RESTACKING THE ODDS

TECHNICAL REPORT

Antenatal care: An evidence based review of indicators to assess quality, quantity, and participation.
Version 2.0

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List of Abbreviations

ANC	Antenatal Care
AUS	Australia
BCPHP	British Columbia Perinatal Health Program
BMI	Body Mass index
CPG	Clinical Practice Guideline
FV	Family Violence
M2	Module 2
NHMRC	National Health and Medical Research Council
NICE	National Institute for Health and Care Excellence
PW	Pregnant Women
QI	Quality Indicator
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation

EXECUTIVE SUMMARY

Restacking the Odds: Project Background

Too many children are born into circumstances that do not provide them with a reasonable opportunity to make a good start in life. Disadvantaged circumstances for children lead to developmental inequities in physical health, social-emotional wellbeing, and academic learning. These inequities emerge in early childhood and often continue into adulthood, contributing to unequal rates of low educational attainment, poor mental and physical health and low income. In some cases, this experience is part of a persistent cycle of intergenerational disadvantage. Inequities constitute a significant and ongoing social problem and – along with the substantial economic costs – have major implications for public policy.

Research has shown that to redress these developmental inequities, effort delivered during early childhood (from pregnancy to 8 years of age) has the greatest benefit. As a result, *Restacking the Odds* focuses on five key evidence based interventions/platforms in early childhood (*see Figure 1: Five Fundamental Strategies)*:

1. Antenatal care;

2. Sustained nurse home visiting;

3. Early childhood education and care;

4. Parenting programs; and

5. The early years of school.

These five strategies are only a subset of the possible interventions, but we have selected them carefully. They are notably *longitudinal* (across early childhood), *ecological* (targeting child and parent), *evidence-based, already available* in almost all communities, and able to be *targeted* to benefit the 'bottom 25 per cent'. Our premise is that by 'stacking' these fundamental interventions (i.e., ensuring they are all applied for a given individual) there will be a cumulative effect - amplifying the impact and sustaining the benefit.

For each of the five strategies, the intent is to use a combination of data-driven, evidence based and expert-informed approaches to develop measurable, best practice indicators of quality, participation (reach), and quantity (access).

Quality: Are the strategies *delivered effectively*, relative to evidence based performance standards? A strategy with "quality" is one for which there is robust evidence showing it delivers the desired outcomes. A large number of research studies have explored aspects of this question (i.e., "what works?"). Therefore, we pay particular attention to the quality dimension in this report.

Participation: Do the *appropriately targeted* children and families *participate* at the right dosage levels? "Participation" shows us what portion of the relevant groups are exposed to the strategy at the level required to generate the desired benefit. (For example, attending the required number of antenatal visits during pregnancy). Participation levels can be calculated whether the strategy is universal (for everyone), or targeted (intended to benefit a certain part of the population).

Quantity: Are the strategies *available locally* in sufficient quantity for the target population? "Quantity" helps us determine the quantum of effort and infrastructure needed to deliver the strategy adequately for a given population.

In this project, indicators of quality, participation and quantity are used to help identify gaps and priorities in Australian communities. This will include testing preliminary indicators in 10 communities over the next 3 years to determine which are pragmatic to collect, resonate with communities, and provide robust measures to stimulate community and government action.

The findings summarised in this report on the first strategic area - Antenatal Care - will provide essential inputs to guide subsequent work for the *Restacking the Odds* project. There is a similar report for each of the five strategies.

FIVE FUNDAMENTAL STRATEGIES

Antenatal	Early childhood		School years
	Birth to 2 years	2-5 years	

1 Antenatal care
- Targeted at parents
- Centre-based
- *Outcomes:* healthy birth weight, good brain health, appropriate care, "adequate parenting"

3 Early childhood education and care
- Targeted at all children (in groups)
- High quality for all children
- Delivered out of home in a "pseudo-home-learning environment"
- *Outcomes:* children on optimal developmental pathway (cognitive and social-emotional), school readiness

5 Early years of school
- Targeted at all children
- School-based
- *Outcomes:* children on optimal learning pathway by Year 3

2 Sustained nurse home visiting
- Targeted at disadvantaged parents
- Health and development support
- Home-based
- *Outcomes:* parents develop parenting skills

4 Parenting programs
- Targeted at parents whose children have behavioural issues (higher prevalence in disadvantaged families)
- Centre-based, delivered in groups or 1:1
- *Outcomes:* remedy of specific emerging behavioural issues

Figure 1: Five fundamental strategies

Introduction: Antenatal Care

Antenatal care is the universal health platform designed to optimise maternal health and fetal development during pregnancy, and minimise adverse outcomes for all women and their infants [1]. Adverse outcomes of pregnancy are sometimes unpredictable events, but are known to be associated with numerous risk factors such as obesity, smoking, diabetes, hypertension, substance misuse, and/or domestic violence. Antenatal risk factors (and associated adverse outcomes) can have short and long-term effects for the unborn child; and there is a well-documented association between antenatal risk factors and adverse trajectories of child learning and development. For example, obesity, stress and depression, alcohol misuse, and low socioeconomic status are each associated with poor fetal outcomes such as low birth weight and preterm birth [2-5]; outcomes which in turn are associated with poorer physical, cognitive, and adaptive outcomes [6]. The quality, reach, and quantity of antenatal

care in Australian communities is therefore an essential starting point from which to begin addressing developmental inequities.

Aim

This targeted review of the evidence base for antenatal care addressed questions in four key areas:

1. *Quality – of the universal provision of antenatal care.* What *clinical best practices* in antenatal care are significantly related to better birth outcomes and improved child developmental outcomes? What *process indicators* can be used to measure and define these best practices?

2. *Quality – of the targeted provision of antenatal care*. Should some populations of women have targeted provision of antenatal care? Do the best practices and indicators differ for targeted (versus universal) provision?

3. *Participation.* What are the best evidence based indicators of the required participation in antenatal care?

4. *Quantity.* Given universal provision, in what quantity should antenatal care be available for a given population?

Method

This project targeted existing robust Australian data, evidence and frameworks already in place and accepted by the field; then compared and contrasted these with similar information in the international arena. The Australian information was based upon existing National Clinical Practice Guidelines for antenatal care, which are underpinned by rigorous research and/or systematic reviews of the available evidence. The following steps were undertaken:

1. A list of topics, actions and recommendations were developed for antenatal *clinical practice,* drawn from Australia's National Health and Medical Research Council (NHMRC) Clinical Practice Guidelines for both universal and high-risk antenatal care. These items were mapped against the guidelines from other regions and countries with generally similar health systems and demographics, identifying which were present or absent in each to produce a comprehensive list of practices identified as clinically important.

2. Existing *quality indicators* from each region were then identified. The United Kingdom (UK) National Institute for Health and Care Excellence (NICE) Quality Standards and Statements provided the most substantial list of indicators and the best linkage to the research literature. The quality indicators from Australia and the other comparable geographic regions and countries were mapped against the NICE indicators, to identify where efforts already exist to capture relevant data on quality.

3. A structured list of *clinical practices* and an associated set of *quality indicators* were then produced, for both universal use and use with high-risk populations (i.e., those with mental health issues, hypertension or diabetes). These were drawn largely from the NICE Quality Standards and Statements.

4. A separate literature search was conducted to examine the research related to thresholds for antenatal care related to *quantity* (that is, the volume of antenatal care provision required in a given community). The research in this area is limited and we have based our indicators on calculations recommended by the World Health Organisation (WHO).

Findings

ANC Quality indicators

Table 1 below provides the distilled list of core indicators of the quality of universal care across five themes; provision of care, attendance, screening and assessments, education and awareness, and fetal monitoring.

Table 1: Antenatal Care Key Quality Indicators: Universal Care

ANTENATAL CARE			
Mother			Fetus
Provision of care	Screening & Assessments	Education & Awareness	Monitoring Fetal Growth & Wellbeing
Universal care: Core Indicators			
QI 1 % of PW with continuity of care from a named midwife	**QI 2** % of PW who have a complete record of the minimum set of routine test results available	**QI 14** % of PW with a BMI 30 kg/m2 or > who are referred for personalised advice from a trained person on healthy eating and physical activity	**QI 16** % of PW who received genetic screenings before 13 weeks 6 days and have results available and acknowledged
	QI 3 % of PW who have their blood pressure recorded at all routine appointments	**QI 15** % of PW who smoke who are referred to an evidence-based stop smoking service	**QI 17** % PW who complete an ultrasound between 18 weeks 0 days and 20 weeks 6 days and have their results available and acknowledged
	QI 4 % of PW whose BMI is calculated and recorded		**QI 18** % PW with confirmed breech presentation after 37 weeks 0 days gestation who are offered and eligible for external cephalic version
	QI 5 % of PW whose smoking status is recorded		**QI 19** % PW attending a 40 week appointment who are offered a vaginal examination for membrane sweeping
	QI 6 % PW whose alcohol use is recorded		**QI 20** % PW attending a 41 week appointment who are offered a vaginal examination for membrane sweeping
	QI 7 % PW whose risk for family violence is recorded		**QI 21** % of PW provided with verbal and written information regarding normal fetal movements during the antenatal period.
	QI 8 % PW whose mental health history is recorded		
	QI 9 % PW with a mental health screen		
	QI 10 % PW who have their risk factor for pre-eclampsia recorded at their booking appointment		
	QI 11 % who have a recorded measure of symphysis fundal height at all routine appointments after 24 weeks 0 days gestation		
	QI 12 % PW who complete testing for gestational diabetes at 24 weeks 0 days to 28 weeks 6 days and have their test results available and acknowledged		
	QI 13 % PW who have a recorded fetal presentation at 30 weeks gestation		

Abbreviations: QL, quality indicator; PW, pregnant women; ANC, antenatal care; BMI, body mass index

In order to determine the quality indicators of antenatal care for high-risk mothers, 21 different quality metrics were identified (these were for high-risk patients with mental health issues, hypertension or diabetes – *see Table 2*). These health conditions were selected from the NICE guidelines because there were specific indicators related to these conditions and each of these conditions requires tailored metrics.

Table 2: Antenatal Care Key Quality Indicators: Triage for High-risk mothers

ANTENATAL CARE		
Indicators for high risk pregnancies		
Hypertension	Mental Health	Diabetes
HT 1 % PW identified at risk of pre-eclampsia who are advised to take low-dose aspirin daily	**MH 1** % PW identified at risk of mental health issues who have a documented mental health plan	**DM 1** % of PW identified at risk of gestational diabetes at the booking appointment who receive testing for gestational diabetes and have their test results available and acknowledged
HT 2 % PW with diagnosed hypertension who receive escalation of care	**MH 2** % PW referred to a mental health professional who are followed up by an antenatal care provider	**DM 2** % PW with pre-existing diabetes who are seen by members of the diabetes team within 1 week of their triage
HT 3 % PW diagnosed with pre-eclampsia have attended obstetrician appointment/s		**DM 3** % PW with pre-existing diabetes who have their HbA1c results available and acknowledged
		DM 4 % PW with pre-existing diabetes whose retinal assessment status is checked
		DM 5 % PW diagnosed with gestational diabetes who are seen by members of the diabetes team within 1 week of diagnosis
		DM 6 % PW with diabetes who are asked about their blood glucose meter results and are provided with feedback

Abbreviations: HT, hypertension indicator; MH, mental health indicator; DM, diabetes indicator; PW, pregnant women; ANC, antenatal care

ANC Participation indicators
The research revealed two indicators of participation for universal care and two indicators of participation for disadvantaged populations – *see Table 3*.

ANC Quantity indicators
The quantity measures of antenatal care are in two categories; Health infrastructure and Health Workforce – *see Table 3*.

Table 3: Antenatal Care Quantity and Participation Indicators

ANTENATAL CARE		
Quantity		Participation
Health Infrastructure	Health Workforce	Attendance
QN 1 Number of antenatal care facilities per 10 000 women of child-bearing age	**QN 3** Number of practicing general practitioners per 10 000 women of child-bearing age	**P 1a** % of PW who attend a booking appointment within the first trimester
QN 2 Number of maternity beds per 1 000 pregnant women	**QN 4** Number of registered midwives working in the antenatal care facilities per 10 000 women of child bearing potential	**P 1b** % of vulnerable PW who attend a booking appointment within the first trimester
	QN 5 Number of OB/GYNs working in the antenatal care facility per 10 000 women of child bearing potential	**P 2a** % of PW who attend at least the recommended number of antenatal appointments – 10 for 1st pregnancy, 7 for subsequent pregnancies
		P 2b % of vulnerable PW who attend at least the recommended number of antenatal care appointments – 10 for 1st pregnancy, 7 for subsequent pregnancies.

Maternal bed density: calculated using the assumption that (a) there should be sufficient beds or all pregnant women (b) an occupancy rate of 80% (to account for the uneven spread of demand over time), and (c) a mean duration of stay of 3 days: the target should be (1000/0.80)x(3/365) = 10 per 1,000 pregnant women. The indicator is scored as n/10 x 100% (maximum 100), where n is the number of maternity beds per 1,000 pregnant women.

An estimation for the number of pregnant women in the population can be derived from the CBR (crude birth rate) for the region of interest and the following equations:

A = estimated number of live births = (CBR per 1000 x total population)

B = estimated live births expected per month = (A / 12)

C = estimated number of pregnancies ending in stillbirths or miscarriages = (A x 0.15)

D = estimated pregnancies expected in a year = (A + C)

E = estimated number of women pregnant in a given month = (0.70 x D)

F = estimated % of total population who are pregnant at a given period = (E/ total population x 100).

Abbreviations: QN, quantity indicator, participation indictor; PW pregnant women; OB obstetrician; GYN, Gynaecologist

CONCLUSIONS

For the strategic area of Antenatal Care, a best-practice benchmark framework across the domains of quality, participation, and quantity was established. This framework was based on the available evidence and is summarised as follows:

- **Quality:** The framework developed will provide a way to measure whether antenatal care is being delivered in accordance with the evidence based standards for quality. It includes 20 universal quality indicators and 21 high-risk quality indicators, which were drawn largely from the UK's NICE Antenatal Quality Statements and Standards.

- **Participation:** The literature revealed that regular antenatal care is associated with better maternal health during pregnancy, fewer interventions in late pregnancy, and positive child health outcomes. The evidence suggests that all women should be seen at least once in the first trimester, and at least 10 times altogether for the first pregnancy (at least 7 times for subsequent pregnancies) [7]. Based on this information, two universal participation indicators and two indicators specific to vulnerable/disadvantaged populations were included in the framework.

- **Quantity:** A determination of the required quantity of ANC services in a given community is a function of the size of the population, the portion of the population participating, and the effort required to provide the right standard of care. The peer-reviewed and grey literature provided little information on 'quantity'. However, the WHO report *Service Availability and Readiness Assessment*, which focussed mainly on low and middle income countries, highlighted the importance of two dimensions of quality: *Health infrastructure* and *Health Workforce*. Based upon this information from the WHO, two indicators related to health infrastructure and three indicators related to health workforce were included in the framework – resulting in five indicators related to quantity.

One of the major strengths of the approach used was that it was pragmatic, focussed on existing frameworks and recommended metrics that are linked to evidence. However, as there was no systematic evaluation of all the antenatal factors that might influence infant/child outcomes; it is not possible to draw any conclusions about the relative merit of each individual indicator. Notably, both documents (NICE and Australian Clinical Practice Guidelines) from which this framework is primarily drawn are based on a substantial evaluation of the literature and are considered high quality, evidence based guidelines.

Implications

Even though the research indicates that all core and high-risk indicators are important, Australian perinatal health authorities collect data on only a small subset of these indicators. Only three of the 20 universal process indicators, and none of the 21 indicators for high-risk groups, are collected routinely at a national population level (there are several other variables collected as part of the Perinatal Minimum National Dataset but are not tracked as indicators, some states and territories also routinely collect more than the national minimum dataset). The three indicators routinely collected nationally are:

1a.   Smoking in the first 20 weeks of pregnancy for all women giving birth,

1b.   Smoking after the first 20 weeks of pregnancy for all women who gave birth and reported smoking during pregnancy, and

2.   Antenatal care in the first trimester for all women giving birth.

This raises important questions, which will be explored in ongoing work as part of this project. Over the next three years, the preliminary indicators in 10 communities will be tested to determine:

- Is a subset of the indicators sufficient to form a reliable view on the performance of the other metrics?
- Is it viable to collect this broad set of ANC metrics? What would that require?

BACKGROUND: RESTACKING THE ODDS

Too many children are born into circumstances that do not provide them with a reasonable opportunity to make a good start in life. Disadvantaged circumstances for children lead to developmental inequities in physical health, social-emotional wellbeing, and academic learning – that is, differential outcomes that are preventable.

Inequities emerging in early childhood often continue into adulthood, contributing to unequal rates of low educational attainment, poor mental and physical health and low income. In some cases, this experience is part of a persistent cycle of intergenerational disadvantage. Inequities constitute a significant and ongoing social problem and – along with the substantial economic costs – have major implications for public policy.

The importance of early childhood and the impact of this period on long-term developmental outcomes has been well documented. Research has demonstrated that this period is crucial for brain development across all domains, and that both risk and protective factors encountered by the child during this time can have life-long impacts [8]. In particular, exposure to multiple risk factors predicts more severe, adverse developmental consequences compared with a singular risk factor (e.g. [9, 10]). Furthermore, research has shown that developmental interventions that isolate only one risk factor are less likely to work than those that are multi-faceted (e.g. [11-13]). The premise behind this approach to intervention is that resources/assets accumulate and the benefits of multiple assets accrue, leading to more positive outcomes. In line with this premise and research on cumulative risk, it is the hypothesis of Restacking the Odds that inequities can be reduced by using existing, evidence based interventions and approaches from service providers of the following five strategies: antenatal care; sustained nurse home visiting; early childhood education and care; parenting programs; and the first 3 years of school. These strategies are notably longitudinal (across early childhood), ecological (targeting child and parent), evidence based, and able to be targeted (aimed at benefiting the 'bottom 25 per cent', namely the most disadvantaged). By 'stacking' these fundamental interventions (i.e., ensuring they are all applied) it is predicted that there will be a cumulative effect, amplifying the effect and resulting in sustained benefits.

In order to achieve this, the *Restacking the Odds* project seeks to use the existing evidence within the 5 fundamental strategies of early childhood, to develop best practice benchmark frameworks that better define indicators of quality, reach (participation), and access (quantity).

This report focuses on the strategy of *Antenatal Care*. There is a similar report for each of the five strategies.

INTRODUCTION: ANTENATAL CARE

Antenatal care is defined as the routine health treatment of pregnant women without symptoms [1]. The aim of antenatal care is to (a) diagnose diseases or complicating obstetric conditions, (b) provide information about lifestyle, pregnancy and delivery, and (c) to monitor and promote the wellbeing of the mother and fetus. The key elements of antenatal care include health care (i.e. clinical assessments, screening for infections and abnormalities) and health education (i.e. offering advice on social and lifestyle factors).

Adverse outcomes of pregnancy are sometimes unpredictable events, but are associated with numerous risk factors such as obesity, smoking, diabetes, hypertension, substance misuse, and/or domestic violence. Antenatal risk factors (and associated adverse outcomes) can have short and long-term effects for the unborn child; and there is also a well-documented association between antenatal risk factors and trajectories of child learning and development. For example, obesity, stress and depression, alcohol misuse and low socioeconomic status are associated with poor fetal outcomes such as low birth weight and preterm birth (e.g. [2-5]); outcomes which in turn are associated with poorer physical, cognitive, and adaptive outcomes (e.g. [6]). Therefore, antenatal care is a health platform that presents an opportunity for early intervention, to optimise maternal health during pregnancy, minimise adverse outcomes for fetal development and have a positive effect on childhood learning and developmental trajectories.

Measuring the quality, reach and quantity, of antenatal care in Australia is complex. There is limited Australian data (outcome or process) on indicators of the quality of antenatal care. Australia has comprehensive clinical practice guidelines (CPGs) for antenatal care, which are based on systematic reviews of the available evidence and graded according to the NHMRC *Levels of Evidence and Grades for Recommendations for Developers of Guidelines* (2009).However, there are no best practice benchmarks that can be used to evaluate or monitor the quality of antenatal care at a local level. At a national population level Australia collects outcome data on only 3 core maternal indicators (*National Core Maternity Indicators* [14] that relate to the antenatal period:

1a.   Smoking in the first 20 weeks of pregnancy for all women giving birth

1b.   Smoking after the first 20 weeks of pregnancy for all women who gave birth and reported smoking during pregnancy

2.   Antenatal care in the first trimester for all women giving birth.

Although the core maternal indicators give a reasonable, although limited, proxy of quality at a national performance level, these indicators do not provide insights into what factors differentiate good quality care between sites, centres, or regions. There is also no data that is easily accessible on how effective clinical processes are that relate to quality because indicators currently collected focus only on outcomes. Additionally, it is important to understand at what *quantity* antenatal care is sufficient, to ensure the best *quality* of care for all pregnant women. These are crucial steps in order to identify gaps in quality and access to care, to achieve the overarching goal of sustainably improving outcomes for disadvantaged children in Australia.

Aim

This targeted review of the evidence base for antenatal care sought to answer questions in four key areas:

1. *Quality – of the universal provision of antenatal care.* What *clinical best practices* in antenatal care are significantly related to better birth outcomes and improved child developmental outcomes? What *process indicators* can be used to measure and define these best practices?

2. *Quality – of the targeted provision of antenatal care*. Should some populations of women have targeted provision of antenatal care? Do the best practices and indicators differ for targeted (versus universal) provision?

3. *Participation.* What are the best evidence based indicators of the required participation in antenatal care?

4. *Quantity.* Given universal provision, in what quantity should antenatal care be available for a given population?

METHOD

Australia already has detailed National Clinical Practice Guidelines for antenatal care, which are underpinned by rigorous research and/or systematic reviews of the available evidence. As such, it was not necessary to carry out a complete evaluation of what antenatal factors are associated with maternal health and fetal development. Instead, a comparison of topics/actions/recommendations for antenatal practice between Australia and overseas was performed. This involved comparing the NHMRC approved Clinical Practice Guidelines with guidelines from other regions and countries with generally similar heath systems and demographics to Australia, identifying which were present or absent in each to produce a comprehensive list of practices identified as clinically important. In order to determine where efforts were already being made to monitor performance, there was also a search for existing quality indicators across the same regions.

The following two sections details the methodology which was used to isolate the key drivers of quality and participation in antenatal care. Quantity is discussed in point 3 below.

1. Clinical Practice Guidelines for Antenatal Care

Clinical practice guidelines are evidence based statements that include recommendations intended to optimise patient care and assist health care practitioners to make decisions about appropriate health care for specific clinical circumstances [7]. Clinical practice guidelines should assist clinicians and patients in shared decision making [7]. They provide a detailed account of the association between aspects of clinical care and other risk factors with adverse pregnancy outcomes.

Search Strategy

The first step in search strategy was to identify existing guidelines on antenatal care in Australia which covered data related to the key drivers quality and participation. The search produced two comprehensive documents – *Clinical Practice Guidelines – Antenatal Care Module 1 and Module 2 [15, 16]*. These clinical practice guidelines were approved by the Chief Executive Officer of the NHMRC on 6 December 2011, under Section 14A of the *National Health and Medical Research Council Act 1992*. They were also approved by Australian Health Ministers' Advisory Council on 31 August 2012. The Guidelines were developed by an Expert Advisory Committee and recommendations were based on systematic reviews of the available evidence and graded according to the NHMRC *Levels of Evidence and Grades for Recommendations for Developers of Guidelines* (2009) [17]. The search also revealed a document from the Royal Australian and New Zealand College of Obstetricians and Gynaecologists entitled "*Standards of Maternity Care in Australia and New Zealand*", which is largely drawn from the evidence base of the NHMRC CPGs [18].

Equivalent antenatal care guidelines were then sought from regions/countries with reasonably similar health systems and demographics. The UK's National Institute for Health and Clinical Excellence *2008 Antenatal Care: Routine Care for the Healthy Pregnant Woman* (the NICE guidelines) were found to be especially comprehensive and the most scientifically robust document - based on the systematic evaluation of the evidence [19]. Although other identified guidelines did not provide the same level of detail or scientific rigor, there were several that were relevant for the purpose of identifying themes and/or activities that were generally regarded as "important" for antenatal care at state or national levels. These guidelines were:

United States. Institute for Clinical Systems Improvement – *Routine prenatal care (2012)* [20]
Canada. British Columbia Perinatal Health Program (BCPHP) – *Obstetric Guideline 19: Maternity Care Pathway (2010)* [21]
Europe. WHO Regional Office for Europe's Health Evidence Network (HEN) – *What is the effectiveness of antenatal care? (2005)* [1].

Data Extraction

Utilising each of the regions guidelines we mapped the topics, actions and recommendations from these documents against Australia's Clinical Practice Guidelines. The aim was to identify which items were present or absent in each to produce a comprehensive list of practices identified as clinically important. *See Appendix A.*

Data was also extracted from the Guidelines, related to the antenatal factors associated with maternal and child outcomes.

2. Quality Indicators for Antenatal Care

Search Strategy

Existing *quality indicators* from each region were then identified. The available research was used to distill a list of documents outlining or reporting on indicators used to monitor improvements in quality. These included:

- NICE: Quality Statements (UK)
- National Core Maternity Indicators (Australia) [14]
- New Zealand Maternity Clinical Indicators (NZ) [22]
- WHO - Improving measurement of the quality of maternal, newborn and child care in health facilities (Europe) [23]
- A framework for the development of maternal quality of care indicators (USA) [24]

The UK's NICE Quality Standards and Statements were the most substantive and are a rigorous evidence based framework used in the UK to assess and monitor the quality of antenatal care. Of note, the NICE Statements provide guidance to services in the UK about where efforts could be placed to capture relevant data and help identify performance gaps across domains (structure, process, and outcome). However, not all indicators are routinely collected nationally.

Data Extraction

Similar to the approach taken to determine clinical importance, the quality indicators from Australia and the other geographies listed above were mapped against the NICE indicators (present/absent). This was done to provide greater clarity around where efforts currently exist to capture relevant data and/or where the evidence base supports best practice. *See Appendix B.*

3. Quantity: Targeted Search Strategy

A separate search for quantity-related data was conducted, as the information related to this driver was not available in the sources discussed above.

Search Strategy

The following databases were used to identify relevant literature related to this topic: PubMed, MEDLINE, and Google Scholar.

Information was also sought from the grey literature (e.g. Departments of health, national guidelines related to child & family health, related frameworks for health etc.), including state and national websites from the following regions and organisations:

- Australia – Victoria, New South Wales
- United Kingdom
- United States
- Canada
- New Zealand
- World Health Organisation

Given the expected low yield, a broad search strategy was used in order to capture as many relevant papers as possible. The search terms included in the Title/s, Abstract/s, MeSH searches and Keywords lists were:

- *Antenatal care, ante-natal, ANC, prenatal care, pre-natal care, obstetric care*
- *Access, Accessibility, infrastructure, workforce, facilities, maternity beds, social determinants of health, equity, health equity*

4. Development of Draft Indicators

Drawing largely from the UK's NICE Quality Standards and Statements, a list of clinical practices and quality indicators was produced for both universal use and for use with high-risk populations (i.e. those with mental health, hypertension or diabetes). These lists formed the basis of the expert consultation process.

5. Expert Evaluation of Draft Indicators

The distilled list of indicators was vetted by two senior Australian ANC experts:

- *Professor Jeremy Oats MD.* Chair of the Victorian Consultative Council on Obstetric and Paediatric Mortality and Morbidity. Professorial Fellow, Melbourne School of Population and Global Health, University of Melbourne.
- *Professor Caroline Homer PhD.* Professor of Midwifery at the Centre for Midwifery, Child and Family Health. Associate Dean and International and Development Associate Head, WHO Collaborating Centre for Nursing, Midwifery and Health Development, Faculty of Health, University of Technology Sydney.
- *Professor David Ellwood DPhil.* Professor of Obstetrics and Gynaecology, Dean and Head of School of Medicine, Griffith University. Director of Maternal-Fetal medicine, Gold Coast Health. Co-Director of Centre of Research

These experts were asked to independently comment on the developed list of antenatal care quality, participation, and quantity indicators.

Clinical Practice Guidelines for Antenatal Care

Six sets of antenatal care clinical practice guidelines were found to be relevant and were examined:

- *Australia.* National Health and Medical Research Council (NHMRC) - *Clinical Practice Guidelines: Antenatal Care – Module 1 & 2 (2012).*
- *United Kingdom.* National Institute for Health and Care Excellence (NICE) – *Antenatal Care: routine care for the healthy pregnant woman (2008).*
- *United States.* Institute for Clinical systems Improvement – *Routine prenatal care (2012).*
- *Australia and NZ.* The Royal Australian and New Zealand College of Obstetricians and Gynaecologists: *Standards of Maternity Care in Australia and New Zealand (2016).*
- *Canada.* British Columbia Perinatal Health Program (BCPHP) – *Obstetric Guideline 19: Maternity Care Pathway (2010).*
- *Europe.* WHO Regional Office for Europe's Health Evidence Network (HEN) – *What is the effectiveness of antenatal care? (2005).*

Of these, the UK's NICE Guidelines and Australia's NHMRC Antenatal Care Clinical Practice Guidelines exhibited a distinctive level of scientific rigour and evidence.

Collectively, the full set of guidelines identified 69 different factors as being clinically relevant. There was a high degree of commonality across the lists, with 44 universal care factors and 4 high-risk pregnancy factors being common to almost all lists - *See Appendix A*.

Utilising the 69 factors, five main themes were identified:

- Provision of Care
- Screening and Assessment
- Education and Awareness
- Fetal Monitoring

Table 4 provides a brief summary of the evidence extracted from the Guidelines, related to the antenatal factors associated with maternal and child outcomes – grouped by theme.

Table 4: Summary of the evidence relating to best practice antenatal care, and maternal and child outcomes

Antenatal Event/Action/Behaviour	Brief Evidence Summary
THEME 1: PROVISION OF CARE	
Continuity of care	Women who experience continuity of care are less likely to: • experience clinic waiting times greater than 15 minutes, • be admitted to hospital antenatally, • fail to attend antenatal classes, • be unable to discuss worries in pregnancy, and • not feel well-prepared for labour. Midwife-led continuity of care may also be associated with: • less augmentation of labour, • less use of epidural analgesia, • fewer episiotomies, • fewer preterm births, and • reduced infant mortality. [25, 26]

Antenatal Event/Action/Behaviour	Brief Evidence Summary
THEME 2: SCREENING & ASSESSMENT	
Blood pressure	Risks associated with high blood pressure during pregnancy include: • placental abruption, • superimposed pre-eclampsia, • fetal loss, • preterm labour, • low birth weight, • perinatal death, and • gestational diabetes. [28-30]
Proteinuria	Maternal proteinuria has been strongly associated with preterm birth. Chronic kidney disease in pregnancy has been associated with: • pre-eclampsia, • preterm labour, • small for gestational age babies, and • perinatal death. [31, 32]
Hepatitis B	• Mother-to-child transmission occurs frequently either in the uterus, through placental leakage, or through exposure to blood or blood-contaminated fluids at or around the time of birth. • Research estimates that people who are chronic carriers of the HbsAg are 22 times more likely to die from hepatocellular carcinoma or cirrhosis than non-carriers. [33, 34]
HIV	• Globally, the vast majority of children with AIDS acquire infection through mother-to-child transmission during pregnancy, during birth, or through breastfeeding. • Mother-to-child transmission is high amongst children born to women diagnosed postnatally (50%) and women diagnosed antenatally who used no interventions. • There are significant associations between antiretroviral treatments and intrauterine growth restriction, congenital abnormalities, or preterm birth. • Short courses of certain antiretroviral medicines are effective and are not associated with any safety concerns in the short term. • Complete avoidance of breastfeeding is effective in preventing mother-to-child transmission of HIV. [35-38]
Rubella	Maternal rubella infection can result in: • spontaneous miscarriage, • fetal infection, • stillbirth, or • fetal growth restriction. [39]
Syphilis	• Maternal syphilis infection results in congenital infection in at least two-thirds of cases. • Congenital infection can occur at any stage of maternal disease, including during incubation, as early as 9–10 weeks of pregnancy, and at any subsequent time during pregnancy. • Congenital syphilis is a serious condition that, if not fatal at a young age, can cause permanent impairment, debilitation and disfigurement. • Pancreatitis and inflammation of the gastrointestinal tract are common in infected infants. [15, 40-43]

Antenatal Event/Action/Behaviour	Brief Evidence Summary
Body mass index (BMI)	Underweight — a low pre-pregnancy BMI is associated with an increased risk of: • Preterm birth, • small-for-gestational-age babies, • low birth weight baby among Aboriginal and Torres Strait Islander women. Overweight — a pre-pregnancy BMI ≥25kg/m^2 has been linked with: • stillbirth, • congenital abnormalities, • neural tube defects, • preterm birth, • low birth weight, • large-for-gestational-age babies, • gestational hypertension, • pre-eclampsia, • gestational diabetes, • postpartum haemorrhage, and • major maternal depressive disorders. Obesity — pre-pregnancy BMI ≥30kg/m^2 is also linked to: • an inability to initiate breastfeeding, • postpartum weight retention, and • an increased rate of caesarean birth. [15, 44-56]
Tobacco smoking	High-level evidence identified in the NICE guidelines indicates a significant association between smoking in pregnancy and adverse outcomes, including: • birth defects including cleft lip and palate; • effects on the pregnancy including perinatal mortality, placental abruption, preterm premature rupture of membranes, ectopic pregnancy, placenta praevia, preterm birth, and miscarriage; • effects on the baby, in particular reduced birth weight (with babies born to smokers being a consistent 175–200 g smaller than those born to similar non-smokers), small-for-gestational-age baby, stillbirth, fetal and infant mortality and sudden infant death syndrome; and • Long-term effects of low birth weight due to antenatal exposure to tobacco smoking suggest an increased risk of coronary heart disease, type 2 diabetes, and adiposity in adulthood (conflicting results) [57-67]
Alcohol consumption	• High-level and/or frequent intake of alcohol in pregnancy increases the risk of miscarriage, stillbirth and premature birth. • Exposure of the fetus to alcohol may result in a spectrum of adverse effects - referred to collectively as fetal alcohol spectrum disorders (FASD) – which can include facial abnormalities, impaired growth, abnormal function/structure of the central nervous system, developmental, behavioural and cognitive problems. • People with FASD experience lifelong problems including learning difficulties and disrupted education, increased rates of mental illness, drug and alcohol problems, and trouble with the law. [68-71]
Maternal depression & anxiety	• Depressive episodes can be a reaction to the pregnancy itself, to associated health issues, or to other major life stressors. Depressive episodes can also be a continuation or relapse of a pre-pregnancy condition, especially among women who stop taking medication on confirmation of pregnancy. • Anxiety may occur in response to fears about aspects of the pregnancy (e.g. parenting role, miscarriage, congenital disorders), or as a continuation of a pre-

Antenatal Event/Action/Behaviour	Brief Evidence Summary
	pregnancy condition and/or with depression. Higher levels of anxiety in pregnancy increase the risk of post-natal depression. [72-75]
Intimate Partner Violence	• Violence poses serious health risks to pregnant women (including breast and genital injury, miscarriage, antepartum haemorrhage and infection, blunt or penetrating abdominal trauma and death) and babies (including fetal fractures, low birth weight, injury, and a suppressed immune system). • Adolescent mothers exposed to violence are more likely to have a miscarriage, stillbirth, premature birth or termination of pregnancy than other young women. • Women exposed to violence during pregnancy are more likely to develop depression in the postnatal period [76-80]
THEME 3: EDUCATION AND AWARENESS	
Smoking cessation	• High-level evidence, based on systematic reviews and randomised controlled trials, shows that smoking cessation interventions reduce smoking rates in pregnant women. • Cessation interventions reduce smoking in late pregnancy and reduce the incidences of low birth weight and preterm births, while increasing birth weight. [81]
Nutrition-related pregnancy interventions	• There is some evidence that intensive antenatal dietary counselling and support is effective in increasing women's knowledge about healthy eating and can influence eating behaviours. [82-85]
THEME 4: FETAL MONITORING	
Fetal development and anatomy	Evidence relating to performing an ultrasound between 18–20 weeks: • sensitivity in detecting structural anomalies increases after 18 weeks gestation; • detection of structural anomalies before 20 weeks gestation, giving women the choice of terminating the pregnancy where this is permitted under jurisdictional legislation, and • A reduced number of inductions for 'prolonged pregnancy'. [86]
Fetal growth	• Intrauterine growth restriction has been associated with pregnancy-related hypertension, pre-existing diabetes, autoimmune disease, maternal heart disease, malnutrition, living at high altitudes, living in developing countries, low socioeconomic status, ethnicity, family or prior history of intrauterine growth restriction, extremes of maternal age, fetal genetic disease, fetal malformations, multiple gestation, placental anomalies, fetal infection and maternal malaria, and toxic exposure to smoking, alcohol or drugs. [87]
Screening for fetal chromosomal abnormalities	• The combined test (nuchal translucency thickness, free beta-human chorionic gonadotrophin, pregnancy-associated plasma protein-A) identifies factors that are known to be associated with fetal chromosomal abnormalities and that are independent of each other. Combining the assessment increases the predictive value and may lead to fewer losses of normal pregnancies. [88, 89]

*Research extracted from Australia's Clinical Practice Guidelines and NICE Guidelines.

Quality Indicators for Antenatal Care

In order to determine where efforts were already being made to monitor performance, there was a search for **existing** quality indicators across the same regions which were examined for their clinical practices. The following documents were identified as outlining or reporting on indicators used to monitor improvements in quality:

- NICE: Quality Statements (UK)
- National Core Maternity Indicators (Australia)
- New Zealand Maternity Clinical Indicators (NZ)
- WHO - Improving measurement of the quality of maternal, newborn and child care in health facilities (Europe)
- A framework for the development of maternal quality of care indicators (USA)

A comparison of the existing quality indicators revealed that Australia has only three outcome indicators collected nationally (*National Core Maternity Indicators* [14] that relate to the antenatal period:

1a.   Smoking in the first 20 weeks of pregnancy for all women giving birth

1b.   Smoking after the first 20 weeks of pregnancy for all women who gave birth and reported smoking during pregnancy

2.   Antenatal care in the first trimester for all women giving birth.

In contrast, there are 11 core and 18 high-risk NICE quality statements, which also contain a range of measures including structure, process, and outcome measures (note the terminology used in the UK differs, i.e. they use *measures* not *indicators*). There were 10 related indicators identified from the USA, two from the WHO, and one from New Zealand. There were 21 specific topics covered by the quality indicators, although two indicators from the WHO only made their short-listing process and were ultimately excluded from the final list of suggested indicators. The indicators of quality are considered below by theme:

Theme 1: Provision of Care
The UK was the only region stipulating an indicator for continuity of care (NICE Quality Statements).

Theme 2: Screening and Assessment
Most of the indicators/measures across the regions fell under the theme of screening and assessment. The UK's NICE Quality Statements had the most detail and covered more topics than any other regions/documents. Broad topics across regions included smoking, family violence, mental health, gestational diabetes, syphilis (short-listed but excluded), anaemia (short-listed but excluded), and hypertension. The relevant national indicator in Australia is smoking status before 20 weeks gestation (National Core Maternity Indicators)[14].

Theme 3: Education and Awareness
There were only two indicators that related to education and awareness - smoking and weight (BMI), and both were in the UK's NICE Quality Statements. Although Australia did not have an indicator specifically related to education and awareness, the following indicator is related to this concept –

"Smoking after the first 20 weeks of pregnancy for all women who gave birth and reported smoking during pregnancy". No other regions/documents included indicators related to this theme.

Theme 4: Fetal Monitoring
The UK's NICE Statements included eight related statements. One other region included an indicator related to fetal monitoring (USA).

High-risk Conditions and Diseases
The UK's NICE Statements included a number of indicators specifically related to high-risk groups. This included diabetes (nine related statements), hypertension (six related statements), and mental health (seven related statements). There were only three additional indicators from other regions related specifically to high-risk groups – two for hypertension (WHO and USA) and one for diabetes (USA).

Other Indicators
There were two indicators identified in "A framework for the development of maternal quality of care indicators" (USA) that were out of scope for this project. Both of these related to preterm births.

Key Performance Indicators: Framework Developed
The NICE Quality Statements were the most substantial and were especially suited to this project, because they included a detailed list of quality parameters - including quality statements, and structure, process and outcome measures (rather than focusing only on outcomes). The measures included indicators for routine (universal) care and for high-risk pregnancies (hypertension, diabetes, and mental health). For these reasons, the NICE measures were implemented into this framework to a large extent. Where possible the metrics of the framework were aligned with the Australia's *National Core Maternity Indicators* data - which included three quality indicators (however these are outcome based thus have been modified to represent clinical processes). There were an additional two indicators added to the list based on the Australian national policy environment (i.e. family violence and alcohol consumption).

1. Quality Indicators: Framework
Based on the themes identified through the Clinical Guidelines, 20 indicators were selected for the quality of universal care – *see Table 5*. An additional 21 indicators were included for high-risk patients, those with mental health issues, hypertension, or diabetes. These health conditions were selected from the NICE guidelines because there were specific indicators related to these conditions and each of these conditions requires tailored metrics – *see Table 6*.

Table 5: Antenatal Care Key Quality Indicators: Universal Care

ANTENATAL CARE			
Mother			Fetus
Provision of care	Screening & Assessments	Education & Awareness	Monitoring Fetal Growth & Wellbeing
Universal care: Core Indicators			
QI 1 % of PW with continuity of care from a named midwife	**QI 2** % of PW who have a complete record of the minimum set of routine test results available	**QI 14** % of PW with a BMI 30 kg/m2 or > who are referred for personalised advice from a trained person on healthy eating and physical activity	**QI 16** % of PW who received genetic screenings before 13 weeks 6 days and have results available and acknowledged
	QI 3 % of PW who have their blood pressure recorded at all routine appointments	**QI 15** % of PW who smoke who are referred to an evidence-based stop smoking service	**QI 17** % PW who complete an ultrasound between 18 weeks 0 days and 20 weeks 6 days and have their results available and acknowledged
	QI 4 % of PW whose BMI is calculated and recorded		**QI 18** % PW with confirmed breech presentation after 37 weeks 0 days gestation who are offered and eligible for external cephalic version
	QI 5 % of PW whose smoking status is recorded		**QI 19** % PW attending a 40 week appointment who are offered a vaginal examination for membrane sweeping
	QI 6 % PW whose alcohol use is recorded		**QI 20** % PW attending a 41 week appointment who are offered a vaginal examination for membrane sweeping
	QI 7 % PW whose risk for family violence is recorded		**QI 21** % of PW provided with verbal and written information regarding normal fetal movements during the antenatal period.
	QI 8 % PW whose mental health history is recorded		
	QI 9 % PW with a mental health screen		
	QI 10 % PW who have their risk factor for pre-eclampsia recorded at their booking appointment		
	QI 11 % who have a recorded measure of symphysis fundal height at all routine appointments after 24 weeks 0 days gestation		
	QI 12 % PW who complete testing for gestational diabetes at 24 weeks 0 days to 28 weeks 6 days and have their test results available and acknowledged		
	QI 13 % PW who have a recorded fetal presentation at 30 weeks gestation		

Abbreviations: QL, quality indicator; PW, pregnant women; ANC, antenatal care; BMI, body mass index

Table 5: Antenatal Care Key Quality Indicators: Triage for High-risk mothers

ANTENATAL CARE		
Indicators for high risk pregnancies		
Hypertension	Mental Health	Diabetes
HT 1 % PW identified at risk of pre-eclampsia who are advised to take low-dose aspirin daily	**MH 1** % PW identified at risk of mental health issues who have a documented mental health plan	**DM 1** % of PW identified at risk of gestational diabetes at the booking appointment who receive testing for gestational diabetes and have their test results available and acknowledged
HT 2 % PW with diagnosed hypertension who receive escalation of care	**MH 2** % PW referred to a mental health professional who are followed up by an antenatal care provider	**DM 2** % PW with pre-existing diabetes who are seen by members of the diabetes team within 1 week of their triage
HT 3 % PW diagnosed with pre-eclampsia have attended obstetrician appointment/s		**DM 3** % PW with pre-existing diabetes who have their HbA1c results available and acknowledged
		DM 4 % PW with pre-existing diabetes whose retinal assessment status is checked
		DM 5 % PW diagnosed with gestational diabetes who are seen by members of the diabetes team within 1 week of diagnosis
		DM 6 % PW with diabetes who are asked about their blood glucose meter results and are provided with feedback

Abbreviations: HT, hypertension indicator; MH, mental health indicator; DM diabetes indicator; PW pregnant women; ANC antenatal care

2: Participation Indicators: Framework

The framework for the participation indicators was developed based on recommendations from the Australian CPGs; recommendations which were also covered by the national quality indicators of most regions/countries. The recommendations revealed two indicators of participation for universal care and two indicators of participation for disadvantaged populations – *see Table 7*.

Table 7: Antenatal Care Quantity and Participation Indicators

ANTENATAL CARE		
Quantity		Participation
Health Infrastructure	Health Workforce	Attendance
QN 1 Number of antenatal care facilities per 10 000 women of child-bearing age	**QN 3** Number of practicing general practitioners per 10 000 women of child-bearing age	**P 1a** % of PW who attend a booking appointment within the first trimester
QN 2 Number of maternity beds per 1 000 pregnant women	**QN 4** Number of registered midwives working in the antenatal care facilities per 10 000 women of child bearing potential	**P 1b** % of vulnerable PW who attend a booking appointment within the first trimester
	QN 5 Number of OB/GYNs working in the antenatal care facility per 10 000 women of child bearing potential	**P 2a** % of PW who attend at least the recommended number of antenatal appointments – 10 for 1st pregnancy, 7 for subsequent pregnancies
		P 2b % of vulnerable PW who attend at least the recommended number of antenatal care appointments – 10 for 1st pregnancy, 7 for subsequent pregnancies.

Maternal bed density: calculated using the assumption that (a) there should be sufficient beds or all pregnant women (b) an occupancy rate of 80% (to account for the eneven spread of demand over time), and (c) a mean duration of stay of 3 days: the target should be (1000/0.80)x(3/365) = 10 per 1,000 pregnant women. The indicator is scored as n/10 x 100% (maximum 100), where n is the number of maternity beds per 1,000 pregnant women.

An estimation for the number of pregnant women in the population can be derived from the CBR (crude birth rate) for the region of interest and the following equations:

A = estimated number of live births = (CBR per 1000 x total population)

B = estimated live births expected per month = (A / 12)

C = estimated number of pregnancies ending in stillbirths or miscarriages = (A x 0.15)

D = estimated pregnancies expected in a year = (A + C)

E = estimated number of women pregnant in a given month = (0.70 x D)

F = estimated % of total population who are pregnant at a given period = (E/ total population x 100).

Abbreviations: QN, quantity indicator, participation indictor; PW pregnant women; OB obstetrician; GYN, Gynaecologist

3: Quantity Indicators: Framework

The determination of the required quantity of ANC services in a given community is a function of the size of the population, the portion of the population participating, and the effort required to provide the right standard of care. So this is largely a practical consideration, and it is not surprising that the evidence reviewed (both peer reviewed and grey literature) provided little information about 'quantity'.

Only one relevant paper from the literature search was located, which related to the quantity of antenatal care. This was a World Health Organisation reference manual entitled "Service Availability and Readiness Assessment (SARA): An annual monitoring system for service delivery." The manual set out a systematic way to assess health facility service delivery including service availability, such as the availability of key human and infrastructure resources. It also focussed on service readiness such as overall capacity of health facilities to provide general health services (e.g. basic amenities, diagnostic capacity, and essential medicines), which are factors more relevant to developing countries and outside the scope of this review.

Based upon the recommendations from the WHO, two indicators related to health infrastructure and three indicators related to health workforce were included – *see Table 7.*

Expert consultation

The professors consulted for the project agreed that the approach and list of indicators were appropriate. They endorsed both the core and high-risk indicators, with some minor alterations. For example, in regards to fetal monitoring they directed the project team to the *Clinical Practice Guideline for the Care of Women with Decreased Fetal Movements* from the Perinatal Society of Australia & New Zealand (PSANZ) and the most relevant recommendation to universal care was therefore used [90]. They also suggested that the list of high-risk indicators could be reduced based on difficulties accessing data, and in fact several of the universal indicators might also be difficult to collect, however at this early stage the full list of indicators have been retained.

CONCLUSIONS

Summary

A best practice benchmark framework across the domains of quality, participation, and quantity was established based on the available evidence, and is summarised as follows:

Quality

The framework developed will provide a way to measure whether antenatal care is being delivered in accordance with the evidence based standards for quality. In the framework, there are 20 universal quality indicators and 21 high-risk quality indicators, which were drawn largely from the UK's NICE Antenatal Quality Statements and Standards (and related process metrics/indicators), as these were the most substantial and had the best linkage to the research literature. The full set of quality indicators was maintained following consultation with expert advisors.

Participation

The literature supports the importance of antenatal care for all pregnant women. More specifically, there is evidence that regular antenatal care is associated with better maternal health during pregnancy, fewer interventions in late pregnancy, and positive child health outcomes [7]. The evidence suggests that all women should be seen at least once in the first trimester, and at least 10 times altogether for the first pregnancy (at least 7 times for subsequent pregnancies) [7]. Based on this evidence, two universal participation indicators and two specific to vulnerable/disadvantaged populations were included in the framework.

Quantity

The determination of the required quantity of ANC services in a given community is a function of the size of the population, the portion of the population participating, and the effort required to provide the right standard of care. So this is largely a practical consideration, and it is not surprising that the evidence reviewed (both peer reviewed and grey literature) had little information about 'quantity'. The WHO report *Service Availability and Readiness Assessment*, which focuses mainly on low and middle income countries, highlighted the importance of two dimensions: *Health infrastructure* and *Health Workforce*. The framework includes five indicators related to quantity.

Strengths of approach

One of the major strengths of the approach used was that it was pragmatic, fitting within already established systems and processes. To this end, there were no attempts to reinvent new methods and metrics, but rather, there was a focus on existing frameworks and recommended metrics based on systems linked to evidence (i.e. UK NICE Statements and Australia's Antenatal Clinical Practice Guidelines).

Limitations of approach

In some ways, the strength of the approach utilised was also a limitation. There were no attempts to do a systematic evaluation of all the antenatal factors that might influence infant/child outcomes. Thus, it is not possible to draw any conclusions about the relative merit of each individual indicator. However, as mentioned, both documents from which this framework is drawn are based on a substantial

evaluation of the literature. Both the NICE and Australian Clinical Practice Guidelines are considered high quality, evidence based guidelines.

Implications

Even though the research indicates that all core and high-risk indicators are important, Australian perinatal health authorities collect data on only a small subset of these indicators. Only three of the 20 universal process indicators, and none of the 21 indicators for high-risk groups, are collected routinely at a national population level (there are several other variables collected as part of the Perinatal Minimum National Dataset but are not tracked as indicators, some states and territories also routinely collect more than the national minimum dataset). The three indicators routinely collected nationally are:

1a. Smoking in the first 20 weeks of pregnancy for all women giving birth

1b. Smoking after the first 20 weeks of pregnancy for all women who gave birth and reported smoking during pregnancy

2. Antenatal care in the first trimester for all women giving birth.

    This raises important questions, which will be explored in ongoing work as part of this project. Over the next three years, these preliminary indicators in 10 communities will be tested to determine:

    • Is a subset of the metrics sufficient to form a reliable view on the performance of the other metrics?

    • Is it viable to collect this broad set of ANC metrics? What would that require?

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Appendix A: Topics/Actions/Recommendations Covered in Each Region's Clinical Practice Guidelines

Key:

(green)	associated recommendation
(pink)	specific recommendation NOT to do
(white)	no specific recommendation mentioned
(orange)	"new" recommendation added in 2017

	NHMRC Antenatal Care Clinical Practice Guidelines (AUS)		NICE Guidelines: Recommendations (UK)		Routine prenatal care. Bloomington: Institute for Clinical Systems Improvement (ICSI) (USA)		The Royal Australian and New Zealand College of Obstetricians and Gynaecologists: Standards of Maternity Care in Australia and New Zealand		CANADA - British Columbia Perinatal Health Program (BCPHP) Obstetric Guideline 19: Maternity Care Pathway		Health Evidence Network (HEN) evidence report on antenatal care - WHO Regional Office for Europe's Health Evidence Network (HEN) December 2005	
	Universal	High Risk	Universal	High Risk	Universal	High Risk	Universal	High Risk	Universal	High Risk	Universal	High Risk
Antenatal visit in the 1st trimester	G		G		G		G		G		G	
Continuity of care	G		G		G		G					
Clinical assessments:												
Gestational age estimate - ultrasound	G		G		G		G		G		G	
Weight and Body Mass Index (BMI)	G		G		G		G		G			
Blood pressure	G		G		G		G		G		G	
Proteinuria	G		G		G		G		G		G	
Ask about psychosocial factors affecting mental health	G		G		G							
Depression &/or anxiety	G		G		G				G			
Domestic violence/family violence	G		G		G							
Nausea and vomiting	G		G		G				G			
Constipation	G		G		G				G			
Fetal development and anatomy	G		G		G		G		G			
Fetal growth and wellbeing	G		G		G		G		G			
Risk of pre-eclampsia	G		G		G				G		G	
Treatment of pre-eclampsia or eclampsia with magnesium sulphate												
Risk of preterm birth - discuss	G		G		G				G		G	
Risk of preterm birth - screening	G		G		G				G		G	

Maternal health screening:

HIV	green		green		green		green		green		green
Hepatitis B	green		green		green		green		green		green
Hepatitis C	orange	green	pink								green
Rubella	green		green		green		green		green		green
Chlamydia	pink	green	pink	green		green		green		green	pink
Syphilis	green		green		green		green		green		green
Asymtomatic bacteriuria	green		green				green				green
Asymptomatic bacterial vaginosis	pink	green	pink						pink		
Vitamin D deficiency - discuss	green		green		green		green		green		
Vitamin D deficiency - screening	pink	green	pink		green		green		green		
Anaemia - testing	green		green				green		green		
Anaemia - iron supplementation for iron deficiency	pink	green	pink								
Gestational diabetes - screening (risk factors)	green		green		green		green		green		
Haemoglobin disorders	green		green		green		green		green		
Gonorrhoea	pink				green				green	green	
Trichomoniasis	pink										
Group B Streptococcus	green		pink		green		green				
Toxoplasmosis	pink		pink		pink		pink		pink		
Cytomegalovirus	pink		pink			green	pink				
Cervical abnormalities	green						green		green		
Thyroid dysfunction	pink							green	green		
Cervical cancer screening					green						
Blood lead screening					green						
Varicella					green			green			

Screening for fetal chromosomal abnormalities

Discussing screening tests	green		green		green		green		green		green
Screening tests in the 1st trimester	green		green		green		green		green		

Lifestyle considerations

Tobacco smoking - assess	green		green		green		green				
Tobacco smoking - referral		green		green	green				green		cessation
Alcohol	green		green		green		green				cessation

Substance use	orange		green		green		
Medicines - limit prescriptions, Therapeutic Goods Administration (TGA) Category A medicines that have been established to be safe in pregnancy	green	green	green	green	green		
Folic acid supplementation	green	green	green	green	green		green
Vitamins A, C, E supplementation	pink	pink	pink		pink		
Iron supplementation	pink	pink	pink				
Oral health	green	green			green		
Nutrition	green	green	green	green	green		
Physical activity	green	green	green	green	green		
Sexual activity	green	green	green	green	green		
Travel	green	green	green	green	green		
Optimising antenatal care							
Antenatal care for migrant and refugee women	green			green			
Antenatal care for women with mental health disorders	green			green			
Core practices in antenatal care							
Preparing for pregnancy	green		green				
Preparing for breastfeeding	green		green				green
Common conditions during pregnancy							
Reflux	green						
Haemorrhoids	green						
Varicose veins	green						
Pelvic girdle pain	green						
Carpal tunnel syndrome	green						
Clinical assessment in late pregnancy							
Fetal presentation (Fetal wellbeing – external cephalic version)				green	green		green
Prolonged pregnancy (Fetal wellbeing – membrane sweeping for prolonged pregnancy)	green		green		green		
Services							
Record Keeping			green				
Preterm delivery and low birth weight							
Antenatal corticosteroid use						green	
Conditions & Diseases							
Diabetes							
Hypertension in pregnancy						green	
Cretinism						green	

Abbreviations: National Health & Medical Research Council, NHMRC; National Institute of Clinical Excellence, NICE; British Columbia Perinatal Health Program, BCPHP, Module 2, M2

Appendix B: Antenatal Care Quality Indicators by Region

Key:

	associated quality indicator/s

ANC Quality Indicator	NICE: Quality Statements (UK)		National Core Maternity Indicators (AUSTRALIA)		New Zealand Maternity Clinical Indicators		WHO - Improving measurement of the quality of maternal, newborn and child care in health facilities.		A framework for the development of maternal quality of care indicators (USA)	
	Universal	High Risk	Universal	High Risk	Universal	High Risk	Universal	High Risk	Universal	High Risk
Provision of Care:										
Continuity of care	☐									
Childbirth classes									☐	
Attendance:										
Antenatal visit in the 1st trimester	☐	☐	☐		☐		☐			
Screening and Assessments:										
Weight and Body Mass Index (BMI)	☐									
Risk assessment – Intermediate risk of venous thromboembolism		☐								
Risk assessment – high risk of venous thromboembolism		☐								
Domestic violence									Screening - upon emergency room or hospital admission.	
Gestational diabetes - screening (risk factors)	☐									
Screening and Assessments cont'd										

Syphilis							In initial short-list but ultimately excluded.		
Anaemia – screening and iron supplementation for iron deficiency							In initial short-list but ultimately excluded.		
Asymtomatic bacteriuria								Related indicator - Hospitalization rate for pyelonephritis, or % of women with pyelonephritis who were not screened for asymptomatic bacteriuria.	
Group B Streptococcus									
Ectopic pregnancy									
Record Keeping: min. ANC test results									
Preterm delivery and low birth weight								Recording indicator.	
Antenatal corticosteroid use								Recording indicator.	
Tobacco smoking - status									
Education & Awareness									
Tobacco smoking - referral									
Weight and Body Mass Index- referral									
Fetal Monitoring									
Screening tests in the 1st trimester	8 related NICE Quality Statements.								
High-risk Group: Conditions & Diseases									

Diabetes		There are 9 NICE quality statements for diabetes.								
Hypertension in pregnancy		There are 6 NICE quality statements for hypertension.								
Ask about psychosocial factors affecting mental health		There are 7 NICE quality statements for mental health.								

Appendix C: Minimum set of tests for routine antenatal care

Test	Timing
Blood pressure	All routine appointments
Urine test for proteinuria	All routine appointments
Blood group and rhesus D status	At booking
Haemoglobinopathies screen	At booking
Hepatitis B virus screen	At booking
HIV screen	At booking
Rubella susceptibility	At booking
Syphilis screen	At booking
Mid-stream urine (MSU) for asymptomatic bacteriuria	At booking
Height, weight and body mass index	At booking
Hepatitis C virus screen	At booking
Haemoglobin	At booking & 28 weeks
Red-cell alloantibodies	At booking & 28 weeks
Ultrasound scan to determine gestational age	Between 10 weeks 0 days and 13 weeks 6 days
Down's syndrome screen	Combined test: between 10 weeks 0 days and 14 weeks 1 day
Serum quadruple test	14 weeks 2 days to 20 weeks 0 days
Ultrasound screen for structural anomalies	Between 18 weeks 0 days and 20 weeks 6 days
Measure of symphysis–fundal height	All routine appointments from 25 weeks
Fetal presentation	36 weeks

THE TEAM

Restacking the Odds is a collaboration between three organisations, each with relevant and distinctive skills and resources:

- *Murdoch Children's Research Institute (MCRI)* brings deep knowledge and credibility in the area of health and educational research, along with a network of relevant relationships
    - **Prof Sharon Goldfeld** – Associate Director Centre for Community Child Health and Co-group leader Policy, Equity, and Translation, Royal Children's Hospital and Murdoch Children's Research Institute
    - **Dr Carly Molloy** – Research Officer and Project Manager, Murdoch Children's Research Institute
- *Bain & Company* brings expertise in the development of effective strategies that deliver real results
    - **Chris Harrop** – a senior partner, and a member of Bain's worldwide Board of Directors

- *Social Ventures Australia (SVA)* brings expertise in providing funding, investment and advice to support partners across sectors to increase their social impact
    - **Nick Perini** – Principal, SVA Consulting.