Supported Mothers, Stronger Futures

THE OPPORTUNITY OF A LIFETIME:

MAKING THE CASE FOR A PLACE-BASED APPROACH TO ANTENATAL CARE COORDINATION AND SUPPORT

Evidence Review and Service Design

MANY TRACKS, ONE ROAD
SUSTAINING COMMUNITY.

Northern Rivers Community Gateway

BEACON STRATEGIES

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Executive summary

The purpose of this review is to present the argument for community-based antenatal care coordination and provide recommendations for the delivery of a service model that is informed by evidence yet responsive to local community needs. The review considers evidence from a range of academic and grey literature.

The emergence of community-based antenatal care coordination as a key priority for generating social impact across the life course is based on the theory that the origins of social disadvantage begin in the womb. Epigenetics, the environmental factors that influence the physiological make up of the fetus, can influence a number of early indicators of poor health and disadvantage. Adverse birth outcomes such as low birth weight and pre-term birth are widely recognised predictors of lifelong health.

Strategies aimed at improving birth outcomes are most effective when they consider a woman's circumstances and aim to improve the social determinants of health. A number of strategies are supported by evidence to improve maternal health, fetal development and birth outcomes, including:

- clinical antenatal care
- nutrition and physical wellbeing
- housing
- domestic violence
- drug, alcohol and smoking cessation
- mental health, wellbeing and resilience
- parenting and attachment
- financial security
- employment, education and training
- legal issues
- family planning
- relationships.

Barriers exist in getting these services to women that really need them, such as those facing difficult socioeconomic circumstances or from ethnic backgrounds. Therefore, a service model aimed at taking the coordination of antenatal care out of the clinical setting and basing it in community sector can help to alleviate these barriers and promise greater impact. This review outlines the crucial roles that coordination, outreach, risk assessment, evaluation, and collective impact play in this service model.

This report presents a compelling argument that investing in the antenatal period through a holistic and community-based approach can save a lifetime of costs, ranging from immediate hospital costs through to better education and academic achievement, higher employment prospects and a reduced likelihood of illness and incarceration. This report demonstrates that providing the optimal conditions for children to thrive in life is the opportunity of a lifetime.

Background

About the project

In late-2016, Northern Rivers Community Gateway (NRCG) engaged Beacon Strategies to assist with co-designing a service model for community-based antenatal care coordination in the Lismore and Richmond Valley regions.

The purpose of this project is to leverage the extensive evidence base available detailing approaches that work and position this within the local context to ensure the proposed service model responds to the needs of the Lismore and Richmond Valley communities.

Beacon Strategies is delivering a number of pieces of work as part of the design of this service model, including:

- evidence review
- population health profile
- service mapping
- community consultation
- community briefing and reporting.

Purpose of the review

Despite achievements in decreasing infant mortality rates over time as a result of improved technology, the prevalence of low weight births has remained largely unchanged in most developed countries. Improving birth outcomes requires eliciting change in the systemic factors and support mechanisms available in the community that enable women to modify their behaviour. There is strong evidence to support the delivery of relatively low cost interventions focused on care coordination for pregnant women, particularly those facing social disadvantage, for both clinical and non-clinical support services to significantly improve birth outcomes.

Evidence suggests that investing in the antenatal period through a holistic approach can save a lifetime of costs, ranging from neonatal healthcare costs in the first weeks of life through to better educational achievement, higher prospects for employment, better health and a reduced likelihood of incarceration. This means providing the optimal conditions for children to have every opportunity to thrive in at the earliest point of intervention. This contributes to enabling intergenerational social and economic advancement and eliminating disadvantage.

The purpose of this review is to present the argument for community-based antenatal care coordination and provide recommendations for the delivery of a service model that is informed by evidence yet responsive to local community needs.

Methodology

The approach taken in this evidence review involved a comprehensive search of academic literature based on a number of search terms, as well as a search of non-peer reviewed grey literature (e.g. government reports, program evaluation reports). Publications were considered appropriate for inclusion if they met one of the following criteria:

- the publication discussed the relationships between a risk factor and adverse birth outcomes
- the publication discussed the relationships between a protective factor and healthy birth outcomes
- the publication discussed the delivery of support services during the antenatal stage through a community-based approach.

Pregnancy: the opportunity of a lifetime

The emergence of the 'Barker Hypothesis'

The argument for community-based antenatal care coordination as a means for creating social impact is based on a compelling argument that the origins of social disadvantage begin in the womb. The critical part of the life-course spent developing from embryo, to foetus and as a child largely determines the trajectory of one's health and personal opportunities.

> *"Fetal origins research suggests that the lifestyle that influences the development of disease is often not only the one we follow as adults, but the one our mothers practiced when they were pregnant with us as well."*
>
> Annie Murphy Paul from *The Nine Months Before Birth That Shape The Rest Of Our Lives*

Almost three decades ago, a British physician and epidemiologist named David Barker began to trace the links between the birth weights of children across English counties and the incidence of heart disease in these same counties a generation later (Barker, 1990). Barker theorised that the conditions faced by unborn children in the womb passed on via their pregnant mother acted to support or inhibit fetal development. This then goes on to predict susceptibility to disease many decades later.

This theory arises from the scientific field of study called epigenetics. Epigenetics describes the process of environmental factors determining the physiological make up of newborn babies, where many lifelong traits and capabilities are determined. Environmental factors have the ability to switch genes on and off, affecting how cells and genes interact and ultimately birth outcomes. The things a pregnant woman experiences in her everyday life is shared with her unborn child through the transmission of information between mother to fetus – these pieces of information have been coined 'biological postcards'. These postcards are argued to lead to physiological adaptations or 'programming' by the fetus.

Over time a growing amount of evidence spanning disciplines such as physiology, social science, zoology and education has supported the argument that fetal development is determined largely by the lifestyle and socioeconomic surrounds of their mother, and the resulting birth outcome helps to predict the person's health, wellbeing and prosperity across the course of their life. Adopting the 'social determinants of health' perspective, it is highly likely these outcomes will be perpetuated between generations, either through social opportunity or disadvantage.

Barker's theory about the developmental origins of health and disease is not without its critics. The inherent difficulty in testing for an association between one variable arising during a person's time in the womb and another arising potentially many years later, and then isolating the cause of this association, is a common source of research scepticism. As such, Barker's ideas were initially attributed to hindsight bias - the result of associating two events with the passage of time without accounting for the events that transpire during that time. Despite some early resistance, it has since become widely accepted by the research community with promising attempts being made around the world at translating Barker's theory into practice.

Figure 1 Coverage of fetal origins research has even made it on to the cover of Time magazine. Source: TIME magazine, Oct. 4, 2010

Other criticisms have arisen from the potential for the theory to provoke a notion of fatalism with birth outcomes. Jerome Groopman, widely renowned science and medicine writer for popular magazine *The New Yorker*, suggests that *"the Barker hypothesis risks bringing the normal simmering anxieties of pregnancy to a neurotic boil"* (Groopman, 2010). If the course of a person's life is indeed decided at birth as a result of fetal development, this suggests that the period of gestation is a 'one-and-done' opportunity.

It is overly simplistic and perhaps misleading to imply that 'nature' beats out 'nurture' in this age-old battle. While epigenetics is a strong predictor of a person's life-course, it is not the only one. The support mechanisms available to a person after their birth will continue to make a difference to their health and prosperity. Instead of putting it down to the genetic lottery of nature, the intent of the Barker Hypothesis is to emphasise that act of nurturing that begins from the moment of conception and relies on the behaviours and socioeconomic conditions of the mother during the critical pregnancy period.

Tackling social disadvantage and improving health outcomes for vulnerable populations in Australia is limited by the availability of finite resources. Re-directing investment to the earliest point of intervention could help to save a lifetime of costs, as indicated by James Heckman's model illustrated below:

Returns to a Unit Dollar Invested

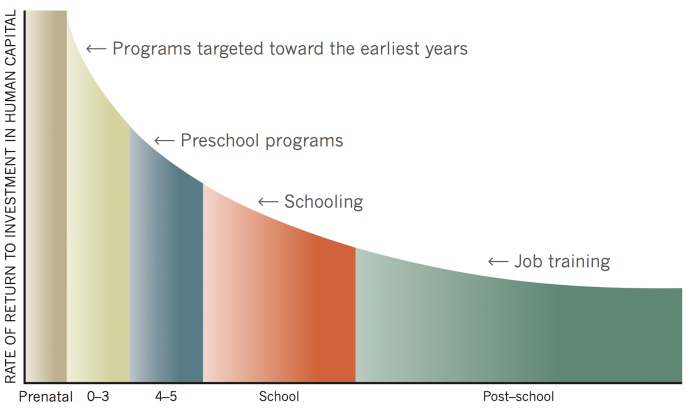


Figure 2 Source: Heckman, JJ (2008) "Schools, Skills and Synapses", Economic inquiry, 46(3): 289-324

Mechanisms of fetal programming

> *Since the 1970's, researchers have been drawing links between access to care during pregnancy, the health of the infant at birth and the IQ of that child some years later*
>
> *(Broman et al., 1975)*

Fully understanding the complex nature of fetal development at the cellular level is beyond the scope of this review, and in some ways continues to lie beyond the reach of modern science. However, it is important to introduce some of the evidence that supports the argument that fetal development can be 'programmed' as a result of external influences during the antenatal period.

As mentioned above, epigenetics refers to the effect of a process called gene expression. Rather than actual changes within the DNA of a developing fetus, which is determined by the combination of genetic material of the mother and father at fertilisation, a range of environmental factors can influence genes causing them to become active or inactive. The prefix *epi-* quite literally refers to 'upon' or 'nearby' genetics. This has led scientists to label this developmental phenomenon as the 'Thrifty Phenotype'.

Malnutrition of a mother during pregnancy has been linked to adaptations in the fetus that play out over the course of a lifetime with an increased vulnerability to disease and illness during childhood and adulthood (Chango and Pogribny, 2015; Chmurzynska, 2010). Researchers have been able to detect abnormal cardiovascular markers of future risk (e.g. leptin and insulin resistance) in infants at the point of delivery that are associated with maternal obesity during pregnancy (Lemas et al., 2015). Similarly, studies have shown that low concentrations of haemoglobin in mothers, the component of red blood cells used to transport oxygen around the body, can impair fetal growth from the very early stages of pregnancy (Bakacak et al., 2015).

It is not only the physical health of mothers that appears to predict the development of and future opportunities afforded to their unborn child. Mothers that displayed symptoms of depression and other psychological disorders during pregnancy were more likely to give birth to children that had impaired cognitive function, even after researchers controlled for a range of possible confounding factors (Barker et al., 2013).

If we accept the biological argument that an unborn child prepares for life outside of the womb by making adaptations based on the conditions it experiences during pregnancy, the importance of a healthy birth outcome is clear.

Evaluating birth outcomes

The period of fetal development is a complex interplay of genetic, physiological and environmental factors that act to 'program' the unborn infant in a way that can't be easily measured. Indicators of adverse development often won't arise until some

years in to a person's life. The most commonly recognised indicators of fetal development are the outcomes of birth weight and gestational age.

The World Health Organisation (WHO) defines low birth weight as an infant born less than 2,500 grams, whilst pre-term birth is defined as a pregnancy of less than 37 weeks gestation. WHO rates low birth weight and pre term birth as the biggest determinants of lifelong health, and has established a global target to achieve a 30% reduction in the number of infants born with a low birth weight by the year 2025.

Australia is recognised as one of the safest places to give birth in the world, with increasingly low rates of maternal and neonatal mortality. However, there has been little progress in lowering the number of adverse birth outcomes such as low birth weight and pre-term birth. A 2013 report from the Australian Institute of Health and Welfare (AIHW) titled *Australia's mothers and babies 2013—in brief* (Australian Institute of Health and Welfare, 2015) presents a snapshot of the current trends in birth outcomes:

- about 1 in 16 live born babies are low birth weight
- less than 1 in 10 are pre-term
- the proportion of low birth weight babies has remained consistently between 6.1% and 6.4% of births between 2003 and 2013.

Low birth weight babies were disproportionately represented within particular groups of mothers, including smokers, those living in remote or very remote areas, lower socioeconomic status (SES) areas, and indigenous mothers (see Figure 3). Additionally, those babies born pre-term or of a low birth weight tend to score lower on a routinely used assessment of a newborn's condition shortly after birth, the Apgar score, which considers basic functions such as breathing, pulse and appearance (see Figure 4).

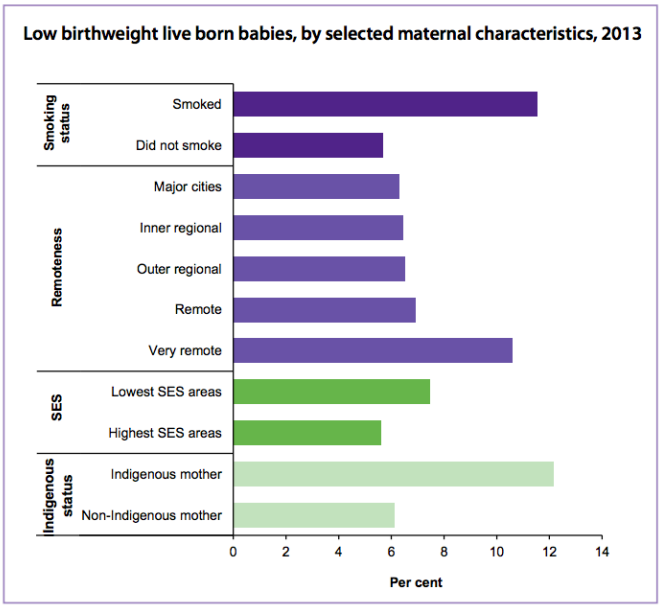


Figure 3 Proportion of low birth weight by maternal factors. Source: AIHW 2013

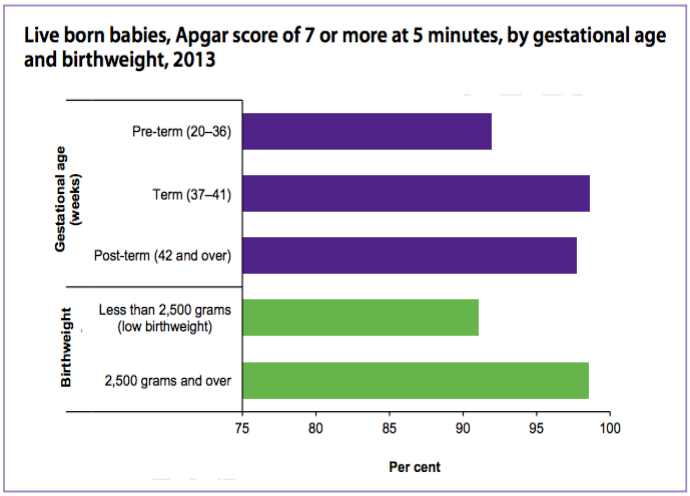


Figure 4 Proportion of normal Apgar score result based on gestational age and birth weight. Source: AIHW, 2013.

The results observed from AIHW data for births in 2013 also indicated the effect of pre-term birth and low birth weight on length of stay in hospital. Figure 5 presents the median length of hospital stay for those babies discharged to home. Low birth weight babies stayed in hospital 6 days longer than the median hospital stay for all births, and pre-term births stayed 5 days more.

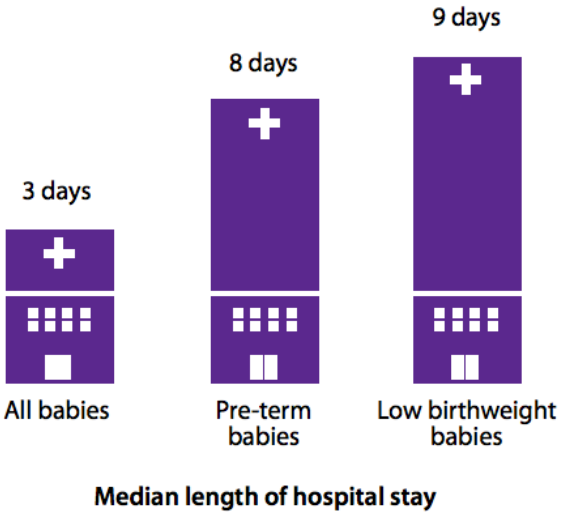


Figure 5 Median length of hospital stay by birth outcome. Source: AIHW, 2013

While economic modelling on the cost of adverse birth outcomes on the healthcare system in Australia are not available, figures from the United States shows that the difference in average cost and length of stay immediately following birth is approximately $15,000 and 12.9 days for pre-term or low birth weight children compared to $600 and 1.9 days for uncomplicated births (Russell et al., 2007).

The healthcare costs for low birth weight babies don't end once they are discharged from hospital. A Canadian research study found that babies born with a low birth weight accrue almost $30,000 per infant more in healthcare costs in their first year of life compared with babies born with a normal birth weight (Thanh et al., 2015). While low birth weight infants represent only around 7% of births, they account for about 37% of the costs associated with health service utilisation for infants' first year of life. Most importantly, intervening to increase birth weight by only 250g has been shown to reduce hospitalisation costs in the first year of life by at least $12,000 (Rogowski, 1998).

Other studies have explored the adverse impact of low birth weight beyond infancy and found it has a significant human and economic cost at various stages of the life-course. These studies indicate that low birth weight increases the likelihood of:

- cognitive impairment in early childhood, particularly for executive functions relating to attention, memory and problem solving (Camerota et al., 2015)
- requirement to utilise special education, social services or carers for children (Petrou et al., 2001)
- poorer academic performance and rates of graduation (Hack et al., 2002; Richards et al., 2015)
- adolescent depression (Costello et al., 2007)
- metabolic diseases such as obesity and insulin resistance (Valente et al., 2015)
- impaired cardiovascular and respiratory functioning (Saarenpää et al., 2015; Sehgal et al., 2013)
- polycystic ovary syndrome (Gur et al., 2015)
- renal disease (Hoy et al., 1999)
- neurodevelopmental disorders such as autism spectrum disorder and schizophrenia (Marques et al., 2013).

It is important to note that while birth weight and gestation length are commonly used measures of fetal development, they may not paint the entire picture. A pair of New Zealand researchers highlighted the risk of an over-reliance on these measures in a 2006 article that stated:

> *"It is now becoming clear that adverse events during pregnancy can affect not only the offspring of that pregnancy but also the next generation. Birth weight is a very crude measure of fetal growth and changes in the intrauterine environment that lead to altered risk of adult disease may not necessarily result in altered birth weight."*
>
> *(de Boo and Harding, 2006)*

While only around 6 to 7 per cent of births are of low birth weight each year, these figures may mask the number of infants born on a trajectory towards other developmental issues such as impaired cognitive function and metabolic disorders but fall within the normal birth weight range.

Disadvantage and birth outcomes

A 2013 report from the Australian Government's Productivity Commission titled *'Deep and Persistent Disadvantage in Australia'* explores how early experiences can influence life chances(Productivity Commission, 2013). These early experiences include the antenatal period (i.e. genetics and epigenetics) and continue in to the first few years of life through quality parenting, family support, safety of the child and education and cognitive development. The report points out differences in the types of early experiences within disadvantaged groups. It also helps to define the concept of disadvantage as much broader than just poverty by referring to deprivation, lack of opportunities and social exclusion.

Pregnancy is a stressful and chaotic period in the lives of expecting women. Understandably, the focus is often on looking ahead to the arrival of the newborn and preparing for what is to be a substantial change in their life. Unfortunately, this often means that their capacity to maintain their health and wellbeing, be resilient with the stress involved in pregnancy and navigate the complex array of services available is often inadequate without the right kind of support.

A large survey undertaken in Australia in 2007 found that two-thirds of women experienced at least one stressful life event or health issue during their pregnancy (Brown et al., 2011). About 18 per cent of women reported experiencing three of more issues, which was found to be associated with later initiation and lower utilisation of antenatal care services, higher levels of reported discrimination from service providers, and subsequently an increased likelihood of having a low birth weight child.

The challenging nature of the pregnancy period is particularly true for those women living in disadvantaged or marginalised settings. These women may also be juggling

broader social issues (e.g. financial, housing, employment, relationships, community). The amount of evidence is growing that demonstrates the extent to which disadvantage can be transferred from one generation to the next (Fox et al., 2015). A paper developed by James Heckman (2011) titled *'The Economics of Inequality'* aptly describes the way in which disadvantage can be perpetuated across generations and within specific socioeconomic groups:

> *Each of us is born into circumstances over which we have no control. Our parents, their genes, education, health status, economic resources, and environment are passed onto us through our families and neighborhoods. These endowments shape the trajectories of our lives.*
>
> *By nature and circumstance, endowments are unequal. At birth, each child inherits different capabilities and different resources to capitalize on them. We can't completely change that picture. But we can change some of it. In particular, we should address the inequity in the resources families have to properly develop their children's potential.*
>
> *It comes as no surprise that there are significant differences in family environments and the resources invested in children across socioeconomic groups… Family status makes a substantial difference."*
>
> *(Heckman, 2011)*

Numerous studies have shown statistically significant associations between adverse birth outcomes (i.e. low birth weight and pre-term birth) with a range of indicators of social disadvantage:

- neighbourhood deprivation (Richards et al., 2015)
- educational level attained by mothers (Mohammad et al., 2014) and grandmothers (Huang et al., 2015)
- economic poverty (Collins et al., 2011)
- ethnic minorities (Witt et al., 2015) and new migrants (Belihu et al., 2016)
- Indigenous Australians (Australian Institute of Health and Welfare, 2015)

Despite this evidence, it is crucial to avoid any sense of fatalism with respect to birth outcomes and socioeconomic status. Any thought that children conceived in to a disadvantaged or marginalised environment are simply destined for a life with limited opportunities is both unhelpful and immoral. Whilst these communities are vulnerable to the fetal programming of disease and disadvantage experienced later in life, it presents a vast opportunity for early intervention to optimise birth outcomes. This requires tackling inequity in access and utilisation of the support services that contribute to a healthy pregnancy, a positive birth outcome and the best possible start to life.

Evidence-based strategies for optimising birth outcomes

Defining the service mix

A broad range of services and activities delivered during the antenatal period have been shown to be associated with improved birth outcomes, particularly in vulnerable or marginalised population groups (Chaudhary et al., 2012; Hillemeier et al., 2015; Hollowell et al., 2011).

> *Receiving a dose of antenatal care services of at least 6 hours of contact has been found to reduce the likelihood of low birth weight by 21%, preterm birth by 26% and admission to neonatal intensive care by 20%*
>
> *(Van Dijk et al., 2011)*

Multidisciplinary antenatal care services have a protective effect by reducing risk factors associated with adverse birth outcomes. In one study of over 3,500 women who undertook an antenatal care program, over half of those reporting smoking, psychological illness or inadequate nutrition were able to resolve that risk factor before giving birth (Ricketts et al., 2005). For those women that had all three risks, 20% were able to resolve all their risks before delivery. These are encouragingly high rates of efficacy that support the argument for investment in the antenatal period.

The mix of services available to women during their pregnancy has traditionally been quite narrow. Services are often clinically focused with the aim of preparing for the impending arrival rather than prioritising the health of the mother during the critical period of foetal development.

A growing amount of evidence supports the argument that a broader view of what constitutes antenatal care is needed to improve birth outcomes (Alexander and Korenbrot, 1995). This reflects the social determinants of health framework that argues a number of upstream factors impact a person's level of health. These factors include socioeconomic status, education, housing, ethnicity, community inclusion, relationships and accessibility to services. Disregarding the upstream factors that act to influence a person's behaviour is a fundamental flaw in any service design.

Investment in antenatal services only makes sense if the proposed service mix is supported by good evidence. This section aims to present the evidence behind a broad range of support services that can be provided to pregnant women, particularly in vulnerable or disadvantaged settings, to help improve birth outcomes. These support services cover the following issues:

- clinical antenatal care
- nutrition and physical wellbeing
- housing
- domestic violence

- drug, alcohol and smoking cessation
- mental health, wellbeing and resilience
- parenting and attachment
- financial security
- employment, education and training
- legal issues
- family planning
- relationships.

Clinical antenatal care

Clinical antenatal care is identified as a critical factor in successful pregnancy outcomes across the globe. Regular antenatal care or midwifery provides the opportunity to monitor the health of both mother and child throughout the pregnancy and resolve any complications that may arise (Asundep et al., 2014). The content of clinical practice for antenatal care is well established in developed countries. In Australia, there are published clinical practice guidelines for health professionals delivering antenatal care (Australian Health Ministers' Advisory Council, 2012). These guidelines cover a number of components for typical pregnancies such as physical examinations, screening for fetal abnormalities, maternal health assessments and advice for women around health behaviours.

For many women, high-quality antenatal care accessed in their choice of setting (e.g. primary care, hospital, private practice) and by their choice of provider (e.g. general practitioner, obstetrician, midwife) offers enough support for a healthy pregnancy and birth. The evidence from a sample of studies below outlines some of the benefits of connecting women with antenatal care services:

- Women receiving antenatal care (e.g. counselling from a health professional, medical examinations, physical examinations and ultra sound) in a substantial dose of between 9 and 10 sessions minimised their risk of having a low birth weight child (Dai et al., 2014).
- Low-cost antenatal care to pregnant women, consisting of diet supplementation, counselling, advice and management of health conditions significantly reduces the chances of delivering a low weight child, even when initiated in the last trimester (Chaudhary et al., 2012)
- Group antenatal care has clinically significant beneficial effects on very low birth weight and child mortality (Tanner-Smith et al., 2014).
- Antenatal home visiting programs have been found to have great effectiveness. Teens who had accessed 6 or more visits by a public health nurse were more likely to give birth to a child in a healthy weight range and at full term (Schaffer et al., 2012).

While clinical antenatal care works for most women, it shouldn't be relied upon as the only type of support service available. Providing tailored support to pregnant women who present with more complex social issues or require intensive case management may reach beyond the capacity of practitioners (Homer et al., 2000). This is generally due to:

- limited time and resources of clinical practitioners
- difficulties in making and sustaining contact with vulnerable clients

- limited knowledge and skills of practitioners to effectively engage with clients about social issues
- client perceptions of stigmatisation or previous negative experiences with the clinical 'system'.

A number of studies have explored women's own experiences of their pregnancy journey and demonstrated that clinical practitioners are often not able to effectively consider and respond to complex social issues in vulnerable or marginalised population groups (Novick, 2009). This doesn't undermine the value of universal clinical antenatal care for all pregnancies. Instead, it provides a rationale for a broader coordinated service mix. The remainder of services should be tailored to the unique needs and priorities of women and aim to complement the provision of clinical antenatal care.

Nutrition and physical wellbeing

Good maternal nutrition and physical wellbeing are critical for a healthy birth. Holistic nutrition programs have repeatedly demonstrated effectiveness in mitigating some of the risks associated with malnutrition during pregnancy. Malnutrition refers to both over- and under-nutrition. In terms of over-nutrition, obesity in pregnancy presents risks to both mother and infant during the birth and well into the child's later years.

In Australia, maternal obesity is a key concern. Almost 20% of women who give birth are classified as obese (i.e. body mass index of >30) (Australian Institute of Health and Welfare, 2015). Preventing rapid weight gain during pregnancy is also an important part of healthy fetal development. At the other end of the spectrum, under-nutrition appears to be less common in most population groups in Australia. However, diets that are deficient in certain nutrients can lead to under-nourishment of the fetus and harm its development (Chmurzynska, 2010).

Nutrition programs and services can include food supplementation, dietary assessment, one-on-one and group education, nutritional plan development or medical referrals. An important factor for improving birth outcomes through nutrition-related services appears to be the size of the 'dose' of the intervention. One study indicated that a dose of at least four individual nutrition consultations combined with three group sessions resulted in a reduction in the chances of giving birth to a child with low birth weight from around 11 per cent to 3 per cent (Santos et al., 2013).

Another study found that reduced rates of low birth weight and higher rates of full-term pregnancies were strongly linked to high program exposure and early initiation. This intervention consisted of food supplements, dietary assessment, one-on-one and group education on nutrition combined with referral to other relevant services (Muhajarine et al., 2012). This trend was consistent across diverse social groups. Finally, an intervention aimed at women with inadequate weight gain during their pregnancy achieved a decrease in the rate of low birth weight from 17.2 percent to 6.7 percent for those women able to resolve their risk by the end of their pregnancy (Ricketts et al., 2005).

Similarly, studies have shown that maternal physical activity can act as a protective factor against low birth weight or pre-term birth as well as a range of changes in metabolic functioning of infants (Brett et al., 2015). There is limited evidence available on the effectiveness of interventions that aim to initiate structured physical activity for previously sedentary women. However, sustaining activity levels in

mothers who are already active, or promoting the benefits of incidental activity should form part of a holistic service focused on nutrition and physical wellbeing.

Housing

Homelessness of expectant mothers during the antenatal period is a risk factor for giving birth to a low birth weight child. Additionally, those without secure housing are notoriously difficult to reach with service delivery, which makes it a mediator of other areas of risk (Smid et al., 2010). Evidence suggests that any program that aims to optimise birth outcomes and prevent low birth weight should prioritise the resolution of homelessness during pregnancy (Cutts et al., 2015). The figure below presents a model of the effect of housing insecurity across the life course.

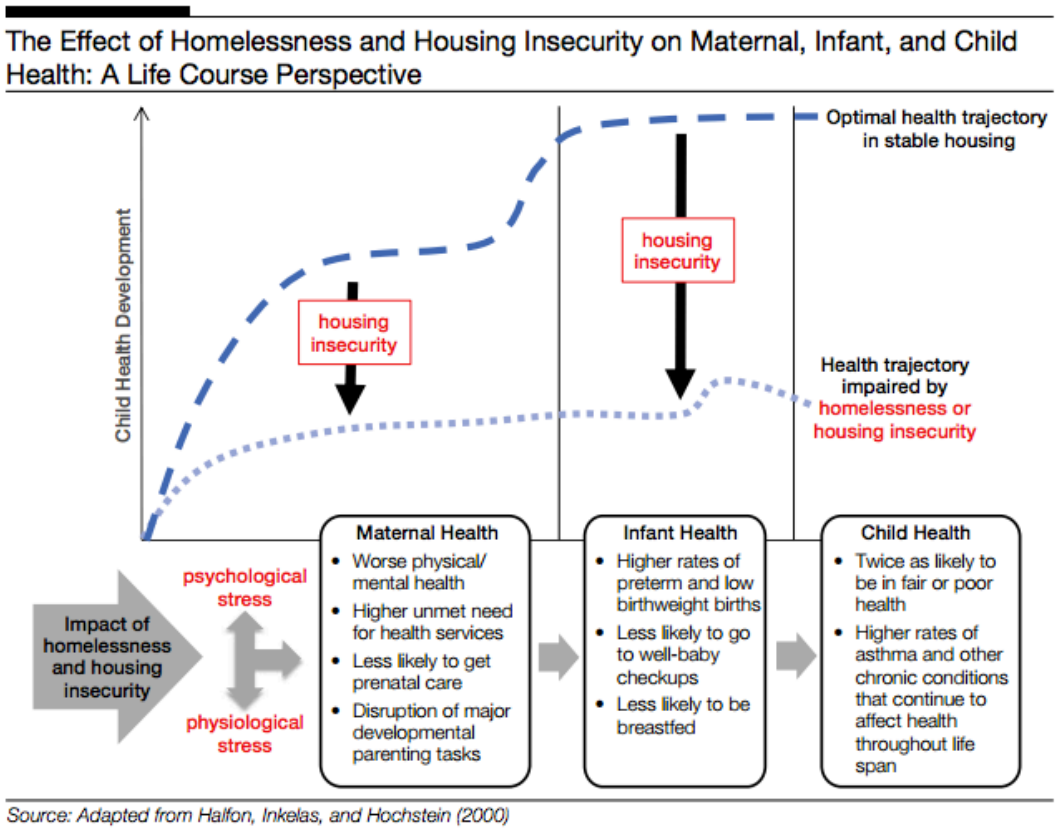


Figure 6 Theoretical impact of housing insecurity across the life course. Source: (Feinberg et al., 2014)

There is broad recognition amongst experts that secure housing has a protective mechanism by alleviating maternal stress, improving health behaviours, ensuring the mother's safety and linking vulnerable women in with the provision of other services (Richards et al., 2011). One study estimated that only half of women experiencing long-term homelessness would be the eventual carer for their children (Crawford et al., 2011). This puts added pressure on downstream services such as child safety and institutional care.

Services dedicated to homeless families and set up in homeless shelters or emergency accommodation facilities can help connect with vulnerable mothers and lead to positive benefits for infant development (Sleed et al., 2013). However, merely making these services available without seeking to resolve the issue of homelessness might help but does not alleviate it as an independent risk factor.

International best practice in homeless policy promotes a 'Housing First ' approach, where transitioning people in to secure and permanent housing is made an immediate priority around which a range of complementary support services are made available. This approach should be of particular urgency for pregnant women.

Initiatives such as the *Healthy Start in Housing* (HSiH) program have been implemented internationally to address the risks associated with homelessness on pregnant women and their offspring. HSiH is a partnership between housing authorities and public health agencies to improve health outcomes for new born babies in Boston, USA by securing and retaining stable housing (Feinberg et al., 2014). Evaluation of the HSiH program has shown that participation in the intervention leads to significant improvements in maternal physical and psychosocial health (Trejo et al., 2014).

Domestic Violence

The likelihood of low birth weight and preterm birth increases significantly among women exposed to domestic violence. Effective programs to identify violence and intervene during pregnancy are essential for the health of the next generation (Shah et al., 2010). The antenatal period is recognised as a possible trigger for domestic violence, with incidence and severity often increasing during this period. A survey of Australian women reported around 9% of all women had experienced violence during pregnancy from a previous partner. In around 25% of these cases, it occurred for the first time during a pregnancy (Australian Bureau of Statistics, 2013).

At present there is limited evidence for efficacy of interventions to reduce domestic and family violence in pregnancy, however this is an emerging field with interesting recent developments. A report by Child Family Community Australia (Campo, 2015) titled *'Domestic and family violence in pregnancy and early parenthood: Overview and emerging interventions'* points to a few key strategies, including:

- Universal screening – effective screening for domestic and family violence and sexual assault in health and social settings can elicit disclosure and trigger referral pathways to relevant services such as crisis accommodation, legal advice and emergency financial relief (Baird et al., 2015; O'Doherty et al., 2014).
- Counselling interventions – supportive counselling in combination with information and resources has shown positive effects with women experiencing domestic violence as well as a reduction in incidence of domestic and family violence episodes (Kiely et al., 2010).
- Perinatal parent-infant therapy – fostering bonding and attachment between parents and infants before birth through certain types of therapy has shown some promise in minimising the harm of domestic violence on the development of infants (Bogat et al., 2011; Lieberman et al., 2011).
- Home visitation programs – home visitation and peer mentoring programs during pregnancy and early parenthood may reduce future incidence of domestic violence among vulnerable families (Bair-Merritt et al., 2010; Sharps et al., 2008; Taft et al., 2011).
- Community education programs – there is limited evidence that community awareness and education programs reduce domestic violence in pregnancy in isolation but they are an important part of any approach to alter community views on domestic violence.

Drug, Alcohol and Smoking Cessation

Problematic use of cigarettes, alcohol and other drugs during pregnancy continues to be a serious yet preventable public health issue (Chamberlain et al., 2013; Grant et al., 2014). In 2013, statistics showed that around 12% of Australian women smoked at some time during their pregnancy. This figure decreased from 15% of women in 2009. Smoking rates were disproportionately higher in younger mothers, Aboriginal and Torres Strait Islander mothers, those living in remote or low socioeconomic areas (Australian Institute of Health and Welfare, 2015). A UK study that consisted of anonymous screening for illicit substances showed that 16% of pregnant women had taken one or more illicit substances during their pregnancy (Sherwood et al., 1999). Estimates in Australia indicate the level of illicit substance use during pregnancy is closer to 5% of women (Australian Institute of Health and Welfare, 2011).

Eliminating or reducing the consumption of cigarettes, drugs and alcohol during pregnancy can decrease the risk of adverse birth outcomes (Johnson et al., 2003; Räisänen et al., 2014). For example, smoking cessation has been linked with an increase in birth weight of almost 300 grams compared with sustained heavy smoking (Benjamin-Garner and Stotts, 2013). Reducing consumption may also be beneficial but as the longer-term consequences are not fully understood; cessation should remain the goal where possible.

The timing of cessation interventions is also important. Mothers able to quit smoking before the third month of pregnancy have been shown to give birth to children of similar weights as non-smokers. Mothers who smoke throughout pregnancy but cut down in the final trimester give birth to children of similar weight to light smokers (Yan and Groothuis, 2015). This evidence suggests that the earliest point of intervention possible should be the goal but there is benefit to reducing or quitting smoking at any stage of a pregnancy.

A sample of interventions found to be effective for smoking cessation during the antenatal period when compared with usual care include:

- psychosocial interventions such as counselling to build motivation, set goals and provide ongoing support (de Vries et al., 2006; Ricketts et al., 2005)
- health education to raise awareness about the risks of smoking during pregnancy and promote self-help (Naughton et al., 2012; Valbø and Nylander, 1994)
- nicotine replacement therapies (Harris et al., 2015)
- providing financial incentives for quitting (Ierfino et al., 2015; Tuten et al., 2015)
- social support from peers or partners (Albrecht et al., 2006; Chamberlain et al., 2013)
- systems level changes, such as regulation of cigarette sales and marketing (Harris et al., 2015).

A sample of interventions shown to be effective in helping women abstain or reduce alcohol and drug use while pregnant include:

- raising awareness of the effects of alcohol and substance use during pregnancy through advice from antenatal care provider (Williams et al., 2014)
- educational and counselling interventions to encourage women to abstain from alcohol or reduce their intake (Stade et al., 2009)

- screening, self-help information and onward referral for further treatment and support. The authors suggest that participation in the assessment component alone may be sufficient to initiate behavioural change (Montag et al., 2015)
- activities that focus on empowering women to deal with underlying sources of stress, build resilience and develop coping strategies (Kitsantas et al., 2014).

A commonly cited challenge with drug, alcohol and smoking cessation programs is the tendency for improvements to be short-lived. Many programs are considered ineffective for the general population if their sustainability beyond six or twelve months can't be demonstrated. However, sustainability should not be a key indicator of success of these programs when delivered with pregnant women due to the nature of the antenatal period. Ideally, women will continue to restrict their intake of smoking, alcohol and drug use beyond the birth of their child but any short-term interruption in consumption during the critical window of fetal development should be seen as an achievement from the perspective of giving children a healthy start to life.

Mental health, wellbeing and resilience

The mental health of pregnant women is a key area to improve the health and development of the unborn child. All women can develop mental disorders during pregnancy but those experiencing poverty, extreme stress, exposure to domestic and sexual violence and low social support are typically at higher risk of specific mental disorders (World Health Organization, 2015).

The relationship between mental wellbeing and fetal development is not just confined to cases involving a diagnosed mental disorder. Adequately coping with stress is a challenge all women face during pregnancy. A systematic review found that women that were not equipped with effective coping strategies tended to have poorer fetal development outcomes such as low birth weight and pre-term birth (Guardino and Schetter, 2014).

A meta-analysis of the efficacy of psychosocial interventions aimed at improving birth outcomes in teenage pregnancies found they reduced the risk of low birth weight by around 40% when compared with usual antenatal care (Sukhato et al., 2015). Effective interventions can be delivered by specialist health professional but also by well-trained non-specialist practitioners in a community setting.

Routine antenatal interactions with service providers present a window of opportunity for identifying women experiencing psychosocial issues and connecting them with appropriate support. Changing practice to take advantage of this opportunity requires concerted and coordinated efforts by practitioners and policy makers to ensure pregnant women are screened appropriately and given brief intervention or referral onward to support services (Yelland and Brown, 2014). Effective screening enables referrals that are better tailored to the unique needs and circumstances of women, rather than non-specific 'cold' referrals to services that are unlikely to ever be accessed. Australian mental health agency *beyondblue* has established clinical practice guidelines for perinatal mental health (beyondblue, 2011). These guidelines recommend that all pregnant women be provided with a routine psychosocial assessment and the development of an appropriate care pathway (Reilly et al., 2013). Care pathways may span from one-off lifestyle advice, peer support groups or non-directive counselling through to more intensive forms of psychological therapy.

For those women experiencing more complex mental health issues such as depression or anxiety, various psychotherapies have been shown to reduce these risk factors in pregnant women (Meintjes et al., 2015). Integrating therapeutic psychological counselling within a coordinated service mix is an important part of improving the mental wellbeing and resilience of mother and child.

Beyond the birth of the child, research has shown that children living with a parent experiencing a mental illness can lead to adverse developmental outcomes (Reupert et al., 2012). Early intervention with relevant service provision can help to minimise the transfer of any adverse effects on to the child in their first few years of life.

Parenting and attachment

The emotional bond that a mother feels toward her baby is critical to the infant's social, emotional and cognitive development. This bonding relationship begins at conception and often determines the level of commitment and responsiveness a mother devotes to nurturing their child. In response, the child will begin to develop a sense of attachment to the parent. Research in the area of 'attachment theory' has regularly shown that fostering attachment early in pregnancy leads to improved fetal development.

The capacity, skills and resilience of parents are largely determined by the opportunities afforded to them in their own lives. As described by Tilbury, Walsh and Osmand, "… there are many difficulties that adults may experience in their lives that can impact on their parental capacity and subsequently their child's wellbeing" (Tilbury et al., 2012). Activities focused on improving parenting and attachment can be hampered by a number of factors including domestic violence, cigarette smoking, poor health care and diet, alcohol and other drug consumption or mental health issues (Rossen et al., 2016). Therefore, a holistic approach that aims to improve the capacity of parents whilst considering the broader circumstances of the woman should be delivered.

Pregnancy intention is a particularly sensitive and personal issue that can influence the extent of bonding and attachment relationships. Unintended pregnancy has been strongly linked with adverse maternal and birth outcomes (Wado et al., 2014). As such, all pregnant women should have access to professional, woman-centred counselling services at the earliest point possible to provide them with an informed choice about their pregnancy options.

Evidence supports a number of activities that can help to create a strong mother-infant bond during the antenatal period that can help to predict secure attachment from infant-to-mother after birth. These include:

- regular interactive ultrasound screening giving mothers the opportunity to see their unborn child as it grows (Yarcheski et al., 2009)
- utilising a pregnancy diary to record feelings of mother-child bonding and discuss these with a trained counsellor (Pajulo et al., 2016)
- education and coaching to develop parenting skills for first-time mothers. Lower levels of parenting self-efficacy felt by expectant mothers have been shown to be associated with higher levels of anxiety or depressive symptoms (Kunseler et al., 2014)

- counselling services that focus on using empathy-based motivational techniques to make brief health-related behavioural interventions. Fostering altruistic attachment may be central to motivation for smoking cessation and other behaviours (Massey et al., 2015)
- creating social networks outside the partner relationship (e.g. group sessions with other pregnant women) enable expectant mothers to reflect on their role as a mother which helps to promote emotional bonding with the unborn child (Condon and Corkindale, 1997).

However, the benefits from fostering early attachment aren't just restricted to birth outcomes. Research shows that high-quality parenting in the first few years of life, based on a parent's ability to respond to the needs of their child, acts to alleviate the effect of some of the risk factors unable to be resolved during pregnancy. These findings have been demonstrated for cognitive function (Camerota et al., 2015) and language ability (Madigan et al., 2015). Another study found that attachment between child and parent negated the effect that maternal cortisol levels, a physiological indicator of stress levels, otherwise had on delaying cognitive development in infants (Bergman et al., 2010).

These results indicate that at the very least, fostering a strong sense of attachment between child and mother during the antenatal period can help to establish a protective factor against the adverse effects of other risk factors that may be more difficult to budge. It should aim to integrate with other strategies that aim to provide parents with a newborn child with specific parenting skills.

Financial security

Financial insecurity can contribute greatly to the overall stress experienced during pregnancy. Evidence exists that links poverty, social disadvantage and stress to adverse birth outcomes and ongoing adverse effects (Larson, 2007). Additionally, financial security means having the resources for a pregnant woman to adequately care for herself and her unborn child through access to essential support such as food, clothing, housing, transport, child care and health services.

Studies have shown that alleviating maternal poverty through government welfare and income tax credit programs can lead to reduced levels of low birth weight (Strully et al., 2010). However, the complex nature of these types of services can make them difficult to navigate, access and demonstrate eligibility for. In particular, these barriers confront vulnerable women not currently engaged with mainstream support services. Direct provision of goods and/or cash to pregnant women for financial relief during crises has the potential to enhance birth outcomes.

Many community organisations offer food, furniture, clothing and emergency financial relief in addition to other service offerings with the aim of ensuring pregnant women can satisfy their basic material needs to maintain a relatively healthy and happy pregnancy. Conditional cash transfer programs for impoverished pregnant women may improve children's birth outcomes and potentially help weaken the cycle of intergenerational poverty (Amarante et al., 2011; Barber and Gertler, 2008). Poor nutrition is recognised as an independent risk factor for adverse birth outcomes but maintaining a healthy diet is often more of a financial predicament than related to knowledge or motivation. Direct provision of healthy food or dietary supplements may be a way to address the undersupply of healthy nutrition for disadvantaged pregnant women (Ma et al., 2015).

Access to professional financial advice and education can help women remain independent and take full control of their financial affairs, including:

- establishing bank accounts
- budgeting
- debt consolidation and repayment
- payment of essential services such as rent, electricity and phone
- unplanned financial expenses such as emergencies, car accidents, tax debts or fines.

Employment, education and training

Empirical evidence on the impact of maternal employment is scarce. The limited evidence available indicates that employment during pregnancy doesn't affect birth outcomes in a negative way. In fact, it helps provide financial security and enables other protective factors such as a healthy diet or access to clinical antenatal care (Wüst, 2015).

Employment, education and training programs are recognised as important to help women enter or re-enter the workforce following a pregnancy. These preparatory initiatives are particularly relevant for pregnant teenagers or women who are currently long-term employed. The aim of these initiatives should be to provide access to education (e.g. finishing high school, vocational training), build the skills and confidence of women, improve their position in the labour market and connect with relevant job opportunities. For example, an Australian Government initiative called 'ParentsNext' is currently being rolled out in a small number of local government areas throughout Australia to link new mothers with services that help to identify pathways to employment opportunities.

The impact of providing women with a minimum level of education, such as graduating from year-12 equivalent studies, goes beyond future employment prospects. One previous study found that pregnant teens that held high aspirations for their education were more likely to have feelings of regret and unwantedness relating to their pregnancy. In turn, this led to stress and lower levels of parenting self-efficacy (East and Barber, 2014). Providing pregnant women with access to an education may have a secondary benefit of fostering a more positive outlook on their situation. This has flow-on positive effects for both maternal health and the development of their unborn child.

Legal issues

Legal issues may accompany a pregnancy for a variety of reasons. No published studies were found that demonstrated that the provision of legal services improves birth outcomes. However, it is well established that any ongoing legal issues during a pregnancy can add to the stress of being pregnant. It also conflates the effect of income and housing insecurity. Community legal centres may provide access to legal services for women during pregnancy facing a range of issues such as dealing with domestic and family violence orders, unresolved legal issues or fines, the legality of deciding to go ahead with a pregnancy and child support.

Family planning, contraception and sex education

Unplanned pregnancies are more likely to lead to negative outcomes for mother and child and can have a lifelong social, health and economic cost (Hindin et al., 2016). Adolescent mothers are at high risk for rapid repeat pregnancy (Han et al., 2014), adding complexity and stress to their family situation.

Empowering women to plan and make informed choices about their pregnancy is critical to ensuring the overall wellbeing of both women and children (Maravilla et al., 2016). Strategies backed by evidence include:

- diagnosing and discussing pregnancy options in a setting free from bias and judgement (Simmonds and Likis, 2011)
- community health worker visitations covering family planning issues to prevent unplanned pregnancy (Maravilla et al., 2016)
- education programs promoting life-skills development and peer support have been associated with declines in pregnancy rates, increases in contraception use, and decreases in sexual activity (Hindin et al., 2016)
- offering contraception to adolescent postpartum mothers which can reduce overall health care expenditure and prevent repeat pregnancy (Han et al., 2014).

Relationships

Maintaining healthy relationships during pregnancy is vital to building strong social support networks and preventing the onset of maternal depressive disorders (Bernard-Bonnin and Canadian Paediatric Society, 2004). This includes spousal relationships, as well as those relationships with family, peers and the wider community.

The stressful nature of the antenatal period, followed by the life-changing experience of having a newborn, can drive women to disconnect from important support networks.

Studies suggest that dissatisfaction with a current relationship can result in emotional distress within pregnant women. Conversely, a satisfying relationship can act as a protective factor even for women reporting other stressful events during their pregnancy, such as moving house, financial stress and insecure work (Ghosh et al., 2010; Røsand et al., 2011). Suitable strategies backed by the evidence include:

- relationship counselling for those in dysfunctional relationships can assist in developing healthy interactions with a spouse (Meintjes et al., 2015)
- providing focused support and attention to women not currently in a supportive partner relationship (Røsand et al., 2011)
- providing scheduled opportunities to meet and connect with other women and provide peer support to reduce feelings of emotional isolation (Ford et al., 2002; Raymond, 2009).

Designing a service model for community-based antenatal care coordination

The section above outlines the mix of services that are supported by evidence as being an important part of a multi-disciplinary antenatal care program. However, the way that those services are coordinated and delivered in practice determines the accessibility, reach and overall success (or not) of any antenatal care program. In 1998, the World Health Organisation established a set of principles that aim to '*endorse the protection, promotion and support necessary for effective antenatal and postnatal care'.* These principles include:

- Care for women with a normal pregnancy and birth should be de-medicalised
- Care should be based on the use of appropriate technology
- Care should be evidence-based
- Care should be local
- Care should be multidisciplinary
- Care should be holistic
- Care should be woman-centred
- Care should be culturally appropriate and culturally safe
- Care should provide women with information and support so they can make decisions
- Care should respect the privacy, dignity and confidentiality of women

Rather than dictating which services a pregnant woman should have access to, these principles outline a set of universal components for how a service model should look in practice. This section of the review aims to describe the elements of a service model that are supported by evidence for successful program delivery. These include:

- a community-based model
- coordination and continuity of care
- ensuring services reach the most vulnerable
- individual risk stratification
- monitoring and evaluation
- collective impact.

A community-based model

> *"The ultimate success of prenatal care in reducing low birth weight may hinge on the development of a much broader and more unified conception of prenatal care than currently prevails."*
>
> *(Alexander and Korenbrot, 1995)*

Over the last decade, the number of community-based models for antenatal care being evaluated in the literature has continued to grow. The promise of the community-based model comes from research undertaken to understand the barriers

that women traditionally face with mainstream clinical healthcare settings, particularly for those women from disadvantaged or marginalised backgrounds (Boerleider et al., 2013; Heaman et al., 2015; Novick, 2009; Phillippi, 2009). These barriers include:

- complexity of the healthcare system to navigate
- an overly clinical, patient-focused approach
- dissatisfaction or discrimination experienced in previous interactions with the system
- lack of language or literacy proficiency
- inaccessible service locations and/or hours
- transportation and child care requirements to attend appointments
- long waits and rushed visits
- lack of motivation or incentives
- lack of continuity of the care provider
- depression or social isolation
- fear of disclosing pregnancy to spouse, family or others
- out-of-pocket costs.

Community-based antenatal care refers to the delivery of a service mix primarily outside the traditional clinical healthcare setting. It typically involves a holistic service mix delivered through an established community organisation that acts as a central hub for overall coordination, client engagement and service referral.

High levels of satisfaction are generally reported for community-based antenatal care models. For example, an evaluation of the St George Outreach Maternity Project (STOMP) delivered here in Australia reported higher perceived quality of care, easier access, shorter wait times for appointments and higher utilisation of services when compared with usual care (Homer et al., 2000). In many cases, community-based models demonstrate a stronger positive effect on fetal development outcomes when compared to antenatal care delivered solely in the clinical setting. The Omaha Healthy Start program is one such example that consisted of case management, home visitation, health screening and education, onward referrals and assistance with transport to appointments for women living in a disadvantaged area. Community-based outreach workers, who were predominantly social workers or community nurses, delivered the program. Evaluation of the Omaha Health Start program found participants had improved birth outcomes, shorter length of hospital stay following childbirth and lower overall hospital costs than a comparison sample that was only provided with standard medical care (Cramer et al., 2007).

Based on the findings of a previous systematic review (Novick, 2009), the needs and priorities of women going through their pregnancy journey include:

- reasonable wait times
- unhurried visits
- continuity
- flexibility
- comprehensive care
- meeting with other pregnant women in groups
- developing meaningful relationships with professionals
- becoming active participants in care
- interactions that are free from judgement and discrimination.

The strength of a community-based model is the ability to respond to these needs and priorities. It is a genuine place-based approach led by an established community organisation. This ensures that services are physically located as near to where women live as possible (Affonso et al., 1993). An example of a suitable organisation would be a neighbourhood centre. Community organisations generally have a number of attributes that make them effective, such as existing links with clients, established referral pathways, community recognition and credibility, support from government agencies and politicians, non-threatening physical facilities, trained staff and a range of services that provide access and intake opportunities.

Additionally, a community-based model enables women to go through their pregnancy journey with the support of a peer group. Studies have indicated that peer-based antenatal care programs that promote interaction between pregnant women in a group setting can lead to better evaluation outcomes than programs that solely provided individualised services (Ford et al., 2002; Tanner-Smith et al., 2014). Relationships forged during pregnancy are often sustained after birth and can an important support mechanism for women during the first few years of their children's lives.

It is important to note that the community-based approach to antenatal care coordination does not replace the delivery of clinical antenatal services in a public hospital, GP clinic or other provider (e.g. private obstetrician). These services are a critical component of the service mix and complement the provision of others. Similarly, advocating for a community-based model should not be misconstrued as undermining the importance, competence or professionalism of clinical practitioners. It recognises the strengths and limitations of the healthcare system and responds to these with a wrap-around service offering that seeks to provide a pregnant woman with whatever support she needs in the critical period of fetal development.

Coordination and continuity of care

The coordination component of an antenatal care service model is critical to providing continuity of care, achieving effective collaboration between service providers, and providing the overarching management of the program (Alexander and Korenbrot, 1995). The person tasked with the role of antenatal care coordinator is fundamental to doing this effectively.

The coordinator role offers a trusted and ongoing point of contact that helps a woman feel like her needs are at the centre of her care. As such, the role is best suited to that of a social worker, community nurse or midwife. However, the most important attributes of the role are not restricted to any one profession. Instead, the ability to undertake outreach work, build rapport with clients, explore their needs, draw up an appropriate service mix, refer clients and manage a caseload is what is essential. The role consists of a number of phased activities that are vital to the achieving an optimal outcome for the client as well as contributing to the integrity of program delivery and evaluation (Lu et al., 2010). A suggested outline of these phased activities is:

- Phase 1: Conduct risk assessment – an initial screening or risk assessment step tool ensures that clients get the right care and support. Individual risk assessment data is used a baseline for reporting against to measure program outcomes. Refer to the section below titled *Individual risk stratification* for more information.

- Phase 2: Develop action plan – an action plan based on identified risk factors should be developed to ensure services align with priorities. Depending on complexity, a client may have an action plan that has one or a number of objectives.
- Phase 3: Coordinate and track service utilisation – activities are scheduled within the action plan based on the range of evidence-based services. Service utilisation is tracked to help assess 'program dose'.
- Phase 4: Evaluate outcomes – monitoring and evaluating outcomes helps to demonstrate efficacy and refine program delivery. Refer to the section below titled *Monitoring and evaluation* for more information.
- Phase 5: Measure impact – demonstrating that program outcomes have contributed to broader social and economic impact is key for any social intervention. Multi-sector collective impact approaches are most effective in demonstrating benefits across the life-course and mobilising support for sustained or additional investment. Refer to the section below titled *Collective impact* for more information.

Reaching the most vulnerable

> *"Children and families cannot benefit from interventions they don't' receive"*
>
> *(Mildon et al., 2013)*

It is critical to identify community members at most risk of poor birth outcomes in order to effectively provide a level of coordinated care and support and for getting the most impact out of the limited resources available. A number of real barriers exist in getting these services to women that really need them, such as those facing difficult socioeconomic circumstances or from culturally and linguistically diverse (CALD) backgrounds.

Unfortunately, it is women in vulnerable situations that are most likely to be missed by mainstream or routine service delivery. A survey of over 4,000 Australian women found that those experiencing multiple stressful live events or social issues during their pregnancy were the most likely to experience discrimination from clinical care settings (Brown et al., 2011).

It is inadequate for service providers to be passive and wait for women in need of support to find and initiate their own services. Therefore, a significant amount of outreach work is required as part of the community-based service model to ensure it is reaching those that need it most. This requires being present in locations where vulnerable women are or building relationships with other contact points or referral pathways, such as schools, church groups, homeless shelters, local GPs and clinics, and government agencies (e.g. Centrelink, child safety). Community organisations such as neighbourhood centres are ideally placed to adopt this outreach role due to their embedded role within local communities and the nature of their operations. These organisations often have soft entry points such as emergency financial relief or crisis accommodation that enable effective referral and transition into services.

Early initiation of antenatal care services is critical. Evidence suggests that those receiving care coordination for three or more months are more likely to have a

healthier birth outcome and resolve more risk factors than those involved for less than three months (Buescher et al., 1991). Similarly, integration and continuation of services following the birth is critical to ensure the physical, emotional and intellectual development of the child in the first few years of life.

Individual risk stratification

Identifying preventable risk factors is vital to making sure that the antenatal care services offered to a woman are those that are most appropriate and accessible for her circumstances (Alexander and Korenbrot, 1995). Pregnancy only presents a short window of time to bring about change. It is often quite a hectic time in a woman's life. Therefore, it is important not to overwhelm or overburden the capacity of that woman to engage with services and commit to significant lifestyle changes.

The service mix tailored for a client should respond to those issues that are most serious in nature. For example, issues such as homelessness, domestic violence and substance abuse cause dramatic upheaval in the social circumstances of mother and the development of the unborn child, which makes them priority issues for targeted efforts. Someone with less complex needs may be provided with a less intensive form of support.

A validated screening tool is critical to ensuring consistency during the risk assessment process. Cumulative risk ratings provide an important mechanism for monitoring progress and evaluating success over the course of the intervention (e.g. reduction in overall cumulative risk rating).

One screening and risk assessment tool described in the literature appears to hold particular promise. The tool is described as *"a risk screening instrument for early antenatal detection of risk factors and tailored prevention in an integrated care setting"* (Vos et al., 2015). It is based on risk ratios between a range of factors and adverse birth outcomes such as low birth weight, preterm birth, congenital abnormalities and perinatal mortality and provides a weighted cumulative risk rating once completed. The 70-item tool consists of four non-medical and two medical domains:

- socioeconomic situation
- ethnicity
- care initiation
- lifestyle (e.g. substance abuse, nutrition, weight)
- ethnicity
- general medical conditions
- obstetric factors

Most importantly, the individual risk assessment should be the first step of a phased initiation of antenatal care coordination. The value of any risk assessment process depends largely on the extent to which effective support services are available and accessible (Gueorguieva et al., 2003). Without the development of an action plan, warm referral to follow-up services and ongoing coordination to ensure services are utilised, individual risk assessments can potentially do more harm than good.

Monitoring and evaluation

The collection of accurate and timely data is central to driving continual improvement and gauging the success of the initiative over time. As demonstrated below, there are a number of important indicators that can be used to gauge the effectiveness of a antenatal care coordination service model. These include short, medium and long-term indicators that would enable a lead organisation, delivery partners and funders to monitor the delivery of outputs and evaluate the resultant outcomes.

Term	Indicator	Type	Source of measurement	Measure-ment frequency	Evidence and Rationale
Short	Number of contacts with service providers	Output	• Antenatal care coordinator/s to track in client management system	Real-time measurement	Determine service 'dose' over the course of the project.
Short	Participant satisfaction with service	Output	• Antenatal care coordinator/s to track in client management system	At the end of each occasion of service	Ensure service acceptability for project participants.
Short	Adequacy of antenatal care (e.g. Kessner index)	Output	• Antenatal care coordinator/s to track in client management system	At the end of occasion of service	Ensure service acceptability for project participants.
Short	Changes to skill, perceptions, confidence and knowledge	Outcome	• Antenatal care coordinator/s to track in client management system	On entry to the program and pre-birth	Gauge the immediate individual impacts and effectiveness of services.
Short	Changes to behaviour	Outcome	• Antenatal care coordinator/s to track in client management system	On entry to the program and pre-birth	Gauge if service interaction results in changes to behaviour.
Short	Improved maternal health	Outcome	• Antenatal care coordinator/s to track in client management system	On entry to the program and pre-birth	Gauge if changes in behaviour have resulted in a measureable individual impact.
Short	Satisfactory intrauterine growth	Outcome	• Antenatal care coordinator/s to track in partnership with health professional in client management system	In line with clinical care schedule	Monitor the growth of the child in utero to track intrauterine development.
Short	Number and rate of low birth weight babies	Outcome	• Antenatal care coordinator/s to track in partnership with hospital in client management system • Queensland Health hospital utilisation data	• Real-time at birth • Annually as Qld Health data released	Gauge the effectiveness of the intervention on birth weight.

Short	Rate of babies born preterm	Outcome	• Antenatal care coordinator/s to track in partnership with hospital in client management system • Queensland Health hospital utilisation data	• Real-time at birth • Annually as Qld Health data released	Gauge the effectiveness of the intervention on preterm births.
Short	Gestational age for weight	Outcome	• Antenatal care coordinator/s to track in partnership with hospital in client management system • Queensland Health hospital utilisation data	• Real-time at birth • Annually as Qld Health data released	Gauge the effectiveness of the intervention on gestational age for weight.
Short	Hospital utilisation (Length of Stay post-birth)	Output	• Antenatal care coordinator/s to track in partnership with hospital in client management system • Queensland Health hospital utilisation data	• Post discharge from hospital • Annually as Qld Health data released	Determine the cost to the health system in the days and weeks after birth.
Medium	Maternal bonding and attachment	Outcome	• Antenatal care coordinator/s to track in partnership with health professional in client management system	1 year post-birth	Maternal bonding with infant is an indicator of longer term outcomes.
Medium	Delay of repeat pregnancy	Outcome	• Antenatal care coordinator/s to track in client management system	1 year post-birth	Repeat pregnancy further complicates already complex living situations and are considered higher risk in younger women.
Medium	Breast feeding rate	Outcome	• Antenatal care coordinator/s to track in partnership with health professional in client management system	1 year post-birth	Breast feeding is associated with childhood development outcomes
Medium	Infant growth and development	Outcome	• Antenatal care coordinator/s to track in partnership with health professional in client management system	1 year post-birth	Developmental milestones are an indicator of future development.
Long	Early childhood development indicators (AEDC)	Outcome	• Australian Early Childhood Development (AEDC) indicators.	Age 5	Childhood development is linked with future health and social outcomes.

It is critical that this evaluation framework is endorsed by program partners and resourced appropriately to ensure that outcomes can be measured. Data collection tools designed for use throughout the project must be practical at the front-end for those practitioners delivering services to use as well as enabling the analysis of outcomes at a program-level for those involved in the social impact assessment.

An online database solution that is designed around evidence-based tools is critical to ensuring that monitoring and evaluation processes can be used easily. This would

provide a structured approach to data collection and management protocols. It is envisaged that this cloud-based platform would incorporate the following service components:

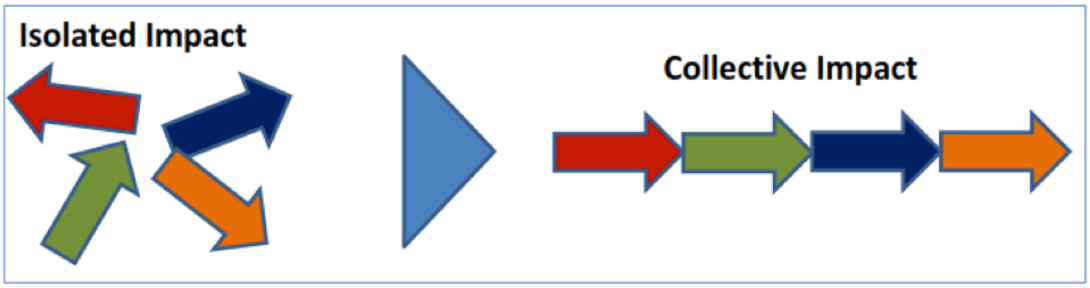
Component	Description
1. Risk assessment	• Collect participant details and consent upon intake • Undertake risk assessment and automate cumulative risk rating • Collect additional information that will inform a service response • Decide on priorities based on identified risks and client preferences
2. Action plan	• Develop action plans to overcome prioritised risk factors. Each action plan has a single objective (e.g. quit smoking)
3. Service utilisation tracking	• Each action plan has a number of activities aimed at achieving its objective • Activity schedule enables visualisation of antenatal care program over time • Each activity is monitored by tracking service interactions to measure program dose • Service interactions recorded in conjunction between care coordination and service partners
4. Outcome evaluation	• Demonstrate whether individual services met their objectives • Measure overall change in risk rating pre- and post-program • Compare program participation with key program outcomes (e.g. birth weight)
5. Impact measurement	• Evaluate community and/or financial impacts resulting from the program • Report to funders and partners on projected program benefits

Previous examples of community-based antenatal care coordination programs have shown that the benefits gained, such as reduced perinatal hospital costs, will continue to compound as program delivery matures (Cramer et al., 2007). This is likely due to ongoing refinements within the first year of the program's existence. This highlights the importance of a multi-year initial investment in the program model to provide ample opportunity for benefits to accrue and be evaluated.

Collective impact

Collective impact refers to an approach where program components are used together to harness the collective power of multiple sectors at the one time to address complex social issues. The term 'collective impact' was coined in 2011 and the framework has been used extensively across the world in campaigns to achieve wide-scale targets (e.g. Global Alliance for Improved Nutrition, Communities That Care, Opportunity Chicago) (Kania and Kramer, 2011).

Collective impact approaches work towards progress and 'moving the needle' on complex social issues. This is compared to the traditional way of working (isolated impact) where non-profit, business and government organisations each work to address social problems independently.



Given the vast impact that fetal development has on life trajectory and intergenerational disadvantage, a collective impact approach holds great promise for this particular area. Evaluation of previous initiatives indicates that a consortium approach is perceived by those involved in program delivery to enhance the achievement of program goals (Brand et al., 2010). To be successful, a community-based antenatal care coordination program requires partnership and collaboration between at least:

- the clinical health system (e.g. hospitals, midwifes, general practice)
- community organisations (e.g. neighbourhood centres, social services)
- government agencies (e.g. health, early years education, child safety).

Adopting a collective impact framework would help to leverage the strengths of each of these groups to plan, coordinate and implement a service model for community-based antenatal care.

Collective impact typically involves five key conditions. These conditions are outlined in the table below, along with an example of how they could potentially be adapted to the context of a community-based antenatal care coordination model.

Domain	Description	Potential local adaptation
1. **Common Agenda**	All participants have a shared vision for change including a common understanding of the problem and a joint approach to solving it through agreed upon actions.	• Brief key stakeholders and community members on the issue to raise awareness and create a sense of urgency • Develop of a population health profile of the local community • Bring key stakeholders and community members together to discuss priority actions
2. **Shared Measurement**	Collecting data and measuring results consistently across all participants ensures efforts remain aligned and participants hold each other accountable.	• Developed shared key performance indicators using the evaluation framework in this review as a guide.
3. **Mutually Reinforcing Activities**	Participant activities must be differentiated while still being coordinated through a mutually reinforcing plan of action.	• Undertake a service mapping exercise of the local area to explore the reach and capabilities of existing service providers • Establish pathways for intake/outreach, referral and coordination.
4. **Continuous Communication**	Consistent and open communication is needed across the many players to build trust, assure mutual objectives, and create common motivation.	• Establish mechanisms for continuous communication with key stakeholders (e.g. steering group) and the broader community
5. **Backbone Support**	Creating and managing collective impact requires a separate organisation with staff and a specific set of skills to serve as the backbone for the entire initiative and coordinate participating organisations and agencies.	• Build the skills of established community organisations (e.g. neighbourhood centres) with strong links to their local areas to own and lead genuinely place-based approaches • Partner with other organisations required for service delivery (in-kind or brokered), funding providers and other experts (e.g. consultants)

Collective impact initiatives can take time to set up. Therefore, the lead organisation responsible for overall program delivery requires stable funding over an adequate period of time to help initiate relationships and begin to work collaboratively. Doing so will ensure that the program has buy-in from key stakeholders and is seen as credible in the local community. The first phase of any collective impact approach involves identifying key stakeholders and forming a cross-sector group. It is recommended that this is where organisations seeking to deliver a community-based model of antenatal care coordination begin.

Conclusion

Despite over two decades having passed since David Barker first pointed to the effect of birth outcomes on disease later in life, the area of fetal programming and epigenetics is still not widely regarded as an urgent public health priority. However, the weight of evidence argues that this predictive relationship surely exists and as such, optimising the health and socioeconomic circumstances of all women during pregnancy remains imperative.

Evidence argues that a service mix should go beyond mere clinical care and take a whole-of- person perspective, incorporating services that can improve the social determinants of health. Existing academic literature has demonstrated that the following service categories can improve birth outcomes:

- clinical antenatal care
- nutrition and physical wellbeing
- housing
- domestic violence
- drug, alcohol and smoking cessation
- mental health, wellbeing and resilience
- parenting and attachment
- financial security
- employment, education and training
- legal issues
- family planning
- relationships.

Most importantly, the community-based service model should adopt an ‘at-all-costs’ approach that reflects the fact that there is no more critical stage for human development, and for plotting the trajectory of a person’s life, than the antenatal period. This means that ensuring continuity of care, reaching out to vulnerable and marginalised women in need of support, and developing risk-based individualised action plans are vital components of the service model. Similarly, collective impact holds great promise for this particular area. To be successful, a community-based antenatal care coordination program requires partnership and collaboration between at least:

Whilst the content of this review presents the evidence currently available about what works in theory, it is just as important to ensure that an antenatal care coordination service model is based on an understanding of local needs. For a service model to be effective in practice, it is vital that the following core components are built in to the program delivery:

1. Community needs assessment – a profile of population health and wellbeing indicators to identify areas of genuine need
2. End-user consultation –engagement with end users within the community through focus groups, interviews and surveys
3. Service mapping – a snapshot of available services and identified service gaps
4. Collaboration and partnership –with prospective program partners to help facilitate collective impact and shared governance.

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