first antenatal visit is extended to before 20 weeks gestation[8] then a significant difference emerges between treatment and control groups, with the control group being associated with lower odds of having their first antenatal visit before 20 weeks gestation (OR = 0.87; 95% CI = 0.80-0.95)[9].

Analysis 2 compares women who accepted the AMIHS program ('treatment') with those who were not offered the program ('control'). Some will argue this is a more appropriate control population since this group is the population that the AMIHS Program is intended to target. Compared with women who received the AMIHS, eligible women who were not offered the program had lower odds of at least seven antenatal visits (OR = 0.69; 95% CI = 0.60-0.79; p<0.0001) and first antenatal visit ≤13 weeks gestation (OR = 0.83; 95% CI = 0.73-0.94; p = 0.003). In other words, women who received the program were 1.45 times more likely to have at least seven antenatal visits and 1.2 times more likely to have their first antenatal visit before ≤13 weeks gestation, compared to eligible women who were not offered the program.

Additionally, compared with women who received the AMIHS, eligible women who were not offered the program had higher odds of preterm birth (OR = 1.43; 95% CI = 1.20-1.71; p<0.0001) and low birth weight (OR = 1.54; 95% CI = 1.30-1.82; p<0.0001). In other words, women who received the program were 1.43 times less likely to have a preterm

---

[8] This sensitivity analysis was conducted because the requirement for AMIHS sites to report on the indicator 'first antenatal visit before 14 weeks' did not commence until 2011/12.

[9] This data is not provided in this report given the density of data already detailed.

birth and 1.54 times less likely to have a low birth weight baby, compared to eligible women who were not offered the program.

However, in this analysis, the AMIHS was not associated with a reduction in small for gestational age; nor was it associated with increases in quitting smoking in the second half of pregnancy or fully breastfeeding at hospital discharge.

There were few significant associations between AMIHS service types (Analysis 1: the 'treatment' group (women offered and accepted the AMIHS service) is compared with the following 'control' group (women offered and declined the AMIHS service and women who were not offered the service). The outcomes are shown in Table 11.

Compared with the reference group the 'Midwife & clinic' service type, the 'AHW-led & home visiting' service type was positively associated with having earlier (OR = 1.18; 95% CI = 1.05-1.33; p<0.0001) antenatal visits. The 'Midwife & home visiting' service type was significantly less likely to have seven antenatal visits. The 'AHW-led & home visiting' service type was also associated with a slightly higher risk of preterm births (OR = 1.24l CI = 1.08-1.43; p = 0.007) when compared the 'Midwife & clinic' service type. For all other outcome variables, the differences between service types was not significant.

A sensitivity analysis was undertaken of this outcome analysis where the comparison between exposed and unexposed groups was limited to the Aboriginal mother population. When compared to the analyses for all mothers, there were almost no differences between the analyses for either analysis 1 or 2 and in regard to any outcome variable. The one exception to this statement was for the variable 'Fully breastfeeding at discharge', which for the Aboriginal mother analysis 2 (where the unexposed group is women 'not offered' the AMIHS service) the outcome difference was now significant (p = 0.043) but the odds ratio had barely changed (from 0.89 to 0.88; CI = 0.79-1.01 and 0.78-1.00 respectively). This means that, compared to Aboriginal women who were not offered the program, Aboriginal women who participated in the program were 1.16 times more likely to be fully breastfeeding at discharge (data are not shown).

Another sensitivity analysis was undertaken on the number of antenatal visits. Instead of casting the outcomes as a binary variable (less than or more than a particular number of visits) it was treated as a continuous variable. The mean number of antenatal visits were 9.09, 9.17 and 7.97 for 'offered and accepted', 'offered and declined' and 'not offered' groups respectively. The difference between means was significant (One-way ANOVA, p<0.0001). Applying analysis 1 and 2 to the number of visits as a continuous variable found those mothers offered and accepting AMIHS were likely to have slightly more visits than those not exposed (offered and declined and not offered, OR = 1.02, p = 0.0002) and moderately more than mothers not offered AMIHS (OR = 1.08, p<0.0001).

*Evaluation of the AMIHS program using administrative datasets: a technical report*

**Table 10: Associations between the AMIHS program (ORs and 95%CIs) and outcomes after adjusting for covariates**

| Analysis type | Potential Program outcomes (p<0.05 is significant) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | At least seven antenatal visits[10] | First antenatal visit ≤13 weeks gestation | Preterm | Low birth weight | Small for gestation-al age | Quit smoking in second half of pregnancy | Fully breast-feeding at discharge | Any breast-feeding at discharge |
| **Type 3, p-value** | 0.080 | 0.953 | 0.066 | 0.242 | 0.008 | 0.160 | 0.108 | 0.728 |
| **Treatment - Offered and accepted** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Control - Offered and declined and Not offered** | 0.93 (0.85-1.01) | 1.00 (0.93-1.07) | 1.10 (0.99-1.22) | 1.07 (0.95-1.20) | 0.87 (0.78-0.96) | 1.09 (0.95-1.26) | 1.06 (0.99-1.14) | 1.01 (0.94-1.10) |
| **Type 3, p-value** | <.0001 | 0.003 | <.0001 | <.0001 | 0.085 | 0.514 | 0.070 | 0.046 |
| **Treatment - Offered and accepted** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Control - Not offered** | 0.69 (0.60-0.79) | 0.83 (0.73-0.94) | 1.43 (1.20-1.71) | 1.54 (1.30-1.82) | 0.84 (0.72-1.0) | 1.08 (0.86-1.34) | 0.89 (0.79-1.01) | 0.88 (0.78-1.00) |

*Source: AMDC 2012-2016*

---

[10] Or at least 10 antenatal visits for mothers in their first pregnancy.

*Evaluation of the AMIHS program using administrative datasets: a technical report*

**Table 11: Evidence of variation in the outcome between AMIHS service types, after adjusting for covariates (ORs and 95%CIs)**

| AMIHS service type | Potential Program outcomes (p<0.05 is significant) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | At least seven antenatal visits[11] | First antenatal visit ≤13 weeks gestation | Preterm | Low birth weight | Small for gestation-al age | Quit smoking in second half of pregnancy | Fully breast-feeding at discharge | Any breastfeed-ing at discharge |
| Type 3, p-value | <.0001 | <.0001 | 0.007 | 0.664 | 0.095 | 0.074 | 0.578 | 0.065 |
| **Midwife & clinic** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **AHW & home visiting** | 1.07 (0.93-1.23) | 1.18 (1.05-1.33) | 1.24 (1.08-1.43) | 1.03 (0.86-1.23) | 1.14 (0.98-1.32) | 1.16 (0.93-1.43) | 0.92 (0.82-1.04) | 0.95 (0.84-1.09) |
| **AMIHS-type** | 0.97 (0.83-1.13) | 0.91 (0.80-1.04) | 1.06 (0.92-1.23) | 0.96 (0.80-1.15) | 1.17 (1.01-1.36) | 1.34 (1.08-1.66) | 1.02 (0.90-1.16) | 1.14 (0.88-1.30) |
| **AHW & Outreach** | 0.93 (0.79-1.09) | 0.72 (0.63-0.82) | 0.93 (0.79-1.11) | 0.93 (0.76-1.14) | 1.09 (0.93-1.28) | 1.22 (0.97-1.54) | 0.96 (0.84-1.09) | 0.94 (0.82-1.08) |
| **Midwife & home visiting** | 0.73 (0. 62-0.85) | 0.90 (0.79-1.02) | 0.97 (0.80-1.16) | 0.87 (0.70-1.09) | 0.95 (0.79-1.14) | 1.22 (0.96-1.57) | 0.98 (0.86-1.12) | 1.06 (0.93-1.22) |

*Source: AMDC 2012-2016*

---

[11] Or at least 10 antenatal visits for mothers in their first pregnancy.

# Retrospective pre-post AMIHS program evaluation

In the MCHR dataset, there were 93,736 women who gave birth to Aboriginal babies in NSW between 1994 and 2015. Of these women, 64,782 (69%) lived within the AMIHS program catchment areas and 28,954 lived outside the AMIHS program catchment areas[12].

Descriptive socio-demographic and antenatal characteristics of women giving birth to Aboriginal babies by AMIHS catchment areas are presented in Table 12. There were slightly higher percentages of younger mothers and Aboriginal mothers living within the AMIHS catchment areas compared to outside the AMIHS catchment areas. Smoking during pregnancy was also slightly higher within than outside the AMIHS catchment areas. There were only minor other differences between women who lived within the AMIHS catchment areas compared to women who lived outside the AMIHS catchment areas.

**Table 12: Socio-demographic and antenatal characteristics of women giving birth to Aboriginal babies by AMIHS catchment areas**

| Socio-demographic and antenatal characteristics of women | Location of mother | |
| --- | --- | --- |
| | **Within the AMIHS catchment areas N=64,782 (%)** | **Outside the AMIHS catchment areas N=28,954 (%)** |
| **Maternal age-group (years)** | | |
| **<=19** | 12,215 (18.9) | 4,635 (16.0) |
| **20-34** | 47,545 (73.4) | 21,395 (73.9) |
| **>=35** | 5,022 (7.8) | 2,927 (10.1) |
| **Aboriginal mother (available from 2001 onwards)** | | |
| **No** | 13,424 (28.3) | 6,953 (33.6) |
| **Yes** | 33,928 (71.7) | 13,731 (66.4) |
| **Index of Relative Socioeconomic Disadvantaged** | | |
| **Missing** | 43 (0.1) | 87 (0.3) |
| **Most disadvantaged** | 12,913 (20.0) | 5,769 (19.9) |
| **Second disadvantaged** | 12,937 (20.0) | 5,779 (20.0) |
| **Third disadvantaged** | 13,170 (20.3) | 5,776 (20.0) |
| **Fourth disadvantaged** | 12,702 (19.6) | 5,661 (19.6) |
| **Least disadvantaged** | 13,015 (20.1) | 5,885 (20.3) |
| **Gestational age at first antenatal visit (weeks)** | | |
| **Missing** | 2,252 (3.5) | 782 (2.7) |

---

[12] Note that the state-wide coverage estimate from the AMDC data was 82.1%. The difference can be accounted for by the addition of several years of data pre-AMIHS Program.

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| Socio-demographic and antenatal characteristics of women | Location of mother | |
|---|---|---|
| | **Within the AMIHS catchment areas** **N=64,782 (%)** | **Outside the AMIHS catchment areas** **N=28,954 (%)** |
| **Did not attend antenatal clinic** | 144 (0.2) | 47 (0.2) |
| **1-13** | 37,084 (57.2) | 16,197 (60.1) |
| **14-19** | 11,905 (18.4) | 5,763 (19.9) |
| **20+** | 13,397 (20.7) | 6,165 (21.3) |
| **Number of previous pregnancies (>20 weeks gestation)** | | |
| **Missing** | 91 (0.1) | 30 (0.10) |
| **0** | 21,715 (33.5) | 10,587 (36.6) |
| **1** | 16,828 (26.0) | 7,857 (27.1) |
| **2** | 11,507 (17.8) | 4,891 (16.9) |
| **3+** | 14,641 (22.6) | 5,589 (19.3) |
| **Smoked anytime during pregnancy (available between 1994-2010 only)** | | |
| **Missing** | 126 (0.3) | 63 (0.3) |
| **No** | 21,761 (47.1) | 11,020 (53.3) |
| **Yes** | 24,319 (52.6) | 9,578 (46.3) |
| **Smoked during first half of pregnancy (available between 2011-2015 only)** | | |
| **Missing** | 24 (0.1) | 4 (0.0) |
| **No** | 10,952 (59.0) | 5,354 (64.5) |
| **Yes** | 7,600 (40.9) | 2,938 (35.4) |
| **Smoked during second half of pregnancy (available between 2011-2015 only)** | | |
| **Missing** | 12 (0.1) | 11 (0.1) |
| **No** | 11,677 (62.9) | 5,822 (70.2) |
| **Yes** | 6,887 (37.1) | 2,463 (29.7) |
| **Any smoking during pregnancy (1994-2015)[1]** | | |
| **Missing** | 140 (0.2) | 66 (0.2) |
| **No** | 32,238 (49.8) | 16,190 (55.9) |
| **Yes** | 32,404 (50.0) | 12,701 (43.9) |

[1]Composite variable created from the three smoking during pregnancy variables available in the MCHR

*Source: MCHR 1994-2015*

Table 13 presents information on how the pre-, post- and implementation AMIHS periods were defined. There were 25,089 Aboriginal babies in the 2001 Cohort and 39,693 Aboriginal babies in the 2008-09 Cohort.

**Table 13: Definitions of the AMIHS periods**

| Period | 2001 Cohort N=25,089 | 2008-09 Cohort N=39,693 |
|---|---|---|
| **Pre-AMIHS period** | Mothers giving birth <u>before</u> 2001[#] (January 1994 to December 2000) (n=6,849) | Mothers giving birth <u>before</u> 2008/2009 (January 1994 to December 2007) (n=22,219) |
| **Implementation AMIHS period** | Mothers giving birth <u>during</u> 2001 (n=1,006) | Mothers giving birth <u>during</u> 2008/2009 (n=3,844) |
| **Post-AMIHS period** | Mothers giving birth <u>after</u> 2001 (January 2002 to December 2015)** (n=17,234) | Mothers giving birth <u>after</u> 2008/2009 (January 2010 to December 2015) ** (n=13,630) |

[#]As only one site was established in 2000, 2001 has been taken to be the implementation period

** Note that after 2010, the question asked at data collection about the duration of pregnancy at first antenatal visit changed so the post-AMIHS period was shortened (January 1994 to December 2010) when investigating the outcome variable 'First antenatal visit before ≤13 weeks'' for the 2001 cohort. For 2008-09 cohort, there no sufficiently consistent data exists to investigate this outcome variable.

*Source: MCHR 1994-2015*

In the post-AMIHS period for both cohorts, there were slightly increased percentages of older women, women in their first pregnancy and both maternal and gestational diabetes (Table 14).

*Evaluation of the AMIHS program using administrative datasets: a technical report*

**Table 14: Maternal socio-demographic and antenatal characteristics by the three-time periods, MCHR 1994-2015**

| Maternal socio-demographic and antenatal characteristics | 2001 Cohort (N=25,089) | | | 2008-09 Cohort (N=39,693) | | |
|---|---|---|---|---|---|---|
| | Births before 2001 n=6,849 | Births during 2001 n=1,006 | Births after 2001 n=17,234 | Births before 2008-2009 n=22,219 | Births during 2008-2009 n=3,844 | Births after 2008-2009 n=13,630 |
| Maternal age-group (years) | | | | | | |
| <=19 | 1,396 (20.4) | 212 (21.1) | 3,195 (18.5) | 4,386 (19.7) | 705 (18.3) | 2,321 (17.0) |
| 20-34 | 5,101 (74.5) | 729 (72.5) | 12,414 (72.0) | 16,373 (73.7) | 2,772 (72.1) | 10,156 (74.5) |
| >=35 | 352 (5.1) | 65 (6.5) | 1,625 (9.4) | 1,460 (6.6) | 367 (9.6) | 1,153 (8.5) |
| Chi-square, p-value | <.0001 | | | <.0001 | | |
| Mother's Aboriginality | | | | | | |
| No | 0 | 257 (25.6) | 4,710 (27.3) | 3,226 (14.5) | 1,055 (27.5) | 4,176 (30.6) |
| Yes | 0 | 749 (74.5) | 12,524 (72.7) | 8,414 (37.9) | 2,789 (72.6) | 9,452 (69.4) |
| Not recorded between 1994-2000 | 6,849 (100) | 0 (0.0) | 0 (0.0) | 10,579 (47.6) | 0 (0.0) | 0 (0.0) |
| Not stated | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 2 (0.01) |
| Chi-square, p-value | Not calculated due to non-response | | | Not calculated due to non-response | | |
| Index of Relative Socio-economic Disadvantage | | | | | | |
| Missing | 34 (0.5) | 0 | 0 | 8 (0.0) | 0 | 1 (0.0) |
| Most disadvantaged | 1,242 (18.1) | 263 (26.1) | 4,128 (24.0) | 3,614 (16.3) | 751 (19.5) | 2,915 (21.4) |
| Second disadvantaged | 952 (13.9) | 286 (28.4) | 3,906 (22.7) | 3,864 (17.4) | 973 (25.3) | 2,956 (21.7) |
| Third disadvantaged | 794 (11.6) | 107 (10.6) | 2,896 (16.8) | 5,135 (23.1) | 959 (25.0) | 3,279 (24.1) |

| Maternal socio-demographic and antenatal characteristics | 2001 Cohort (N=25,089) | | | 2008-09 Cohort (N=39,693) | | |
|---|---|---|---|---|---|---|
| | Births before 2001 n=6,849 | Births during 2001 n=1,006 | Births after 2001 n=17,234 | Births before 2008-2009 n=22,219 | Births during 2008-2009 n=3,844 | Births after 2008-2009 n=13,630 |
| Fourth disadvantaged | 931 (13.6) | 249 (24.8) | 3,907 (22.7) | 4,082 (18.4) | 682 (17.7) | 2,851 (20.9) |
| Least disadvantaged | 2,896 (42.3) | 101 (10.0) | 2,397 (13.9) | 5,516 (24.8) | 479 (12.5) | 1,628 (11.9) |
| Chi-square, p-value | <.0001 | | | <.0001 | | |
| Number of previous pregnancies (>20 weeks gestation) | | | | | | |
| Missing | 6 (0.1) | 1 (0.1) | 11 (0.1) | 63 (0.3) | 4 (0.1) | 6 (0.0) |
| 0 | 2,149 (31.4) | 331 (32.9) | 5,945 (34.5) | 7,054 (31.9) | 1,319 (34.3) | 4,917 (36.1) |
| 1 | 1,877 (27.4) | 260 (25.8) | 4,407 (25.6) | 5,802 (26.1) | 933 (24.3) | 3,549 (26.0) |
| 2 | 1,293 (18.9) | 179 (17.8) | 2,999 (17.4) | 4,101 (18.5) | 644 (16.8) | 2,291 (16.8) |
| 3+ | 1,524 (22.3) | 235 (23.4) | 3,872 (22.5) | 5,199 (23.4) | 944 (24.6) | 2,867 (21.0) |
| Chi-square, p-value | <.0001 | | | <.0001 | | |
| Previous pregnancy (>20 weeks gestation) | | | | | | |
| Not stated | 6 (0.1) | 1 (0.1) | 2 (0.0) | 63 (0.3) | 4 (0.1) | 4 (0.0) |
| No | 2,149 (31.4) | 331 (29.9) | 5,945 (34.5) | 7,054 (31.7) | 1,319 (34.3) | 4,917 (36.1) |
| Yes | 4,694 (68.5) | 774 (70.0) | 11,287 (65.5) | 15,102 (68.0) | 2,521 (65.6) | 8,709 (63.9) |
| Chi-square, p-value | <.0001 | | | <.0001 | | |
| Gestational age at first antenatal visit (weeks) | | | | | | |
| Missing | 285 (4.2) | 48 (4.8) | 442 (2.6) | 1184 (5.3) | 91 (2.4) | 202 (1.5) |
| Did not attend antenatal clinic | 52 (0.8) | 0 | 0 | 92 (0.4) | 0 | 0 |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| Maternal socio-demographic and antenatal characteristics | 2001 Cohort (N=25,089) | | | 2008-09 Cohort (N=39,693) | | |
|---|---|---|---|---|---|---|
| | **Births before 2001**<br>**n=6,849** | **Births during 2001**<br>**n=1,006** | **Births after 2001**<br>**n=17,234** | **Births before 2008-2009**<br>**n=22,219** | **Births during 2008-2009**<br>**n=3,844** | **Births after 2008-2009**<br>**n=13,630** |
| 1-13 | 3,028 (44.2) | 432 (42.9) | 9,991 (58.0) | 12,717 (57.2) | 2,785 (72.5) | 8,131 (59.7) |
| 14-19 | 1,587 (23.2) | 234 (23.3) | 3,363 (19.5) | 3,727 (16.8) | 509 (13.2) | 2,485 (18.2) |
| 20+ | 1,897 (27.7) | 292 (29.0) | 3,438 (20.0) | 4,499 (20.3) | 459 (11.9) | 2,812 (20.6) |
| Chi-square, p-value | <.0001 | | | <.0001 | | |
| Any smoking during pregnancy | | | | | | |
| Missing | 16 | 1 | 11 | 93 | 7 | 12 |
| No | 3,046 (44.6) | 451 (44.9) | 8,829 (51.3) | 10,219 (46.2) | 2,014 (52.5) | 7,679 (56.4) |
| Yes | 3,787 (55.4) | 544 (55.1) | 8,394 (48.7) | 11,907 (53.8) | 1,823 (47.5) | 5,939 (43.6) |
| Chi-square, p-value | <.0001 | | | <.0001 | | |

*Source: MCHR 1994-2015*

Table 15 presents results from the regression models to determine associations between the AMIHS implementation (Pre-AMIHS period, Post-AMIHS period and the Implementation AMIHS period) and outcomes.

***The results are presented for three separate models:***

1.  2001 Cohort only – Eligible women who birthed in the post-AMIHS period were 1.25 times more likely to have their first antenatal visit by ≤13 weeks of gestation (OR = 1.25; 95% CI =1.08-1.44; p=0.003), compared to eligible women who birthed in the pre-AMIHS period. However, the AMIHS was not associated with improvements in any of the other outcomes investigated.

2.  2008-09 Cohort only – Eligible women who birthed in the post-AMIHS period were less likely to have ever smoked during pregnancy (OR = 0.79; 95% CI = 0.74-0.84; p<0.0001) and had lower odds of having a small for gestational age baby (OR = 0.87; 95% CI = 0.79-0.95; p = 0.003), compared to eligible women who birthed in the pre-AMIHS period. In other words, eligible women who birthed in the post-AMIHS period were 1.27 times less likely to have smoked during pregnancy and 1.15 times less likely to have a small for gestational age baby, compared to eligible women who birthed in the pre-AMIHS period. The AMIHS Program was not associated with improvements in any of the other outcomes investigated but women who birthed in the post-AMIHS period were more likely to have a preterm baby (OR = 1.19; 95% CI = 1.07-1.33; p = 0.001)[13].

3.  2001 and 2008-09 cohorts combined – in the Post-AMIHS period compared to the Pre-AMIHS period, women were less likely to have small for gestational age babies (OR = 0.91; 95% CI = 0.84-0.99; p = 0.021) or ever smoke during pregnancy (OR = 0.85; 95% CI = 0.80-0.90; p, 0.0001). The AMIHS program was not associated with improvements in any of the other outcomes investigated.

---

[13] Note that after 2010, the question asked at data collection about the duration of pregnancy at first antenatal visit changed so that a comparison between those time periods was untenable (see details in the 'Method' section). Accordingly, only the 2001 cohort, where sufficient consistent data exists to allow a pre- and post-AMIHS period comparison, has an analysis been performed. No data is provided in Table 15 for the 2008/9 or combined cohorts for the outcome variable 'First antenatal visit before ≤13 weeks'.

*Evaluation of the AMIHS program using administrative datasets: a technical report*

**Table 15: Associations between the AMIHS program and outcomes (ORs and 95% CIs) after adjusting for covariates**

| Cohorts | Program outcomes (p<0.05 is significant) | | | | | |
|---|---|---|---|---|---|---|
| | **First antenatal visit ≤13 weeks** | **Preterm** | **Low birth weight** | **Small for gestational age** | **Any smoking during pregnancy** | **Perinatal death** |
| **2001 Cohort** | | | | | | |
| **Type 3, p-value** | 0.003 | 0.626 | 0.999 | 0.157 | 0.643 | 0.558 |
| **Pre-AMIHS period** | 1 | 1 | 1 | 1 | 1 | 1 |
| **Post-AMIHS period** | 1.25 (1.08-1.44) | 1.06 (0.84-1.35) | 1.00 (0.79-1.27) | 0.87 (0.71-1.06) | 1.03 (0.90-1.19) | 1.18 (0.68-2.04) |
| **2008-09 Cohort** | | | | | | |
| **Type 3, p-value** | | 0.001 | 0.090 | 0.003 | <.0001 | 0.128 |
| **Pre-AMIHS period** | | 1 | 1 | 1 | 1 | 1 |
| **Post-AMIHS period** | | 1.19 (1.07-1.33) | 1.10 (0.98-1.24) | 0.87 (0.79-0.95) | 0.79 (0.74-0.84) | 1.20 (0.97-1.49) |
| **Combined cohorts** | | | | | | |
| **Type 3, p-value** | | 0.049 | 0.316 | 0.021 | <.0001 | 0.650 |
| **Pre-AMIHS period** | | 1 | 1 | 1 | 1 | 1 |
| **Transition AMIHS period** | | 0.98 (0.86-1.12) | 1.02 (0.89-1.17) | 1.01 (0.90-1.13) | 0.94 (0.87-1.01) | 1.28 (0.75-2.17) |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| Cohorts | Program outcomes (p<0.05 is significant) | | | | | |
|---|---|---|---|---|---|---|
| | First antenatal visit ≤13 weeks | Preterm | Low birth weight | Small for gestational age | Any smoking during pregnancy | Perinatal death |
| **Post-AMIHS period** | | 1.10 (1.00-1.20) | 1.07 (0.97 -1.19) | 0.91 (0.84-0.99) | 0.85 (0.80-0.90) | 1.08 (0.78-1.50) |

*Source: MCHR 1994-2015*

# Interrupted time series analysis

In Tables 16 and 17 a new statistic, the 'risk ratio' (also known as relative risk), is used to estimate the strength of the association between treatments (exposure) and outcome. It is like the odds ratio but not exactly the same (Schnell, 2018). The basic difference is that the odds ratio is a ratio of two odds, whereas the risk ratio is a ratio of two probabilities. The values of RR can be interpreted similar to the OR as follows:

RR = 1 means that exposure does not affect the outcome;

RR < 1 means that the risk of the outcome is decreased by the exposure;

RR > 1 means that the risk of the outcome is increased by the exposure.

Tables 16 and 17 present results from the ITS analysis among Aboriginal babies within and outside the AMIHS catchment areas, respectively. For each cohort, the key results are:

1. 2001 Cohort only
    a. During the pre-intervention period, the risk of a mother of an Aboriginal baby born in an AMIHS catchment area having a low birth weight baby was increasing by a factor of 1.016 per quarter (Table 16). During the post-intervention period, the risk was decreasing by a factor of 0.995 per quarter (change in trend RR = 0.979; 95% CI = 0.966-0.993; p=0.002). However, a similar change in trend from pre- to post-AMIHS was also observed among Aboriginal babies who were born in non-AMIHS catchment areas (Table 17), suggesting that factors other than the AMIHS program may have contributed to the reduction in low birth weight among Aboriginal babies born in AMIHS catchment areas.
    b. During the pre-intervention period, the risk of a mother of an Aboriginal baby born in an AMIHS catchment area having a small for gestational age baby was stable. During the post-intervention period, the risk was decreasing by a factor of 0.992 per quarter (change in trend RR = 0.991; 95% CI = 0.983-0.998; p=0.010). However, a similar change in trend from pre- to post-AMIHS was also observed among Aboriginal babies who were born in a non-AMIHS catchment area (Table 17), suggesting that factors other than the AMIHS program may have contributed to the reduction in small for gestational age among Aboriginal babies born in AMIHS catchment areas.
    c. During the pre-intervention period, the risk of a mother of an Aboriginal baby in an AMIHS catchment area smoking during pregnancy was stable. During the post-intervention period, the risk of a mother of an Aboriginal baby smoking during pregnancy was decreasing by a factor of 0.994 per quarter (change in trend RR = 0.996; 95% CI = 0.992-0.999; p=0.015). No such change in trend from pre- to post-AMIHS was observed among mothers of Aboriginal babies who lived in a non-AMIHS catchment area at the time of the birth of their child (Table 17), providing

further evidence that the AMIHS program likely contributed to reduced antenatal smoking.

d) During the pre-intervention period, the trend in early antenatal presentations (≤13 weeks) was stable (Table 16) for babies born to mothers in the AMIHS catchment areas. The trend changed direction in the post-intervention period, with a significant increasing trend in early antenatal presentation by a factor of 1.010 per quarter (change in trend RR=1.017; 95% CI = 1.004-1.029; p=0.009). No such change in trend from pre- to post-AMIHS was observed among mothers of Aboriginal babies who lived in a non-AMIHS catchment area at the time of the birth of their child (Table 17), providing evidence that the AMIHS program likely contributed to early engagement with antenatal care.

e) For this cohort, there were no significant differences in the pre- and post-intervention trends for preterm births and perinatal deaths for mothers who lived in an AMIHS catchment area or for those mothers who lived outside an AMIHS catchment area. For preterm births, there were no significant trends in both the pre- and post-AMIHS periods for both groups of mothers. In the case of perinatal deaths, there was a significant decreasing trend only in the post-AMIHS period for women living outside the AMIHS catchment areas (RR = 0.991; 95% CI = 0.983-0.999; p=0.036) (Table 17).

2. 2008-09 Cohort only

The AMIHS program was associated with statistically significant but modest decrease in trend from the pre-AMIHS period to the post-AMIHS period for any smoking during pregnancy.

During the pre-intervention period, in the AMIHS catchment areas, the risk of a mother of an Aboriginal baby smoking during pregnancy was decreasing by a factor of 0.998 per quarter (Table 16). During the post-intervention period, the risk was decreasing by a factor of 0.992 per quarter (change in trend RR = 0.994; 95% CI = 0.991-0.998; p=0.004). No such change in trend from pre- to post-AMIHS was observed among mothers of Aboriginal babies who lived in a non-AMIHS catchment area at the time of the birth of their child (Table 17), providing evidence that AMIHS exposure contributes to reduced antenatal smoking.

For this cohort, there were no statistically significant changes in trend from pre- to post-AMIHS implementation for any of the other outcomes investigated.

*Evaluation of the AMIHS program using administrative datasets: a technical report*

**Table 16: Associations between AMIHS program and outcomes among Aboriginal babies within the AMIHS catchment areas using ITS analysis (RRs, 95% CIs and p-value)**

| Cohorts | Program outcomes (p<0.05 is significant) | | | | | |
|---|---|---|---|---|---|---|
| | **First antenatal visit ≤13 weeks** | **Preterm** | **Low birth weight** | **Small for gestational age** | **Any smoking during pregnancy** | **Perinatal death** |
| **2001 Cohort** | | | | | | |
| **Pre-intervention trend** | 0.993 0.985-1.002 0.130 | 1.001 0.992-1.010 0.750 | 1.016 1.004-1.029 0.009 | 1.001 0.995-1.008 0.683 | 0.999 0.995-1.002 0.434 | 1.003 0.983-1.024 0.769 |
| **Post-intervention trend** | 1.010 1.001-1.018 0.027 | 1.000 0.996-1.003 0.846 | 0.995 0.991-0.999 0.013 | 0.992 0.989-0.995 <.0001 | 0.994 0.993-0.996 <.0001 | 0.995 0.987-1.003 0.2339 |
| **Change in trend** | 1.017 1.004-1.029 0.009 | 0.998 0.989-1.007 0.714 | 0.979 0.966-0.993 0.002 | 0.991 0.983-0.998 0.010 | 0.996 0.992-0.999 0.015 | 0.992 0.970-1.014 0.480 |
| **2008-09 Cohort** | | | | | | |
| **Pre-intervention trend** | | 1.001 0.999 -1.003 0.469 | 1.003 1.000-1.006 0.028 | 0.999 0.997-1.001 0.186 | 0.998 0.997-0.999 <.0001 | 0.999 0.993-1.006 0.864 |
| **Post-intervention trend** | | 1.006 0.998-1.014 0.173 | 1.006 0.997-1.015 0.191 | 0.994 0.987-1.002 0.145 | 0.992 0.988-0.996 <.0001 | 0.996 0.975-1.018 0.730 |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

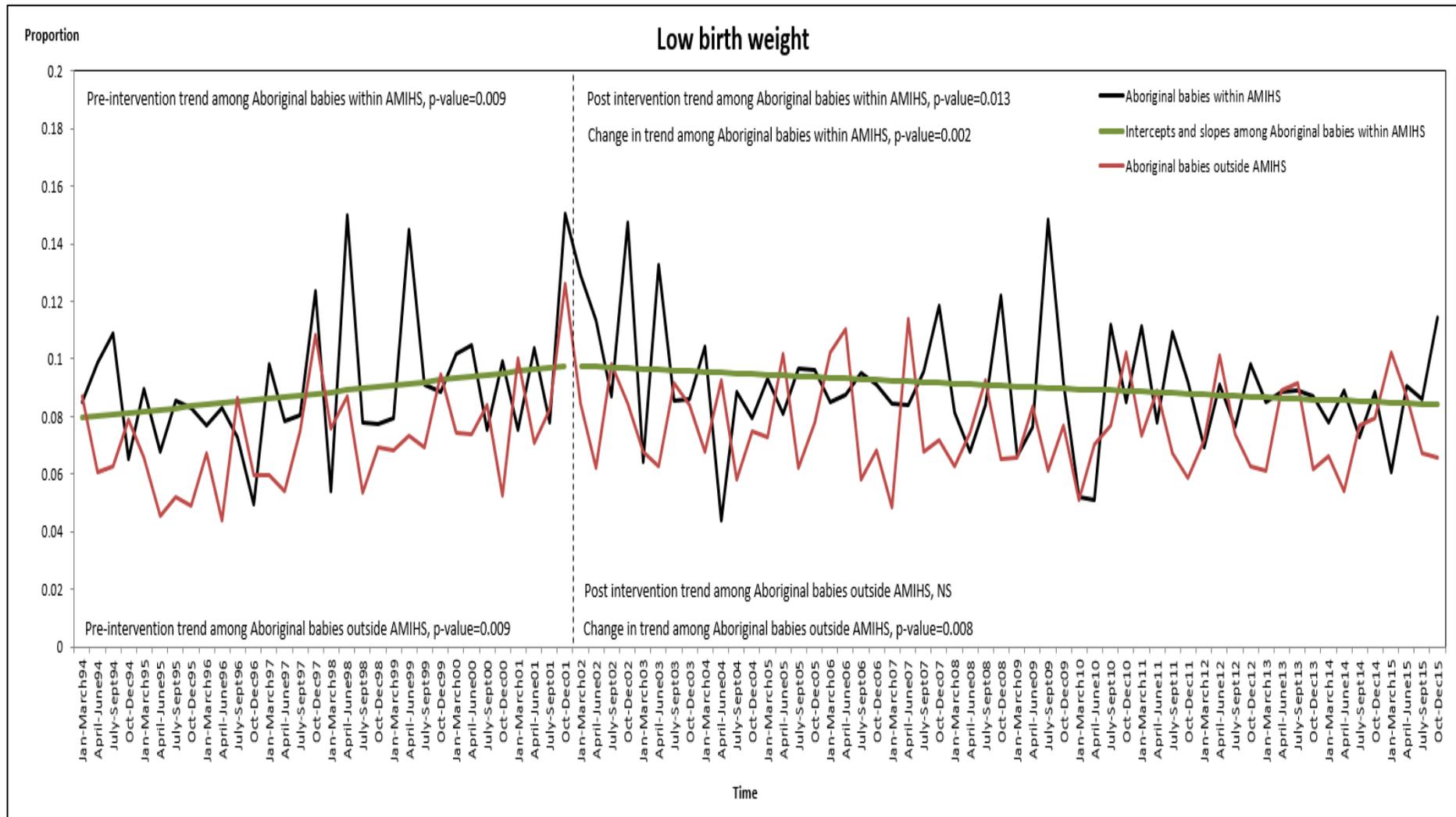| Cohorts | Program outcomes (p<0.05 is significant) | | | | | |
|---|---|---|---|---|---|---|
| | First antenatal visit ≤13 weeks | Preterm | Low birth weight | Small for gestational age | Any smoking during pregnancy | Perinatal death |
| Change in trend | | 1.005 | 1.003 | 0.996 | 0.994 | 0.997 |
| | | 0.996-1.013 | 0.994-1.01 | 0.988-1.003 | 0.991-0.998 | 0.975-1.019 |
| | | 0.264 | 0.516 | 0.260 | 0.004 | 0.778 |

*Source: MCHR 1994-2015*

**Table 17: Associations between AMIHS program and outcomes among Aboriginal babies born outside the AMIHS catchment areas using ITS analysis (RRs, 95% CIs and p-value)**

| Cohorts | Program outcomes (p<0.05 is significant) | | | | | |
|---|---|---|---|---|---|---|
| | First antenatal visit ≤13 weeks | Preterm | Low birth weight | Small for gestational age | Any smoking during pregnancy | Perinatal death |
| **2001 Cohort** | | | | | | |
| Pre-intervention trend | 1.003 | 1.008 | 1.011 | 0.998 | 0.995 | 1.009 |
| | 0.986-1.008 | 1.000-1.016 | 1.003-1.020 | 0.992-1.005 | 0.992-0.998 | 0.990-1.030 |
| | 0.294 | 0.063 | 0.009 | 0.550 | 0.002 | 0.355 |
| Post-intervention trend | 1.008 | 0.999 | 0.999 | 0.991 | 0.994 | 0.991 |
| | 1.003-1.013 | 0.996-1.002 | 0.996-1.002 | 0.988-0.994 | 0.993-0.996 | 0.983-0.999 |
| | 0.001 | 0.559 | 0.498 | <.0001 | <.0001 | 0.036 |
| Change in trend | 1.005 | 0.992 | 0.988 | 0.993 | 0.999 | 0.982 |
| | 0.999-1.012 | 0.983-1.000 | 0.979-0.997 | 0.986-1.000 | 0.996-1.003 | 0.961-1.003 |
| | 0.115 | 0.052 | 0.008 | 0.042 | 0.691 | 0.095 |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| Cohorts | Program outcomes (p<0.05 is significant) | | | | | |
|---|---|---|---|---|---|---|
| | First antenatal visit ≤13 weeks | Preterm | Low birth weight | Small for gestational age | Any smoking during pregnancy | Perinatal death |
| **2008-09 Cohort** | | | | | | |
| **Pre-intervention trend** | | 1.002 <br> 1.000-1.005 <br> 0.092 | 1.002 <br> 0.999-1.005 <br> 0.222 | 0.997 <br> 0.995-1.000 <br> 0.020 | 0.996 <br> 0.995-0.997 <br> <.0001 | 1.000 <br> 0.993-1.007 <br> 0.955 |
| **Post-intervention trend** | | 1.003 <br> 0.993-1.014 <br> 0.568 | 1.002 <br> 0.991-1.013 <br> 0.745 | 0.996 <br> 0.986-1.006 <br> 0.378 | 0.993 <br> 0.988-0.997 <br> 0.002 | 0.987 <br> 0.958-1.018 <br> 0.411 |
| **Change in trend** | | 1.001 <br> 0.990-1.012 <br> 0.891 | 1.000 <br> 0.989-1.012 <br> 0.992 | 0.998 <br> 0.988-1.009 <br> 0.720 | 0.997 <br> 0.992-1.002 <br> 0.172 | 0.987 <br> 0.957-1.018 <br> 0.415 |

*Source: MCHR 1994-2015*

*Evaluation of the AMIHS program using administrative datasets: a technical report*

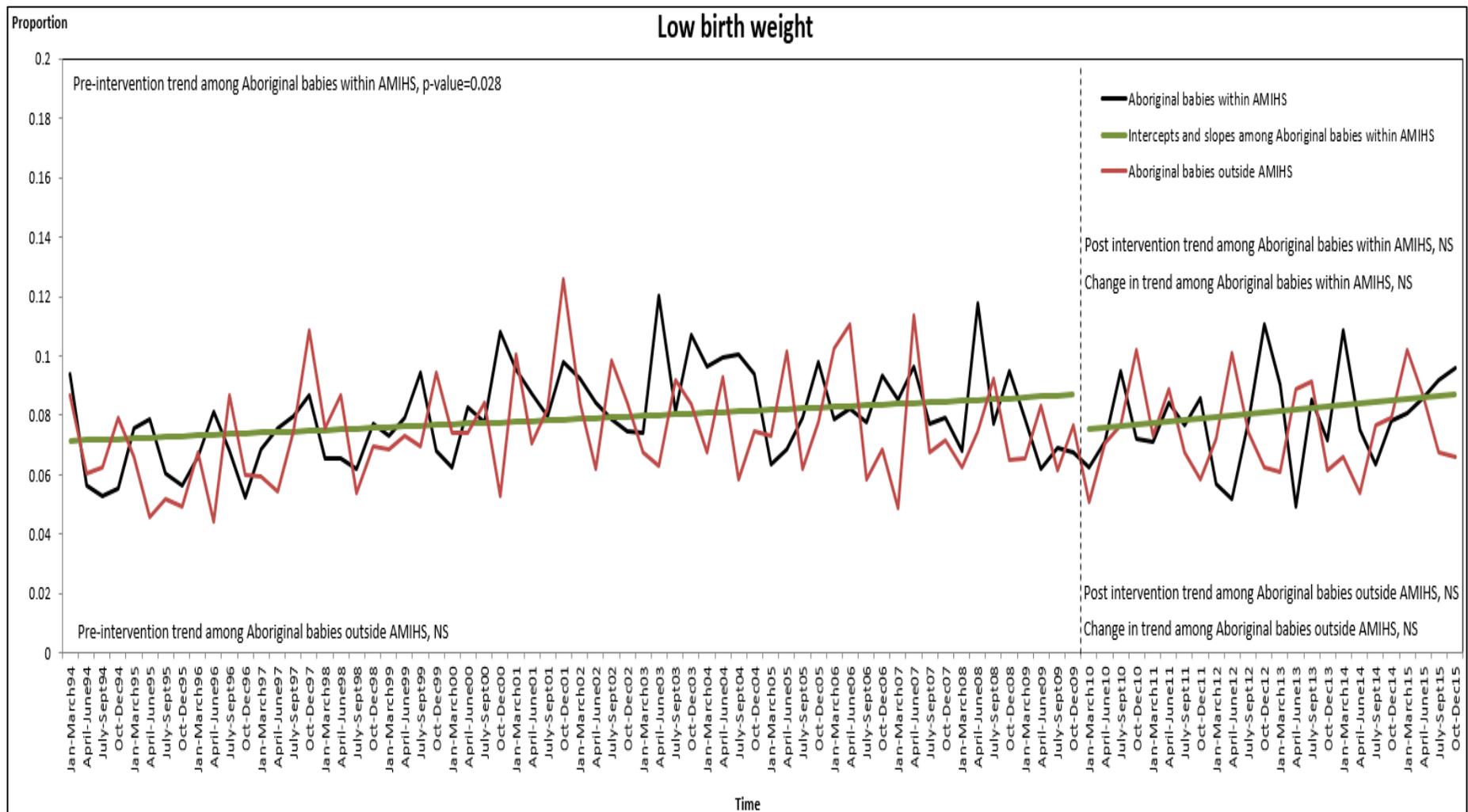**Figure 9: Time series of the proportion of low birth weight Aboriginal babies for the <u>2001 cohort</u> by AMIHS catchment area**



*Source: MCHR 1994-2015*

*Evaluation of the AMIHS program using administrative datasets: a technical report*

**Figure 10: Time series of the proportion of low birth weight Aboriginal babies for the 2008-09 cohort by AMIHS catchment area**



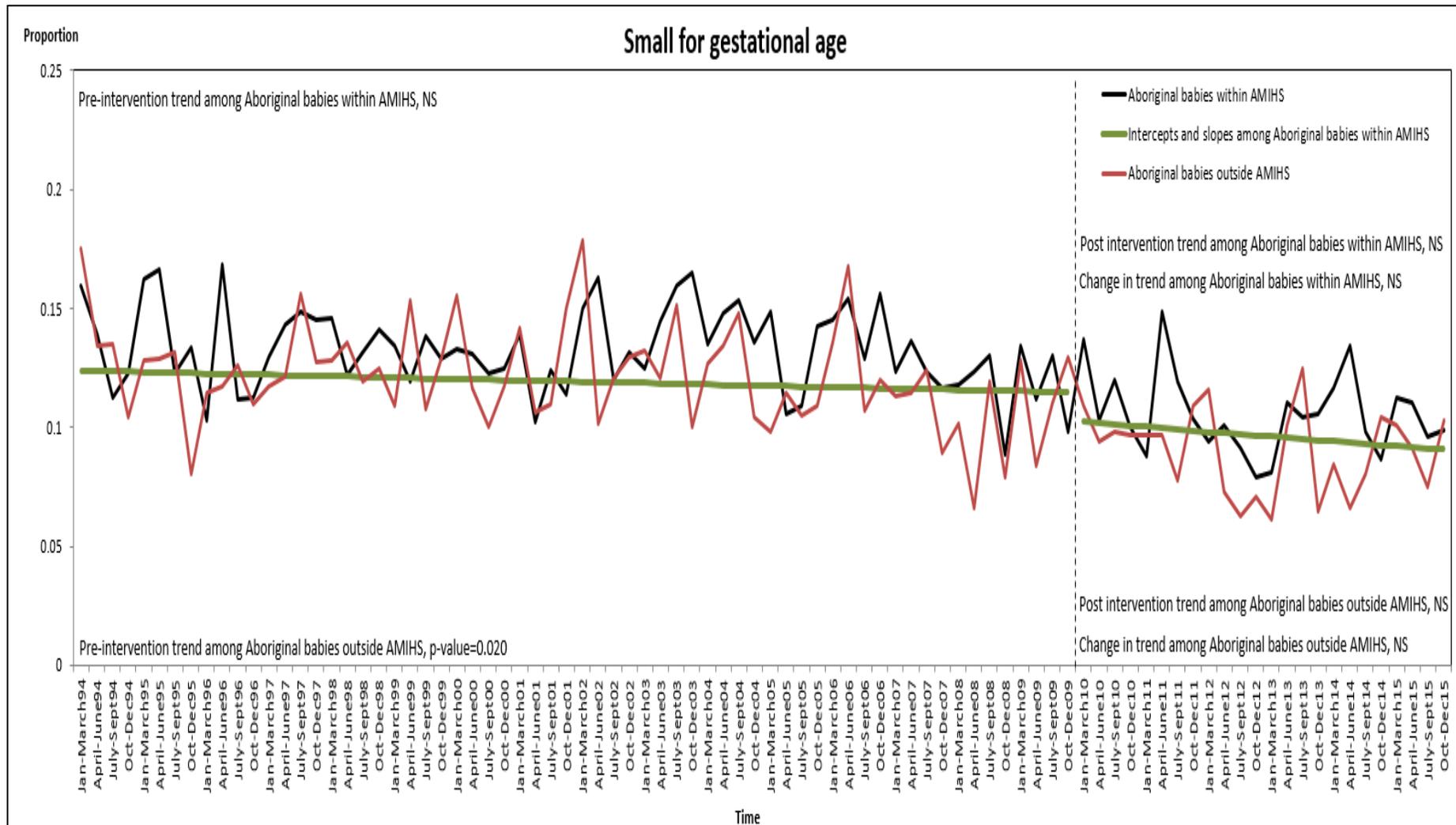*Source: MCHR 1994-2015*

*Evaluation of the AMIHS program using administrative datasets: a technical report*

**Figure 11: Time series of the proportion of small for gestational age Aboriginal babies for the <u>2001 cohort</u> by AMIHS catchment area**
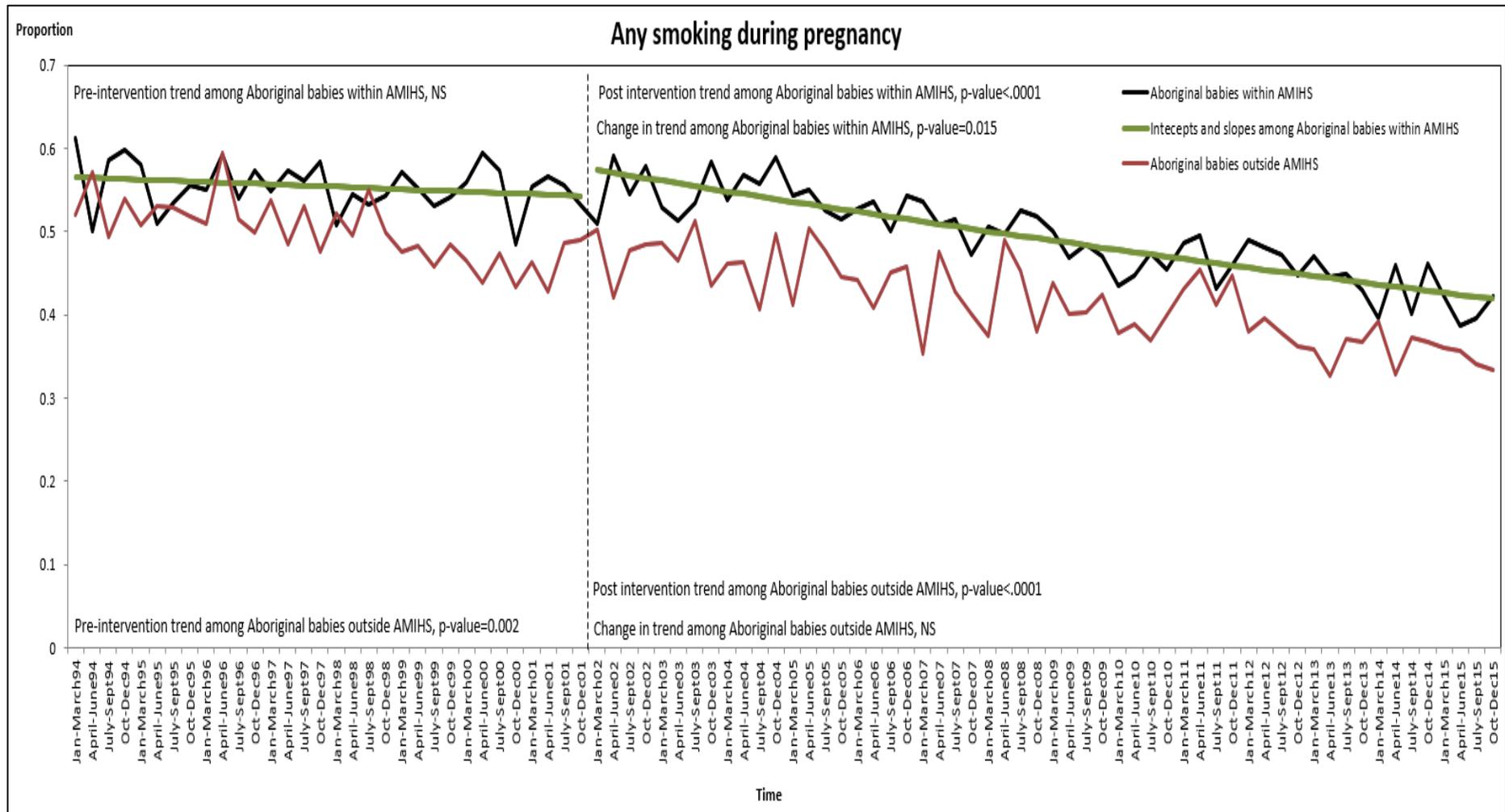


*Source: MCHR 1994-2015*

*Evaluation of the AMIHS program using administrative datasets: a technical report*
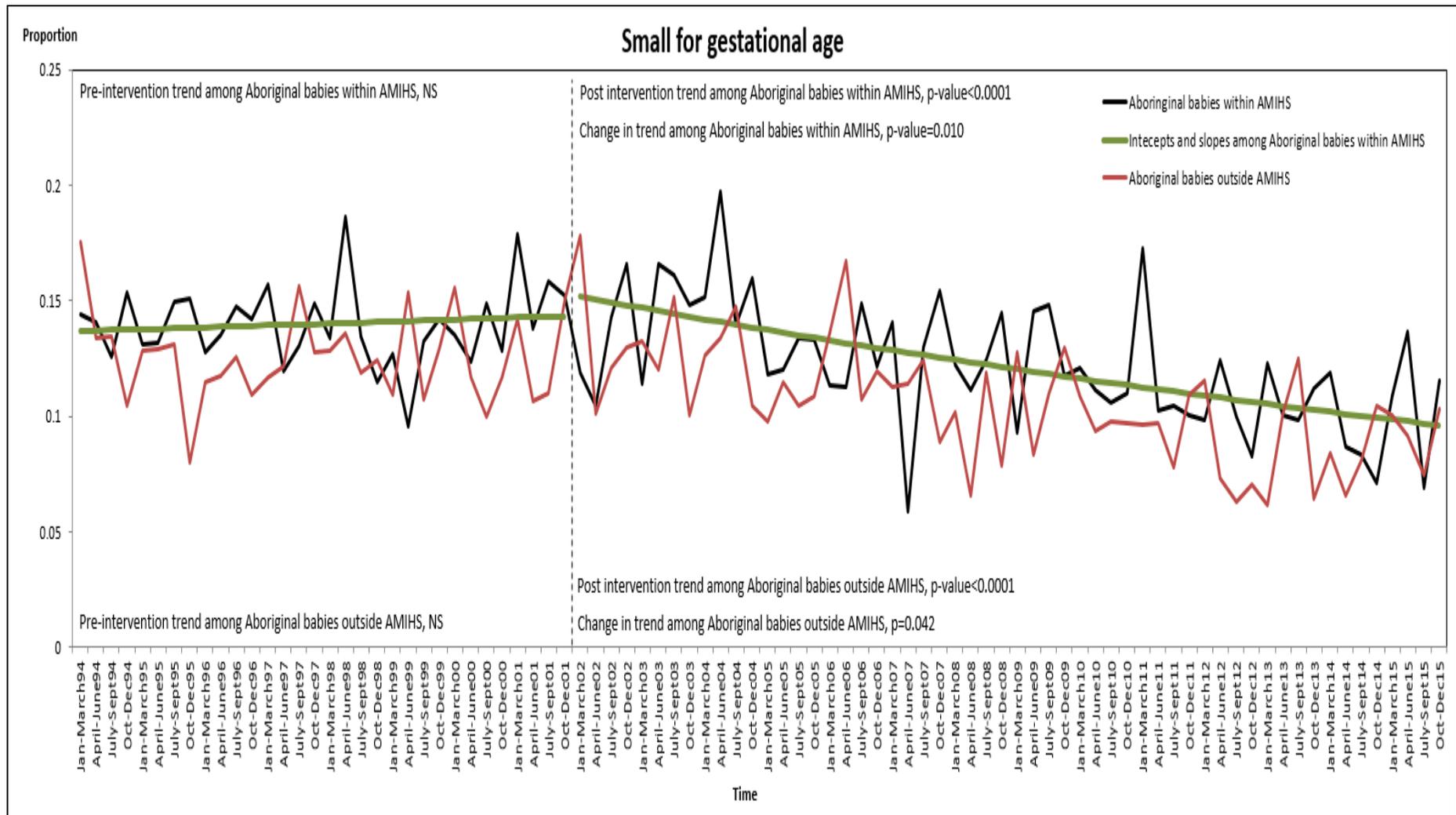
**Figure 12: Time series of the proportion of small for gestational age for Aboriginal babies for the <u>2008-09 cohort</u> by AMIHS catchment area**
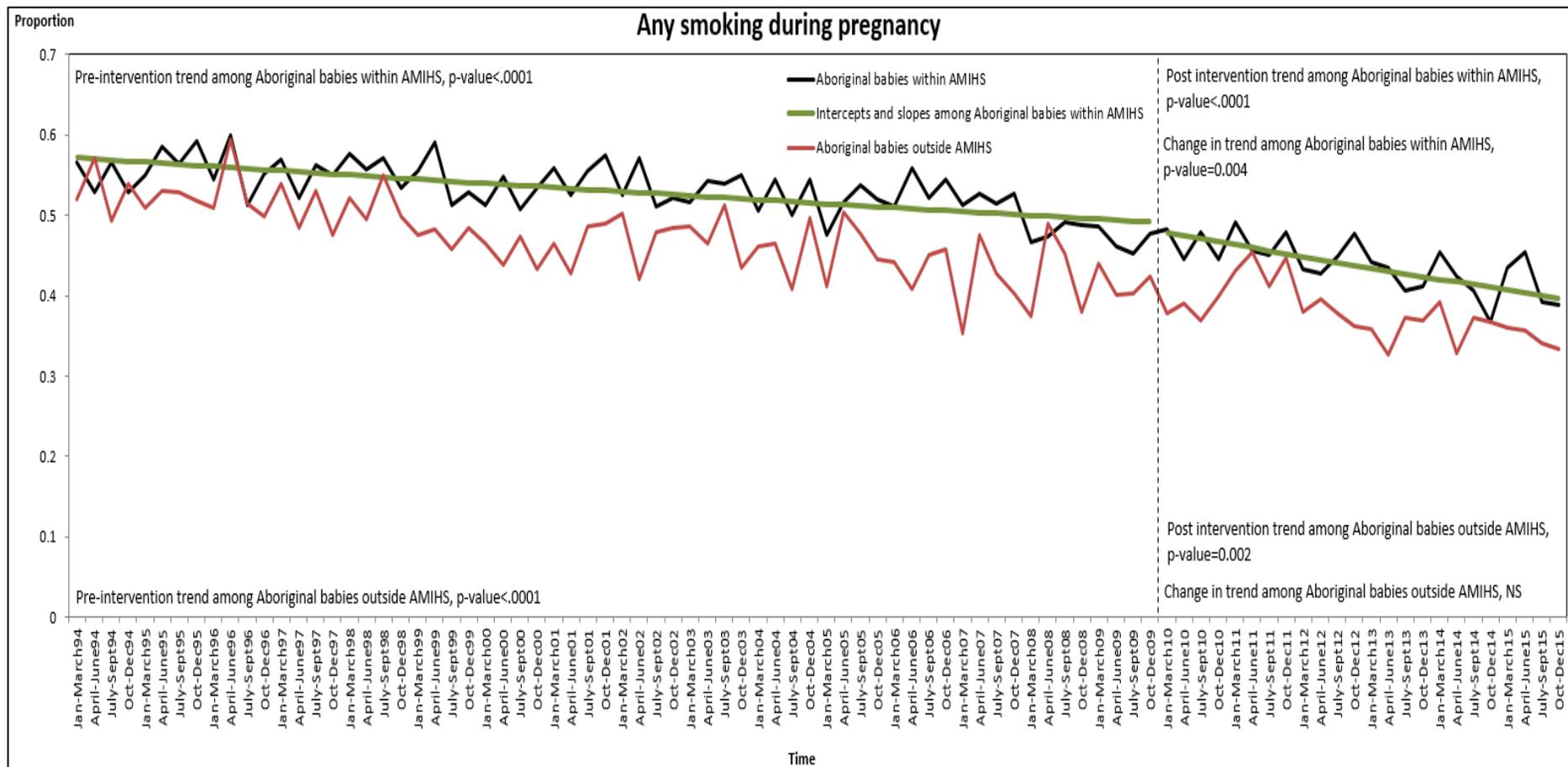


*Source: MCHR 1994-2015*

**Figure 13: Time series of the proportion of any smoking during pregnancy for Aboriginal babies for the <u>2001 cohort</u> by AMIHS catchment area**
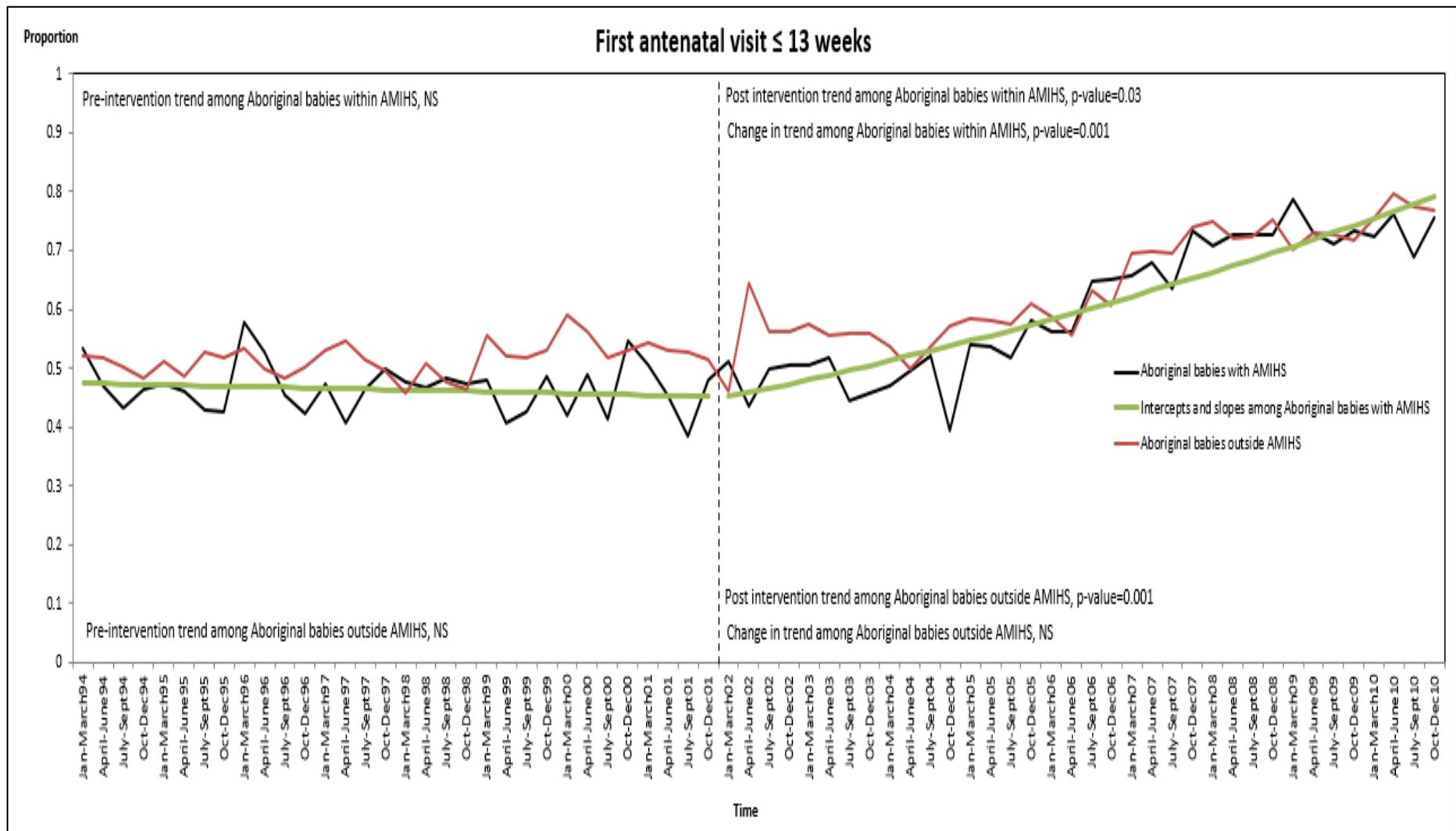


*Source: MCHR 1994-2015*

**Figure 14: Time series of the proportion of any smoking during pregnancy for Aboriginal babies for the 2008-09 cohort by AMIHS catchment area**



*Source: MCHR 1994-2015*

**Figure 15: Time series of the proportion of first antenatal visit ≤ 13 weeks for Aboriginal babies for the 2001 cohort by AMIHS catchment area**

# G.   DISCUSSION

## Introduction

This technical report aims to determine the reach of the AMIHS program, identify the factors that influence the reach of the AMIHS program, determine whether women who attend the AMIHS program have better outcomes than women who did not attend the AMIHS program and finally to determine whether women who live in AMIHS catchment areas have better outcomes after the implementation of the AMIHS program.

## Reach of the AMIHS program

### AMIHS reaches a large number of mothers

According to AMDC data, the current AMIHS Program footprint (NSW postcodes to which a service is offered) means that 82% of all Aboriginal babies born could have received the service. That is, four out of every five eligible mothers of Aboriginal babies born in NSW, could have accessed AMIHS support.

Based on AMDC data, between 2012 and 2016, 51% of eligible women accepted the service offer and received antenatal support. It is estimated that this represents 41% of mothers of Aboriginal babies in NSW[14].

### The reach could be higher still

The potential reach of AMIHS is compromised by not all mothers in the AMIHS catchment areas being given an actual choice to use the Program; one in 10 eligible women were not offered the AMIHS Program. This amounts to over 2000 mothers over a four-year period who were not offered a service.

When queries as to how a mother was categorised as 'not offered' were made, it was found that the category is used and interpreted differently at each site. The AMIHS offer is usually made and recorded at the first comprehensive antenatal visit (booking in), which may be completed by an AMIHS midwife or a midwife at a hospital antenatal clinic. The aim is for women to understand and be able to choose from the full range of maternity care options available, but the amount of information about AMIHS given to women may differ between sites. It was suggested that 'not offered' may be recorded if a midwife does not ask the woman about her Indigenous status or does not have a good understanding of all local services available (i.e. student or new midwives).

---

[14] Due to under-reporting in the AMDC, this figure is an estimate only.

## Factors influencing reach

In multivariable regression models, where the confounding factors were accounted for and the influence of clustering factors such as sites in the LHD were removed, the predictors of reach ('Offered and accepted' the AMIHS program) were:

1. Younger women more likely to accept AMIHS (almost twice as likely as older groups, $p < .0001$)
2. Aboriginal mothers more than twice as likely to accept AMIHS ($p < .0001$)
3. Mothers with previous pregnancies more likely to accept AMIHS (up to 20% more likely, $p = 0.002$)
4. Mothers whose antenatal visit is early in pregnancy more likely to accept AMIHS (10-20% more likely, $p < .0001$)
5. Mothers who smoke during pregnancy more likely to accept AMIHS (17-30% more likely, $p < .0001$)

The strongest predictor of accepting an offer of AMIHS support was maternal age and Aboriginality of the mother, with young and Aboriginal women more than twice as likely to participate in AMIHS compared to older Aboriginal and non-Aboriginal women.

When comparing AMIHS service type, the 'Midwifes & home visiting' service type was associated with greater reach.

# Outcomes of the AMIHS Program

## Discussion of methods

Three separate methods of analysis were employed in the study to try to understand the impact of receiving the AMIHS Program on a range maternal and baby health outcomes. The three methods were:

- A comparison of outcomes between an '*exposed*' (a population who received AMIHS service support) and '*control*' (a population who did not receive AMIHS) group. This method of analysis adopted two models, in which the 'control' group population could vary (between a population that did not receive AMIHS and a subset of this population that were 'not offered' AMIHS).
- A comparison of outcomes of a population *before* the introduction of AMIHS with a population *after* the introduction of AMIHS. This method of analysis was undertaken for two separate AMIHS service cohorts based on when those services commenced (one set that commenced in 2001 and another set that commenced in 2008/9).
- A comparison of the trend in outcomes of a population *up to the* introduction of an AMIHS service with the trend in outcomes of a population *exposed* to an AMIHS service during and after service implementation. This method of analysis was also undertaken for two separate AMIHS service cohorts based on when those services commenced.

These different methods of analysis (effectively providing six sets of analysis) delivered a complex and somewhat inconsistent picture of results that requires careful interpretation and judgement as to what weight to afford the different results.

## A key comparison

Of the six forms of analysis undertaken arguably the most sensible is that using AMDC data to compare an 'exposed' group with a 'control' group where the 'exposed' group was babies of mothers that had received AMIHS and the 'control' was babies of mothers eligible for AMIHS services who had not been offered AMIHS. This 'control' group is possibly superior because eligible mothers of babies who were 'not offered' the AMIHS service are very similar in age composition, Aboriginality, number of pregnancies and smoking behaviour to the population of mothers who accepted AMIHS. Much more similar than the mothers of babies who were offered and declined AMIHS.

In this analysis there is a clear association between being exposed to AMIHS and frequency of antenatal visits, early commencement of antenatal visits, and less incidence of preterm births and low birth weight babies (Table 18). The results for breastfeeding are less clear but indicate a greater likelihood of fully breastfeeding at discharge among Aboriginal mothers associated with AMIHS exposure.

**Table 18: Results of analyses comparing mothers and babies 'offered and accepted' AMIHS and 'not offered' AMIHS**

| Pregnancy or birth outcome | Evidence of association between AMIHS and improvements in the outcome |
|---|---|
| At least seven antenatal visits (or at least 10 antenatal visits in first pregnancy) | Women who received the program were 1.45 times more likely to have at least seven antenatal visits, compared to eligible women who were not offered the program. |
| First antenatal visit ≤13 weeks gestation | Women who received the program were 1.2 times more likely to have their first antenatal visit by ≤13 weeks gestation, compared to eligible women who were not offered the program. |
| Quit smoking in second half of pregnancy | No evidence that AMIHS is associated with an increase in antenatal smoking cessation |
| Preterm baby | Women who received the program were 1.43 times less likely to have a preterm birth, compared to eligible women who were not offered the program. |
| Low birth weight baby | Women who received the program were 1.54 times less likely to have a low birth weight baby, compared to eligible women who were not offered the program. |
| Small for gestational age (SGA) baby | No evidence that AMIHS is associated with a reduction in small for gestational age |

| Pregnancy or birth outcome | Evidence of association between AMIHS and improvements in the outcome |
|---|---|
| Fully breastfeeding at hospital discharge[15] | No evidence that AMIHS is associated with an increase in fully breastfeeding at hospital discharge. |

*Source: AMDC data, 2012-2016*

## The balance of evidence from all analyses

Table 19 summarises the findings from all six analyses including the analysis described in the previous section in Table 18. Assessment ratings of the weight of evidence were based on the following criteria:

- "No evidence" was applied where AMIHS was not associated with an improvement in the outcome (either an increase or a decrease) in any of the analyses conducted
- "Initial evidence" was applied where (1) 1-2 analyses found an association between the program and an improvement (either an increase or a decrease) in the outcome and (2) no other analyses found an association between the program and a deterioration in the outcome
- "Moderate evidence" was applied where (1) three or more analyses found an association between the program and an improvement (either an increase or a decrease) in the outcome, (2) no other analyses found an association between the program and a deterioration in the outcome, and (3) an improvement in the outcome was absent in the Aboriginal babies born in the non-AMIHS areas cohort
- "Inconclusive evidence" was applied where AMIHS was associated with an improvement in the outcome (either an increase or a decrease) in one or more analyses but was also associated with a poorer outcome in one or more analyses.

In Table 19, despite the somewhat favourable status afforded the analysis in Table 18, all forms of analysis are treated equally and given equal weighting as evidence, as all have limitations that may introduce bias in the findings (see later section).

---

[15] Compared to Aboriginal women who were not offered the program, Aboriginal women who participated in the program were 1.16 times more likely to be fully breastfeeding at discharge.

*Evaluation of the AMIHS program using administrative datasets: a technical report*

**Table 19: Triangulation of results of analyses comparing: (1) exposed and unexposed groups[1]; and (2) pre- and post-AMIHS cohorts**

| Outcome[16] | Key findings for each of the six forms of analysis | | | | | | Weight of evidence following triangulation of findings |
|---|---|---|---|---|---|---|---|
| | Cross-sectional exposed vs unexposed[17] analysis (AMDC) | Cross-sectional exposed vs not offered (AMDC) | Pre-Post AMIHS analysis 2001 cohort (MCHR) | Pre-Post AMIHS analysis 2008/09 cohort (MCHR) | Time series analysis 2001 cohort (MCHR) | Time series analysis 2008/09 cohort (MCHR) | |
| **At least seven antenatal visits (or at least 10 antenatal visits in first pregnancy)** | Unexposed group slightly less likely to have at least seven antenatal visits compared to exposed group (OR = 0.93) but finding not statistically significant (p= 0.08). If comparison is based on | Not offered group almost half as likely (OR - 0.69; p < 0.0001) to have at least seven antenatal visits compared to group exposed to AMIHS | N/A | N/A | N/A | N/A | **Initial evidence** that AMIHS is associated with women attending at least seven antenatal visits[18] and attending antenatal care more frequently (albeit minimally). |

---

[16] The 'Perinatal death' outcome is not included in this Table because (a) Perinatal death was only able to be examined through the analyses based on MCHR data, and (b) none of the analyses undertaken provided statistically significant results.

[17] Unexposed group includes mothers of Aboriginal babies 'offered and declined' AMIHS and eligible mothers 'not offered' AMIHS.

[18] Or at least 10 antenatal visits in first pregnancy.

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| Outcome[16] | Key findings for each of the six forms of analysis | | | | | | Weight of evidence following triangulation of findings |
|---|---|---|---|---|---|---|---|
| | Cross-sectional exposed vs unexposed[17] analysis (AMDC) | Cross-sectional exposed vs not offered (AMDC) | Pre-Post AMIHS analysis 2001 cohort (MCHR) | Pre-Post AMIHS analysis 2008/09 cohort (MCHR) | Time series analysis 2001 cohort (MCHR) | Time series analysis 2008/09 cohort (MCHR) | |
| | actual number of visits, unexposed group likely to have less antenatal visits (OR = 0.98) | | | | | | |
| **First antenatal visit ≤13 weeks gestation** | No association found between receiving AMIHS and early engagement with antenatal care. However, if 'early' is defined as <20 weeks then exposed group more likely to | Not offered group almost 20% less likely to have early engagement with antenatal visits compared to group exposed to AMIHS (OR = 0.83; p = 0.003) | Post-AMIHS group more likely to have first antenatal visit ≤13 weeks gestation compared to Pre-AMIHS group (OR = 1.25) | N/A | Post-AMIHS group trend to more likely to have first antenatal visit ≤13 weeks gestation however difference is only just significant (RR = 1.01; p = 0.027). Difference | N/A | **Moderate evidence** that receiving AMIHS is associated with early engagement with antenatal care. |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| Outcome[16] | Key findings for each of the six forms of analysis | | | | | | Weight of evidence following triangulation of findings |
|---|---|---|---|---|---|---|---|
| | Cross-sectional exposed vs unexposed[17] analysis (AMDC) | Cross-sectional exposed vs not offered (AMDC) | Pre-Post AMIHS analysis 2001 cohort (MCHR) | Pre-Post AMIHS analysis 2008/09 cohort (MCHR) | Time series analysis 2001 cohort (MCHR) | Time series analysis 2008/09 cohort (MCHR) | |
| | visit early (OR = 1.15) | | | | between pre- and post-trends significant (p = 0.009). | | |
| **Quit smoking in second half of pregnancy** | No association found between receiving AMIHS and quitting smoking during pregnancy | No association found between receiving AMIHS and quitting smoking during pregnancy | N/A | N/A | N/A | N/A | **No evidence** that AMIHS is associated with quitting smoking during pregnancy |
| **Smoked at any stage in pregnancy** | N/A | N/A | No association found between receiving AMIHS and a | Post-AMIHS group less likely to smoke during pregnancy compared to | Change in trend of outcome in desired direction from pre- to post- | Change in trend of outcome in desired direction from pre- to post- | **Moderate evidence** that AMIHS is associated with a modest population-level |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| Outcome[16] | Key findings for each of the six forms of analysis | | | | | | Weight of evidence following triangulation of findings |
|---|---|---|---|---|---|---|---|
| | Cross-sectional exposed vs unexposed[17] analysis (AMDC) | Cross-sectional exposed vs not offered (AMDC) | Pre-Post AMIHS analysis 2001 cohort (MCHR) | Pre-Post AMIHS analysis 2008/09 cohort (MCHR) | Time series analysis 2001 cohort (MCHR) | Time series analysis 2008/09 cohort (MCHR) | |
| | | | reduction in smoking during pregnancy | Pre-AMIHS group (OR = 0.79) | intervention (OR = 0.996). | intervention (OR = 0.994) | reduction in smoking during pregnancy |
| **Preterm baby** | Unexposed group slightly more likely to have a preterm baby compared to exposed group (OR 1.10) but finding not statistically significant (p= 0.066) | Not offered group almost 40% more likely to have a preterm baby when compared to group exposed to AMIHS (OR = 1.43; p < 0.0001) | No association found between receiving AMIHS and a reduction in preterm births | Post-AMIHS group more likely to have preterm birth compared to Pre-AMIHS group (OR 1.19) | No association found between receiving AMIHS and a reduction in preterm births | No association found between receiving AMIHS and a reduction in preterm births | **Inconclusive evidence**, as statistically significant associations found in both directions. |
| **Low birth weight baby** | No association found between receiving AMIHS and a reduction in | Not offered group almost half as likely to have low birth weight | No association found between receiving | No association found between receiving | Change in trend of outcome in desired direction from | No association found between receiving | **Initial evidence** that receiving AMIHS is associated with a modest reduction |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| Outcome[16] | Key findings for each of the six forms of analysis | | | | | | Weight of evidence following triangulation of findings |
|---|---|---|---|---|---|---|---|
| | Cross-sectional exposed vs unexposed[17] analysis (AMDC) | Cross-sectional exposed vs not offered (AMDC) | Pre-Post AMIHS analysis 2001 cohort (MCHR) | Pre-Post AMIHS analysis 2008/09 cohort (MCHR) | Time series analysis 2001 cohort (MCHR) | Time series analysis 2008/09 cohort (MCHR) | |
| | low birth weight | baby when compared to group exposed to AMIHS (OR = 1.54; p < 0.0001) | AMIHS and a reduction in low birth weight | AMIHS and a reduction in low birth weight | pre- to post-intervention (OR 0.979). However, similar change in trend among Aboriginal babies born in non-AMIHS areas | AMIHS and a reduction in low birth weight | in low birth weight. However, factors other than AMIHS may account for this observed association |
| **Small for gestational age (SGA) baby** | Unexposed group less likely to have small for gestational age baby compared to exposed group (OR 0.87) | No association found between receiving AMIHS and having a SGA baby | No association found between receiving AMIHS and a reduction in SGA | Post-AMIHS group less likely to have a SGA baby compared to Pre-AMIHS group (OR 0.87) | Change in trend of outcome in desired direction from pre- to post-intervention (OR = 0.991). However, similar change | No association found between receiving AMIHS and a reduction in SGA | **Inconclusive evidence**, as statistically significant associations found in both directions. Factors other than AMIHS may account for observed |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| Outcome[16] | Key findings for each of the six forms of analysis | | | | | | Weight of evidence following triangulation of findings |
|---|---|---|---|---|---|---|---|
| | Cross-sectional exposed vs unexposed[17] analysis (AMDC) | Cross-sectional exposed vs not offered (AMDC) | Pre-Post AMIHS analysis 2001 cohort (MCHR) | Pre-Post AMIHS analysis 2008/09 cohort (MCHR) | Time series analysis 2001 cohort (MCHR) | Time series analysis 2008/09 cohort (MCHR) | |
| | | | | | in trend among Aboriginal babies born in non-AMIHS areas | | improvements in this outcome. |
| **Fully breastfeeding at hospital discharge** | No association found between receiving AMIHS and an increase in fully breastfeeding at hospital discharge. | No association found between receiving AMIHS and an increase in fully breastfeeding at hospital discharge | N/A | N/A | N/A | N/A | **No evidence** that AMIHS is associated with an increase in fully breastfeeding at hospital discharge. |

*Source: AMDC and MCHR data*

# Reach and outcomes associated with AMIHS service types

There were five AMIHS service types that were analysed for their effect on reach and their association with different outcomes.

There was a significant difference between service types in their association with reach. The 'Midwife and home visiting' and 'AMIHS-type' service types are most associated with higher reach into the eligible mother population. These service types within their catchment areas are capturing a higher proportion of the eligible mothers (up to 70%), although it is not clear why this should be so. One common feature of these service types is a home visiting component.

A summary of the association of AMIHS service types with different outcomes is provided in Table 20. Apart from an association with access to antenatal services and level of use, there is little evidence of a strong relationship between AMIHS service type and particularly baby health outcomes, although a sensitivity analysis for only Aboriginal women showed some service types to have a positive effect on smoking reduction.

**Table 20: Summary of analyses comparing AMIHS service types on outcomes**

| Pregnancy or birth outcome | Evidence of variation in the outcome between AMIHS service types |
|---|---|
| **At least seven antenatal visits (or at least 10 antenatal visits in first pregnancy)** | When compared with the 'Midwife & clinic' service type, all other service types are not statistically different, except for the 'Midwife & home visiting' service type which is less likely to achieve the minimum level of antenatal care visits |
| **First antenatal visit ≤13 weeks gestation** | When compared to the 'Midwife & clinic' service type, the 'AHW-led & home visiting' type service is 18% more likely to have women commence their antenatal visits before 14 weeks gestation. The 'AHW & outreach' service type had lower odds of achieving this outcome than the 'Midwife & clinic' service type |
| **Quit smoking in second half of pregnancy** | No evidence that any service type is associated with a reduction in antenatal smoking[19] |
| **Preterm baby** | When compared with the 'Midwife & clinic' service type, women who received the program through the 'AHW & home visiting' service type were more likely to have a preterm birth |
| **Low birth weight baby** | No evidence that any service type is associated with a reduction in low birth weight. |

---

[19] One of the sensitivity analyses showed Aboriginal women who received the program through the 'AMIHS-type' or 'Midwife & home visiting' service type were over 40% more likely to quit smoking in the second half of pregnancy, compared to the 'Midwife & clinic' service type.

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| Pregnancy or birth outcome | Evidence of variation in the outcome between AMIHS service types |
|---|---|
| Small for gestational age (SGA) baby | No evidence that any service type is associated with a reduction in small for gestational age |
| Fully breastfeeding at hospital discharge | No evidence that any service type is associated with an increase in fully or even some breastfeeding at hospital discharge. |

*Source: AMDC data, 2012-2016*

# Summary of analyses by outcome

## Early access to and use of antenatal services

There is comparatively strong evidence that associates mothers of babies who have accessed an AMIHS service with earlier use of antenatal services when compared with mothers who have not been exposed to AMIHS. The 'exposed' vs ''control' comparison using AMDC data where the control or 'unexposed' population is women who were not offered AMIHS, suggests that AMIHS mothers are 20% more likely to have their first antenatal visit ≤13 weeks gestation. Additionally, other analyses found initial evidence that receiving AMIHS is associated with early engagement with antenatal care.

Not only do AMIHS mothers access antenatal services earlier, but also more frequently. On average, AMIHS mothers who have delivered full-term babies have received an average of 9.1 antenatal visits, almost equal to the visits of mothers who were 'offered and declined' an AMIHS service but significantly more ($p<0.0001$) than mothers 'not offered' AMIHS (average of 8 visits). When confounding factors are considered, mothers who have received an AMIHS service are likely to have 2% more antenatal visits than mothers who were 'offered and declined' and 8% more visits than mothers who were 'not offered' an AMIHS service even though eligible.

These 'intermediate' type outcomes are not health outcomes *per se* but are important precursor outcomes to achieving improvements to baby health. In the program logic that underpins the conceptualisation of the AMIHS model and its implementation principles, achieving these outcomes is understood to provide the longer-term baby health outcomes desired at least at a population level. The literature strongly supports this program logic (e.g. Brock, et al., 2014).

That the AMIHS program was able to demonstrate evidence of an impact on antenatal service access (timing and extent) should not surprise, since this is the most common type of impact identified in most other evaluations and investigations of similar interventions. For instance, Jan et al. (2004) showed in a study of an Aboriginal specific service in Western Sydney that gestational age at first visit was a little lower and the average number of antenatal visits greater (10.5 vs 5.5) than a non-intervention comparison. In an evaluation of an Aboriginal specific service within Mt Isa Hospital, Nel and Pashen (2003) found key outcomes of the specialised service included increased service utilisation and improved antenatal attendance. Panaretto,

et al. (2005) reporting on an urban Indigenous Mums and Babies intervention in Townsville found intervention clients had more antenatal care visits, improved timeliness of first visit, and fewer pregnancies with inadequate care.

## Smoking during pregnancy

Smoking during pregnancy is a major risk factor for pregnancy complications and poor birth outcomes. Reducing smoking in pregnancy is an important 'intermediate' outcome that can improve Aboriginal maternal and infant health. Pursuit of this outcome is integral to the program logic of the AMIHS model and is similarly widely supported in the literature (e.g. Cnattingius, 2004). Mothers of babies who accepted an AMIHS service are between 20 and 30% more likely to be smoking during pregnancy than mothers who do not use AMIHS.

Moderate evidence was obtained, particularly from the ITS analysis, that AMIHS exposure is associated with a modest decrease in smoking during pregnancy. This modest impact is consistent with some studies that have identified a decrease in mothers smoking from a specific intervention (Panaretto, et al., 2005) but otherwise such an impact has not been widely reported.

## Breastfeeding at hospital discharge

Another intermediate outcome desired from AMIHS participation would be that mothers are breastfeeding fully or at least to some extent at the time of discharge from hospital. There is little evidence to indicate mothers of babies who have received AMIHS support are any more likely to breastfeed than mothers unexposed to an AMIHS service.

The literature provides little support for attainment of this outcome through similar interventions to AMIHS (Halliday and Segal, 2012) even though it would seem to be an easier outcome to attain than say smoking cessation where there is the added difficulty of dealing with an addiction. There are perhaps cultural factors influencing behaviour that are not immediately obvious.

## Health outcomes of the baby

Unlike the above 'intermediate' outcomes, low birth weight, preterm baby and SGA baby are all 'endpoint' health outcomes. The literature reveals few studies in the past where an Aboriginal specific antenatal intervention has shown an association with statistically significant baby health outcomes. Some of the exceptions include Panaretto, et al. (2005) who reported improvements in preterm births (less) and average birth weight (higher) and Sloman (1999) who in an Anangu Pitjantjatjara Lands antenatal care study found mean birth weight increased and low birth weight and perinatal mortality rates decreased.

This study follows previous research with largely inconclusive results in relation to baby health outcomes except for some initial support for AMIHS having possible influence on birth weight. One analysis of the comparison between an exposed population and an unexposed population of mothers who were not offered AMIHS (see Table 18) found women who received the program were 1.54 times less likely to have a low birth weight baby, compared to eligible

women who were not offered the program. A corollary of this outcome no doubt, women who received the program were 1.43 times less likely to have a preterm birth, compared to eligible women who were not offered the program.

In the case of low birth weight baby outcomes one of the time series analyses also indicated a possible trend in reduction in low birth weight babies associated with the AMIHS intervention. The same trend though was observed in Aboriginal babies born to mothers in non-AMIHS catchment areas, meaning causation is difficult to attribute to the AMIHS intervention outcome.

# Limitations of data and analysis

In the foregoing sections the findings regarding each of the objectives of the quantitative study were detailed. In the method section the data analysed, and the forms of analysis employed were described and some of the shortcomings of both acknowledged. It is worth summarising the potential limitations of this study and the data analysed again.

The administrative data sources, the AMDC and MCHR, used for the analysis are both 'secondary' data sources, that is, the data were collected for a purpose other than the purposes of this study. As such they present weaknesses common to all studies that use administrative datasets (James, 2017) including:

- The quality of the administrative data used in these analyses depends on midwives and other clinic staff accurately recording relevant information in local patient information systems. It also depends on the local site practices, systems and communication infrastructure. In the case of the AMDC data we know that a significant number of Aboriginal births are not recorded.

- Some variables have not always been recorded or not recorded accurately. For example, feedback from AMIHS site managers indicates that a key variable, the offer and acceptance of the AMIHS service to eligible women, may have been under-recorded (the reasons for this are outlined on page 65 above).

- For some variables the number of missing values was so great as to render analysis impossible. In other cases, analysis was deemed possible, but it was impossible to know if the missing data might be biased in some way.

- In some program sites, service funding may place limits on the number of eligible women who can attend AMIHS. In this instance the 'offer and decline' number may be misleading.

- Some of the proposed outcome indicators have limitations. For example, the AMDC contains very limited data about smoking cessation. Women who report smoking at any time in the second half of pregnancy are recorded as smoking, regardless of if they later stopped smoking during this period. Hence, smoking cessation occurring during

the second half of pregnancy is not captured. This will result in the rate of smoking cessation during pregnancy being underestimated.

From the perspective of the analysis:

- The groups being compared in this study were not established through random allocation. While there has been an attempt to control for key differences in potential confounding factors between groups, there remains potential for bias in the findings.

- The MCHR data combines the 'treatment' population, those who received a direct care service from the AMIHS Program, with a 'non-treatment' population in a single group. This has the effect of 'blunting' or effectively 'diluting' the potential to measure impact of the AMIHS Program. In addition, and further muddying the waters, eligible women in the catchment areas, even if not receiving direct care, could be exposed to the AMIHS through community development and health promotion activities.

- The AMIHS program includes community development and health promotion strategies. The approaches to evaluating program reach and outcomes described above do not account for interaction that eligible women who chose to decline an AMIHS service offering may have still had with these community-based activities. This may also have the potential to dilute the impact of the AMIHS Program.

# Conclusion

**Overall the AMIHS Program is servicing the intended target population**, that is, the mothers that need it most. The AMIHS model is meant to target young pregnant women having Aboriginal babies, Aboriginal women, mothers smoking and mothers living in disadvantaged socio-economic circumstances. These characteristics are associated with the population receiving AMIHS services except for disadvantage, where the pattern of association is not clear. The reach of the Program is significant, both in proportional terms (within the AMIHS catchment areas) and absolute terms within the total population of Aboriginal babies born in NSW. The impressive reach figures are likely to be under-estimates given some of the data collection and recording issues noted and that all eligible women were not afforded an actual offer of AMIHS service.

**Women who attended AMIHS had better outcomes than women not offered AMIHS.** The most consistent and conspicuous differences in baby and mother outcomes were identified from a comparative analysis of the outcomes of Aboriginal babies from mothers who were 'offered and accepted' an AMIHS service with babies from mothers 'not offered' the AMIHS service. Arguably this is the most appropriate and powerful of all the analyses undertaken since the two populations being compared, 'offered and accepted' and 'not offered', are very much alike in all respects except for one – one group received the AMIHS service.

**The clearest difference in outcomes associated with AMIHS is related to antenatal service access and use.** Across most forms of analysis mothers who are offered and accept the AMIHS service are more likely to access antenatal services earlier, and to use those services

more often. According to the AMIHS model program logic, such use of antenatal services should deliver better baby health outcomes if intermediate outcomes (such as reduced smoking and increased breastfeeding) are achieved.

**Some encouraging signs were detected regarding trends in mothers' smoking**. Any reductions in smoking during pregnancy would benefit both the mothers and the babies. There is moderate evidence that AMIHS may be contributing to a population level decline in smoking in pregnancy among mothers of Aboriginal babies.

**There is a possibility that some model types are more conducive to achieving reach** and more consistent use of the service (earlier and more antenatal contacts). It is not obvious how this might translate into other baby outcomes or what this means for future investment. This should be explored further.

# REFERENCES

Bernal, J., Cummins, S and Gasparrini, A. (2016) Interrupted time series regression for the evaluation of public health interventions: a tutorial. *International Journal of Epidemiology, 46* (1): 348-355

Brock E, Charlton K, Yeatman H. (2014) Identification and evaluation of models of antenatal care in Australia – A review of the evidence. *The Australian and New Zealand Journal of Obstetrics and Gynaecology.* 54(4):300-11. doi: 10.1111/ajo.12210.

Bywood P, Raven M, Erny-Albrecht K. (2015) *Improving health in Aboriginal and Torres Strait Islander mothers, babies and young children: A literature review*. Adelaide: 2015.

Cnattingius, S. (2004) The epidemiology of smoking during pregnancy: Smoking prevalence, maternal characteristics, and pregnancy outcomes. *Nicotine & Tobacco Research Volume 6*, Supplement 2 (April 2004) S125–S140

Centre for Epidemiology and Evidence (2018) *Aboriginal kids—A healthy start to life: Report of the Chief Health Officer.* Sydney: NSW Ministry of Health

Centre for Epidemiology and Evidence (2019) *HealthStats NSW*. Sydney: NSW Ministry of Health. Available at: www.healthstats.nsw.gov.au. Accessed 12 March 2019.

Dobbins TA, Sullivan EA, Roberts CL, Simpson JM. (2012) Australian national birthweight percentiles by gestational age, 1998–2007. *MJA*, 198(4):189

El-Masri, M. (2014) *Terminology 101: Retrospective cohort study design*. Canadian Nurse, April. Accessed January 2019 https://canadian-nurse.com/en/articles/issues/2014/april-2014/terminology-101-retrospective-cohort-study-design

Halliday, D. and Segal, L. (2012) *What works in Indigenous primary health care health reform? A review of the evidence.* Health Economics & Social Policy Group: Research Paper University of South Australia

James, N. (2017) *Retrospective Cohort Study: Strengths and Weaknesses.* Tufts Open Courseware. Tufts University. Retrieved 2 August 2017.

Jan S, Conaty S, Hecker R, Bartlett M, Delaney S, Capon T. (2004) An holistic economic evaluation of an Aboriginal community-controlled midwifery programme in Western Sydney *Journal of Health Serv Res Policy.* 9(1):14-21.

Jongen C, McCalman J, Bainbridge R., Tsey K. (2014) Aboriginal and Torres Strait Islander maternal and child health and wellbeing: a systematic search of programs and services in Australian primary health care settings. *BMC Pregnancy and Childbirth* 14: 251

Kildea S, Van Wagner V. (2013) *'Birthing on Country' maternity service delivery models: an Evidence Check rapid review.* Brokered by the Sax Institute on behalf of the Maternity Services InterJurisdictional Committee for the Australian Health Ministers' Advisory Council. Sydney: Sax Institute

Mann, C J (2003) Observational research methods. Research design II: cohort, cross sectional, and case-control studies. *Emergency Medicine Journal*. BMJ Publishing Group Ltd. 20: 54–60. doi:10.1136/emj.20.1.54. PMC 1726024. Retrieved 2 August 2017.

Nel, P. and Pashen, D. (2003) Shared antenatal care for indigenous patients in a rural and remote community. *Australian Family Physician 32* (3): 127-31

NSW Health (reviewed 2014) *Service Delivery Model: Aboriginal Maternal and Infant Health Service*. NSW Health, North Sydney

Panaretto, K., Lee, H., Mitchell, M, Larkins, S., Manessis, V., Buettner, P., et al. (2005) Impact of a collaborative shared antenatal care program for urban Indigenous women: a prospective cohort study. *Medical Journal of Australia; 182* :514-9

Penfold, R and Zhang, F. (2013) Use of interrupted times series analysis in evaluating health care quality improvements. *Academic Paediatrics, 13* (6): S38-S44

Schnell, A. (2018) The Difference Between Relative Risk and Odds Ratios. The Analysis Factor (accessed from https://www.theanalysisfactor.com/the-difference-between-relative-risk-and-odds-ratios/, 14/01/2019

Sloman D. (1999) *Obstetric and Child Health Outcomes on the Anangu Pitjantjatjara Lands, 1984-1996: A Preliminary Analysis*. 5th National Rural Health Conference; Adelaide, South Australia. p. 189-95.

StatSoft, Inc. (2013). *Electronic Statistics Textbook*. Tulsa, OK: StatSoft. - accessed 13 June 2017 at http://www.statsoft.com/textbook/

Szumilas, M. (2010) Explaining Odds Ratios. *J Can Acad Child Adolescent Psychiatry. 19* (3): 227–229.

# APPENDIX 1: DEFINITIONS

The following definitions apply to the study:

<u>Women eligible for AMIHS:</u> Pregnant women who gave birth to an Aboriginal baby and lived in an AMIHS catchment area at the time of birth. Information on the catchment areas of AMIHS sites and the period of operation of each site will be provided by AMIHS managers employed in LHDs and Aboriginal Community Controlled Health Services (ACCHS).

<u>An Aboriginal birth:</u> A birth for which the baby was recorded as Aboriginal or Torres Strait Islander, including all live births and stillbirths of at least 20 weeks gestation or at least 400 grams birth weight. If information about the baby's Aboriginality is missing or not available (prior to 2011), the mother's Aboriginal status will be used as a proxy indicator.

<u>Referred to an AMIHS site:</u> Eligible women who are recorded as being referred to an AMIHS site in the AMDC.

<u>Attended an AMIHS site:</u> Eligible women who are recorded in the AMDC as attending an AMIHS site at any stage during the antenatal period.

<u>AMIHS client referred to an early childhood health service:</u> Women who attended an AMIHS site at any stage during their pregnancy and are recorded in the AMDC as being referred to an early childhood health service prior to being discharged from hospital.

<u>AMIHS client attended an early childhood health service:</u> Women who attended an AMIHS site at any stage during their pregnancy and are recorded in the AMDC as attending an early childhood health service prior to being discharged from AMIHS (up to 8 weeks postpartum).

<u>Antenatal visit:</u> Contact with any clinician for antenatal care, and not only contact with the hospital of birth. Antenatal visits include visits for antenatal screening, history or pathology testing. They include a visit for pregnancy test and referral, but do not include contacts that occurred during the pregnancy that related to other non-pregnancy related issues. They do not include contacts after the onset of labour.

In relation to the PDC and AMDC variable "Duration of pregnancy (weeks) at first antenatal visit" there was a substantial change in the definition of "Antenatal visit" in 2011, from "the first contact with any clinician for antenatal care" to the more comprehensive definition provided above.

<u>Smoking cessation:</u> A woman is considered to have ceased smoking during pregnancy if she reported smoking in the first half of pregnancy but not in the second half of pregnancy (as recorded in the AMDC and PDC).

<u>Breastfeeding on hospital discharge:</u> A woman is considered to be breastfeeding on discharge from hospital if she is fully breastfeeding (baby is breastfed or receiving expressed breastmilk and not receiving infant formula) when discharged (as recorded in the AMDC and PDC).

<u>Low birth weight:</u> A live born baby weighing less than 2,500 grams.

Small for gestational age: Babies born small for their gestational age are singletons with a birth weight below the 10th percentile of Australian national gestational age- and sex-specific birth weight percentiles.[14]

Preterm birth: Live births for which gestational age was less than 37 weeks.

Perinatal death: Stillbirths and deaths within 28 days of birth (neonatal deaths). Deaths occurring after discharge or transfer of the baby may not be recorded in the PDC and AMDC.

# APPENDIX 2: DEFINITION OF AMIHS CATCHMENT AREAS

AMIHS clinic catchment areas were defined by postcodes provided by the NSW Ministry of Health and supplemented by postcodes obtained through the qualitative study. The postcodes that defined the AMIHS catchment areas are as follows:

## Postcodes for all AMIHS clinics

2010,2011,2016,2017,2035,2036,2147,2148,2155,2259,2264,2264,2265,2267,2278,2280, 2281,2282,2283,2284,2285,2286,2287,2289,2290,2291,2292,2293,2294,2295,2296,2297, 2298,2299,2300,2302,2303,2304,2305,2306,2307,2312,2315,2316,2317,2318,2319,2321, 2322,2324,2350,2351,2354,2358,2365,2400,2406,2415,2422,2429,2430,2450,2451,2452, 2453,2454,2455,2456,2672,2761,2762,2763,2765,2766,2767,2768,2769,2770,2828,2830, 2831,2836,2877,2879,2880,2167,2171,2250,2251,2256,2257,2258,2260,2261,2320,2321, 2322,2323,2325,2326,2327,2328,2329,2330,2333,2334,2335,2336,2337,2338,2339,2340, 2341,2342,2343,2352,2353,2355,2356,2357,2360,2361,2369,2380,2388,2390,2403,2420, 2421,2431,2440,2441,2443,2444,2445,2446,2450,2460,2462,2463,2464,2466,2469,2470, 2471,2474,2475,2476,2477,2478,2480,2536,2537,2545,2546,2548,2549,2550,2551,2557, 2558,2559,2560,2563,2564,2565,2566,2567,2568,2569,2570,2571,2572,2573,2574,2575, 2620,2621,2622,2623,2648,2650,2651,2652,2653,2655,2656,2661,2663,2665,2680,2681, 2700,2701,2702,2705,2706,2710,2715,2717,2722,2737,2738,2739,2745,2747,2748,2749, 2750,2759,2765,2775,2787,2794,2795,2799,2800,2821,2827,2828,2832,2833,2834,2840, 2869,2870,2871,2974

## Postcodes for AMIHS clinics which were established in 2000-2001

2010,2011,2016,2017,2035,2036,2147,2148,2155,2259,2264,2264,2265,2267,2278,2280, 2281,2282,2283,2284,2285,2286,2287,2289,2290,2291,2292,2293,2294,2295,2296,2297, 2298,2299,2300,2302,2303,2304,2305,2306,2307,2312,2315,2316,2317,2318,2319,2321, 2322,2324,2350,2351,2354,2358,2365,2400,2406,2415,2422,2429,2430,2450,2451,2452, 2453,2454,2455,2456,2672,2761,2762,2763,2765,2766,2767,2768,2769,2770,2828,2830, 2831,2836,2877,2879,2880

## Postcodes for AMIHS clinics which established in 2008-2009

2167,2171,2250,2251,2256,2257,2258,2260,2261,2320,2321,2322,2323,2325,2326,2327, 2328,2329,2330,2333,2334,2335,2336,2337,2338,2339,2340,2341,2342,2343,2352,2353, 2355,2356,2357,2360,2361,2369,2380,2388,2390,2403,2420,2421,2431,2440,2441,2443, 2444,2445,2446,2450,2460,2462,2463,2464,2466,2469,2470,2471,2474,2475,2476,2477, 2478,2480,2536,2537,2545,2546,2548,2549,2550,2551,2557,2558,2559,2560,2563,2564, 2565,2566,2567,2568,2569,2570,2571,2572,2573,2574,2575,2620,2621,2622,2623,2648,

2650,2651,2652,2653,2655,2656,2661,2663,2665,2680,2681,2700,2701,2702,2705,2706, 2710,2715,2717,2722,2737,2738,2739,2745,2747,2748,2749,2750,2759,2765,2775,2787, 2794,2795,2799,2800,2821,2827,2828,2832,2833,2834,2840,2869,2870,2871,2974

## Postcodes for individual AMIHS clinics

The following table presents the postcodes that are within the catchment area for each of the AMIHS clinics.

**Table 21: Postcodes in AMIHS clinic catchment areas**

| AMIHS clinic | Postcodes |
| --- | --- |
| Armidale | 2350, 2351, 2354, 2358, 2365 |
| Ballina | 2477, 2478 |
| Bathurst | 2787, 2795, 2799, 2800 |
| Bega - Katungal AMS | 2546,2548,2549,2550,2551, |
| Blacktown - Bulbwul Werowe | 2147, 2148, 2155, 2761, 2762, 2763, 2765, 2766, 2767, 2768, 2769, 2770 |
| Bourke | 2840 |
| Broken Hill - Maari Ma AMS | 2836, 2879, 2880 |
| Casino | 2469, 2470 |
| Clarence | 2450, 2460, 2462, 2463, 2464, 2466 |
| Coffs Harbour | 2450, 2451, 2452, 2453, 2454, 2455, 2456 |
| Condobolin | 2877 |
| Cowra | 2790, 2794 |
| Dareton | 2648, 2715, 2717, 2737, 2738, 2739 |
| Dubbo | 2830, 2831 |
| Forbes | 2794, 2869, 2870, 2871 |
| Gilgandra, Gulargambone | 2827, 2828 |
| Gosford | 2250, 2251, 2256, 2257, 2258, 2260, 2261, 2775 |
| Greater Newcastle | 2259, 2264, 2265, 2267, 2278, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2302, 2303, 2304, 2305, 2306, <br><br> 2307, 2315, 2316, 2317, 2318, 2319, 2321, 2322, 2324, 2415, 2264 |
| Griffith | 2680,2772,2652,2665,2681,2705,2706 |
| Gunnedah | 2380 |

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| AMIHS clinic | Postcodes |
|---|---|
| Inverell | 2360, 2361, 2369, 2403 |
| Kempsey–Durri AMS | 2431, 2440, 2441 |
| Kyogle | 2474, 2475, 2476 |
| Lake Cargelligo | 2672, 2828 |
| Lismore | 2357, 2471, 2477, 2480 |
| Macksville | 2441, 2447, 2448, 2449 |
| Maitland | 2320, 2321, 2322, 2323, 2325, 2326, 2327, 2334, 2335, 2420, 2421 |
| Malabar (A) | 2035, 2036, 2010, 2011, 2016, 2017 |
| Moree-Gamilaroi | 2356, 2388, 2400, 2406 |
| Moruya | 2536, 2537, 2545, 2546 |
| Narellan, Macarthur | 2167, 2171, 2557, 2558, 2559, 2560, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2745. |
| Narrabri | 2388, 2390 |
| Narrandera | 2700, 2705, 2710 |
| Narromine | 2821, 2869 |
| Parkes | 2870, 2871, 2869, 2974 |
| Peak Hill | 2821, 2869, 2870, 2871 |
| Penrith - Wel-leng-al-lie | 2747, 2748, 2749, 2750, 2759, 2765 |
| Port Macquarie | 2443, 2444, 2445, 2446 |
| Queanbeyan | 2620,2621,2622,2623 |
| Quirindi | 2339, 2341, 2342, 2343 |
| Shellharbour | 2500, 2502, 2505, 2506, 2508, 2515, 2516, 2517, 2518, 2519, 2522, 2525, 2526, 2527, 2528, 2529, 2530, 2533, 2534 |
| Shoalhaven | 2535, 2536, 2539, 2540, 2541, 2577 |
| Singleton | 2328, 2329, 2330, 2333, 2336, 2337, 2338 |
| Tamworth | 2340, 2352, 2353, 2355 |
| Taree | 2312, 2422, 2427, 2428, 2429, 2430 |
| Wagga Wagga | 2650, 2651, 2652, 2653, 2655, 2656, 2661, 2663, 2701, 2702 |
| Walgett AMS | 2832, 2833, 2834 |

(A) Malabar site reports as part of the AMIHS program (AMDC and annual reports) but is not funded through AMIHS.

Seven postcodes were excluded (2259, n=408; 2321, n=61; 2322, n=151; 2441, n=84; 2450, n=598; 2765, n=101; 2828, n=141) from the analyses as they were reported as belonging to AMIHS clinics established in both 2000-2001 and 2008-2009. This resulted in excluding 1,544 births (3.8% of all births).

# APPENDIX 3: CLUSTER ANALYSIS

## Approach

This section outlines the characteristics of five apparently distinct implementation models that were identified from a cluster analysis of the data from the Manager Surveys and Document Review. The framework for this data collection process was established in the form of a Field Implementation Rating Scale (FIRS) which was developed to identify the key characteristics of the AMIHS Service Delivery Model. The FIRS reflected the essential attributes of the AMIHS Service Delivery Model and incorporated key data collection headings under each attribute. This process was greatly assisted by the input of consumer and service delivery stakeholders in August and September 2016. The FIRS in turn informed the construction of the Manager Survey instrument prior to the survey process which occurred in March and April 2017 (with a 100% response rate for Survey Part A, that is, non-financial information).

Self-reported data from each site was collected from the Document Review (annual reports submitted from each AMIHS site) (Component 1) and the Manager Survey Part A (Component 2). The data was then collated into a database using the FIRS program implementation framework. The information was then analysed using a 'cluster analysis' technique to identify the different ways in which the AMIHS program is being implemented.

Cluster analysis is a useful technique for classifying or identifying groups that are not already known or clearly evident within a dataset (Statsoft, 2013). This is done by identifying the similarities (of variables) within groups and the differences between groups. Clustering is strongest or more distinct when there are significant similarities within groups and significant differences between groups.

The technique also allows for a high degree of transparency and independence as there is no distinction between dependent and independent variables. Identification of groups is then entirely dependent on the available data. The data from component 1 and 2, therefore, allowed for five distinct clusters or implementation models to be identified. The variables that defined the five groups are listed below.

Sites within each group were then ranked according to their cluster score (i.e. how similar they were to the core grouping profile or model). This process strongly assisted in the identification of possible case study sites, with the selection of the final recommended case study sites also being informed by additional factors, such as geographic location, attendance at birth, community-controlled site and number of babies delivered, in order to achieve a range of insights into the operation of AMIHS throughout the State.

## Distinguishing characteristics for clustering

A number of characteristics were the most influential for defining the clusters for models of AMIHS program implementation including effectiveness of consultation with community,

proportions of service delivery type (home visits, clinic-based, outreach), worker input for expenditure of health promotion and community development funds, relationship with local child and family health services, relationship with the local Aboriginal Community Controlled Health Service and/or Aboriginal Medical Service, working conditions match program needs, leadership distribution of service delivery tasks, ratio of Midwives to Aboriginal Health Workers, and proportion and leadership of time spent in community engagement. Table 22 provides a comparison of each of the clusters in relation to each of the defining characteristics.

*Evaluation of the AMIHS program using administrative datasets: a technical report*

**Table 22: Comparison of clusters by defining characteristics**

| | Cluster 1<br><br>Higher ratio midwives<br><br>Clinic based | Cluster 2<br><br>AHW led<br><br>Home visiting | Cluster 3<br><br>AMIHS-type | Cluster 4<br><br>Higher ratio AHWs<br><br>Outreach | Cluster 5<br><br>Higher ratio midwives<br><br>Home visiting |
|---|---|---|---|---|---|
| Service delivery type | Clinic and home visits | Home visits | Home visits | Other outreach | Home visits |
| Staff ratios | Higher ratio midwives | Higher ratio AHW | Equal ratio | Higher ratio AHW | Higher ratio midwives |
| Division of tasks | Midwife/AHW undertake tasks together | More AHW led tasks than other clusters but significant number of tasks also undertaken together | Midwife/AHW undertake tasks together | Midwife/AHW undertake tasks together <br><br>OR tasks equally likely to be led by midwife or AHW | Midwife/AHW undertake tasks together |
| Working conditions match program needs[20] | High agreement | High agreement | Medium agreement | Medium agreement | Very low agreement |
| Community engagement, community development and health promotion (CD&HP) | Effective consultation<br><br>Low level of community engagement, CD&HP<br><br>(AHW led) | Somewhat effective consultation<br><br>Low level of community engagement, CD&HP | Extremely effective consultation<br><br>High level of community engagement, CD&HP<br><br>(AHW led) | Somewhat effective consultation<br><br>High level of community engagement, CD&HP<br><br>(Midwife-led) | Effective consultation<br><br>No time spent in community engagement, CD&HP |

---

[20] *Do program working conditions for the AHW and Midwife match program needs, e.g. out of normal hours work, support to do home visits, flexible hours policy?*

*Evaluation of the AMIHS program using administrative datasets: a technical report*

| | Cluster 1 Higher ratio midwives Clinic based | Cluster 2 AHW led Home visiting | Cluster 3 AMIHS-type | Cluster 4 Higher ratio AHWs Outreach | Cluster 5 Higher ratio midwives Home visiting |
|---|---|---|---|---|---|
| | | (both midwife and AHW) | | | |
| | High worker input into CD&HP expenditure | High worker input into CD&HP expenditure | Low worker input into CD&HP expenditure | Low worker input into CD&HP expenditure | Low/nil worker input into CD&HP expenditure |
| **Relationship with:** | | | | | |
| C&FH | Extremely effective | Extremely effective | Extremely effective | Extremely effective | Effective |
| ACCHS/AMS | Somewhat effective | Effective | Effective | Effective | Somewhat/not at all effective |
| Number of sites | 10 | 13 | 9 | 8 | 6 |

Some characteristics played a stronger role in defining a cluster; these are listed in Table 23 below.

**Table 23: Summary description of clusters**

| | **Cluster characteristics** |
|---|---|
| 1. | Higher ratio midwives and clinic-based service model<br>Number of sites: 10<br>Sites in this cluster most closely represent traditional maternity services. They are predominantly characterised as being Midwife-led with a higher ratio of Midwives and delivering a higher proportion of clinic-based services.<br>However, Aboriginal Health Workers and Midwives undertake tasks together at most sites and there is a high level of agreement that working conditions match program needs.[21]<br>Sites consider community consultation to be 'effective'. They report low levels of community engagement, community development and health promotion activities, but a high level of input from the Aboriginal Health Worker and Midwife into how funds for these activities are expended.<br>Working relationships with local Aboriginal Community Controlled Health Service/Aboriginal Medical Services are considered 'somewhat effective' but are reported as 'extremely effective' with local child and family health services. |
| 2. | Aboriginal Health Worker-led and home visiting service model<br>Number of sites: 13<br>Cluster 2 sites are predominantly characterised as having a higher ratio of Aboriginal Health Workers and, compared to other clusters, more tasks are led by the Aboriginal Health Worker. However, strong collaboration between Aboriginal Health Workers and Midwives is present across sites in this cluster. Sites report delivering predominantly 'home visit' type services and there is a high level of agreement that working conditions match program needs. Community consultation is considered to be 'somewhat effective'. Sites report a low level of time spent in community engagement, community development and health promotion activities yet a high level of input by the Aboriginal Health Worker and Midwife is reported into how funds for these activities are expended. Sites are also characterised by 'effective' working relationships with Aboriginal Community Controlled Health Service / Aboriginal Medical Services and 'extremely effective' working relationships with local child and family health services. |
| 3. | AMIHS-type service model<br>Number of sites: 9<br>Sites in Cluster 3 are characterised as being most strongly aligned with the documented AMIHS Service Delivery Model. |

---

[21] Responses in relation to working conditions address the following key question in relation to the documented AMIHS model: "Do the AMIHS program working conditions for the Aboriginal Health Worker and Midwife match the program needs, for example allowance for out of normal hours work, support to do home visits, flexible hours policy?"

| | Cluster characteristics |
|---|---|
| | In general, service delivery is by 'home visits', there is a one-to-one ratio of Aboriginal Health Workers to Midwives, and tasks are undertaken jointly by the Aboriginal Health Worker and Midwife. <br> Consultation with the community is considered to be 'extremely effective'. There is a high proportion of community engagement, community development and health promotion activities, which are predominantly led by the Aboriginal Health Worker. But a low level of input from the Aboriginal Health Worker and Midwife into how health promotion and community development funds are expended. <br> Sites consider working relationships to be 'effective' with Aboriginal Community Controlled Health Services / Aboriginal Medical Services and 'extremely effective' with local child and family health services. |
| 4. | Higher ratio of Aboriginal Health Workers and outreach service model <br> Number of sites: 8 <br> Cluster 4 sites are characterised by outreach service delivery and a higher ratio Aboriginal Health Workers. There is generally an equal relationship between the Aboriginal Health Worker and Midwife with most tasks undertaken together or equally likely to be led by either worker. <br> Community consultation is considered to be 'somewhat effective'. There is a high proportion of community engagement, community development and health promotion activities, which are predominantly led by the Midwife. But a low level of input from the Aboriginal Health Worker and Midwife into how health promotion and community development funds are expended. <br> Sites consider working relationships to be 'effective' with local Aboriginal Community Controlled Health Service/Aboriginal Medical Services and 'extremely effective' with local child and family health services. |
| 5. | Higher ratio midwives and home-visiting service model <br> Number of sites: 6 <br> Sites in this cluster are characterised as being least aligned with the documented AMIHS service delivery model. <br> Sites are generally Midwife-led with a higher ratio of Midwives, but Aboriginal Health Workers and Midwives undertake tasks together at most sites. <br> Sites are characterised by 'home visiting' type service delivery, however, there is very low agreement that working conditions match the program needs. <br> Sites in this cluster report no time spent in community engagement, community development or worker input into funds for these activities are expended. <br> Working relationships with local child and family health services were considered 'effective' for this cluster. <br> Half of the sites reported that there was no Aboriginal Community Controlled Health Service and/or Aboriginal Medical Service in their catchment area, while the other half, reported an 'effective' to 'extremely effective' relationship. |