# THE SAFETY OF RURAL MATERNITY SERVICES WITHOUT LOCAL ACCESS TO CESAREAN SECTION

2015-11-03

An Applied Policy Research Unit Review

Commissioned by Perinatal Services BC, BC Women's Hospital and Health Centre & University Centre for Rural Health, Australia

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# Executive Summary of The Safety of Rural Maternity Services without Local Access to Cesarean Section

*Introduction*

British Columbia, like many other jurisdictions in Canada and internationally, is currently undergoing a review of the structure and organization of rural maternity services. This has been precipitated by the ongoing challenge of sustaining small rural maternity services due to a confluence of reasons including difficulties recruiting and retaining rural providers with maternity skills and the predominance of specialist-based, centralized care. Ideally, maternity care is provided within an environment that supports operative delivery capability, should it be necessary. Where population and infrastructure do not make this efficient, however, the planning question becomes: *Is it safer for a rural population to have no local intrapartum services, or primary maternity services*? Answering this question is predicated on understanding the relative safety of primary maternity services when compared to services with local cesarean section capacity, but also compared to understanding the population health outcomes from communities with no access to local care. This latter perspective has been largely overlooked in health planning to date.

Two contextual influences raise the importance of looking at evidence regarding the best model of maternity care for rural communities: (1) the advent of the First Nations Health Authority and the attendant prioritization of "Improving access to the full range of maternity services for First Nations and Aboriginal women, bringing birth closer to home and into the hands of women," (Transformative Change Accord, 2005) and (2) the development and endorsement of the *Joint Position Paper on Rural Maternity and Surgical Care* and the articulation of the Networked Model of care on which it is predicated. The Networked Model is based on the support of small rural services by regional referral centres through formal referral patterns between sites. The Joint Position Paper on Rural Maternity and Surgical Care has identified a professional structure to support low-resource settings, support that currently has been on a case-by-case basis and not systematized.

The current review uses judicious consideration of rigorous evidence to support sound decision-making that balances population need (including satisfaction) with effective care in a costing context with competing priorities. We had three *a priori* assumptions of fundamental criteria for good maternal-newborn and health system outcomes of primary maternity services. They include the need for:

1. Skilled and confident maternity care providers with an understanding of the contextual realities of supporting childbirth in a low-resource setting;

2. Local maternity services must correspond to population need. Where higher resourced maternity services can be sustained, primary maternity without surgical support is not a replacement.

3. The primacy of birth for families, communities and the health system, where birth is the most common reason for hospitalization

4. That patient centred care means a health system that matches both the health needs and values of the people using the system

5. That risk and safety each have many definitions and perspectives, all of which must be considered when optimizing health system outcomes.

**It is essential to note that the level of local maternity services (pre- and post-natal only, primary maternity care, maternity care supported by Family Physicians with Enhanced Surgical Skills (FPESS), mixed FPESS-Specialist models or models supported only by specialists) must correspond to population need. This can be determined by calculating the average number of births in a community, the vulnerability of the community and distance to next cesarean section (Grzybowski, Stoll and Kornelsen, 2013). Instituting a service level lower or higher than the requirements of the population may lead to service instability and/or compromised health outcomes.**

*Methods and Approach*

This research synthesis was undertaken using the established methodology of a realist review (Pawson et al 2005), the intent of which is to "take the dynamically changing policy landscape into consideration to identify the issues as opposed to the generalization truths" (Pawson et al 2005). The reviewer (Applied Policy Research Unit, Centre for Rural Health Research) and commissioners (Perinatal Services BC, BC Women's Hospital and Health Centre and University Centre for Rural Health, Lismore Australia) met to discuss the question, the key thematic areas useful to cover and the policy context of the review. Through these meetings, the specific intent of the review, to contribute to key-stakeholder planning discussions on rural perinatal surgical services, was identified. 156 articles were identified for review through the database search. Please see the full report for additional details and rationale including search terms used and databases accessed.

The precise research question was:

> *What is the relative safety of rural maternity health services without local access to caesarean section?*

The sub-questions include:

1) What are the safety outcomes associated with higher volume birthing services?
2) What are the safety outcomes associated with increased travel distance or time to primary services?
3) What are the psychosocial risks associated with extraction / referral from the home community for intrapartum care?

Based on a database search and pearling methods 156 relevant articles were included for full review.

*Findings: The safety of Rural Primary Maternity Care*

Physician Led Services: Key Points

1. Service closure or crisis negatively impacted neonatal mortality in primary communities between 2000-2007, underlining the importance of service stability
2. High-quality outcomes depend on system supports like relationships with providers in referral communities and inter-facility transport services;
3. Neonatal morbidity is impacted by distance to services, outflow and evacuation from rural communities;
4. Intrapartum transfer decisions are made significantly earlier by rural family physicians compared to urban family physicians.
5. Rates of spontaneous vaginal delivery have been found to be higher for patients of rural primary practice;

Midwifery Led Services: Key Points

1. Midwifery-led care shows lower intervention rates while maintaining strong outcomes for women in remote environments.
2. The importance of inter-professional relationships is highlighted for midwives relative to generalist physicians due to differences in birth philosophy.

Midwifery-led models have the capacity to incorporate western medicine knowledge systems alongside values and skills regarding traditional, culturally-specific birth practices, decreasing psycho-social risk and increasing cultural safety.

Psycho-Social Risks: Key Points

1. Psycho-social outcomes are worst among women expected to evacuate for care;
2. Local care experiences often include a greater sense of pride and empowerment;
3. Our needs as patients extend beyond physical safety to include community, control and respect, as well as services that match our values and expectations;
4. Risk and safety are subjectively weighed by women to include personal, psychological and social risks;
5. Women consciously employ strategies to mitigate their psycho-social risks that may increase their clinical risk.

Distance to Care: Key Points

1. For BC women, neonatal mortality is three times more likely for births in which the women had to travel four or more hours to services;
2. For BC women who have to travel more than 1 hour, induction is 1.3 times more likely due to travel logistics;
3. International evidence shows that increasing numbers of women traveling longer distances to care is creating greater resource usage to compensate for greater rates of morbidity;
4. An unequivocal relationship exists between distance and outcomes: as distance goes up, so do negative outcomes.

Relationship Between Volume and Outcome: Key Points

1. Undisputed high quality evidence indicates that tertiary care is associated with better outcomes for very low birth weight and very premature births;
2. Hospital-based data is conflicting, but most shows U-shaped relationship where low-volume and highest-volume facilities have slightly worse outcomes
3. Population- or catchment-based data shows equivalency based on the functioning mechanism of risk-based referral
4. The statistical differences found in most hospital-based datasets correspond to very small absolute differences, which do not appear in population-level data
5. The literature notes its own limitations with regard to identifying the mechanisms of potential differences in outcomes between unit sizes
6. Critically, this literature examines all hospital users and not the safety to rural and remote women of traveling to use the services

The Importance of Service Sustainability to Safety: Key Points

1. Physicians working in primary maternity service environments express the stress and challenges of providing maternity services without local access to c-section;
2. Outflow is higher in primary service communities without local c-section;
3. Caseload midwifery may be a sustainable practice model for low-volume, rural and remote communities;
4. Mixed model (general physician-midwife) may reduce on-call requirements and stress in primary environments.

*Recommendations:*

Services must be planned to meet the Institute of Health Improvements' Triple Aim goals and consideration of the safety of primary maternity services must take place within recognition of an expansive definition of safety to include cultural, social and personal safety in addition to physiological safety. Additionally, clear lines of responsibility for rural maternity care must be established in the Ministry of Health, Health Authorities and Perinatal Services BC to ensure consideration, uptake and evaluation of the following recommendations. From this vantage point, the following criteria must be met to support primary maternity services:

I. Planning Issues

1. Maternity services for rural and remote communities must be systematically planned based on the need for services of the population catchment;
2. Special consideration needs to be given to meeting the maternity service needs of remote aboriginal populations;
3. Rural primary maternity services need to be supported as a stated priority for health planners;
4. Services must be positioned within a regional networked model of maternity care, which assumes clear referral lines for triage to higher levels of care when necessary;
5. Guidelines for identification of candidates for birth in a low resource environment (those likely to have an uncomplicated vaginal delivery) need to be refined and adopted across the rural and remote environment;
6. Effective and efficient perinatal transport systems must be in place for instances when emergency transport is necessary;
7. A quality management framework for rural community services needs to be established and led by rural maternity providers, and
8. A decision aid for facilitating decision on place of birth at a patient level must be developed representing the patient priorities alongside relevant clinical data.

II. Provider Issues:

1. Individuals providing rural maternity services must be well-qualified and work within a Continuous Quality Assurance monitoring framework with adequate opportunities for Continuing Medical Education;
2. Innovative models of midwifery services for rural communities with planned primary maternity services and absence of current maternity services need to be supported;
3. Barriers to interprofessional practice between midwives and generalist physicians in rural and remote communities need to be identified and addressed;
4. Primary maternity services must take place within the context of a well-functioning interdisciplinary local team including care providers, allied health providers and local administrators.

III. Evaluation:

1. Population catchment outcomes need to be prospectively monitored and feedback needs to be given in a timely and flexible way to individual communities, service strata, and regions;
2. Service utilization patterns as well as referral patterns at the population catchment level are an important indicator of the quality of service and need to be part of the ongoing monitoring;
3. CME/CPD should be provided inter-professionally, on site, and linked to outcome monitoring and driven by the needs of the local maternity care team.

## Assumptions underscoring this review

We assume three fundamental criteria for good maternal-newborn and health system outcomes of primary maternity services:

1. Skilled and confident maternity care providers with an understanding of the contextual realities of supporting childbirth in a low-resource setting;

2. Local maternity services must correspond to population need. Where higher resourced maternity services can be sustained, primary maternity without surgical support is not a replacement.

3. The primacy of birth for families, communities and the health system, where birth is the most common reason for hospitalization

4. That patient centred care means a health system that matches both the health needs and values of the people using the system

5. That risk and safety each have many definitions and perspectives, all of which must be considered when optimizing health system outcomes.

## Context and Background

British Columbia, like many other jurisdictions in Canada and internationally, is currently undergoing a review of the structure and organization of rural maternity services. This has been precipitated by the ongoing challenge of sustaining small rural maternity services due to a confluence of reasons including difficulties recruiting and retaining rural providers with maternity skills (Kornelsen, Gryzbowski and Iglesias 2006; Kornelsen and Gryzbowski 2008) and the social context of specialist-based centralized care (Kornelsen, Iglesias, Humber et al 2013). This underscores the larger challenge of balancing *comprehensiveness* of local rural services with *sustainability*. Parallel – or due – to this, is the growing awareness of lack of equitable access to services for rural residents (Milleret al 2012) with potential attendant maternal-newborn health consequences (Gryzbowski, Stoll and Kornelsen 2011). The province has responded through both a targeted approach (*Primary Maternity Care Action Plan*) and a system-wide approach within the rubric of a series of policy papers resulting from the provincial strategic health plan (*Setting Priorities for the BC Health System*, February 2014). Most directly applicable to the issue of rural maternity care is *Rural Health Services in BC: A Policy Framework to Provide a System of Quality Care* which notes, among other things, the need to understand population and patient health and develop quality and sustainable health care models. This comes at a time of increasing centralization of rural maternity services and the attrition of primary maternity services. However, *Rural Health Services in BC* notes the importance of responding to population health needs, alongside flexibility and innovation in models of care.

Ideally, maternity care is provided within an environment that supports operative delivery capability, should it be necessary. The question that is central to this review is: *Is it safer for a rural population to*

*have no local intrapartum services, or primary maternity services*? Answering this question is predicated on understanding the relative safety of primary maternity services when compared to services with local cesarean section capacity. This question drives the current review. It is embedded, however, in the more general question of the appropriate (population responsive) level of services for rural communities based on key characteristics. For maternity care, characteristics include the number of births in the community, the socio-economic vulnerability of the population and its isolation, as defined by distance to nearest cesarean section service. This modeling has been developed in and applied to British Columbia (Gryzbowski, Kornelsen and Schuurman 2009) and validated in Australia (Kildea and Sratigos 2010; Barclay, *Conference Presentation*, 2015).

**It is essential to note that the level of local maternity services (pre- and post-natal only, primary maternity care, maternity care supported by Family Physicians with Enhanced Surgical Skills (FPESS), mixed FPESS-Specialist models or models supported only by specialists) must correspond to population need. This can be determined by calculating the average number of births in a community, the vulnerability of the community and distance to next cesarean section (Grzybowski, Stoll and Kornelsen, 2013). Instituting a service level lower or higher than the requirements of the population may lead to service instability and/or compromised health outcomes.**

Calculations regarding the number of communities that could currently support primary maternity care are based in part on current remuneration schemes (fee-for-service) within a historical care provider model (physician-based) and BC's historical health administrative structures. With the advent of the First Nations Health Authority and the attendant prioritization of "Improving access to the full range of maternity services for First Nations and Aboriginal women, bringing birth closer to home and into the hands of women," (Transformative Change Accord: First Nations Health Plan 2006), adjustments may need to be made to account for the prioritized emphasis on the cultural needs of communities within an alternative payment model serviced by midwives. This forces health planners to adjust for low volume – high needs communities and to be adaptive to the sub-set of rural First Nations settings that may not fit into established parameters but could potentially support local primary care services. This emerging cohort will have a growing influence on health services delivery in BC over the next decade.

The Transformative Change Accord: First Nations Health Plan is resonant with the larger pan-Canadian perspective endorsed by the Society of Obstetricians and Gynecologists of Canada evidenced through their 2010 policy statement on the return of birth to Aboriginal, rural and remote communities in Canada. Key to their position is the recognition of the cultural importance of local birth, of the need to respect women's rights to choose where they give birth, and the need to facilitate an infrastructure conducive to low-volume environments. This follows on the 2012 updates to the Joint Position Paper on Rural Maternity Care (Iglesias et al 1998) advocating, as it did in 1998, that high-quality maternity care should be available as close to home as possible (Miller et al 2012). The position paper goes on to note that:

> *While local access to surgical and anaesthetic services is desirable, there is evidence that good outcomes can be sustained within an integrated perinatal care system without local access to operative delivery.*

The paper was endorsed and published against a backdrop of continued closures of rural services across the country in the face of increasing centralization. A tacit and unsupported claim that closures occurred due to apparent safety risks associated with small local services seemed to emerge around the same time.

However, a more recent development in the national landscape has significant bearing on the current organization of rural maternity care: the development and endorsement of the *Joint Position Paper on Rural Maternity and Surgical Care* (Iglesias et al. 2015) and the articulation of the Networked Model of care it is predicated on. The Joint Position Paper on Rural Maternity and Surgical Care is the representation of inter-professional consensus between the Canadian Association of General Surgeons, the Society of Obstetricians and Gynecologists of Canada, the Society of Rural Physicians on Canada and the Royal College of Physicians and Surgeons of Canada on mechanisms to provide surgical and maternity care to rural communities. Drawing from international models of distributed surgical care, it suggests a new organizational infrastructure between specialists in regional referral centres and General Practitioners with Enhanced Surgical Skills in rural settings based on mutual support and reciprocity of practice opportunities and settings. Specifically, a Networked Model is based on the support of small rural services by regional referral or regional centres through formal referral patterns between sites. Although the Joint Position Paper on Rural Maternity and Surgical Care has identified the Networked Model as a framework for surgical care (grounded in the recognized need for perinatal surgical care), when interpreted within the context of the Joint Position Paper on Rural Maternity Care and the mandate of care "closer to home," the Networked Model provides an efficient context within which primary maternity services may be considered. That is, it provides a structure for increased awareness and respect for the capacity in rural sites in the referral centres on which monitoring and quality improvement activities can be built. As the Joint Position Paper on Rural Maternity and Surgical Care notes, the Networked Model

> *Invests in preventative, upstream and recovery services as close to home as possible in order to provide appropriate and efficient care by avoiding unnecessary involvement of higher levels of care.*

From a wider perspective, the present interest in primary maternity services is also precipitated by the growing body of evidence attesting to the psycho-social consequences of traveling to access care (Kornelsen, Stoll and Grzybowski 2011b), evidence that is reviewed below and suggests higher levels of stress incurred, a disruption to family and wider social relationships and, for Aboriginal communities, detachment from sacred territorial lands with the socio-cultural attendant consequences (Kornelsen, Kotaska, Waterfall et al 2010). Historically, this evidence has been somewhat in tension with evidence on the safety of primary and generalist care, seen as disparate priorities battling for authority in decision-making and health planning. In this review, these twin pillars of "safety" are both considered. The challenge of meaningfully weighing and appropriately integrating both into decision making, however, remains.

British Columbia is at a cross-roads in planning rural maternity care, the same cross-roads arrived at by colleagues in jurisdictions across Canada and internationally. The lever enabling sound decision-making that balances population need (including satisfaction) with effective care in a costing context

appropriate to competing priorities is the judicious consideration of rigorous evidence. For these reasons, BC Women's Hospital, Perinatal Services BC and the University Centre for Rural Health (Lismore, Australia) have commissioned this review to consolidate the international evidence on the safety of primary maternity services. As per convention in the discipline of evidence-based health planning, the commonly accepted ranking hierarchy for scientific evidence was applied to review of findings, starting with attention to systematic reviews and meta-analysis, randomized controlled trials, cohort studies, case control studies, cross-sectional surveys, expert opinion and anecdotal information. This scheme proved to be challenging when applied to this topic due to the lack of 'higher level' methodologies used. The strength, consistency and coherence of 'lower levels' of evidence, however, including parturient women's and family's experiences of care, reflections on the impact of lack of access to local services by care providers and thoughtful summative editorials, were persuasive. The primacy of the patient journey and the complex inter-relationship between psycho-social and physical health in understanding models of health care still needs to be reconciled.

## Limitations

Historically, rural primary maternity care as a health planning model has been considered only in the case of geographic necessity and the absence of alternatives. This has resulted in a comparative focus on primary services to cesarean section services and the neglect of a comparison of primary maternity services to *no* local maternity services. This was further embedded in the larger research approach due to two highly powered studies on the relationship of institution delivery volume on maternal-newborn outcomes at the turn of the century. Findings from these studies on the relationship between high-technological birth environments and optimal safety were repeated in other jurisdictions resulting in a growing body of research on volume-to-outcomes measures and neglect of the more relevant question for rural communities, which is comparison of primary services versus *no* local services. This has only recently begun to be addressed in the literature.

Alongside the epidemiological approaches to models of care, a field of postcolonial qualitative work emerged, focused on women's experiences of care and birth in rural settings, largely without local access to services. Although this work lacked the methodological power to make a claim about outcomes, it pointed at the potential for psycho-social conditions to influence clinical morbidity. However, this evidence emerged in relative isolation to the volumes-to-outcomes data, and the consequent focus in providing care in high-volume settings, noted above. This review is the first attempt to connect these fields of inquiry around rural maternity care as different ways of measuring the same real world phenomenon of rural and remote women needing and using maternity services. The methodology for integration is unclear. However, by placing cultural safety and psycho-social risk inside clinical safety we are privileging the mechanisms by which small volume, primary-only maternity care can be made both safe and acceptable to patients.

# Methods and Approach

## Realist Approach

This evidence review uses a realist approach. The purpose of a realist approach is to consider the mechanisms of good quality outcomes within their rich context to identify what works, for whom, in what circumstances, in what respects and how. Traditionally, research synthesis takes the form of systematic reviews and meta-analysis. In these approaches, the unit of analysis is the (usually weighted) evidence from each carefully selected study, taken in aggregate with the intention of providing a clear answer to a narrowly defined question. This approach can be highly effective for determining the relative merits of a controlled clinical intervention. However, in health services, the success of an intervention is contingent on a variety of complex factors, both social and structural. A realist approach is intended to generate a detailed, practical and sophisticated understanding of that complexity so it can be considered when making policy and programming decisions (Pawson et al. 2005).

The research team articulated a complex hypothesis (see 'CMO', below) of how primary maternity services function in rural environments to achieve good outcomes and then tested that hypothesis using data found in the international literature. Rather than confirming or not confirming the hypothesis, however, the model is iteratively amended to provide a rich description of how the system can best meet its objective (safe, satisfactory and cost-effective care)). Fundamentally, the realist approach requires that we see the system as contextualized in real-world possibilities and vulnerable to influences of change we could not have anticipated.

Rural, primary birthing services without access to local surgical care in British Columbia and similar jurisdictions are categorically small, low-volume services. The alternative in most cases is to have no local services. Under the condition of no local services, the model of care involves women evacuating their home community and traveling to care in a referral centre, in some instances before the onset of labor. This contextual background framed the sub-themes of inquiry used to organize data to answer the review question. The themes and sub-themes include:

1) Safety of Primary Services without local access to c-section
    a. Safety of midwifery led services
    b. Safety of physician led services
2) Psycho-social risk
3) Distance to care
    a. Accidental, out-of-institution births
4) Volume to Outcomes relationship

## Context, Mechanism and Outcome ('CMO')

*Description of CMO:* The premise of a CMO (Context-Mechanism-Outcomes) model is to create a hypothesis predictive of how a real world, complex system functions by identifying the mechanisms of positive outcomes and the contexts within which those mechanisms are best suited. Woven together, this is the programme theory of a complex intervention, providing a rich understanding of how a system

works to produce good outcomes and how to foster the best possible support for that system in the local setting.

Within the context of primary maternity services (those without access to cesarean section within one hour surface travel time), we attempted to identify which mechanisms work at what levels of the system to produce clinically and psycho-socially safe care for rural and remote women, neonates and their families. Clear framing of the CMO supports the transferability of the findings to other jurisdictions with the application of local expert knowledge.

***Context:***

In addressing the research question, a series of related and contentious issues must be considered. The findings must be applicable to the real world challenges faced by pregnant women, their care providers, and the system managers. Fiscal, logistic and efficiency constraints that appropriately centralize high levels of care in dense urban areas confront the geographic constraint that women from rural and remote areas without local services must travel for care. Although most of the literature assessing the safety of rural primary maternity services uses full obstetrical services as the comparator, the likely scenario is the choice between primary services and *no* services. Findings on safety must be considered through this lens.

The efficacy of a rural primary maternity care service rests on the expectation of a regionalized model of care in which risk-associated triage is performed and higher risk pregnancies are referred to higher resourced environments. Women with a high likelihood of an uncomplicated vaginal delivery are suitable candidates for local delivery. Avoidable clinical risk accumulates to those low risk women who may be required to leave their communities due to the lack of local infrastructure. A confluence of psycho-social stressors related to traveling to care compound with both personal anxiety and logistical risks associated with being distant from care. This demands attention to a holistic characterization of risk.

The *characteristics* of service models and their sustainability are an important consideration, ideally driven by the needs of the local population within accepted clinical standards. Local and system features such as the level of provider stress will influence sustainability.

***Mechanisms:***

The mechanisms of safe primary-only maternity care are complex but fall into three major categories: strong local risk screening with a holistic consideration of risk, a network of support for rural sites and functional transport.

At a care provider level, rural providers without immediate access to c-section support show lower tolerance for risk. Earlier, more accurate referral was found among rural physicians. Greater outflow occurs from primary intrapartum settings staffed by both physicians and midwives when distant from surgical services. As well, increasing accuracy of risk screening and referral was found between 1980 and 1996, eventually reaching a plateau in developed nations of <10% of high-risk cases appearing in low-risk environments.

At system level, safe care clearly rests on a functional relationship between local primary services and their nearest referral site(s) capable of definitive care. Providers are unlikely to take on maternity services without a network of support within the system, possibly including consultation and patient transfer. This relies on emergent transfer teams (e.g. ambulance services) as well as inter-professional learning and support.

Finally, at the highest system level, the mechanisms of safe care will include effective training and updating, sustainable program support (including the appropriate health human resources and infrastructure), supportive programming (including locum support and call support) and supportive policy (including appropriate funding models, team-based payment and integrated networks of care).

***Outcomes:***

Greater attention has been given to those clinical outcomes measurable at the moment of intrapartum service with less attention given to the worsened clinical outcomes resulting from system circumstances that engender psycho-social stress and inhibit access. Greater distance to care, reduced pre-natal and post-natal care access and higher rates of psycho-social stress are reflected in worsened clinical outcomes, including:

- pre-term birth
- perinatal mortality
- higher rates of intervention
- higher rates of complication
- neonatal intensive care unit days

In keeping with a holistic consideration of risk, we found other indicators of poor outcomes including higher rates of accidental, out-of-institution birth, lower satisfaction and/or the expression of psycho-social risk by the women involved and their families and lowered trust in the health system and providers.

## Identifying the Research Question

This review was commissioned by Perinatal Services British Columbia (PSBC), BC Women's Hospital and the University Centre for Rural Health (Lismore, Australia) to address challenges in rural health planning faced in both jurisdictions. The commissioners articulated a research question of mutual interest:

> *What is the relative safety of rural maternity health services without local access to caesarean section?*

The question understood from a patient perspective by grounding interpretation of evidence in an evaluation of which service model provides the greatest level of safety for women who live in small rural and remote communities. To this end, sub-questions were generated which attempt to consider the safety of primary services against the real-world alternative of no local services and evacuation for care. In this way, the outcomes of different levels of service are placed in the context of the patient journey to access those tiers of service. The sub-questions include:

1) What are the safety outcomes associated with higher volume birthing services?

2) What are the safety outcomes associated with increased travel distance or time to primary services?
3) What are the psychosocial risks associated with extraction / referral from the home community for intrapartum care?

## Search Structure and Strategy

There were two distinct phases to the search structure. In phase one, the review team searched the following electronic bibliographic databases: MEDLINE Ovid, MEDLINE Ebsco, Pubmed, EMBASE, CINAHL, EBM Reviews (inc. The Cochrane Database of Systematic Reviews), Canadian Health Research Collection, PAIS and EIHR. Very high sensitivity terms were used from known relevant literature and optimized for each database using additional MeSH (or equivalent) terms and customized syntax which combined terms regarding rurality, maternity care, safety and outcomes. (See below)

Phase two included a modified pearling method intended to overcome potential limitations in the databases searched and to ensure comprehensive data on each review question listed above. In this phase, seminal and/or controversial papers in each of the review areas and from a variety of jurisdictions were used as centring 'pearls' or 'nodes' in looking forward in the literature (using Google Scholar and Web of Science for research citing said work) and backward (by examining the citations of each paper). Those papers found using this method were then subjected to the same inclusion criteria, abstract and full article review procedures as those found through the database searches.

The primary nodes used were as follows (citations as of March 10th, 2015 on Google Scholar):

- Accidental out-of-institution birth: Viisainen et al. 1999 (cited 42 times)
- Distance to Care: Grzybowski, Stoll and Kornelsen 2011 (cited 35 times)
- Psycho-social risk: Kornelsen and Grzybowski 2005 (cited 44 times)
- Safety of services without c-section: Lynch et al. 2005 (cited 22 times)
- Safety of services by midwives without local c-section: Van Wagner et al. 2007 (cited 64 times)
- Volume to outcome: Moster, Lie and Markestad 1999 (cited 47 times)

For each node, a map of the articles citing the node article was made. This citation map displayed the country origin of the data, the year of publication and how many citations it had received.[1] The intention of mapping was to determine the appropriateness of the node, as well as examine the reach and duration of the academic discussion on the given topic.

Considerable overlap between the two phases suggests a high degree of validity in the search and abstract exclusion process of phase one. Still, this supplementary method improves the confidence of the research team that jurisdictional limitations will not be a source of bias. More importantly, the research team has been able to gather the best available evidence on all of the anticipated considerations related to the phenomenon of providing service to rural and remote parturient women.

[1] According to Google Scholar at the time of the mapping in March 2015, coded into categorical variables.

Though often from discreet academic literature sets, each objective above contributes to the real world health services system for rural women.

Below are the basic search terms used in the phase one search. MeSH terms are shown with capitalization. Similar terms for other index structures were used. The search was maximized for sensitivity after a number of trials.

Keywords and MeSH terms within a single concept below were combined with 'OR' operators to maximize sensitivity. The combination of terms was structured as follows: (Maternity Services terms) AND (Rural and remote health services terms) AND ((Outcomes terms) OR (Safety terms)).

*Table 1.1: Search concepts and terms used in Phase 1*

| CONCEPT | Keywords | Reasoning |
|---|---|---|
| Maternity services | birth / or returning birth / or birthing on country / or pregnancy / or maternal health services / or perinatal services / or obstetric*<br><br>Pregnancy<br><br>(exp) Delivery, Obstetric | Appropriate terms were furnished to limit the search to maternity care. Terms were sought to maximize sensitivity. "Returning birth" and "birthing on country" are terms specific to literature subsets (post-colonial Indigenous maternity and Australian rural maternity respectively). |
| Rural and remote health services | rural / or remote<br><br>Rural Health<br><br>Hospitals, Rural<br><br>Rural Health Services | Rurality is defined very differently in various jurisdictions and varies with the type of study undertaken. The most sensitive terms were sought and are reflected to the left. "Remote" is a keyword that is also found in non-rural literature (e.g. remote monitoring literature), leading to some unmitigated loss in specificity. |
| Maternal and newborn outcomes | outcome*<br><br>(exp) Pregnancy Outcome | The use of the 'Pregnancy Outcome' MeSH term showed equivalent sensitivity to a keyword search and made the maternity terms redundant in some databases. Such effective indexing was not found in other structures. A keyword search showed greater sensitivity in that case and so was used in logical combination with maternity terms |

| | | where appropriate. |
|---|---|---|
| Patient safety | safe*<br><br>Patient Safety<br><br>Safety | It was found that outcomes from utilization or case-specific data will often include safety as a keyword. As well, safety was found as a keyword in cultural safety, subjective safety and holistic risk literature subsets. Index terms were ineffective in this search in most databases. |

## Search Results

*Table 1.2: Total Search results by database*

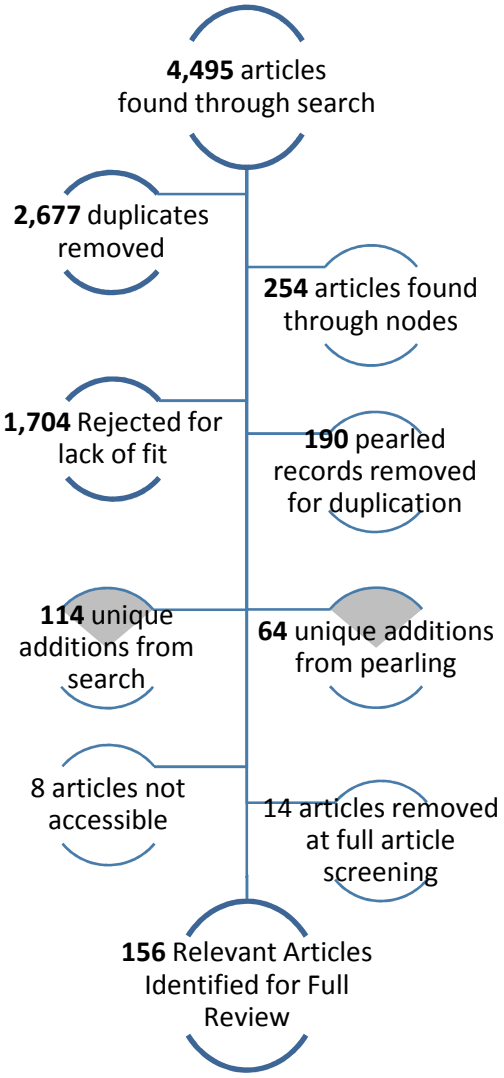
| Database | Outcome | Safety | Other |
|---|---|---|---|
| MEDLINE Ovid | 746 | 237 | |
| MEDLINE Ebsco | 376 | 235 | |
| EMBASE | 578 | 169 | |
| Pubmed | 724 | 299 | |
| CINAHL | 231 | 86 | |
| EBM Reviews (inc. Cochrane Reviews) | 466 | 184 | |
| CHRC | | | 95 |
| EIHR | | | See comments |
| PAIS | 44 | 25 | |
| Total | 3165 | 1235 | 95 |

There was considerable overlap in the results, as expected by the review team. A total of 1,818 non-duplicate records were compiled from the total 4,495 found in the above searches.

## Inclusion Criteria

Only articles written in the English language in developed settings were included. The nature of the data being sought pertains primarily to Canada, Australia, Norway, Scotland, England, New Zealand, and the United States, all jurisdictions in which most academic publications are written in English. Considerably shorter distances to care found in much of continental Europe made comparisons in the data more

challenging. However, all relevant literature from developed jurisdictions was included on the condition that it could be found in English. This included data from Sweden, Germany, the Netherlands, Finland, and France in addition to those nations listed above. There were no publication date restrictions for this review, although consideration was given to the potential for strained applicability according to age of the data and the system context at the time of its analysis.




A large majority of the results (1,704) were excluded for lack of fit. Primarily, these articles were from low and middle income developing nation jurisdictions where progress toward the Millennial goals for maternal and child health frame a large body of research. This was anticipated as part of a non-limited search on primary maternity. While Canada and other developed nations doubtlessly have much to learn from maternity care in these environments, the research question for this review is focused on the safety of primary services for a developed nation with public health care and regionalized services.

Less commonly, the search found evidence on remote fetal monitoring and data from higher-risk populations such as substance users, those with a high BMI and those attempting labour after a previous c-section. As noted above, the loss of specificity due to the dual meaning of 'remote' was anticipated and corrected with manual title and abstract screening. Literature on higher-risk pregnant populations in rural were excluded as they exceed the risk parameters for birthing without cesarean section backup.

Data on the safety of home birth were excluded for this same reason. The expectation in BC (as well as many other developed jurisdictions) is that home birth take place within thirty minutes of surgical services. The nature of this question – safety of services an hour or more from surgical support – precludes this arrangement. It is widely known that home birth is taking place without immediate access to surgical and emergency services in many jurisdictions, both inside and outside the system (Kornelsen and Grzybowski 2006). This data is not in the academic or grey literature. Therefore, literature on the safety of home birth was excluded from consideration.

Finally, there exists a large body of research spanning multiple decades regarding prospective labour risk assessment tools. A handful of such articles appeared in this search structure and were considered

carefully by the review team. Importantly, prospective risk assessment is an identified mechanism of high quality care and good outcomes in rural and primary services. However, experience with this literature among the review team and the consulting expert indicated that it held very limited insight for this review. This literature is focused on developing a model of risk assessment. As the breadth and duration of the academic discussion indicates, a lasting, instructive model has not been designed, nor has one been implemented in physician or midwife training or best practice decision making. Provider discretion is still expected in this field beyond the consensus indictors of increased intrapartum risk such as BMI>38, diagnosed chronic health conditions, episodic acute illness, pregnancy-induced health conditions, history of adverse pregnancy outcomes and substance use (PSBC Maternal and Fetal Levels of Service Classification Tool 2012). Consequently, this literature holds little insight into how providers are making risk assessment decisions and is instead an on-going discussion of how they might make such decisions more accurately in a hypothetical future.

## Type and Nature of Included Data

In a realist review, there are no inclusion limitations according to research design as various approaches to evidence gathering can yield a rich overall picture. In accordance with that tradition, this review includes expert opinion, case study data, cross-sectional population data, cohort data (almost exclusively retrospective cohort designs), as well as some randomized trials of course of care and systematic reviews of both qualitative and quantitative evidence. As well, grey literature was considered from relevant policy, regulatory and surveillance bodies to ground the findings in the current reality of maternity care and pregnancy outcomes in BC and Canada.

Once all relevant information was included, the quality of evidence was determined via research design and coherence of results. As each research design has its strengths and weaknesses when it comes to constructing knowledge, it became important to look at what methodological approaches were being used in what contexts. The majority of studies applied a type of observational design (cohort, cross-sectional and case-control studies) where a database of clinical outcomes was examined retrospectively based on the researcher's frame of inquiry and the variables that were available for study. A smaller portion of studies applied qualitative design to understand the experiences and contexts, for example cultural and geographical, of the women who utilize the services and to some extent that of the providers. Qualitative designs apply a social constructionist approach that emphasizes the impact of culture and context in understanding societal structures, in this instance health services, and the knowledge that underpins them.

Mann (2003) notes that the observational studies are appropriate to investigate prevalence, incidence, associations, causes and outcomes when there is little evidence on a subject; they can be a cost effective way of generating hypotheses with available data before embarking on a large research initiative. Their weakness however, is a lack of contextual information to interpret their findings. Indeed, using a database of variables that has been designed to collect feedback on a system we are trying to improve may not shine light on new and improved ways of running the service.

That the bulk of research work we reviewed is composed of observational studies hints at the nascence of this research area. Conclusions from observational studies should be seen as a building block to

further knowledge construction and certainly acknowledged for the substantial work that has been done in identifying important variables for further research. Caution is warranted however, in making system-changing decisions based on these results alone; more work needs to be done to put these variables in context. Qualitative research often provides a more complete account of that context and provides essential accounts of women's experiences, impactful cultural factors, geographic variations and the complex interplay of socio-demographic factors. We have privileged the conclusions of these studies, when well designed, to frame our interpretations of the observational studies included in the review.

# Findings

## The Safety of Rural Primary Maternity Care

### Overview

In BC, two models of primary maternity services exist – that led by general practice physicians and that led by midwives in a continuity of care, caseload model. Midwifery has been legalized, regulated and publically funded in BC since 1998 and is growing quickly. Currently, 18% of BC deliveries have midwife involvement (http://www.cbc.ca/news/canada/british-columbia/midwives-from-other-countries-to-practise-in-b-c-1.2900718) with considerable annual growth since 2000 (PSBC Special Report, *Midwifery in British Columbia*, June 2008). There are 216 registered midwives in the province (Canadian Association of Midwives, 2015).

In rural BC, however, midwife-led services remain less common. Of the 196 registered midwives in 2013, 30% self-identified as rural practitioners (Kornelsen and Ramsey 2013). A total of 8% of rural parturient women had a midwife involved in their care between 2003 and 2008 (Stoll and Kornelsen 2014). A number of rural communities have access to registered midwives, but just two sites currently exist where midwives are the main providers of maternity care and surgical backup is more than one-hour away (Haida Gwaii and Salt Spring Island) (PSBC 2015, Facility Maps by Delivery Provider).

When considered against national numbers, midwifery is highly subscribed in BC. Canada wide, just 5% of births are attended by midwives (4% of rural) (CIHI 2013)[2]. In contrast, family physicians have been involved in maternity care in rural British Columbia at higher rates than in the rest of Canada (CIHI 2013).

There exists considerably more data on the safety of midwife-led primary care than physician-led primary care. Historically in Canada, Australia, the United States, Scotland and other countries, rural generalist physicians models of maternity care have included GPs with enhanced surgical and/or anesthesia skills to provide local c-section. Considerable research exists on these providers and is reviewed in a previous APRU realist review (Kornelsen and McCartney 2014). Physician-led primary care model data is often slightly older – dating as far back as the earliest pressures toward centralizing and standardizing maternity services among developed nations in the 1970's and '80's.

[2] Note: midwifery is not regulated or funded in every province and territory of Canada. Publicly-funded midwifery care is available in B.C., Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Nunavut, Nova Scotia, and the NWT (Midwives Association of BC).

For myriad reasons, including the particular culture of risk present in Canada, Australia and other developed nations (Kornelsen and Grzybowski 2012), specialist-led services are the gold standard against which other services are measured. It is likely for this reason – namely, onus – that both midwife- and physician-led primary services are compared to specialist services.

Studies on the efficacy of the midwifery model in rural environments include data from Canada's arctic region, rural and remote Australia, and various European countries with uninterrupted histories of legalized midwifery. While much of the data in this section is case study based, high level comparative reviews and randomized trials were found regarding the quality and safety of midwifery services in urban environments. A brief overview of this data is provided for context, as it shows equivalent clinical outcomes, reduced intervention and improved client satisfaction compared to other models of care. This is the promise of rural midwifery as well, though the data is less complete.

In considering physician-led models of primary care, considerable population level data is examined. This is our most aggregated level of data and reveals the importance of referral and transfer for higher-risk mothers and newborns from multiple settings and time periods. Although related, studies on outflow (the rate of women leaving a community for care) are included in the sections on Distance to Care and Sustainability, with the following section focused exclusively on the outcomes services without local access to cesarean section.

## Physician Led Services

Key Points

1. Service closure or crisis negatively impacted neonatal mortality in primary communities between 2000-2007, underlining the importance of service stability
2. High-quality outcomes depend on system supports like relationships with providers in referral communities and inter-facility transport services;
3. Neonatal morbidity is impacted by distance to services, outflow and evacuation from rural communities;
4. Intrapartum transfer decisions are made significantly earlier by rural family physicians compared to urban family physicians.

## Population Data vs. Institutional Data

This important difference deserves a word of clarity.

Population data looks at the outcomes of all people in a given catchment regardless of where they received services or eventually gave birth. Institutional (or utilization) data examines outcomes at specific hospitals or institutions. In a primary care environment, as many as 2/3rds of women will be referred to higher levels of care based on risk screening criteria for possible delivery complications or emergencies. Using institutional data, that 2/3rds of higher risk pregnancies should appear in referral hospital data (reflecting good diagnostic screening and referral).

Using population data, Grzybowski, Stoll and Kornelsen (2013) are able to show outcomes for people according to what services are available where they live, regardless of where they eventually give birth. All things being equal, populations should have the same health outcomes.

When population outcomes differ, we look for reasons including demographics, health behaviours, access *to* services and adequacy *of* services. Grzybowski, Stoll and Kornelsen (2013) argue service stability may also be a cause of problems.

The data on physician-led services is a mixture of population and institutional data – the former typically being high-powered statistical studies of birth outcomes according to chosen organizing frames and tested mechanisms and the latter often using a case study approach.

A recent Canadian paper compares population outcomes of over 150,000 rural births by catchment in the provinces of BC, Alberta and Nova Scotia between 2003-2008 (Grzybowski et al. 2015). Data was reported for eight care models: no local care (>4 hours to care; 2-4h to care; 1-2 hours to care), primary only care (with access to surgical services greater than one hour away) and various surgical-supported models including specialist care. Controlling for maternal age, parity and pregnancy complications, those communities without any local care showed the highest rates of perinatal mortality and prematurity (<37 weeks). Those communities with primary care more than one hour to surgical support achieved better outcomes than those communities without any local intrapartum services and similar outcomes to those communities with local surgical services (Grzybowski et al. 2015). Those women without local surgical services (both with and without local primary care) had lower rates of c-section regardless of where they gave birth across the three provinces. (Grzybowski et al. 2015).

This study builds on a BC-specific study by Grzybowski, Stoll and Kornelsen (2013) that examined population outcomes for rural women using a similar methodology between 2000-2007. In the 2013 study, more analytical focus was placed on communities served by family physicians with enhanced surgical skills (FPESS or GPESS). As well, lone parent status and social vulnerability (catchment-level proportion of First Nations people and Population Data BC social vulnerability score) were controlled in the 2013 study.

In total, 4,569 births were recorded across 16 catchments with primary only services, of which less than 30% were delivered locally (Grzybowski, Stoll and Kornelsen 2013). This study is of particular importance to this review because it is the only study to find that women from communities with primary care had a greater chance of perinatal mortality relative to those without any local care. This finding is not statistically significant[3], but it leads the authors to examine the data more deeply and reveal an important insight regarding service stability and outcomes.

Key health services changes occurred in BC during this study period. The authors note that "[o]n careful examination of the individual communities… we found that a number of the deaths occurred in communities that were in crisis during the study period and transitioning into closure." (Grzybowski, Stoll and Kornelsen 2013, 128). During the study period (2000 to 2007), a provincial election occurred which resulted in the re-organization of provincial health services into five regional health authorities. Further, the period of 2000 to 2015 saw a rapid decline in the number of rural maternity services, with

[3] This finding is presented in the paper as statistically significant. However, those calculations are based on over 87,000 births across six service strata. When isolating the comparison between primary and no local services, this finding becomes non-significant. This finding is based on a secondary calculation using published data from the article. A 2x2 chi-square test was performed, finding x=1.176, p=0.2781.

as many as 24 community services out of 80 losing services.[4] Closure is often the result of staff shortages, but BC also saw many planned hospital closures during this time. As is seen in other jurisdictions (Blondel et al. 2011; Kruske et al. 2015; Engjom et al. 2013), smaller units were the most commonly closed with the system expectation of catchment drainage into larger referral facilities.

Mortality rates are not the only marker of birth outcome found in Grzybowski, Stoll and Kornelsen (2013). In fact, rates of prematurity (<37 weeks gestation) among rural women with local primary care were comparable to the rates found among women with local surgical care models (66 per 1,000 with Primary Care; 68-69 for GPESS, mixed generalist and specialist, and general surgeon supported models; 76 for OB/GYN models), and considerably better than the rate found among women with no local access to services (87 per 1,000). Further, the rate of admission to tier-three neonatal intensive care units (NICU-3; high acuity) were 50% higher among women with no local care (6 per 1,000 compared to 4 among those with primary care access and 4 among those with local specialist care) and the average number of NICU-3 days were double (71 without local services to 35 with local primary services). NICU-2 (low acuity) admission and days in care were higher for both those with local primary care and those without any local care, likely reflecting the impact of distance to services, outflow and evacuation.

Proving the safety of rural primary maternity care while some of those services are unstable is a challenge found in Grzybowski, Stoll and Kornelsen (2013) because of the volatility in health services in BC during the study period of 2000-2007. Nevertheless, the data demonstrates a clear benefit of local maternity services to mothers, their neonates and the health system. Women from communities with any form of maternity care showed lower rates of prematurity, lower rates of admission to high acuity NICUs and shorter stays in high-acuity NICUs (Grzybowski, Stoll and Kornelsen 2013).

Across three jurisdictions (where the timing of health services changes are staggered) using 2003-2008, Grzybowski (et al. 2015) evinced a clear pattern in what is the strongest evidence to date that rural maternity services improve population health outcomes over centralization with and without local surgical services. Without local services, perinatal mortality and rates of prematurity increase (Gryzbowski et al. 2015).

A case study by Simonet (et al. 2009) from the remote arctic setting of eastern Nunavik provides evidence that physician-led primary care is safe in remote environments relative to population standards. Examining nearly 1,200 Inuit births from seven Inuit communities around Ungava Bay between 1989-2000, the crude neonatal (0-28 days) mortality of 5.0/1,000 (Simonet et al. 2009). Excluding very preterm (<28 weeks) neonatal mortality, the rate of neonatal loss in the Ungava communities falls to 3.4/1,000 – well below regional standards. As well, the primary service delivers 67% of the local births while transferring 28% (Simonet et al. 2009) to the nearest surgical services over two

[4] There are a host of difficulties in determining the number of closures. For example, the current organization in charge of tracking the number of facilities began their work after 2001. PSBC Surveillance Data from 2002/03 shows 79 hospitals with births. As of 2013/14, 62 hospitals had births, of which 12 were specifically noted to not have planned obstetrical services. It is not noted in available surveillance data how many hospitals with births in 2002/03 did not have obstetrical services. Further, services occasionally re-open due to staffing or service pattern changes and so these numbers are not fixed. They are often cited as 'over 20 closures' for this reason.

hours away by plane to Montreal (Frame 2014) (5% missing data). With just over 100 births per year in a remote area of exclusively fly-in communities, the other most plausible maternity model is complete evacuation (no local services), the historic reality for Nunavik.

Affirmation of the safety of physician-led primary care model can be found internationally as well. Population data from Iceland shows that those without any local maternity services had higher perinatal mortality than those with primary services (Haraldsdottir et al. 2015). Leeman and Leeman (2002) examined historical data from a 37-bed rural hospital without c-section capability in New Mexico staffed by general practice physicians and a part-time nurse-midwife. Transfer time to a surgical facility was 40 minutes by ground travel. The pre-labour transfer rate was 25.6% among the 1,132 women to give birth at the facility between 1992 and 1996, while the intrapartum transfer rate was 9.5%. No adverse outcomes occurred due to lack of surgical facilities in the Leeman and Leeman (2002) study and the rate of emergency c-section (7.3%) was roughly one-third the national average in the United States at that time.

Leeman and Leeman (2003) identified the expectation of consensus between two physicians regarding the need for intervention and the support of specialists at two referral sites as mechanisms that ensured patience with the process of labour and ultimately led to low intervention rates while maintaining strong outcomes.

Further research by Rosenblatt, Reinken and Shoemack (1985) identified high quality relationships between generalist physicians in primary care units and specialists at higher tiers of service as a key mechanism in a functional system of regionalization in New Zealand.

High quality outcomes are noted to depend on system support as well as provider- or model-specific safety. The state of a given provider's relationships with the providers in referral communities and the functioning of the inter-facility transport system could impact outcomes, and may be compromised in communities undergoing crisis or intermittent service interruptions as seen in Grzybowski, Stoll and Kornelsen (2013).

Historical data of three types from four different jurisdictions also indicated the effectiveness of physician-led primary maternity care, even without surgical support. In Canada, a prominent study on this topic was undertaken by Black and Fyfe (1984) in Northern Ontario. Using population data, this study sought to examine whether safe care was being provided by obstetric units with low volumes and without some of the conditions suggested as ideal at the time. These conditions included 24-hour availability of cross-matched blood, 24-hour laboratory and radiology services, and the availability of anesthesia and c-section within 30 minutes. Level 1A hospitals (providing delivery services without local access to anesthesia or c-section) served nine communities in the study, delivering 57% of the 1,165 neonates (Black and Fyfe 1984).

The primary finding of this seminal study was that neonatal loss (including stillbirth, early and late neonatal mortality) was not significantly different between levels of local service (Black and Fyfe 1984). Though not identical, the rates of loss were very similar across the 24,000 births in communities with different local service levels. Communities with 1A local services had a neonatal loss rate of 13.73 per

1,000 newborn admissions (95% CI 7.85-22.30). Examining early neonatal death (0-7 days) exclusively, those with 1A local services experienced a crude rate of 5.19 deaths per 1,000 live births, compared to a crude rate of 4.62 experienced by those with local specialist services (secondary data calculation from Black and Fyfe 1984). The findings of this study have to be considered in the context of two sub-analyses reported briefly by the authors: women living in non-reserve communities more than 1-hour from a hospital accounted for 636 newborns and a neonatal loss rate of 25.15/1,000 admissions and women residing on First Nations reserves had a loss rate of 14.55/1,000. These findings put women from First Nations reserves at the high end of loss rates for all communities and shows that rural women without any local care within one-hour had a loss rate twice as high as the observed population rate of 12.27 (95% CI 10.89-13.65) (Black and Fyfe 1984).

A major concern in planning for levels of maternity care is accurate referral of maternity care based on risk. Rosenblatt, Reinken and Shoemack (1985) studied the institutional outcomes of different levels of maternity units in New Zealand and found that the Level 1 units (primary units staffed by general practitioners and nurse midwives) had lower birth-weight specific mortality than the units to which they referred, indicating that regionalized referral was effectively moving higher risk cases to higher resourced environments. The observed perinatal mortality rate among neonates >2500gms in primary units was just 3.2 per 1,000 births, almost half the rate observed in tertiary units (6 per 1,000) (Rosenblatt, Reinken and Shoemack 1985). Only 2.8% of babies born in primary units weighed less than 2500gms, compared to 8.2% of newborns in tertiary units. Further, 0.2% of babies born in primary units had a very low birth weight (<1500gms), compared to 1.6% of babies born in tertiary units. Primary units had a higher rate of mortality for very low birth weight neonates (547.8 per 1,000 vs. 408.7 per 1,000), but it was both statistically non-significant and remained lower than secondary units (regional referral units; 581.5 per 1,000). Clearly, tertiary units were a critical part of improving outcomes for very sick neonates while primary units were safe precisely because of early referral and transfer.

A similar pattern emerged in Australia before regionalization had been formalized. Neonatal mortality was more than seven times more likely in units larger than 100 annual births for those weighing 2500-3000 gms (Lumley 1988), showing the impact of screening and referral from small communities. Controlling for late transfers, larger centres showed a gradient of improving outcomes for all low-birth weight babies as well as an increasingly proportion of low-, very low- and extremely low-birth weight infants despite Australia not having the formal regionalization policy found in New Zealand at the time (Lumley 1988). However, early transfer of low-birth weight neonates to higher resourced units was not as consistent in the de facto Australian system examined by Lumley (1988). Lumley concluded in 1988, "[i]t is also of interest that effective regionalization need not involve the closure of small maternity units on the grounds of safety" (p392).

One smaller American study from the same time period used a unique methodology to examine the same mechanism of efficient risk referral and transfer. Chaksa (et al. 1989) compared morbidity of ~300 births from each of a rural, peri-urban and urban primary care family physician-led practice and assigned birth outcomes to the site at which pregnancy diagnosis was made rather than where the birth occurred. Interestingly, "[a]lthough there was no significant difference in timing of total referrals overall, [urban family physician] intrapartum transfers occurred significantly later than [rural family physician]

intrapartum transfers… 20/57 transfers during stage 2 labor in [urban family physician practice] and 9/58 in [rural family physician practice]" (Chaksa et al. 1989, p155). The urban family physicians shared a building with obstetrician specialists, while the rural site was a 20-bed hospital 30 minutes from the referral site with surgical capacity. The urban practice also transferred more low-risk and fewer high-risk patients than the rural practice, and a higher proportion of transferred patients by urban physicians had an instrumental delivery. Rates of spontaneous vaginal delivery were higher for patients of the rural practice, with rates of both forcep and surgical delivery lower (Chaksa et al 1989). The Chaksa (et al 1989) study provides evidence that rural family physicians employed earlier transfer and more aggressive risk screening to ensure good outcomes than did their urban family physician counterparts.

The data on physician led service safety clearly shows the importance of referral and transfer of higher risk women and newborns while providing some evidence of the importance of considering distance and social vulnerability in understanding model safety. As well, we are left to consider the potential of service stability as an important mechanism of good primary care, including high quality communication around formalized mechanisms for referral and transfer and the availability of personnel familiar with and comfortable in a low-resources setting.

***Decision to Delivery Intervals (DDI) for Emergency C-Section***

International best practice regarding 'decision to incision' timing originates from guidelines developed by the American College of Obstetricians and Gynaecologists (ACOG) recommending maternity units have the capability to begin a c-section within 30 minutes. This guideline was based on member surveys in the 1970's. In a review of international evidence regarding the clinical efficacy of DDI <30 minutes, Homer and Catling-Paul (2010; 2012) found neonatal outcomes were not improved when decision to delivery timing was less than 30 minutes, and many studies found neonatal outcomes were actually poorer. Little difference was found between 30 and 75 minutes. International evidence does not support a defined interval of 30 minutes in most cases. Referral to the appropriate level of care according to antenatal risk screening may be a more appropriate mechanism for ensuring high quality outcomes.

## Midwife Led Services

Key Points

1. Midwifery-led care shows lower intervention rates while maintaining strong outcomes for women in remote environments.
2. The importance of inter-professional relationships is highlighted for midwives relative to generalist physicians due to differences in birth philosophy.
3. Midwifery-led models have the capacity to incorporate western medicine knowledge systems alongside values and skills regarding traditional, culturally-specific birth practices, decreasing psycho-social risk and increasing cultural safety.

Much of the applicable literature for this review comes from very remote jurisdictions – the Canadian arctic prominently, as well as the Norwegian arctic and the Australian outback. There is a concern for a publication bias in these results as the impulse to publish is often to share positive results. The nature of rural and remote primary maternity services precludes large, randomized studies as clinical indication for higher levels of care requires early detection, referral and support.

Nevertheless, the positive outcomes found from midwives serving low-risk women in remote environments around the world are in line with the findings of large, randomized trials performed in urban settings with immediate access to emergency tertiary care. In this section, we consider four distinct areas of inquiry that, together, indicate the safety of midwifery-led primary maternity care for rural women: 1) the safety and efficacy of a caseload midwifery model of care as shown in highly powered urban studies; 2) the safety of primary care relative to care with immediate surgical capacity; 3) the safety of primary care relative to no local care (i.e. expected 100% evacuation); and 4) the facilitators of success when implementing midwifery-led care in rural environments.

The safety of midwifery led maternity care in urban settings is widely established in the literature. Numerous controlled trials (CTs) and randomized controlled trials (RCTs) have been completed, resulting in five systematic reviews of midwifery outcomes being available. A meta-review was also available (Sutcliffe et al. 2012) reporting on a total of 21,105 births across 29 separate trials from Canada, Australia, the United States, and the United Kingdom. This meta-review compiled the highest quality evidence on caseload midwifery practice and found no associated adverse outcomes for low- and mixed-risk women (Sutcliffe et al. 2012).

In fact, from the perspective of normal birth, those randomized to midwifery care showed improved outcomes, mostly lesser use of instrumental delivery and pain relievers (Sutcliffe et al. 2012). Another Cochrane Review examining 13 RCTs and 16,242 women (Sandall et al. 2013) supports these results – the authors found no increased likelihood of adverse outcomes for women or their neonates when randomized to a caseload midwifery model. Additionally, there were decreases in instrumental deliveries, episiotomy and analgesia use. The table below (Table 1) is reproduced from Sutcliffe (et al. 2012) detailing the specific benefits of caseload midwifery found among the 29 trials examined.

**Table 1: Reproduction from Sutcliffe et al. 2012**

Table 3: Maternal physiological outcomes by direction of evidence.

| Evidence of improved outcomes with midwife-led care | No evidence of a difference between care providers | Outcomes with mixed evidence [of improved outcomes and no difference] |
|---|---|---|
| Avoidance of vacuum extraction and/or forceps delivery | Caesarean section | Pregnancy induced hypertension |
| Avoidance of episiotomies | Antepartum haemorrhage | Use of amniotomy |
| Avoidance of regional analgesia/anaesthesia | Postpartum haemorrhage | Perineal injuries |
| Avoidance of intrapartum analgesia/anaesthesia | | Induction of labour |
| Avoidance of both analgesia and anaesthesia | | Augmentation/oxytocin during labour |
| Avoidance of opiate analgesia | | Manual removal of the placenta |
| | | Use of intravenous fluids |
| | | Anaemia |
| | | Malpresentation |

This high quality evidence demonstrates the safety of caseload midwifery in urban settings in developed nations. At the same time, however, these systematic reviews of RCTs actually hide many of the mechanisms of good quality, safe care and offer little insight into how transferability might be accomplished in building or supporting a caseload midwifery service. Further, while the countries involved in the studies share many similarities, where and how midwives practice in each nation is historically conditioned and broadly dissimilar. The shared goal of normal birth is one of the few unifying conditions.

The purpose of these studies for this review is small but important. The findings reviewed below of successful models of rural and remote primary midwifery without local c-section show similar outcomes to the urban models above – namely, a focus on normalizing birth, reduced rates of intervention, reduced outflow compared to physician-led primary maternity services and a high-quality outcomes for mother and baby. The confluence of data on midwifery-led care between urban and remote shows us that this model of care is working as intended in the case studies reviewed below.

Eight studies were reviewed that offer insight into the contexts in which midwifery operates and the facilitators of safe midwifery care without local access to surgical support. Van Wagner's studies (et al. 2007; et al. 2012) of the Innulitsivik midwifery services along the Hudson Bay coast of Nunavik in Canada demonstrates an outstanding remote model within a very specific context. Frame's (2014) study compares the Innulitsivik model to two additional models: midwifery-led care in Fort Smith, North West

Territories, and an evacuation model in Hay River, North West Territories. Norum (et al. 2013) discusses the maternity care in the sub-arctic areas of Norway. Holt (et al. 2001) compares the outcomes of a midwifery model that is implemented as an alternative to the evacuation model in the very remote Lofoten Islands of Norway. In BC, Stoll and Kornelsen (2014) looked at outcomes for rural women with a midwife involved in their care. As well, Kornelsen and Ramsey (2014) examined the outcomes from Salt Spring Island, a solo-midwife community and one of two sites in BC with exclusively midwife-led maternity services. Lastly, Quinn (et al. 2013), perhaps most explicitly, notes the prospective challenges and facilitators of introducing a midwifery model of care into remote areas by gathering the opinions of rural maternity clinicians.

*Innulitsivik Midwifery*

The Innulitsivik midwifery services along the Hudson Bay coast of Nunavik, Canada is an example of a successful remote model. This model calls for fewer women to travel to care, and those who are traveling to go shorter distances.[5] The current midwife-led services began in Puvirnituq in 1986 amid community ground-swell and activism – more than a decade before midwifery was legalized in the rest of Quebec – and expanded to Inukjuak (1998) and Salluit (2004) more recently. Together, they serve a low density population of approximately 5,500 mostly Inuit people living along the eastern coast of Hudson's Bay above the $55^0$. In 1983, 91% of Hudson coast women were evacuated for care to hospitals outside Nunavik (Van Wagner et al. 2007), while today just 13.7% of women give birth outside of Nunavik and 17.8% of women leave Nunavik for maternity care, including postpartum transfer (Van Wagner et al. 2012).

Collectively, the three centres provide birth services for roughly 200 births annually without local surgical capacity and more than 1500km from the referral hospital in Montreal (Van Wagner et al. 2007). Approximately 25% of women giving birth in these centres still travel for care from their smaller communities along the Hudson Bay coast, but receive care much closer to home, in one of the Inuit languages, provided by Inuit Midwives (Van Wagner et al. 2007).

The safety of the Innulitsivik midwifery services is well documented. Vicki Van Wagner has conducted two studies on the services showing a likely improvement in outcomes over time. Between 1986-2005, 80% of local births took place in Nunavik (Van Wagner et al. 2007) and up to 86% in the years 2000-2007 (Van Wagner et al. 2012). At Inukjuak specifically, local delivery rose from 48% to 79% between opening in 1998 and 2002. An internal audit of all three sites from 2002-2005 found a 9.3% maternal transfer and 1% neonatal transfer, with 84% of those going to Montreal and the rest to the largest midwifery site at Puvirnituq (Van Wagner et al. 2007). This is in line with other primary sites around the world (Frame 2014; Grigg et al. 2015; Holt et al. 2001; Kornelsen and Ramsey 2014; Leeman and Leeman 2002). However, the found rate of < 5% urgent intrapartum transfer is unusually low (Van Wagner et al. 2012; Houd, Qinuakuak and Epoo 2004), and may reflect the increasing caution of providers according to level of remoteness.

[5] A larger discussion of this and other potential models of care for rural and remote primary care can be found in Kornelsen and McCartney (2015).

Surgical intervention has been uncommon in this population under all models of care, with a 4.1% rate of c-section noted in 1983 during the period of total evacuation, declining steadily to 2.1% in the period 2000-2007 (Van Wagner et al. 2012). Van Wagner (et al. 2012) notes that Nunavut's rate is just 10% territory-wide, further showing the unique characteristic of the Inuit population.

Most critically, the rate of stillbirth and perinatal mortality are found to be well within normalized standards for the population. Between 1986 and 2004, the rate of total neonatal loss was 9 per 1,000 (21 losses in 2,253 births planned for Nunavik). Canada as a whole recorded a rate of 8 per 1,000 in the same period, and more comparable populations showed worse outcomes – Nunavut with 11 per 1,000 and the Northwest Territories with 19 per 1,000 (all numbers taken from Van Wagner et al. 2007). In an ethnography of nursing practice in one northern First Nations community, Tarlier (et al. 2013) found maternal-child health outcomes below levels expected for developing nations under the UN Millenium Development Goals. In the period 2000-2007, one maternal death occurred in Montreal after planned pre-natal transfer for twins (Van Wagner et al. 2012). Four fetal deaths (2.9 per 1,000) and five neonatal deaths (3.9 per 1,000) occurred, which compare favourably with Canada's 2005 national rates of 6.0 and 3.7 per 1,000 respectively (Van Wagner et al. 2012).

It is not entirely clear how to reproduce the mechanisms of the successful Innulitsivik model. The successes of midwifery services in Nunavik include a radical change in the psycho-social risk (including cultural safety) to women, a shortening of distance to care from 4-8 hours by plane to local care for 75% of women, lower rates of intervention while maintaining high quality outcomes and a sustainable model staffed by locally recruited and trained Inuit midwives. Rankin Inlet attempted to replicate the model but struggled to find midwives prepared for the expanded role of a remote community and equally struggled to attract traditional midwives with a top-down service design approach (James et al. 2014).

In addition to the historical circumstances of community activism in the creation the Innulitsivik model, Douglas (2010) contends that the very epistemology of the model is unique. The model began in Puvirnituq, where traditional midwives had worked in the Nunavik nursing stations during the years of evacuation and internalized the skills required for a western system of regionalized medicine alongside their values and skills regarding traditional birth (Kornelsen and McCartney 2015). In Van Wagner's work, adequacy of primary care is shown relative to population standards and the historic model of evacuation. Recent research by Frame (2014) goes further to compare the outcomes of these primary models to like-communities with no local primary care.

*Fort Smith, Hay River, and Innulitsivik Compared*

Frame (2014) examined outcomes in Canada's Western Arctic by comparing the midwifery service at Fort Smith of the Northwest Territories to both the Innulitsivik midwifery program and to the community of Hay River, Northwest Territories where all women must evacuate for intrapartum care. This study is unique in the literature for comparing three services in context.

Midwifery services began in Fort Smith in 2005 with 66% of parturient women attending the service in the first year, 80% in the second year, and 100% of local women using the service in each subsequent year. Fort Smith is a two-hour transfer to the referral hospital at Yellowknife.

Important demographic differences described by Frame (2014) highlight the uniqueness of the Innulitsivik model. The women of Fort Smith were on average older (mothers <20 years old: 14.3% in Fort Smith vs. 31.1% in Nunavik), and were less likely to have a parity >4 (1.1% vs. 11.8%) compared to Nunavik. Fort Smith women were also ethnically more diverse (40% First Nations, 37% non-Aboriginal, 17% Metis and 7% Inuit/Inuvialuit) compared to the Nunavik cohort (99% Inuit/Inuvialuit). This data was not captured for women from Hay River.

***The Impact of Prenatal Care?*** *Frame (2014) found that women serviced by the local midwifery services in Fort Smith had an average of 13.9 prenatal visits by an average of two care providers. Women from Hay River had a mean of just 9.3 visits by a mean of 4.8 care providers. Continuity, as well as frequency and cultural appropriateness, were found by Bar-Zeev (et al. 2014) to be key factors of quality in antenatal care among remote Australian women. In a large population study of Washington state births, Larson, Hart and Rosenblatt (1992) found the number of prenatal visits and the quality of prenatal care were each consistently lower for rural (vs. urban) women, potentially contributing to a persistent outcomes disadvantage – a disadvantage found to be most pronounced among high outflow communities without local maternity services in study of Washington state by Nesbitt (et al. 1997).*

In the Northwest Territories (NWT), travel costs for elective transfer from Fort Smith to the referral hospital are covered. In Nunavik (and most Canadian provinces), only those travel costs incurred because of medically necessary referral and transfer are reimbursed. The NWT policy allows women greater freedom to choose their place of birth. Of the 288 women in the original sample, 74.3% (*n*=214) were deemed appropriate for birth in Fort Smith. Fifty-five of those women chose an elective transfer at 37 weeks, with 35 electing to deliver at a Level 2 facility and 15 electing to deliver at a tertiary unit. Of the 138 (43.4%) women who remained in Fort Smith at the onset of labour, 12 (8.7%) were transferred to the Level 2 facility in Yellowknife intrapartum – consistent with other primary sites noted above.

The Innulitsivik sample performed well above the midwifery model in Fort Smith: neonates in Fort Smith were more than twice as likely to have a 1-minute APGAR score <7 compared to neonates in Innulitsivik.

Frame's (2014) core finding of equitable safety outcomes between the local midwifery services at Fort Smith and the evacuation model for Hay River has arguably been part of Hay River recently launching its own midwifery service. At the same time, the study gives us insight into the value of midwifery to the health system as well as to remote women.

*Lofoten Islands*

Reduced intervention after a switch to midwife-led care was also found in a unique study from the Lofoten islands above the Arctic Circle in Norway. Holt (et al. 2001) documented the first year of what was termed a 'pragmatic trial' of midwifery care for a remote population of 23,000 people five hours

from the referral hospital by ferry and car. Three fixed wing ambulances (including one dedicated to the referral hospital) or a search and rescue helicopter might be used (approx. 30 minutes each way). Prior to the trial, Lofoten hospital cared for roughly 300 births and 35 c-sections per year, with high risk women still referred to the mainland. The 2-year trial was launched in 1997/98, when Lofoten hospital re-organized care to be a midwife-led service while maintaining two surgeons and an obstetrician on-call.

Holt's (et al. 2001) study was designed primarily to evaluate the selection process for trial and to ensure good outcomes. Using a prospective, population-based study design, the maternity unit defined its desired outcome as a non-operative delivery at 35-42 weeks gestation to an infant not needing resuscitation (Holt et al. 2001). Of the 628 parturient women from the four communities on the Lofoten islands, 435 (69%) gave birth at the midwife managed unit. A further 152 (24.2%) were screened as most appropriate to deliver at the referral hospital, and 41 (9.4% of those delivering locally) were transferred to the referral hospital (27% of those because of request for epidural). Only 8 of the 484 women offered a delivery attended by a midwife at the modified Lofoten unit chose to travel to the referral hospital instead.

Remarkably, the desired outcome was achieved in 94% of local births to the midwife-led unit, and in 50% of births at the referral hospital (Holt et al. 2001). Thirteen c-sections were performed at Lofoten hospital during the study period by the on-call surgical support. The audit panel concluded that "most probably all 13 women might have been transferred to the central hospital without any appreciable risk for fetus or woman" (Holt et al. 2001, 209). Further, the selection process appropriately confined higher risk deliveries to the referral unit, with 1-minute APGAR < 8 unlikely in the midwife-led unit (OR 0.3; 95% CI 0.17-0.51) and 5-minute APGAR < 8 being very unlikely (OR 0.07; 95% CI 0.07-0.33).

The population also saw absolute declines in rates of intervention. Comparing the period prior to re-organization (1992-1996) to the study period (1997-98), intervention rates for all births by women from the Lofoten islands declined from 21.2% to 16.4% (OR 0.73; 95% CI 0.57-0.93). As well, rates of c-section for the population declined from 15.8% to 11.8% (OR 0.71; 95% CI 0.54-0.94). Given that more than 2/3rds of women were able to birth locally with a 94% rate of non-operative delivery of a healthy neonate, the authors conclude, "[t]his

## Adverse Outcomes

Perinatal and maternal mortality are very rare events in Canada – even more so among relatively healthy babies and mothers. Thus, small data sets such as case studies are often not sufficiently powered to determine statistical differences in rates of sentinel events.

It can be important to keep in mind that while some of the other so-called outcomes used in the literature are, indeed, outcome measures (e.g. blood loss, severe perineal tearing, APGAR scores), others are intervention measures. Intervention can be indicated as necessary to avoid a poor outcome but is more expensive for the health care system and can lead to longer, more difficult recoveries for mother and infant. Still other measures are pregnancy process measures, such as prematurity, low birth weight and other factors correlated with morbidity and mortality. These may not reflect intrapartum service quality as much as prenatal care, stress, health behaviours during pregnancy, genetic and environmental factors.

While not every adverse outcome can be predicted and not every adverse process measure requires tertiary care, we should expect to see lower rates of both intervention measures and higher-risk process measures in primary services due to appropriate triage.

model might be an alternative to centralization of births in sparsely populated areas" (Holt et al. 2001, 211).

This Lofoten Islands unit joined five other midwife-led maternity units in the administrative health district of Northern Norway – a mostly arctic area with a sparse population, inclement weather and seasonal darkness. Norum (et al. 2013) looked at the care quality measures for Northern Norway between 2009-2011 but was not able to disaggregate the results by model. At the birth unit level, each of the six midwife-led sites had better than average rates of 5-minute APGAR <7 and lower rates of vacuum and forceps delivery than the Northern region and Norway in general, owing in part to functioning regionalized care (Norum et al. 2013).

In a study of all primary maternity homes in Norway between 1995 and 1997, strong outcomes were shown including better than average 5-minute APGAR scores, low rates of intervention, low rates of blood loss and just 2 neonatal deaths across 1275 births studied (Schmidt, Abelsen and Oian 2002). These remote primary services were between 2 and 3.5 hours from the nearest hospital and delivered 218 babies who could not get to those hospitals due to inclement weather (recorded as 'unplanned') (Schmidt, Abelsen and Oian 2002). Presumably, these and perhaps other births would have been unplanned, out-of-institution births were the primary services not available. Among these unplanned births, no 5-minutes APGAR scores <7 were recorded.

*British Columbia*

Stoll and Kornelsen (2014) replicated the methodology used by Grzybowski, Stoll and Kornelsen (2013), stratifying rural population catchments according to their local maternity services, including no services (>2hrs to care; 1-2hrs to care); primary care without local (within 1hr) c-section; GPESS; Mixed model; or local general surgeon or OB specialist. The focus of the Stoll and Kornelsen (2014) study, however, was on disaggregating women who had midwives involved in their maternity care (though not necessarily as the primary birth attendant) to examine these outcomes exclusively. Between 2003-2008, 5,031 rural women had a midwife involved in their maternity care for a singleton birth without congenital anomalies. Most of these women lived in communities with available specialist backup. Just 5% lived greater than one hour from any maternity services and 2.6% lived greater than 2 hours away from maternity care (Stoll and Kornelsen 2014).

Of interest to this review, Stoll and Kornelsen (2014) found that transfer of care from midwives to physicians was most common among those practicing in environments more than one hour from surgical support, evincing early risk-screening and referral. Decision-making and early referral by midwives to account for the challenges of transfer in the event of an emergency was also documented in a mixed-methods study of rural midwives in New Zealand (Patterson 2009).

Despite greater transfer of care rates, more than 50% of women who had a midwife involved in their care in a primary care environment without c-section delivered in that primary environment in BC (Stoll and Kornelsen 2014). As well, women with local care of any type had lower rates of prematurity and low birth weight babies. Mortality was too infrequent to be a meaningful measure, though no stillbirth or

neonatal mortality was recorded among women with local primary care who had a midwife involved in their care.

Kornelsen and Ramsey (2014) discussed the outcomes of a solo midwifery practice on Salt Spring Island from 2004 to 2008. Almost 72% of the 86 average annual births by women residing on the island were attended by the midwife, of which 65% were delivered on the island. This compares well to a case study from Australia, which found that just over 74% of local births were able to be delivered by the midwife-led primary maternity unit (Kruske et al. 2015). The Salt Spring practice had favourable results compared to provincial averages (which include higher risk mothers and neonates) and the data on women from communities with primary care published by Grzybowski, Stoll and Kornelsen (2013).

Among those registered for delivery with the Salt Spring midwifery practice, just 7.6% had an emergency intrapartum c-section, compared to a provincial average during the period of 18.1% and a rate of 13.7% among those with local primary services by physicians reported in Grzybowski, Stoll and Kornelsen (2013) (Kornselsen and Ramsey 2014). Further, the rate of spontaneous vaginal delivery was over 75%, compared to just 60.4% province-wide (Kornelsen and Ramsey 2014). Induction, augmentation, episiotomy, epidural and postpartum hemorrhage were all lower in the stable Salt Spring midwifery practice than was seen in the physician-led primary care group from the reference study (Kornelsen and Ramsey 2014). Despite Salt Spring Island's two-hour transfer time and isolation by water, the transfer rate was lower than the average seen in primary environments in BC with midwife involvement (26.5% pre-labour, 7.6% intrapartum; Kornelsen and Ramsey 2014).

Also consistent with literature from around the world is the importance of inter-professional relationships for good outcomes. While the midwife on Salt Spring works in a solo practice, she remains embedded in a network of supportive professionals, including registered nurses who will attend home births, rural locums who will provide relief and specialists in two referral hospitals who will support patient transfer (Kornelsen and Ramsey 2014).

*Facilitators and Challenges According to Rural Clinicians*

A unique study by Quinn et al. (2013) asked rural Australian clinicians with extensive maternity care experience to examine a Cochrane review (Hatem et al., 2008) on midwifery and rate the relevancy of the findings while considering their rural and remote experience in Far West New South Wales (Quinn et al. 2013). Fourteen rural clinicians participated in the study from a variety of professional backgrounds including Nurse Manager, Obstetrician, GP Obstetrician (also known as a GP with enhanced skills), Nurse Practitioner, Remote Area Nurse, Midwife and Clinical Midwifery Consultant. After being presented with the results of Hatem's (et al. 2008) review, eleven participants 'Strongly Agreed' with the conclusion that "most women should be offered midwife-led models of care and women should be encouraged to ask for this option."

Quinn (et al. 2013) then explained to the participants that none of the RCTs in Hatem's (et al. 2008) review were rural specific. Nine of the fourteen participants indicated they still felt that caseload midwifery remained 'Extremely' or 'Very' relevant to rural and remote settings. Three indicated it was 'Somewhat' relevant, while two indicated it was 'Not Very' or 'Not At All' relevant.

Qualitative comments by the rural clinicians elucidated their experiences on what works in rural midwifery as well as their concerns. Two primary themes emerged: 1) positive outcomes were the consequence of midwife-led care facilitated by continuity of care and risk screening; and 2) good outcomes are expected for a low risk group, and so findings regarding an urban low-risk population are applicable to a low-risk population in a rural setting (Quinn et al. 2013). Further, inter-professional tension is a subtle undercurrent of the conversation, with twelve participants suggesting the model of care would be 'Extremely' or 'Very' acceptable to rural women, but only nine of the fourteen indicating the same about acceptability to other health professionals. Inter-professional trust was also listed as a potential barrier and the importance of staff sharing the values of midwifery as a necessary enabler (Quinn et al. 2013). Further, the safety of home birth in very remote communities was noted as a reason for concern despite a majority agreeing that caseload midwifery is safe in rural and remote settings in general (Quinn et al. 2013). Respondents noted that such a setting could have 'extreme' distances to other levels of care across potentially challenging geography.

Each of these concerns around safety, distance to care and geographic isolation have been explored in the studies outlined above. Van Wagner (et al. 2007), Frame (2014), and Holt (et al. 2001) examined the potential value of primary maternity where no other level of service is likely to exist and have gleaned solid evidence, in situ, not only the safety of midwifery-led care, but the benefits that can be afforded beyond that offered by current models of evacuation.

*Summary of Insights from the Literature*

The literature reviewed covered four areas of inquiry: 1) the safety and efficacy of a caseload midwifery model of care as shown in highly powered urban studies; 2) the safety of primary care relative to care with immediate surgical capacity; 3) the safety of primary care relative to no local care (i.e. expected 100% evacuation); and 4) the facilitators of success when implementing midwifery-led care in rural environments. Evidence on midwifery-led primary maternity care shows lower intervention rates while maintaining strong outcomes for women in remote environments. However, achieving those numbers depends on active collaboration between all health professionals, appropriate risk screening, functional regionalized referral and the availability of emergency transfer. Inter-professional relationships are vital to any practicing clinician and especially highlighted for midwives who are operating at a distance. It is essential that there is openness to value-sharing in order for the birth philosophies of midwifery to be upheld while maintaining a strong inter-professional support system for referral and transfer..

The epistemology behind midwifery care is unique compared to physician-led models. Even within caseload midwifery practice, it is important to note that philosophies can carry cultural nuances. Culturally appropriate, post-colonial care will require administrative and governance flexibility and responsiveness to the expressed needs of parturient women and their communities (Varcoe et al. 2013).

## Psycho-Social Risk

Key Points

1. Psycho-social outcomes are worst among women expected to evacuate for care;
2. Local care experiences often include a greater sense of pride and empowerment;
3. Our needs as patients extend beyond physical safety to include community, control and respect, as well as services that match our values and expectations;
4. Risk and safety are subjectively weighed by women to include personal, psychological and social risks;
5. Women consciously employ strategies to mitigate their psycho-social risks that may increase their clinical risk.

The evidence regarding the psycho-social stress outcomes of rural pregnancy and birth is primarily qualitative. However, considerable clinical research also exists regarding the effect of psycho-social stress on pregnancy outcomes, including increased changes for low birth weight and preterm birth (Hobbel and Barret 2008; Paarlberg et al. 1995) as well as preeclampsia and intrapartum complications (Paarlberg et al. 1995). Relatively fewer studies have examined this stress for rural women specifically, giving us limited insight into the clinical effects of stress caused by lesser access to care.

The literature on psycho-social stress experienced by rural women has focused on the experiences of women evacuating for care. In this context, the concept of stress becomes more personal and is placed alongside feelings of anxiety and fear, combining and accumulating according individual women's perceived risk of tangibly worsened experiences of birth, including lack of prenatal care, financial burden, unnecessary intervention or even roadside delivery. Feelings of isolation and loss of control are argued to result in loneliness, worry, anxiety, loss of appetite and increased smoking in women, while creating disruption in the lives of other family members as well (Kornelsen et al. 2010; Overgaard, Fenger-Gron and Sandall 2012)).

This section will consider the literature on the markers of increased psycho-social stress faced by women without local access to care then discuss the perceived trade-off between psycho-social needs for physiological safety and in some cases vice-versa through evacuation resistance tactics. We will introduce the importance of organizing care around the values of communities through the concept of culturally competent birth services for BC's First Nations.

***Psycho-Social Needs of Rural Women***

Using the Rural Pregnancy Experience Scale, Kornelsen, Stoll and Grzybowski (2011b) found that women without local care were significantly more stressed and anxious than women without local access to services. Parturient women who traveled to care were 7.4 times more likely to experience moderate or severe perceived stress compared to those with local services provided by at least one specialist,

controlling for maternal age, parity, education, household income, ethnicity, lone parent status and pregnancy complications (Kornelsen, Stoll and Grzybowski 2011b). Surveys were completed by 187 women across 52 rural communities in BC.

In the international literature, the maternity care needs of rural women are clearly stated. Overgaard, Fenger-Gron and Sandall (2012) surveyed women who gave birth in freestanding midwifery units in the more sparsely populated north of Denmark as well as a matched control group of women who gave birth in more common specialist-led obstetrical units. Their findings showed an improved birth experience, including a greater sense of support, attention to their needs, participation in decision making and control over both the labour and the actions of the staff (Overgaard, Fenger-Gron and Sandall 2012).

A systematic review of international qualitative evidence on women's care needs by Hoang, Le and Ogden (2014) shows a high degree of homogeneity across different jurisdictions. Hoang (et al., 2014) compared results from twelve qualitative studies on the experience of birth for rural women – six from Australia, three from Canada, two from Scotland and one from England. Sources of psycho-social stress were strongly consistent among rural women of different jurisdictions. Women across jurisdictions prioritized safety for their newborn and themselves. Continuity of care, as well as care that was 'professional', 'lovely', 'supportive', 'understanding', 'helpful', 'consistent', and 'expert' were desired. Women also expressed the need for making informed choices about their care. Many women felt alternative models of care were often not mentioned, and that evacuation to a tertiary centre in a referral community was often presented by doctors as the only option. Finally, social support was found to be an important need among women in every country. A lack of local services could mean that women delivered without a partner present and at considerable distance from other parts of their social support network.

Access to each stage of care from prenatal care through postpartum care was complicated for women with barriers to travel, such as not having a car or driver's license. Stress was heightened for women with limited financial resources, as well, as the costs of travelling for prenatal care and of evacuating for intrapartum care could be considerable and often in excess of the small travel reimbursements available. These costs included direct costs of traveling long distances – fuel and maintenance for a car and other travel expenses – as well as indirect costs such as time off work, long distance phone calls, child care, the inconvenience of short appointments requiring several hours of travel, lost income for a partner and more (Hoang, Le and Ogden 2014; Evans et al. 2011). Some women facing early evacuation from remote locations reported having to pack and plan for up to seven weeks away from their community and family (Hoang, Le and Ogden 2014). Women also experienced fear and anxiety about the dangers of traveling itself, including inclement weather and bad roads to and from prenatal appointments, during labour or while returning to the community with their newborn (Dietsch et al. 2010; Hoang, Le and Ogden 2014). Women not required to stay in the referral community in the weeks prior to anticipated labour spoke about the dangers of timing their trip for labour. In Ireland, women were aware that those arriving too early may be sent home or have a greater chance of induction (Sheeran 2008) - a reality for women in BC as well (Kornelsen, Moola and Grzybowski 2009; Kornelsen,

Stoll and Grzybowski 2011). In one Australian study, 12 of 42 women who left their community for care gave birth in an unintended location (Dietsch et al. 2010).

From the perspective of population statistics, accidental out-of-hospital births are rare. However, the risk of this outcome is disproportionately born by those relatively few women in the population who travel for intrapartum care. From the perspective of these women, the occurrence may seem considerably more common and the threat of it happening creates fear, anxiety and stress during pregnancy.

***An Unnecessary Trade-Off of Needs?***

Findings from the literature present the qualities of a birth experiences that reduce the psycho-social stress of rural parturient women. Specifically, this includes decreasing fear and anxiety regarding the danger of travel and the potential for financial burden while increasing a sense of control and creating an empowering experience that meets the needs of both physical and emotional health.

Kornelsen and Grzybowski (2005) found through 44 interviews with rural women that participant needs aligned with Maslow's hierarchy of needs, demonstrating that fears regarding the financial costs of referral and the dangers of traveling while in labour threaten to undermine physiological, psycho-social and emotional safety. The authors found that a birth experience that was congruent with the desires, expectations and values of the woman giving birth were most satisfying. Participants who left their community often found this difficult to achieve as they felt less involved in decision-making and had to attend to basic needs such as organizing accommodation and food. Those women who were able to have a birth that matched their values expressed profound positivity about the experience (Kornelsen and Grzybowski 2005). Similarly, this was the finding of the Marathon, Ontario oral history project.

Orkin and Newbery (2014) interviewed 12 women from rural Ontario and found that women placed considerable importance on safety, family and familiarity, comfort, relationships with birthing providers and kindness in their birthing experience. Those women able to give birth in their home community stated a sense of personal empowerment and considered the opportunity an expression of their values.

One study incidentally confirmed the findings of Kornelsen and Grzybowski's (2005) hierarchy of needs by examining what rural women would trade for safe care. This Scottish study found that local, continuous care that was midwife-led was a priority for rural and remote women at the beginning of focus groups, but that this priority was complex and could be separated into parts (Pitchforth et al. 2007). The authors found that women were willing to travel up to two hours to access safe care even though they stated a preference for local midwifery care. The study could be seen through the lens of competing needs. Safety and health were the most basic needs and under the discreet-choice experiment model used, women were willing to trade travel time for assured safety – a hypothetical trade that imagines safety to begin at hospital doors. Studies that ask open-ended questions regarding the fears and experiences of women traveling to care reveal nuances of the experience and the risk associated with traveling to care – even when that care is of the highest quality. In a study of women who left their community for intrapartum care, Dietsch (et al. 2010) found that 12 of the 42 women in the study had given birth en route – including five before arrival, two in small hospitals en route, one in an ambulance and one unplanned home birth. In a lived situation where women had to choose between

two stressful, unpleasant options of waiting for weeks in the referral community or risking birthing in transit, the women of Dietsch's (et al. 2010) study questioned why either was required when their preference was for local, continuity of care by a midwife. Such sentiments were echoed by women living in the Indian Ocean Territories off the coast of Perth (Roach and Downes 2007). These participants, like those in Canada and elsewhere, expressed a complex set of needs even as they eschewed some of their needs for what seemed to be the safest option of evacuation for care. This compromise of needs can be seen more drastically where women are resisting relocation.

***Resistance Tactics***

Importantly, worsened psycho-social and clinical outcomes are not the only consequences of unmet maternity care needs. In BC, Kornelsen and Grzybowski (2005; 2006) found that when circumstances (either personal or health system circumstances) challenged women's ability to give birth in their home community in a mode that fit their values, they employed strategies to assert their priorities. These strategies included elective induction, seasonal timing of pregnancy to best avoid inclement weather, presenting at the local hospital too late in labour to be transported to a referral community and having an unassisted home birth (Kornelsen and Grzybowski 2006). The authors offer an explanation of this choice by calling it 'reactance' – or the "motivational state aimed at recapturing the [perceived loss of] freedom." (Kornelsen and Grzybowski 2006, 263).

Aboriginal women in one remote town in Australia made the same choices to decline urban referral and birth at home. Ireland (et al. 2011) found that "…women, through their previous experiences of standard care, make conscious decisions and choices about managing their subsequent pregnancies and births." (640)

In this context, Kornelsen and Grzybowski (2006) argue that planners must balance the safety of birth inside high-resource institutions with the risks associated with limiting choice. Women who must leave their community for maternity care experience increased stress, anxiety, fear, loneliness, barriers to care, financial burden, risk of road side deliveries, risk of unwanted induction and intervention and powerlessness associated with unmet physical, social, cultural and emotional care needs. For some women, the risk of birthing at home against the best-intentioned advice of the health care system is less than the risk of traveling for care.

***Culturally Competent Care***

A model of meeting women's needs more comprehensively is presented in a study examining the psycho-social impact of a local midwifery practice in Canada's Northwest Territories. This study contends that the potential gains made by leaving the community for a higher level of care may be off-set by the psycho-social stress engendered (Chamberlain and Barclay 2000; Chamberlain et al. 2001). Chamberlain and Barclay (2000) found that evacuation of Inuit women from their home community created a psycho-social disruption, including emotional, physical and economic stressors. Comparing two similar Inuit communities in Canada's article, Chamberlain (et al. 2001) found that the community which opened a midwifery practice saw considerable decline in these stressors, coinciding with gains in local social support during pregnancy and birth and a greater feeling of choice and control. Mothers who

delivered in the birthing centre enjoyed having their families with them, the continuity of care offered by the midwives and giving birth the way they wanted (Chamberlain et al. 2001).

Varcoe (et al. 2013) argue that control and choice in birth are crucial parts of improving health outcomes as well as vibrancy in Indigenous communities. In this way, birth services can either contribute to on-going process of disempowerment and colonization or support the movement toward self-determination. The authors link the practice of health services with the need to better account for the historical and social processes of creating health inequalities (Varcoe et al. 2013).

Kornelsen (et al. 2010) contends that the psycho-social effects of evacuating for care are felt more acutely by First Nations women. Findings from a survey (*n*=55) and interviews (*n*=12) with women from Bella Bella, BC (Waglisla, Heiltsuk territory) indicated that community support is a central feature of local birth. Interviewees expressed a sense of emotional and material support from their community, including child care, a sense of connection, the presence of family and friends in the local hospital and a community celebration for the new born (Kornelsen et al. 2010). As well, the expectation of local birth was expressed as both a sense of tradition and a connection to the life cycle of the community and its members. Some women chose to go to a referral centre despite the presence of local birth until 2001. For these women (and those who would have chosen to leave the community had local birth been available after 2001), the presence of choice mitigated much of the typical stress. For those who chose to give birth in their home community, the social significance was therapeutic and raised the importance of seeing health beyond the basic needs of high quality medical care (Kornelsen et al. 2010).

Among the successes of the Inuulitsivik midwifery model in Nunavik reviewed above in the findings of midwifery-led care is the radical change in psycho-social risk to local women without trading-off physiological safety (Van Wagner et al. 2007). Douglas (2010) suggests that the exceptional outcomes by the Inuulitsivik model rest on having a locally developed philosophy of birth congruent with the values of the users of the service. Inuulitsivik is among the most profound example of culturally appropriate care, with community ownership, sustainable recruitment and retention of local women to be midwives and a model of care that emerged from intentional political action. Smaller examples of efforts at culturally competent care underscore the need to mitigate psycho-social risk among indigenous women.

O'Driscoll (et al. 2011) found that many rural First Nations women faced considerable cultural barriers in accessing maternity care in Ontario, in addition to many of the other fears and anxieties present for women of any social group traveling for care. The goal of the Sioux Lookout Meno Ya Win Health Centre is to be a centre of excellence in Aboriginal health care, in part by mitigating some of hardships experienced by rural First Nations women traveling for care through culturally safe care. Interviews with 13 women who traveled for maternity care at the Sioux Lookout Meno Ya Win Health Centre found that women were still lonely, missed their families and commented on the lack of funding for escorted travel (O'Driscoll et al. 2011). Women were generally positive about their medical care and reported no difficulties re-integrating into their home communities, but the act of traveling for care and spending weeks away from their families still resulted in a negative emotional experience.

The situation is similar in Australia. Kildea (et al. 2010) provide a compelling case that the health burden of Indigenous people may be reduced through the provision of accessible, culturally competent primary maternity care to the 55% of Aboriginal and Torres Strait Islander women living in rural and remote Australia. A review of the features of such care highlighted that the best culturally competent rural maternity services offered a choice of local, high-quality, low-intervention care in a continuity model with a focus on respect, communication and community (Kildea and Van Wagner 2012).

## Distance to Care

Key Points

1. For BC women, neonatal mortality is three times more likely for births in which the women had to travel four or more hours to services;
2. For BC women who have to travel more than 1 hour, induction is 1.3 times more likely due to travel logistics;
3. International evidence shows that increasing numbers of women traveling longer distances to care is creating greater resource usage to compensate for greater rates of morbidity;
4. An unequivocal relationship exists between distance and outcomes: as distance goes up, so do negative outcomes.

In Canada, 18% of births occur to women who live in rural and remote areas (CIHI 2013). Over 40% of those women must travel more than one hour to access services (compared to less than 2% of urban women traveling over an hour). One in six rural women (3% of total Canadian parturient women; 41,408 women from 2007/08-2011/12) will have to travel more than two hours to reach a hospital for intrapartum care (CIHI 2013). In BC, there are many northern, coastal and island communities where distance to care exceeds four hours and includes ferries or flights that are not available at all times. Between 2000-2004, 506 singleton, term infants were born to women living more than four hours to care in BC (Grzybowski, Stoll and Kornelsen 2011). In many studies that do not account for this distance, the small number of women traveling the greatest distances to care are subsumed inside larger populations and the impact of distance to services on birth outcomes is hidden.

International data demonstrates unequivocally that greater distance to care puts mothers and their infants at greater risk of poorer outcomes. This effect is shown below to be independent of many of the other causal mechanisms known to be involved in pregnancy outcomes, including social determinants, health behaviours and prenatal care, and to have a positive gradient effect – as distance increases, so does risk of adverse outcomes. One of the outcomes often measured is the rate of accidental, out-of-hospital births according to distance as a function of service closures or a dearth of services. Literature regarding accidental, out-of-hospital births is included in this section and reviewed as an outcome related to distance from nearest maternity service.

Grzybowski, Stoll and Kornelsen (2011) examined 49,402 singleton births (excluding both congenital anomalies and late termination) to rural women in BC between 2000 and 2004 according to travel time

from services. Distance was measured from postal code centroid to nearest services and stratified into four different care types: no local services (sub-categorized as 1-2, 2-4 and >4 hours from care); local (within 1 hour) primary care with and without c-section capability; local mixed model care; and local specialist services (reference category). Over 5% of the sample (n=2,612) were born to women without any local services and residing more than one hour to the nearest services with c-section capability.

The impact of no local services was dramatic for women in BC. For those few women who had to travel the longest distance (greater than 4 hours to care), neonatal mortality was three times more likely (OR=3.17, 95% CI 1.45-6.95) (Grzybowki, Stoll and Kornelsen 2011). Newborn intensive care admissions and bed days were also higher for all women traveling to care.[6] Induction for logistical reasons was also most common among women 2-4 hours from care, and was found in a previous study to be 1.3 times more likely for any women traveling for care in BC (Kornelsen, Moola and Grzybowski 2009).

Steenkamp (et al's 2012) study examined whether remoteness was an independent factor in birth outcomes and found that remote women remained both less likely to have a normal birth and less likely to have a healthy baby relative to urban women even after controlling for other variables.[7] Steenkamp's (et al. 2012) study struggles with a small sample size and descriptive (rather than potentially causal) stratification, giving us only the broadest sense of remote area pregnancy being more prone to poor outcomes that urban area pregnancy.

Another important finding in the BC population data is the rate of accidental, out-of-hospital (AOOH) births according to distance to care. Intuitively, we might imagine a stepwise gradient according to categories of distance, but Grzybowski, Stoll and Kornelsen (2011) found that while those living >4 hours to care were more than three times more likely to experience an AOOH birth (OR=3.63, 95% CI 1.4-9.4), women 1-2 hours to care were even more likely to experience one (OR=6.41, 95% CI 3.69-11.28). This relationship is found in Australia as well, where Kildea (et al. 2015) found that the born before arrival (BBA) rate was highest for women in Inner Regional and Outer Regional districts, followed by those who lived in Remote areas, likely due to early evacuation. Even in Iceland, a study by distance to the capital region found those who were peri-urban (within 70kms) and those most distant (>250kms) had the worst perinatal outcomes (Haraldsdottir et al. 2015).

Kildea's (et al. 2015) work is not distance specific, but instead is one of a handful of studies that looks at AOOH births according to unit closure. Australia witnessed a 41% decrease in total number of maternity units between 1992-2011, with 209 small units (<100 annual births) and 21 larger units (>2000 annual births) closing as birth services centralized. This same pattern was found by Viisainen (et al. 1999) in Finland, where AOOH rapidly fell between 1963-1973 during a period of hospital building, but rose from

[6] Including 179 NICU 3 (high acuity) days per 1,000 births to women 2-4 hours from care, and 100 NICU 3 days per 1,000 births to women 1-2 hours from care, compared to just 24 NICU 3 bed days per 1,000 births to women with local primary care available, and 42 per 1,000 to those with local specialist care available (Grzybowski, Stoll and Kornelsen 2011).

[7] This study looked at two samples of remote women – Top End (TE) and Central Australian (CA) – relative to two samples of urban women from the same jurisdictions. Healthy Baby - Central Australia Urban (ref): Top End Remote, aOR=0.79 (95% CI 0.58-1.10); CAU (ref): CA Remote, aOR=0.83 (95% CI 0.56-1.23). Normal birth – CAU (ref): TER, aOR=0.47 (95% CI 0.34-0.66); CAU (ref): CAR, aOR=0.52 (95% CI 0.35-0.76).

0.4 per 1,000 live births to 1.0 between 1973 and 1993 as small units began closing. Heminnki, Heino and Gissler (2011) noted that the same pattern continued in Finland from 1991-2008. Finland's rate, though rising due to closure, is still low by international standards. Norway – a country with a large and sparsely populated arctic region – reports an annual AOOH rate of 6.8/1,000 births between 1999-2013 (Gunnarsson et al. 2014). Despite distances to care that are short relative to rural Canada, the raw out-of-institutional birth rate in France was 4.3 per 1,000 live births in 2005-06 (Blondel et al. 2011).

The danger of AOOH births is considerable. In Finland, the crude risk factor for perinatal death is six times higher among babies born accidentally out of hospital (Viisainen et al. 1999), and still three times more likely even when controlling for birth weight (Heminnki, Heino and Gissler 2011). In Norway, the rate of perinatal mortality among those with an AOOH was 11.4/1,000, compared to 4.9/1,000 for all other births (Gunnarsson et al. 2014). In the Australia, the national average was 4.29/1,000 between 1992-2011 (Kildea et al. 2015), with starkly rising numbers in some provinces due to closure. In Queensland, the rate rose from 3.05 in 1992 to over 7/1,000 in 2011 (Kildea et al. 2015) and doubled between 1991-2008 in Victoria to nearly 5/1,000 (McLelland, McKenna and Archer 2013). The relationship of distance to AOOH births and the relative danger of AOOH births was found in literature from France, as well.

France, like Canada, has not progressed their maternity outcomes at the same rate as other OECD countries over the last decade, falling from 7$^{th}$ in the world in 1999 to 20$^{th}$ in 2009 (Pilkington et al 2014). Rural France is comprised of many small, adjacent municipalities interconnected by high quality roads and highways. Expectations of short distances to care are combined with limited barriers to accessing that care. Nevertheless, the data from France resonates with that from other parts of the developed world that witnessed the centralization of services, particularly around out-of-hospital births. Nationally, the supply of maternity units declined from 815 units in 1996 to 526 in 2010, with closures primarily affecting units with <300 births (Combier et al 2013). Units with no specialized neonatal care declined from 415 to 263 in this period, while specialized units with highly resourced neonatal intensive care capacities increased in number from 56 to 60 (Combier et al 2013).

Evidence is mixed on the impact of these closures. The relatively rural Burgundy region faced the greatest rate of closure at 36% and yet mean time to the nearest maternity centre increased by only four minutes between 2000 and 2009 (Combier et al 2013). However, when considered for the rural population specifically, the change has been more drastic. The maximum travel time to care in Burgundy rose from 65 minutes to 86 minutes between 2000 and 2009 (Combier et al 2013). As well, the proportion of women who took over 30 minutes to arrive at the hospital grew in Burgundy from 6.7% in 2000/01 to 8.8% in 2009 (Combier et al. 2013). Nationally, the rate of those living more than 30km to care increased by 52% and the rate of those more than 45km to care rose by 105% between 1998 and 2003 (Pilkington et al 2008).

Blondel (et al. 2011) found a substantial relationship between distance to care and the rate of accidental, out-of-hospital births among 1.3 million births in France. French data shows that both distance and parity played a significant role with large jumps in the rate of AOOH for those women with parity $\geq$3 and those more than 30kms to care. For example, women with parity $\geq$ 3 and more than 45km

from care were found to be over six times more likely than women with lower parity within 5km of maternity service to experience AOOH. In Norway, young multiparous women were 20 times more likely to experience an AOOH compared to older nullipara women, and most occurred to women living in remote locations (Gunnarsson et al. 2014). -

The danger of such a birth in the French context was shown by Pilkington (et al. 2014). Pilkington (et al. 2014) examined distance to care in 6.2 million births between 2001-2008. Descriptive data from this study showed that "[d]eaths after out-of-hospital birth increased sharply when residence was >45km to the closest maternity unit. Both stillbirth and neonatal deaths were more frequent in urban[8] and rural areas and lower in peri-urban areas. Out-of-hospital death rates were higher in rural areas" (Pilkington et al. 2014, 906). For those living 15-30km to care, the adjusted risk ratio of such death was 1.58 (no CI presented but did not include 1). For those 30-45km to care, aRR=1.51 (CI not presented but did include 1). For those >45km to care, the aRR was 3.68 (no CI presented, did not include 1, Wald <0.01) (Pilkington et al. 2014). There were 14,860 deaths in the entire study period, of which 282 occurred after an accidental out-of-hospital birth. The sharp increase at the 45km mark is concerning for a jurisdiction like BC where distance to care for rural women is very often larger than 45km.

Combier (et al. 2013) was the only French study to use minutes of travel time, rather than raw distance to care, to study the effect of distance on outcomes. This allowed them to use a "0 minutes" coding for those women who delivered in their own municipality. They found that increasing numbers of women traveling longer distances to care is creating greater resource usage to compensate for greater rates of morbidity. Clearly, this is contradictory to the goal of centralization towards improving care. A logistic regression model adjusted for both individual (maternal age, child sex, history of preterm labour, adverse obstetrical history) and environmental (deprivation index and urbanization classification) factors was used to analyze 111,000 singleton births gestated to >22 weeks between 2000 and 2009 in the Burgundy region, and found that adverse outcomes were more frequent for those women 30 or more minutes travel time to care. Odds ratios were statistically non-significant for stillbirth and extended (within 28 days) perinatal death, but still showed a gradient relationship between categories from <15 minutes to >45minutes travel time to care. Fetal distress and hospitalization each increased by travel time to care (Combier et al. 2013).

Though the contextual differences between Canadian rural primary care and that of much of continental Europe are too great to consider most data regarding models of care, the relationships found in distance to care are elucidating. A highly powered study from the Netherlands (Ravelli et al. 2011) and another from Wales (Paranjothy et al. 2014) provide strong evidence confirming what was found in France; a gradient relationship exists between travel time to care and birth outcomes. This body of work creates

[8] At this national level, large hospitals serving high vulnerability urban populations (those <5km to care) overwhelm the rural data as the urban reference group was found to have the highest rates of social confounders such as unemployment, foreign-born mothers, single-parent households and mothers over 35. Their statistical finding that rates of stillbirth and neonatal death were not associated with distance to care while using those <5km to care as the reference category is not surprising, but it is ill-fitting in the Canadian context where the rates of social vulnerability are typically higher among rural parturient women than urban (CIHI 2013).

impetus to consider BC's longer travel times increasingly dangerous as they extend well beyond France's maximum time to care of 86 minutes.

Ravelli (et al. 2011) examined over 750,000 births in the Netherlands from 2000-2006 to find that a travel time of over 20 minutes to care resulted in higher total mortality (OR=1.17; 95% CI 1.002-1.36), higher neonatal mortality within 24 hours (OR=1.51; 95% CI 1.13-2.02) and higher rates of adverse outcomes (OR=1.27; 95% CI 1.17-1.38). The statistical power of the study allowed Ravelli (et al. 2011) to find a per-minute increase in the odds of a poor outcome (OR=1.01/minute). Few women in the Netherlands have a driving time of more than 30 minutes to care, making much of the data from the jurisdiction incompatible with more sparsely populated regions like BC and Australia. However, applying the per-minute odds of adverse outcome in the Netherlands for distances in BC shows congruence. Neonatal mortality when 240 minutes (four hours) to care in BC was found to be 3.17 times more likely (Grzybowsky, Stoll and Kornelsen 2011), compared to 3.40 times more likely according to Ravelli's (et al. 2011) per-minute odds.

Using Welsh data on over 400,000 births between 1995-2009, Paranjothy (et al. 2014) found increased risk of neonatal mortality for greater distance to birth hospital. For every 15-minute increase in travel time to the birth hospital, the risk of both early (0-7 days) and late (7-28 days) neonatal death rose (early: OR 1.13; 95% CI 1.07-1.20; late: OR 1.15; 95% CI 1.05-1.26) (Paranjothy et al. 2014). Again, a crude application of 15-minute odds to the BC context suggests that those traveling 240 minutes to care (4 hours) would have an increased risk of early neonatal death of 3.08 and of late neonatal death of 3.4 – similar to the numbers found in both BC and the Netherlands.

The potential of primary only services to address the issue of distance is more nuanced than immediately apparent. Paranjothy (et al. 2014) argue that re-organizing maternity and neonatal services may not have a strong impact on outcomes because their analysis found a weak association between mortality and distance to the nearest hospital (rather than the birth hospital). The contention of Paranjothy (et al. 2014) is that risk of mortality remains higher for those with complications, who may be referred to a distant, high-resource environment that could not be sustained in rural and remote environments anyway. This is an unfortunately simple view, as risk of morbidity also increases for women of all risk statuses, as does the risk for out of hospital births. Moreover, even among rural communities with fewer barriers and shorter distances to care than found in Canada's arctic or island settings, local services are shown to make a considerable difference to population outcomes (i.e. outcomes for women of all risk statuses from a given catchment).

Nesbitt's work (et al. 1997; et al. 1990) is unique in the literature for examining the effect of maternity care availability on neonatal outcomes from the perspective of outflow. During the 1980's, Washington State saw a rapid decline in the number of family physicians offering obstetrical services, including in rural, where the number of obstetrical providers shrank by 23% between 1980 and 1988 (Nestbitt et al. 1990) and continued to decline such that just 37% of rural family physicians were offering obstetrical services by 1992 (Nesbitt et al. 1997). At the same time, the number of family physicians offering normal newborn care declined over the same period to just 65% in 1992 (Nesbitt et al. 1997). Much like the decline in maternity service sites in BC over the last 15 years, the lack of services created greater

outflow from rural towns. That is, more women left their home community for intrapartum care and in many case, pre- and post-natal care as well.

Nesbitt (et al. 1997) compared health outcomes and resource use among 19,984 births according to whether the mother lived in a low outflow communities or high outflow communities. Those from low outflow communities averaged 2.8 maternity providers per 100 births and had access to local services during the entire three-year study period. The result was that less than 17% of births occurred outside the local community. Those from high outflow communities averaged 1.1 maternity providers per 100 births and many of the 16 included communities had service interruptions during the study. Over 86% of births from these communities occurred in a referral facility. Nesbitt (et al. 1997) found that for extremely premature infants, outflow did not determine resources use. However, resource use among both premature and term neonates with complications were more likely to exceed $3000 and 5 days in care for women from high outflow communities (Nesbitt et al. 1997). These costs could plausibly be associated with iatrogenic risks or the perceived safety of traveling home after care.

In a regression analysis controlling for parity, race, maternal age and gestational age, those from high outflow communities were at greater risk of having a non-normal neonate among both insured patients (OR 1.30; 95% CI 1.17-1.44) and those on Medicaid (OR 1.22; CI 1.05-1.40) (Nesbitt et al. 1997). As well, the likelihood of infant charges over $3000 increased by outflow among insured (OR 2.28; CI 1.68-3.11) and Medicaid (OR 1.75; CI 1.07-2.32) patients (Nesbitt et al. 1997). Nesbitt (et al. 1997) found that increased resource use was not the consequence of higher rates of prematurity among women from high outflow communities (Nesbitt et al. 1997), but suggests it is the outflow itself that creates risk of prematurity.

Closure of rural maternity units may also have an immediate physiological impact. A study in rural Missouri examining outcomes for pregnancies from seven rural communities (<10,000 people, >40 miles from metropolitan centre) after the closure of maternity services showed an average 18.2% increase in low birth weight infants in the year following closure (Sontheimer et al. 2008). The rate of low birth weight remained stable at the state level, and other factors of care (rates of no prenatal care, inadequate prenatal care and c-section) saw no change in the study communities. As the authors note, low birth weight infants are at increased risk for morbidity, mortality, intensive care use and long-term reduced quality of life (Sontheimer et al. 2008), though the study did not examine these factors.

## The Relationship of Procedural Volume to Outcome

Key Points

1. Undisputed high quality evidence indicates that tertiary care is associated with better outcomes for very low birth weight and very premature births;
2. Hospital-based data is conflicting, but most shows U-shaped relationship where low-volume and highest-volume facilities have slightly worse outcomes
3. Population- or catchment-based data shows equivalency based on the functioning mechanism of risk-based referral
4. The statistical differences found in most hospital-based datasets correspond to very small absolute differences, which do not appear in population-level data
5. The literature notes its own limitations with regard to identifying the mechanisms of potential differences in outcomes between unit sizes
6. Critically, this literature examines all hospital users and not the safety to rural and remote women of traveling to use the services

There has been a strong momentum toward centralizing maternity care in developed nations over the last four decades. In this section, **we aim to connect the largely abstracted idea of improving outcomes by increasing the proportion of women who use high-resource referral centres to its real world requirement of more rural women traveling greater distances to urban hospitals to give birth.** To reach this aim, we examine the veracity of the international literature claiming greater safety of higher volume maternity centres for low-risk rural women.

Importantly, greater volume itself provides no inherent benefit, but is used as a proxy for access to greater resources, complimenting specialties and advanced technology. However, volume does not necessarily indicate any specific level of perinatal resources in a given hospital, which can change according to context. Consequently, data from one jurisdiction is unlikely to be applicable in another. More critically, measuring volume can confound the actual mechanisms of good care, from hospital resources, which it intends to approximate, to teamwork and staffing models, which it obscures.

Institutional research in this area has mixed results and ultimately shows the limitations of a volume-based analysis, with the potential for high in-group differences and hidden causal mechanisms leading to unanswered questions from a policy and planning perspective. Population level data (or catchment data) does not show improved outcomes according to greater volume (Serenius et al. 2001; Viisainen, Gissler and Hemminki 1994).

Below we will examine two influential studies that found improved neonatal outcomes in larger birthing centres using an institutional, volume-based analysis, as well as three further studies with similar findings. Subsequently, a discussion of the conceptual and methodological limitations of this data will reveal that even in those studies which find an outcomes advantage among high-volume units, volume

analyses serve to obscure worsened outcomes for the relatively smaller number of rural women required to travel greater distances under conditions of greater centralization. Further, we will consider that a tipping point may exist in risk screening accuracy, such that volume data before 1996 has a different pattern than volume data after 1996.

***Claims of Safety in High-Volume Settings***

Considerable evidence exists showing that greater procedural volume by specific providers or institutions leads to improved outcomes for some highly complex procedures (e.g. carotid endarterectomy), with public health care and regionalized referral dampening the statistical power of this relationship (Urbach et al. 2005). Yet, the value of higher volume centres for lower risk pregnancies is contested and the presence of any volume-to-outcome relationship is not well established in maternity care procedures.

It is important to clearly note that although centralization of maternity care for rural women with low-risk pregnancies is contested, referral of higher risk pregnancies to higher tiers of service with greater procedural and technological capacity is a critical component of good population outcomes. Undisputed, high quality evidence indicates that tertiary care is associated with better outcomes for very low birthweight and very premature births (Lasswell et al. 2010).

Two volume studies have had substantial international impact in the movement toward centralization. Heller (et al. 2002) performed an analysis of over 582,000 births between 1990-99 in Hesse, Germany, which showed a gradient trend of increasing safety according to increasing volume of an obstetric unit. Most alarmingly, the study finds that smaller units (<500 annual births) are more than three times more likely to experience a neonatal death than a large unit (>1500 annual births) among healthy weight neonates (>2500g).

The Heller (et al. 2002) study was preceded by a study of 1.25 million births of singleton, healthy weight neonates across three decades in Norway by Moster, Lie and Markestad (1999), which found that units with <100 births were 2.1 times more likely to experience a neonatal death than a unit with 2001-3000 annual births (95% CI 1.6-2.8). Even among 700,000 births deemed low risk, neonatal death among the smallest units was 1.8 times more likely (95% CI 1.1-3.1).

Snowden (et al. 2012) claim to corroborate Heller (et al. 2002) in their study of all 268 Californian hospitals to perform at least 50 births in 2006 (n=527,617) according to four volume categories. This is not strictly true. Crude mortality in this study demonstrated a functioning referral system, with the highest rates of preterm birth, low birthweight and neonatal death in the largest institutions. Excluding preterm and low birthweight neonates, no difference was found in mortality rates by volume. All four volume categories were between 0.2 and 0.3 neonatal deaths per 1,000 healthy weight births with no found pattern (Snowden et al. 2012). Restricted to exclusively rural hospitals, a U-shaped relationship was found in neonatal death, but it was statistically non-significant.

Snowden's (et al. 2012) study appears to support the need for centralized birth is in rates of asphyxia, however, which are stated to be higher in small volume units, even among healthy weight neonates and

rural hospitals.[9] However, the volume categories are so wide as to undermine the applicability of that claim. The low-volume category are those units with between 50-1,199 births, and even the rural focused analysis uses 50-599 births as a single category. A small hospital with 50 births would likely be the equivalent of a 1A or 1B unit in BC, while those delivering 500 babies would plausibly be the specialist referral unit for those smaller units. Those delivering 1,100 would again likely have a different model of care and staff mix from those with 500 annual births and share little in common with a 1A unit. Further, as the only study in the world to examine hypoxia/anoxia rates by volume, the findings are not strongly relevant to those of Heller (et al. 2002), particularly as the mortality findings actually show no difference by volume.

Merlo (et al. 2005) recognized the limitation of using volume as a proxy for level of care and instead grouped Swedish hospitals by the tier of service offered. Merlo (et al. 2005) still found a large unit outcomes advantage among low-risk births between 1990-95 (n=461,167 of 691,742 total births). Using a multilevel regression that nested individual outcomes inside hospital outcomes and adjusting case mix through propensity weighting, Merlo (et al. 2005) found a small difference between the four levels of hospitals for low-risk birth (median odds ratio=1.16). This corresponded to a survival probability difference of 0.06%, from 99.90% in the least equipped units to 99.96% in the highest resourced units (Merlo et al. 2005), a difference Merlo (et al. 2005) called negligible from the individual's perspective.

Moster, Lie and Markestad (2001) also attempted to adjust for the limitations of their volume study published in 1999. Their follow-up study compared geographical areas where most births occurred in large hospitals to those areas where most births occurred in small hospitals. This catchment-style analysis was intended to compensate at the data collection level for patient referral bias of high risk pregnancies from small units to larger units. Consistent with their 1999 institutional data of the same study period, Moster, Lie and Markestad (2001) found a small but statistically significant outcomes advantage in areas where more than 75% of births occurred in larger hospitals (OR 0.8; 95% CI 0.7-0.9), and that those areas served by units with <100 births were 1.4 times as likely to witness a neonatal death (95% CI 1.1-1.7).

Together, these studies have been the most compelling evidence to show improved outcomes for centralizing maternity services into larger, presumably better resourced centres. There are challenges with this structure of data organization and analysis, discussed more fully below.

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[9] The measurement of birth asphyxia as a volume outcome is unique to this study and is complicated by four issues. First, most asphyxia literature examines unit readiness and is examined in relationship to when a birth occurs (e.g. at night vs. day time deliveries). Second, a 2005 consensus statement by the American College of Obstetricians and Gynecologists claims asphyxia is too complex to be a birth outcome measure, as it has sundry complex causes and consequences. Third, the ICD codes used by Snowden (et al. 2012) were not actually asphyxia codes (perhaps owing to an American system recording bias after the ACOG consensus statement) but cerebral hypoxia and anoxia. Though the authors never state their reasoning for using these codes, we might assume their causal assumption is that delays in addressing intrauterine asphyxia increases rates of newborn cerebral hypoxia/anoxia. However, fourth, the wide range of models of care and hospital resources contained within each volume category makes such a narrative unreasonable to assume and the actual potential cause of higher rates of hypoxia/anoxia impossible to see. There is no way to be certain even what types of hospitals are most likely to experience or record hypoxia/anoxia given the massive intra-category ranges used by Snowden (et al. 2012).

***The Challenge with Categorizing by Volume: Intra-Category Differences***

There are a few central problems associated with these studies that negatively impact both their generalizability to other jurisdictions and their applicability to understanding rural health services. While Snowden's (et al. 2012) study has obvious conceptual problems within volume categories (reviewed above), other differences found between hospitals within volume categories are instructive.

The hospitals examined by Heller (et al. 2002) are exclusively those led by specialist obstetricians and considerable problems persist in applying the findings to even the larger maternity system in Hesse, Germany. The authors discuss the limitations of using volume as a proxy for greater resources by noting that the actual mechanisms of improved or worsened outcomes are not present in their analysis by volume. Heller (et al. 2002) suggests that missing variables of impact might include type of delivery unit, presence of pediatric or neonatological services, lower staffing, unit readiness, skill, teamwork, equipment, transfer guidelines, training programs, staff mix, NICU size and distance to a higher capacity NICU.

The difference in hospital capability rather than capacity was an important distinction made by Grytten (et al. 2014) in Norway, as well. Grytten (et al. 2014) grouped hospitals according to having or not having a dedicated neonatal department for dealing with high risk births,[10] and, after controlling for variation in patient cases, found no difference in neonatal or infant mortality by type of hospital for births from 1979 to 2005. This highly powered finding is in direct opposition to the highly powered volume-based work of Moster, Lie and Markestad (1999; 2001) simply by grouping hospitals by their capacities rather than their volume.

Kozhimannil (et al. 2014) examined processes measures instead of mortality in rural hospitals across nine US states between 2002-2010 and found that volume was not associated with hospital differences. Kozhimannil (et al. 2014) states, "[o]ur study results indicated that obstetric quality and safety outcomes vary significantly across rural hospitals by birth volume, but that better performance is not consistently associated with lower- or higher volume facilities" (339). In essence, volume is not the causal variable.

Differences between the hospitals grouped together inside broad volume categories may be a key to understanding how case study data reviewed above can indicate the safety of low volume primary care, while high-level, observational institutional data suggests otherwise. In Heller (et al. 2002), especially large confidence intervals among the <500 annual birth group suggests that the variance in outcomes between hospitals may have been too large to make meaningful comparisons to other volume categories. That is, the differences between hospitals within the small volume group were just as large as the differences between volume groups, rendering volume categories unsound for meaningful statistical analysis.

[10] In Canada, this would be level 1 units compared to level 2 and 3.

### *Gains in Risk Screening: A Tipping Point in 1996*

Grytten's (et al. 2014) study offers a different explanation for the change in outcome patterns through the 1990's. Grytten (et al. 2014) notes that risk screening became more effective over time and reached a plateau after 1996. Twenty-five percent of all low birth weight deliveries in Norway took place in level one or maternity clinic settings in 1980, falling to under 10% in and after 1996. For the first time in and after 1996, over 90% of high-risk pregnancies were successfully identified and referred appropriately. The reader may note that Moster, Lie and Markestad's (1999; 2001) study period ends in 1995, as does Merlo's (et al. 2005). Even if we accept that volume was a meaningful indicator of safety up to 1995, that relationship is less certain after 1996.

Further, Heller (et al. 2002) presents data from the study decade in time-groups: 1990-93; 1994-96; and 1997-99. This part of the study shows that neonatal death declined from 0.045% among all healthy weight live births in 1990-93 to 0.021% (less than half) among all healthy weight live births in 1997-99. Despite a large sample size in the time-groups 1994-96 (n=164,528) and 1997-99 (n=164,055), no statistically significant difference in outcomes by unit size could be detected in either time interval. In other words, after 1993, the statistically significant difference found in the Heller (et al. 2002) study disappeared.

Volume-to-outcomes is studied after 1996 and universally finds no effect on neonatal mortality among low-risk pregnancies.[11] Tracy (et al. 2006) is the most famous example, replicating the Moster, Lie and Markestad (1999) study in Australia with data from 1999-2001. Tracy used the same unit volume categories as Moster, Lie and Markestad (1999) to analyze over 750,000 births by delivery institution volume in Australia. Among health weight neonates (>2500g) delivered by mothers without pre-existing or antenatal development of hypertension or diabetes, rates of mortality were comparable in units with <100 deliveries and those with >2000. Units of all sizes were found to have similar outcomes, while smaller units tended to have less intervention, including lower rates of c-section (Tracy et al, 2006).

### *Other Meaningful Considerations*

Finnstrom's (et al. 2006) catchment study of delivery unit size in Sweden considered maternal health characteristics as an important factor in neonatal outcomes. The researchers adjusted for each of year of birth, maternal age, gestational age and parental cohabitation, as well as smoking during pregnancy and maternal body mass. Among catchments of <500, 500-999, 1,000-2,499, and >2,500 annual births, no neonatal mortality relationship was found after these maternal health considerations were controlled for in the analysis. Moster, Lie and Markestad (1999; 2001) controlled for marital status as a proxy for social health, year of birth, maternal and gestational age, while Heller (et al. 2002) were only able to control for gestational and maternal age. Social determinants of health and maternal health are especially important to consider in BC, where the rural population tends to have worse health behaviours and suffer a greater social health disadvantage. Likewise, findings from these studies must be understood in a rural BC context, marked by a scattered rural population facing large distances to referral centres through seasonally inclement weather and difficult geography.

[11] This includes the Snowden (et al. 2012) study, which recommends centralization of services but finds no difference in neonatal death by volume.

Limited Canadian data exists on the relationship of volume to outcomes. One study by Fallis, Dunn and Hildtich (1988) found that birthweight specific mortality (>2500g) was lower among small volume Ontario hospitals than large from 1970-1985. No mortality difference was found between small or large volume hospitals among healthy birthweight neonates in the other two provinces under study (Saskatchewan and Newfoundland). Significant changes in the models of care, the proportion of women delivered by specialists, the availability of midwifery and the technology of pregnancy and birth render these findings difficult to apply to modern BC, even as the geographic and service contexts are similar.

*"For rural women and their families, the pressing question is not whether a given birthing unit, model or tier of service is safer, but whether that potential improvement in safety out-weighs the increased risk of traveling to care."*

The expected improvement in health outcomes from having more women deliver in higher volume maternity units must also be understood in the real-world context of having rural women from small communities travel to larger centres for maternity care. For rural women and their families, the pressing question is not whether a given birthing unit, model or tier of service is safer, but whether that potential improvement in safety out-weighs the increased risk of traveling to care.

Data categorized by volume excludes out-of-institution births. Additionally, the number of women traveling the greatest distances to receive care is small and easily overwhelmed in statistical analysis by the much larger number of women receiving local care in urban centres. Examining rural women traveling to urban centres in California specifically, Hughes (et al. 2008) found that neonatal mortality rates were significantly higher in babies born to rural mothers with no pregnancy complications who delivered a normal weight baby vaginally at an urban hospital compared to urban mothers of the same description birthing at an urban hospital (0.2/1,000; 95% CI 0.2-0.4 vs. 0.1/1,000; 95% CI 0.1-0.1). This aligns with population data from Washington State that found worse outcomes for communities with higher outflow (Nesbitt et al. 1990; Nesbitt et al. 1997).

Of the 2.6 million births analyzed by Hughes (et al. 2008), the cohort of rural women with health pregnancies delivering healthy weight babies vaginally in urban centres was just 22,616. In a volume-specific analysis, this relatively tiny group of women would disappear. Yet, this is the target group of low-risk women intended to benefit from centralization to higher levels of care.

Data from Norway demonstrates this same effect at a population level. From 1979 to 2005, the number of level two and three maternity hospitals in Norway remained static at 22, while the number of level one maternity units declined from 43 to 26 (Grytten et al. 2014). From 1980-1994, the number of maternity clinics also fell from 30 to 10. Together, this meant a decline in the proportion of births delivered in rural and remote hospitals and clinics from 35.2% in 1980 to 19.5% in 2005 (Grytten et al. 2014). Engjom (et al. 2013) found that the proportion of women living outside a 1-hour travel distance to obstetric care rose from 7.9% to 8.8% between 2000 and 2010 in Norway and that maternal

morbidity increased at the same time from 1.7% to 2.2% (aOR 1.4; 95% CI 1.2-1.5). Regional differences in maternal morbidity also increased, suggesting worsening equality of access. Engjom (et al. 2013) also found the risk of accidental, out-of-hospital birth rose over time from 0.4% in 1979-83 to 0.7% in 2004-2009.

At the same time as maternal morbidity rose, perinatal mortality declined from 2000 to 2009 in Engjom's (et al. 2013) data. The authors do not discuss this finding, but Grytten (et al. 2014) analysed the trend in Norway. Examining the the five-year period before and after each of 13 maternity unit closures, Grytten (et al. 2014) found centralization was not improving neonatal mortality, even as neonatal mortality continued to decline during the period of centralization. Rather, Grytten (et al, 2014) credits the resiliency of the downward trend in neonatal mortality to other social and health system mechanisms.

A hypothetical model using over a retrospective cohort of 1.16 million births in the Netherlands estimated the impact of closing the ten smallest (of 99 total) maternity units (Poeran et al. 2014). This unique study modeled the closure of the ten smallest hospitals against the closure of the ten smallest hospitals while avoiding adjacent closures. The former resulted in a 10% rise in neonatal mortality, while the latter caused improvement for some sub-groups and deterioration for others (Poeran et al. 2014).

***Conclusion***

The data on the relationship of unit volume to outcomes in maternity services for low-risk women must be interpreted with caution and there may be more meaningful causal mechanisms that should be considered for policy and planning. The examination of Norway's experience before and after small maternity unit closures should provide some warning. Increasing rates of maternal morbidity, regional differences in access to care and growing distances to care pose a risk to patient safety and are costly to the system. In spite of the influence of the above volume-advantage studies on policy worldwide, the balance of evidence with regard to maternity volume shows that it is not a meaningful way to evaluate safety. In the final analysis, low-volume settings with risk screening and regional referral appear to be a safe option.

## The Importance of Service Sustainability to Safety

Key Points

1. Physicians working in primary maternity service environments express the stress and challenges of providing maternity services without local access to c-section
2. Outflow is higher in primary service communities without local c-section
3. Caseload midwifery may be a sustainable practice model for low-volume, rural and remote communities
4. Mixed model (general physician-midwife) may reduce on-call requirements and stress in primary environments

A recurring finding in this review is the relationship between sustainable local care and safety. How service sustainability is fostered and maintained deserves more considerable focus, but falls slightly outside the scope of this review. This overview, then, is a reflection on its relevance to the safety of primary services.

Two considerations are important for this review. First, there is evidence that physicians feel considerable stress at providing maternity services without surgical support and without evidence-based policy to guide their clinical decisions (Grzybowski, Kornelsen and Cooper 2007; Hoang, Le and Kilpatrick 2012; McIlwaine and Smith 2000). Second, the proportion of women retained by a service increases with local access to surgical services (Grzybowski, Stoll and Kornelsen 2012; Kornelsen, Grzybowski and Iglesias 2006).

Physician burnout in a primary setting naturally leads to higher rates of turnover and service instability, and may degrade the quality and availability of primary care for both parturient women and the community at large. Stress was found to relate to providing care without immediate access to surgical support in the event of an emergency, maintaining clinical confidence in low-volume settings and the social and ideological strain of trying to balance the desires and needs of parturient women with the clinical limitations in the community (Grzybowski, Kornelsen and Cooper 2007). Solutions to that stress are naturally complex but include obstetric training for nurses and better preparation for the more varied case mix in rural hospitals (MacKinnon 2010). Two providers in Bella Coola noted the encouragement they felt from academic literature suggesting the outcomes for their community would be worse without services (McIlwaine and Smith 2000), and physicians in four other BC communities noted the need for evidence-based policy to guide their decisions (Grzybowski, Kornelsen and Cooper 2007). Strong relationships between primary providers and providers in referral communities are perhaps a pillar of clinical confidence (Kornelsen and Ramsay 2014). The relative value of different education and evaluation models (including CME and CQI) and how to plan effective inter-facility transport are components that require investigation outside the scope of this review that nevertheless play important roles in provider efficacy and confidence.

From a system perspective, greater rural outflow has cascading effects for already busy referral centres and system resource use, as well. Those women traveling the greatest distances to care demonstrably bear the greatest perinatal health burden, including greater psycho-social risk, increased likelihood of accidental out-of-hospital birth, increased perinatal mortality and increased rates of low birthweight and premature birth. This was confirmed and reflected in population data that found communities with the greatest outflow – the highest proportion of women leaving the community - suffered the worst outcomes. Closure of satellite sites may increase volume in referral hospitals beyond capacity, and those women traveling to care may be presenting with a higher average level of morbidity.

Primary maternity sites (1A) 'risk-out' a greater proportion of local women than do sites with cesarean section capability, which may undermine the sustainability of the service. Historical case study evidence comparing 1A primary services on Haida Gwaii to 1B services in Bella Coola found the only difference was the proportion of women delivered locally – 50.2% and 69.8% respectively between 1986-2000 (Lynch et al. 2005).

BC-wide numbers for rural BC women with a midwife involved in their maternity care also suggest 50% of women can deliver locally in a 1A environment (Stoll and Kornelsen 2014). As well, primary care by midwives in New Zealand delivered 47% of their local women between 2010-2012 despite additional transfer for earthquakes during the study period (Grigg et al. 2015). However, hospital-based midwives in remote Scotland delivered just over 31% of local births (Tucker et al. 2010). As well, only 33.6% of women were delivered in remote maternity homes in Norway (Schmidt, Abelsen and Oian 2002). A major difference in BC and New Zealand is the possibility of home birth. In fact, 72 of the 184 local births reported in Stoll and Kornelsen (2014) as midwife-involved pregnancies to women with local 1A services were delivered at home.

This may be a factor in the difference found between midwife- and physician-led primary communities. The proportion of local deliveries in physician-led primary care communities in BC and Alberta is shown to be roughly 1/3rd while those with generalist surgical support typically deliver between 78-85% of local pregnancies (Kornelsen and McCartney., "Optimal Perinatal Surgical Services for Rural Women: A Realist Review" 2014).

These numbers are deeply influenced by the culture of birth, too. The Innulitsivik midwifery model in Nunavik reports delivering 86% of local pregnancies (Van Wagner et al. 2012). The physician-led primary model at Ungava Bay, Nunavik delivered 72% of local pregnancies in 1995-96 (Simonet et al. 2009). Lynch (et al. 2005) found that the 1A service in Haida Gwaii delivered 55% of local women in 1986, declining to 35% in 2000 and closing that year (the moratorium has since been lifted). At the same time, the 1B site at Bella Coola saw a similar decline from 78% of local women delivering in their home community in 1986, down to 61% in 2000. That year, providers in Bella Coola published their concerns about maintaining competence and confidence with declining numbers (McIlwaine and Smith 2000). Iglesias, Iglesias and Arnold (2010) argue that a severe decline in the proportion of generalist physicians practicing obstetrics as a consequence of a specialist culture of practice created recruitment challenges in Bella Bella that ultimately led to closure of maternity services in the isolated community after 70 successful years.

Parturient women and obstetrical care providers have different conceptions of risk, with providers concerned about the emotional, social and professional toll of a poor outcome for a member of their community and women concerned with both the emotional and social toll of leaving their home (Kornelsen and Grzybowski 2012). While no easy answer exists to this tension, it is clear that outflow from primary services is increasing for cultural as well as clinical reasons. The rate of surgical intervention is significantly smaller than the 55% difference between those deemed safe to deliver at 1A and those able to deliver at 1B services, reflecting both real differences in clinical capacity and a culture of risk avoidance.

System and policy support for rural providers and maternity services has clear benefits for parturient women, their neonates, rural providers, referral hospitals and the system itself. Sustainable primary practice begins with evidence-based policy regarding its safety relative to the alternative of no services. Where population size, community isolation and social need indicate capacity for a maternity service with surgical capability, this type of service is shown to reduce outflow further. For remote

communities, those too small to support surgical services and those with a non-interventionist culture of birth, primary maternity services should be supported as a safer alternative to excessive outflow.

## Rural Health Disadvantage: A Social Disparity

Key Points

1. Social health disparities (education, socio-economic status) explain only part of rural outcomes disadvantage: *distance to services independently adversely impacts maternal-child health outcomes*.
2. However, socio-economic status can impact birth outcomes regardless of rurality or urbanity.
3. Characterization of rural is inconsistent across the literature, leading to comparative challenges.
4. Studies have demonstrated differential rural effects on First Nations and non-First Nations women, outcomes for the former being more adversely effected.

The Canadian Institute for Health Information (CIHI) reports, at a population level, that residents in remote regions are disadvantaged with regard to education and employment opportunities, income and access to goods and services. These disadvantages lead to overall less favorable social well-being and health outcomes (CIHI 2006). However, there is a growing recognition that:

> *Communities have widely different opportunities and constraints that shape their potential development and their health, and that the policy process should not overlook this diversity of conditions. At the provincial/territorial and federal levels, attention to small territorial units is required in order to understand how universal policies might affect different areas, as well as to assess the potential for local policies. Decentralization of services and increased responsibilities allocated to local and regional administrative bodies have stimulated analysis of health performance on a smaller geographic scale. (CIHI 2006, p.16)*

In examining the diversity of conditions in rural health, researchers have put forward a rural health gradient, observing in some regions that maternal health outcomes worsen as rural isolation increases. Other studies have found a maternal health benefit for living rurally if that community is adjacent to an urban center. Maternal and community characteristics are also studied as influencing factors on birth outcomes with a significant body of work looking at health disparities seen in Aboriginal communities. Many of the findings come back to a key influencing variable for health disparity, which is socio-economic status of a community.

***Rurality Gradient***

In two different studies, one set in Quebec (Luo and Wilkins 2008) and one in New York State (Struz et al. 2010), findings pointed to a simple spectrum of rurality and maternal outcomes: the more rural a woman was, the higher the likelihood for morbidity.

Luo and Wilkins (2008) studied all births in Quebec between 1991 and 2000 for risks of adverse birth outcomes in connection to the degree of rural isolation and how maternal sociodemographic and socio-economic characteristics could account for some of the differences in health outcomes in rural areas. Luo and Wilkins (2008) found that the less metropolitan influence an area had, the higher the rates of preterm birth, stillbirth, neonatal death and post-neonatal death. In this study, rates of observed birth outcomes were nearly identical for rural areas with strong metropolitan influence and urban areas. In the areas with the least metropolitan influence, the risks for infant death due to congenital anomalies, post neonatal SIDS, preterm, SGA, and low birth weight infants were substantially elevated.

The researchers applied a stepwise regression to find which variable had the largest effect on post-neonatal death (28 – 364 days) and found that maternal education was the most influential (often used as an indicator in social health of socio-economic status). In areas with no metropolitan influence the proportion of mothers who had not graduated high school was 42% compared to 15% in areas with strong metropolitan influence and 13% in urban areas.

Where Luo and Wilkins (2008) looked at birth outcomes across a spectrum of rurality, Strutz (et al. 2010) compared three different rurality classifications commonly used in health services planning in New York State. Each of the three classifications had different proportions of women that were considered rural: 50%, 21%, and 15%. Overall, the study showed that rural populations had the poorest birth outcomes across the classification approaches with some differences. Though rural women had higher odds of low birthweight and preterm delivery, there was a weak correlation for the small for gestational age outcome. The typology that classified 21% of women as rural, actually showed an advantage for this group when it came to gestational age. This examination of typologies suggests that the way rural residence is categorized might influence findings of disparity and benefit.

Further studies that have been designed to investigate the spectrum of rurality have also demonstrated a rural advantage. In challenging the supposition that rural women will be at a disadvantage compared to urban women, Hillemeier (et al. 2007) used four levels of residential categorization: 1) urban-focused area, (2) large rural city-focused / town-focused area, (3) small rural town-focused area, and 4) isolated small rural town-focused area. They also collected information on the following variables: educational attainment, marital status, tobacco use, chronic hypertension, diabetes, prenatal care, and adequacy of prenatal care utilization, percent of high school graduates within the mother's zip code, and percentage of people below poverty within the mother's zip code.

In most rural areas women were youngest and least educated and their area was most likely to suffer from a shortage of primary health care professionals. Still, the women living in one of the rural areas had an advantage. Women in the larger rural city-focused area had a significantly lower likelihood of having

a low birth weight infant compared to urban-focused areas (aOR=0.82; 95% CI= 0.67 to 1.02) and there was no difference between urban-focused areas to the two more isolated rural categories. Hillemeier's (et al. 2007) results support a claim of heterogeneity in rural areas and indicate that large rural cities may be conferred the benefits of both rural and urban areas.

This pattern of rural-adjacent urban benefit was also found in Eastern Iowa. A study done by Hulme and Blegen (1999) looked at birth records for 263 women who delivered by caesarean section over an 18-month period in 1992-1993 at a tertiary care hospital. The categories for comparison were women from urban counties, rural-adjacent urban counties, and rural counties. Overall, the rural women had worse birth outcomes and traveled the greatest distance for delivery. Women residing in a rural area adjacent counties (at least 5% commuting to the urban areas and with at least one town greater than 2,500 people, but not greater than 50,000 people) to an urban one had the best birth outcomes of the three groups, even though they were the youngest, least educated, least likely to be married, and the least likely to be privately insured. The outcomes for this group did not follow the expected pattern of correlation between socio-demographic factors and birth outcomes. That is to say, even though most of the risk factors were high, this group had the best overall birth outcomes, which were related to their place of residence.

Consequently, we begin to see a pattern in which social health disparities, including education and socio-economic status, are only part of a persistent rural outcomes disadvantage in maternal-child health. Isolation – or, phrased differently, distance to services – is negatively impacting maternal-child health outcomes for rural and remote people independently of social health determinants.

***Aboriginal Communities and Rural Health Disparity***

An important characteristic of Canadian and BC rural communities is their relatively high proportion of Aboriginal residents compared with urban centers (CIHI 2006). Research findings indicate birth outcomes are persistently worse among Aboriginal as compared to non-Aboriginal populations (Luo et al. 2010). While the underlying causes of health disparity are not fully understood, there are studies that look at rurality as an influencing factor (Luo et al. 2010; Graham et al. 2007; Simmons, Khan and Teals 2005; Powell and Dugdale 1999).

Many Aboriginal communities are rural or remote. According to Health Canada (2003), the majority of Aboriginal communities, 64%, are non-isolated (road access and less than 90 kilometers away from physician services); 14% are semi-isolated (road access, physician services at greater than 90 kilometers); and 22% are isolated or remote isolated (isolated: scheduled flights, good telephone services, no road access; remote isolated: no scheduled flights or road access and minimal telephone or radio service).

Luo (et al. 2010) investigated if degree of rurality might impact Aboriginal people differently than non-Aboriginal people in rural Manitoba, hypothesizing that there are different mediating factors for Aboriginal people, including less access and effective use of health centers as well as poorer socio-economic conditions. Looking at all live births to residents of Manitoba from 1991 to 2000, Luo (et al.

2010) compared 25,143 First Nations births to 125,729 non First Nations births across four levels of rurality-urbanity. The four levels of rurality were no, weak, or moderate/strong urban influence, and urban. Luo (et al. 2010) found that First Nations women had an elevated risk of infant mortality compared to non-First Nations women (relative risk=1.96; 95% CI 1.69 to 2.27). When it came to the spectrum of rurality, rates of infant mortality significantly lowered from most rural to urban for non-First Nations women (7.4, 6.0, 5.6, and 4.6 per 1,000); however for First Nations women there were no significant improvements (10.7, 9.9, 7.9, and 9.5 per 1,000). Large for Gestational Age (LGA) and high-birth-weight rates improved for non-First Nations women as they moved towards urbanity as well, but not for First Nations women. This study demonstrates a social disparity in health for First Nations and non-First Nations women in Manitoba: the degree of rural isolation affected infant mortality differently depending on the parents' status as First Nations. Luo (et al. 2010) speculates that the disparity exists because of barriers in access and effective use of more advanced health facilities in urban areas. Luo's (et al. 2010) examples of barriers are lack of culturally-relevant health materials and language barriers, whereas other researchers list fear of hospitals, feelings of vulnerability, miscommunication, as well as loneliness and isolation as barriers (Simmons, Khan and Teals 2005).

Findings from three Australian studies demonstrate the importance of studying social disparity within cultural and geographical context. Graham's (et al. 2007) study looked at all births to Aboriginal women in Australia and found a progressive disadvantage as mothers' residence became more rural. While looking at the issue country-wide can be helpful in demonstrating that a disparity exists, it is difficult to ascertain where and how to close the gap. Indeed, broad population perspectives can also be harmful by using aggregate statistics to stereotype groups. A study by Simmons, Khan and Teals (2005) that looked specifically at Aboriginal women in the Goulbourn Valley of Australia compared to non-Aboriginal women in the same area and found constructive areas to lessen disparity, for example education about the benefits of breast feeding and that local Aboriginal antenatal services are having a positive effect on lessening outcome differences. Powell and Dugdale (1999) compared birth outcomes of Aboriginal women who lived in the Cherbourg community to those of non-Aboriginal women in the same rural area and found that Aboriginal women were more likely to have a lower weight infant. The researchers included maternal histories in their model and found that when they controlled for sexually transmitted diseases (STDs), gravida, and alcohol intake, there was no significant difference in birth weight, highlighting a focus for improving health disparity in the Goulbourn Valley.

***Socio-Economic Status***

Generally speaking, rural communities have different socio-economic and demographic profiles than urban communities and face challenges in these areas, that is, on measures of education, employment, and income rural communities tend to have less on average (CIHI 2006). Aging populations, economic challenges, and geographic isolation are often put forward as explanatory variables for health vulnerabilities in rural areas (CIHI 2006). Specifically for rural maternal health, rural women are more likely than urban women to live in poverty, have lower levels of education, limited employment opportunities and more limited access to health services (Strutz et al. 2012; Hillemeier et al. 2007). Though, drawing a dichotomy between urban and rural populations on the basis of socio-economic status is not that straightforward. In a study by Luo (et al. 2004) on BC birth records between 1985 and

2000, the researchers studied the birth outcomes of rural and urban women by placing them in income quintiles. Urban areas showed a clear disparity across birth outcomes between the richest and the poorest neighborhoods whereas rural areas only showed a slight disparity on one birth outcome, preterm birth, between the poorest and the richest neighborhoods. Luo's (et al. 2004) work indicates that socio-economic disparity is a factor that impacts maternal health within urban and rural areas differently. Indeed, in urban areas, there was a higher proportion of mothers living in poorer neighborhoods who were more than 50km away from the nearest hospital with specialist services. In both rural and urban areas, Luo (et al. 2004) observed differences in maternal and pregnancy characteristics where women in the poorer rural and urban neighborhoods were more likely to be of First Nations ethnicity, unmarried, young, have a maternal illness, and delivered instrumentally. Despite the general consensus of a rural versus urban divide in the literature, given Luo's (et al. 2004) results, it would seem more apt to conclude that socio-economic status can impact birth outcomes regardless of rurality or urbanity. There are further examples in the literature that look at health more generally and produce conflicting results on urban-rural health disparity even within the same geographic area (CIHI 2006). The most consistent finding is that a community's health is greatly influenced by the proportion of residents who live in poverty and the economic well-being of the area (CIHI 2006). Even in studies that have found rural women are less likely to receive as much prenatal care as urban women, findings can still show comparable birth outcomes when there are shared socio-economic realities (Hulme and Blegen 1999).

***Conclusion***

Population-level research in social disparity shows general trends towards a rural disadvantage and a disadvantage for Aboriginal women. When specific groups and places are examined more closely, research shows contradictions and constructive modifiers to this general trend. There are undeniable health benefits conferred by higher socio-economic status (having a higher income and access to educational achievement). At the same time, isolation and distance to services play an important role in individual and community health outcomes. Greater poverty and greater isolation each have psycho-social dimensions as well as physiological dimensions, often resulting in greater but non-specific clinical morbidity.

This growing body of knowledge shows that when it comes to developing health policies, programs, and community level interventions, *place* needs to be considered as a key factor in its relationship to health (CIHI 2006). This relationship might be different depending on the place itself, either through the independent effect of isolation, or an interaction of social and cultural effects. Decentralization of maternal health services can bolster the opportunity for communities to determine and develop health opportunities that fit their unique strengths and facilitate overcoming their constraints.

## Discussion and Conclusion

The limitations of health service research to date are laid bare in a large scale review of this type. Research in maternity services often includes mention of methodological limitations. A reliance on retrospective cohort designs, case studies, and expert opinion (including patients, providers, researchers and system administrators) is argued to undermine the confidence of firm research answers. This limitation speaks to a positivist ontology and implies that if we had randomized, prospective designs, we could answer the question of safety more completely. In fact, through an investigation of the complex mechanisms of this intervention, this review has shown that the limitations of research in this area are not primarily methodological. The more fundamental limitations relate to how the pregnant woman, her family and their needs are situated.

Considerable resources of every type have been applied in answering whether the safety of small, low-volume services in rural communities are as safe as highly resourced, specialist-led services in larger centres. Nuance and insight has been applied – the holistic consideration of safety, the valuing of the experience of actors in the system, the accurate identification of contributing factors to outcomes in a complex system – but this review is the first attempt to consider all of this research as inter-related. The authors contend this is due to an enduring provider/service lens – rather than a patient lens – by researchers and policy makers alike.

The question on safety is not whether a given maternity service or model of care is safer, but whether it is safer for rural and remote women to use the service. This subtle reframing has profound implications for how we consider the research in the field within this realist review, but equally profound implications for how data should be organized and managed for evaluation.

The least clear data in making a political, service system or clinical decision regarding the safety of primary maternity services was precisely that data with the greatest claim to scientific rigor. The aggregation of data into larger and larger groups obscured the context of outcomes in a stepwise pattern – that is, small case studies afford an opportunity to understand when and why services function and for whom, while many of the largest, most methodologically advanced studies provided no clear insight into the 'ideal' system. While each has an important place in system administration, the parameters of safety in rural are easily overwhelmed by population level data. Further, the small numbers of women traveling the greatest distances to care and/or experiencing the greatest social vulnerability are hidden when aggregated alongside other rural people who might be adjacent to services and enjoy greater privilege. High level data might show a persistent outcomes disadvantage, but the use of large datasets may hide the reasons why and thus the opportunities to make significant and cost-efficient changes.

The contention that higher resourced units have better outcomes speaks to a comparison by unit. Evidence has been found that both indicates and counter-indicates that such a relationship exists in maternity for developed nations with regionalized care. Considerations include controls for prognostic variables (maternal age, relative health, social status, and more), the models of care at each volume level (case mix, skill mix, provider competency, sustainability), and the relative power of outliers when maternal and neonatal mortality are relatively rare events (demanding the need for larger and larger

datasets, more precise data on why and how mortality occurred, and operationalization of 'avoidable' mortality). The impulse of the research to date has been to call for higher quality studies. Prospective cohorts of sufficient size may indeed provide a clear statistical answer to the difference in outcomes according to the volume and resources of the maternity unit.

Yet, when seen from the rural patient's perspective, the claim of safety in larger centres – if it were found – creates a system imperative that necessitates the parturient woman travel for her care (at least intrapartum). That presumed safety represented by volume then must surpass the threshold of increased risk represented by greater distance to care. And further, it must surpass the next threshold of worsened outcomes from greater psychosocial stress engendered by evacuation practices. Both distance to care and psychosocial risk are well studied and documented factors in evacuation and both are shown to lead to worsened clinical outcomes.

When we consider this as one phenomenon, the literature becomes quite clear. We have strong evidence that distance to care, accidental, out-of-hospital births, increased psycho-social stress, social and cultural vulnerability and unstable services lead to worsened outcomes for women and their babies. The evidence regarding the effects of decision-to-incision timing and volume-to-outcome relationships in maternity for a developed country with regionalized public health care are considerably more contested and uncertain.

The centralization of services has the stated intention of improving outcomes. To date, the onus of proof has been on small volume, rural, generalist maternity services. If reconsidered in the light of this review, the burden of proof shifts. Centralizing to higher tiers of care must prove it improves outcomes beyond the threshold of increased morbidity and mortality witnessed as a consequence of evacuation. That proof still has to be weighed in relation to the other tenants of the Triple Aims value framework of improved experiences of care and lower per capita costs.

At the same time, we must recognize that emergency transfer will occasionally be necessary and there will be cases in which unpredictable events will raise the risk level of a woman intrapartum or immediately postpartum. When situated in the real world phenomenon, we find that those small communities with primary maternity services with emergency skills and regionalized transfer and referral support will do better in those emergent situations (including preterm births, hemorrhage, cord prolapse, failure to progress with non-reassuring fetal heart tones, and even women of high risk who have chosen to arrive in labour without warning) than will communities without primary maternity services and without even basic obstetrical expertise.

The implications for policy and planning are thus similarly clear. Primary services in rural and remote communities are not a solution for all women – many of whom will have or develop complex health risks that indicate a higher level of care - but do improve maternal child outcomes for local, low-risk women. For those women who are a poor fit for a primary service but end up giving birth in their home community anyway, the presence of primary maternity service knowledge and maternity providers is better than the real world alternative of undertrained emergency staff or no medical personnel at all.

Planners can confidently encourage local birth services led by midwives and/or physicians for low risk women in rural and remote environments. The service providers must be engaged in a CQI system to ensure the maintenance of skills and confidence, have effective professional support, be integrated into a regionalized system of referral and transfer, and have access to effective emergency transport. Providers of all disciplines should have maternity emergency course preparation like the one provided by PSBC.

More uniquely, an easy to interpret decision aid for the risks involved in the choice of where to birth should be developed. Ideally, this decision aid would be place specific, with changes made according to referral patterns, local capacities and more. As well, a planning aid for how to decide community appropriateness for where to place 1A birthing services needs to be developed.

## Recommendations

*Context:*

Services must be planned to meet the Institute of Health Improvements' Triple Aim goals of

a. Improving the health of populations;
b. Improving the patient experience of care (including quality and satisfaction), to which B.C. has recognized the additional requirement of improving the experience of delivering care for providers and support staff as critical to patient-centred care built on efforts of those who deliver and support health services and
c. Reducing the per capita cost of health by focusing on quality (especially effectiveness and appropriateness) and the efficiency of health care delivery.

Consideration of the safety of primary maternity services must take place within recognition of an expansive definition of safety to include cultural, social and personal safety in addition to physiological safety. Additionally, clear lines of responsibility for rural maternity care must be established in the Ministry of Health, Health Authorities and Perinatal Services BC to ensure consideration, uptake and evaluation of the following recommendations. From this vantage point, the following criteria must be met to support primary maternity services:

I. Planning Issues

1. Maternity services for rural and remote communities must be systematically planned based on the need for services of the population catchment;
2. Special consideration needs to be given to meeting the maternity service needs of remote aboriginal populations;
3. Rural primary maternity services need to be supported as a stated priority for health planners;
4. Services must be positioned within a regional networked model of maternity care, which assumes clear referral lines for triage to higher levels of care when necessary;

5. Guidelines for identification of candidates for birth in a low resource environment (those likely to have an uncomplicated vaginal delivery) need to be refined and adopted across the rural and remote environment;
6. Effective and efficient perinatal transport systems must be in place for instances when emergency transport is necessary;
7. A quality management framework for rural community services needs to be established and led by rural maternity providers, and
8. A decision aid for facilitating decision on place of birth at a patient level must be developed representing the patient priorities alongside relevant clinical data.

II. Provider Issues:

1. Individuals providing rural maternity services must be well-qualified and work within a Continuous Quality Assurance monitoring framework with adequate opportunities for Continuing Medical Education;
2. Innovative models of midwifery services for rural communities with planned primary maternity services and absence of current maternity services need to be supported;
3. Barriers to interprofessional practice between midwives and generalist physicians in rural and remote communities need to be identified and addressed;
4. Primary maternity services must take place within the context of a well-functioning interdisciplinary local team including care providers, allied health providers and local administrators.

III. Evaluation:

1. Population catchment outcomes need to be prospectively monitored and feedback needs to be given in a timely and flexible way to individual communities, service strata, and regions;
2. Service utilization patterns as well as referral patterns at the population catchment level are an important indicator of the quality of service and need to be part of the ongoing monitoring;
3. CME/CPD should be provided inter-professionally, on site, and linked to outcome monitoring and driven by the needs of the local maternity care team.

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## Appendix A: Annotated Bibliography

| Bibliographic reference | Jurisdiction | Research question | Context | Study Design | Main Findings |
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| Bailey, B. A., & Cole, L. K. J. (2009). Rurality and birth outcomes: findings from southern Appalachia and the potential role of pregnancy smoking. The Journal of Rural Health : Official Journal of the American Rural Health Association and the National Rural Health Care Association, 25(2), 141–149. | US, southern Appalachia | • What are the associations between rurality and related community conditions to newborn outcomes in southern Appalachia and can smoking during pregnancy explain some of these associations? | Many factors, including poverty, minimal education, inadequate access to medical care, and negative health behaviors, are more prevalent in rural environments, and may partially explain the elevated rates of LBW and PTB in rural southern Appalachia specifically | Retrospective cohort design using hospital records that include self-report data for pregnancy smoking | Babies born to women residing in completely rural counties weighed on average over 700 grams less, were an inch and a half shorter, and were born over 3 weeks earlier; 4.5 times more likely to be LBW, 4 times more likely to be born preterm, and more than 5 times as likely to be admitted to the NICU; for this group of infants, rates of LBW, PTB, and NICU admission approached 50%. |
| Bartels, D. B., Wypij, D., Wenzlaff, P., Dammann, O., & Poets, C. F. (2006). Hospital volume and neonatal mortality among very low birth weight infants. Pediatrics, 117(6), 2206–14. | Germany, Lower Saxony | • How does NICU volume (small, medium, large) impact neonatal mortality? | Delivery hospitals and neonatal care units are often detached. This "decentralization" concept, with many small units, was reinforced (eg, in Germany) to minimize distance and duration of neonatal transport. Today, the obvious advantages of large perinatal centers and in utero transport, as well as economic benefits, have led to the quest for centralization. Unfortunately, supportive data are lacking. In the absence of a specific classification system that quantifies the level of care, hospitals can be compared with respect to outcomes by using hospital caseload as a proxy. Most previous studies showed that high hospital volume was associated with better | Retrospective population-based data analysis. | Results suggest that creating larger perinatal centers may improve perinatal health care. The volume of the NICU was associated more strongly with 28-day mortality than was the volume of the delivery hospital, and it had the largest impact on survival for infants of _29 weeks. |

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| | | | outcomes.9 Difficulties in those studies included differences in case mixtures and study populations, varying definitions of hospital categories, presence of bias,10 and focus only on specific procedures. | | |
| Bartels, D. B., Wenzlaff, P., & Poets, C. F. (2007). Obstetrical volume and early neonatal mortality in preterm infants. European Journal of Epidemiology, 22(11), 791–8. | Germany, Lower Saxony | • how does annual delivery volume impact early neonatal mortality among very preterm births? | timely referral to a perinatal centre is often possible, with beneficial effects on perinatal outcome. The structural characteristics of the tertiary perinatal centre, however, may also influence outcome and prognosis of mother and child. In this regard, it has been shown that hospital volume can serve as a surrogate quality criterion for e.g. experience, staff, multidisciplinarity, and 24 h physician availability, which may all affect patient outcome. Most countries have defined levels of perinatal care based on staff, equipment and risk profiles of mother and foetus, but not on hospital volume. Since the 1950s, national professional organisations and regulatory authorities have considered recommended minimum numbers of annual hospital deliveries. Discussed cut-offs range from 1,500 to 2,000 annual deliveries, but have not yet been implemented consistently. Moreover, delivery unit and NICU are usually combined within perinatal centres, thus the individual impact of the delivery vs. neonatal unit | Population-based cohort design | Study has shown a slight, but non-significant association between obstetrical volume and early neonatal mortality. In future studies the impact of caseload on outcome may become more evident when referring to high risk patients instead of to the overall number of deliveries |

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| | | | volume cannot be distinguished | | |
| Bar-Zeev, S., Barclay, L., Kruske, S., Bar-Zeev, N., Gao, Y., & Kildea, S. (2013). Use of maternal health services by remote dwelling Aboriginal women in northern Australia and their disease burden. Birth (Berkeley, Calif.), 40(3), 172–181. | Australia, Northern Territory | How are maternal health services used by remote dwelling Aboriginal women in northern Australia during pregnancy | Disparities exist in pregnancy and birth outcomes between Australian Aboriginal women and their non-Aboriginal counterparts. Understanding patterns of health service use by Aboriginal women is critical. This study describes the use of maternal health services by remote dwelling Aboriginal women in northern Australia during pregnancy, birth and the postpartum period and their burden of disease | Retrospective cohort | Ninety three percent of women attended antenatal care. This often commenced late in pregnancy. High levels of complications were identified and 23 percent of all women required antenatal hospitalization. Birth occurred within the regional hospital for 90 percent of women. By 6 months postpartum, 45 percent of women had documented postnatal morbidities and 8 percent required hospital admission. The majority of women accessed remote health services at least once; however, only one third had a record of a postnatal care within 2 months of giving birth. |
| Black, D.P. & Fyfe, I.M. (1984). The safety of obstetric services in small communities in northern Ontario. Canadian Medical Association Journal, 130, 571-576. | Canada, Northern Ontario | Is safe care being provided in communities served by obstetric units that do not meet standards suggested for level 1 units?<br><br>Is safe care being provided in communities where caesarean sections are undertaken without the services of specialists in obstetrics or paediatrics? | We need to know more about the safety of small obstetric units before recommending that they either upgrade their services or close. With proper control and careful selection of patients, small units may be safe. We also need to know if the care provided in small hospitals doing caesarean sections and using anesthetics is safer than the care provided in the hospitals where all patients requiring these interventions are transferred to larger centres. | | There was little difference in perinatal loss rate for residents of areas served by different levels of obstetric care. Areas served by units where caesarean sections are done regularly but which do not have specialists in obstetrics or paediatrics had a perinatal loss rate of 10.43, whereas areas served by units staffed with two or more specialists in both obstetrics and paediatrics and handling more than 1000 delivers per year had a perinatal loss rate of 12.13. Although many of the smaller hospitals did not have the minimum capabilities suggested for obstetric units, relatively safe care was being provided. These results do not support the need for further centralization of obstetric services in northern Ontario. |
| Brown M, Dietsch E. The feasibility of caseload midwifery in rural Australia: A literature review. *Women and Birth* 2013; 26(1): e1- | Australia | • What is the viability of the caseload midwifery model of maternity care? | • More than 50% of Australia's rural maternity services have been closed since 1992, and it is widely believed that this has made birthing unsafe in rural communities<br>• There is evidence of poorer outcomes where no local | Literature review | • The benefits of the caseload midwifery model are well documented, including a reduction in fetal death, higher normal birth rates, more home births, lower rates of induction/augmentation of labour, fewer surgical deliveries, etc.<br>• International studies (NZ and UK) have shown that local birth is safe for low risk women, |

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| e4. | | | maternity services exist, and there are associated dangers of being forced to travel for delivery<br>• The traditional midwifery model has been described as fragmented, and lacking continuity.<br>• Caseload midwifery is a model that ensures that women know the midwives who provide them with service, thereby ensuring continuity of care | | even those in rural settings<br>• Caseload midwifery has been evaluated as a safe alternative to the traditional models of midwifery which dominate the Australian provision of maternity care<br>• Caseload midwifery has been demonstrated as a care model that promotes superior retention, job satisfaction, less burnout, and more occupational autonomy for midwives. It is therefore likely that this model provides sustainability of services |
| Chamberlain M, Barclay K, Kariminia A, Moyer A. Aboriginal Birth: Psychosocial or Physiological safety. *Birth Issues* 2001; 10(3): . | Australia and Canada | • What is the relative safety of communities with a culturally sensitive birthing center as compared to those without one. | • Since the 1970s, both Canada and Australia have adopted the practice of the transfer of mothers in late pregnancy to hospitals in urban centers.<br>• In addition to the Medical Health Officer of Canada deeming that birth in remote locations was unsafe, Aboriginal women have been doubly targeted for the policy of relocation for birth because they are identified as a high risk for adverse birth outcomes.<br>• In the 1990s, birth centers were established for low-risk women in the NWT in order to provide safe and culturally sensitive care. | Editorial | • Numerous studies have shown that women's level of isolation, either through location, language, or lack of support systems, directly influences the likelihood of postnatal depression and exhaustion. This remains true of aboriginal women who are forced become isolated through relocation.<br>• By comparing a community with a birthing center to one without any local birthing options, this study found that the latter group was more likely to incur feelings of separation, anxiety, financial stress, and alienation from family.<br>• The theme of stress around birth was rarely mentioned by mothers who delivered in a community with a birthing center. Those without a birthing center however noted stress, as well as a significant lack of choice and support. |
| Cheyne, H., Dalgleish, L., Tucker, J., Kane, F., Shetty, A., McLeod, S., | Scotland, rural and remote | • How do midwives working in urban and rural settings | There are persistent concerns about the quality and safety of birth in rural areas. Where local | Midwives and Obstetricians described | When reviewing the same case information in vignettes midwives in different settings and obstetricians |

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| & Niven, C. (2012). Risk assessment and decision making about inlabour transfer from rural maternity care: a social judgment and signal detection analysis. BMC Medical Informatics and Decision Making, 12(1), 122. | | and obstetricians make intrapartum transfer decisions?<br>1. What case and contextual factors influence intrapartum transfer decisions?<br>2. What are the relative contributions of these factors to case assessments?<br>3. Do these factors and their relative contribution to assessments vary between midwives and obstetricians and between different types of midwifeled maternity unit?<br>4. To what degree can clinicians distinguish higher risk cases from lower risk cases and the overall level of risk required (across the case) before the decision to transfer is made?<br>5. Do thresholds for decision making | maternity services are not provided women living in remote areas may be required to travel long distances to urban centres to await birth. These women may experience increased rates of induction of labour, emotional distress due to separation from family and community, and family financial hardship. Further, risks to community sustainability and cultural safety have been highlighted in areas where local facilities for childbirth have been lost. Even where community maternity facilities are available some women may opt to travel from their local area in order to receive obstetric led care which they perceive as being safer. The paradox is that childbirth is viewed both as a normal life event and also as a time of increased risk and vulnerability. | scenarios influencing their transfer decisions. Vignettes were developed based on these descriptions and presented to a larger group of midwives and obstetricians. Social judgment analysis was used to identify factors in risk assessment and signal detection analysis was used to identify participants' ability to distinguish high and low risk cases and personal decision thresholds. | made very similar risk assessments. Despite this, a wide range of transfer decisions were still made, suggesting that the main source of variation in decision making and transfer rates is not in the assessment but the personal decision thresholds of clinicians. |

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| | | vary significantly between midwives and obstetricians and between different types of midwifery unit? | | | |
| Combier, E., Charreire, H., Le Vaillant, M., Michaut, F., Ferdynus, C., Amat-Roze, J.-M., … Zeitlin, J. (2013). Perinatal health inequalities and accessibility of maternity services in a rural French region: Closing maternity units in Burgundy. Health and Place. | Burgundy region (depts. 21, 58, 71, 89), France | • What is the impact on perinatal outcomes of greater travel time to the nearest maternity unit? | • Centralization of maternity in France has continued since the 1980's.<br>  • 815 maternity units in 1996; 526 in 2010.<br>• These closures have impacted mostly small hospitals with 300 or fewer births.<br>• Between 2001-2010, Level one units declined from 415 to 263; Level three units rose from 56 to 60. Total national bed capacity declined from 19,025 to 16,986.<br>• Burgundy faced 36% closure rate<br>• Burgundy has one tier 3 maternity unit, six tier 2s. Tier 1 units fell from 20 to 15 in the region during the study period (2000-2009)<br>• Number of French parturient women living more than 30 minutes from the nearest maternity rose from 10,310 to 13,679 (+33%); more than 45km from care rose from 736 to 1520 (+106%).<br>• While mean time to services in Burgundy rose only slightly (+3 minutes between 2000 and 2009), the maximum time rose | Cross-Sectional; Hierarchical regression | • The primary finding of the study is that longer travel time to the nearest maternity unit had a negative outcomes impact on indicators of maternal and neonatal morbidity and mortality.<br>• Distance to care increased as a social phenomenon with hospital closures. In 2000-2001, 6.7% of women took longer than 30 minutes to arrive at hospital. In 2009, 8.8% took longer (p<0.001).<br><br>• Accidental Out of institution birth: No out of hospital births for those 45+ minutes to care (n=337 women), but increased rate for 16-30 mins (crude OR 1.56, 95% CI 1.20 – 2.04) and 31-45mins (crude OR 1.86, 95% CI 1.23 – 2.75). Adjusted ORs by time interval cohorts: <15: 1; 16-30: 1.73 (1.23-2.46); 31-45: 1.64 (1.06-2.54)<br>• Mortality:<br>o Statistically non-significant results for stillbirth and extended (within 28 days) perinatal death. However, gradient beta coefficient still found.<br>o Crude ORs for extended perinatal death by time cohort: <15: 1; 16-30: 0.96; 31-45: 1.09; >45: 1.86<br>o ADJ ORs: 1; 1,08; 1.18; 1.85<br>o Crude ORs for stillbirth by time cohort: 1; 0.98; 1.25; 1.89 |

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| | | | from 61 minutes to 72 minutes. | | o ADJ ORs: 1; 1.16; 1.31; 1.90<br>• Fetal Distress:<br>o Heart rate abnormalities were non-significant for Crude ORs, but Adjusted model showed beta coefficient spike in those furthest from care. ADJ ORs by time cohort: 1; 0.97; 1.28 (sig); 2.60 (sig) (CI 1.95-3.48)<br>o Meconium-stained amniotic fluid by time cohort: ADJ ORs: 1; 1.13; 1.59 (sig); 3.68 (sig) (CI 2.50-5.40)<br><br>• Hospitalization<br>o Prenatal hospitalization by time cohort: ADJ ORs: 1; 1.11 (Sig); 1.17 (sig); 1.38<br>o Hospitalization 24+hrs before delivery by time cohort: 1; 1.10 (sig); 1.16 (sig); 1.78 (sig)<br>• Induction non-significant. Crude ORs show unclear pattern that in which only greatest distance cohort shows increased rate of induction. ADJ ORs show gradient effect, but still non-sig.<br>• Importantly, associations were similar between crude and Adj ORs, with the impact of distance to care being more prominent in the model accounting for individual variables and residential environmental variables. |
| Darmawikarta. The baby blues: Challenges and limitations of delivering obstetrics care in rural Canada. *University of Western Ontario Medical Journal* 2014; | Canada | • What are the challenges and limitations of providing obstetrical care in rural Canada? | • Fewer than half of family physicians provide maternity service in their practices, as opposed to 70% in 1983<br>• Many newly graduating physicians refuse to practice in rural settings, and rural practice is vastly different from urban | Literature review | • N/A |

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| 83(1): . | | | practice. Rural physicians also have less support from allied health professionals<br>• Maternity care is most likely to be provided by a family physician in rural locations as opposed to an OB/GYN. C-sections are therefore most commonly provided by family physicians in rural locations, and studies have shown no difference in outcomes for c-sections provided by FPs and those provided by OB/GYNs.<br>• As stated in a study published by CIHI reported, women from rural areas were less likely to have a c-section and more likely to undergo a spontaneous normal birth. Women from remote areas were however more likely to undergo induction | | |
| Dietsch E, Shackleton P, Davies C, Alston M, McLeod M. 'Mind you, there's no anaesthetist on the road': women's experiences of labouring en route Rural and Remote Health 10: 1371. 2010 | New South Wales, Australia | • What is the experience of women who laboured en route from their local rural community, where a maternity unit has closed, to a centralised maternity unit | • There have been 130 closures of maternity units in Australia between 1996-2006<br>• Local birth is no longer an option in any form for members of 32 communities<br>• There has been no formal study of the risks of road travel to access care, and there has been no analysis of the safety or cost-effectiveness of rural maternity closures<br>• Perinatal outcomes in Australia have not improved | Case Study | • There is an erroneous assumption on the part of policymakers that all women have access to transport. Many women lacked any means of transportation, and taxis in expansive rural areas are prohibitively expensive.<br>• There existed a common perception among women that birthing on the side of the road was a frequent occurrence, so it therefore increased their anxiety<br>• Given that the average travel time for participants was four hours (and the self-selecting element of this study) the rates of emergency during travel were quite high. Participants were in labour en route for 30% |

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| | | | over time despite the increase in medicalization, centralization, and technological advance<br>• Remote Inuit villages in Canada served midwives have comparable or even more favourable outcomes compared to larger centers in which birth is medicalized. | | of births, and 12% of births occurred on the road.<br>• One woman who gave birth en route indicated that her experience was better and more empowering than a prior birth in a hospital with interventions (epidural), therefore seriously calling into question the conclusion that medicalized birth is superior. |
| Douglas VK. The Inuulitsivik maternities: Culturally appropriate midwifery and epistemological accommodation. *Nursing Inquiry* 2010; 17(2): 111-117. | Northern Canada | Two research questions:<br><br>• First, what does traditional childbirth mean to the Inuit and how has it changed since contact?<br>• Second, how have Inuit society and epistemology reacted to southern biomedicine and governmental authority and adapted in response to their influence? | • The basic epistemology of birthing practices is a source of contention in the Canadian North; biomedicine is a western invention, and in recent years there has been a resurgence in traditional birthing practices of northern indigenous nations<br>• Traditional indigenous views on birth perceive nature, society, and birth to be interconnected<br>• Inuit peoples are not rejecting biomedicine, however there is an impetus to strip away its concomitant modernist worldview and replace it with traditional knowledge<br>• In Nunavik, there is a gradually increasing number of birth centers that incorporate the above characteristics and provide maternity care<br>• It is believed that the harsh environment of northern conditions led the pre-contact Inuit peoples to have a strong emphasis on group survival, | Literature review | • N/A |

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| | | | which has manifested and persisted in birthing practices continuing to this day<br>• Anecdotal evidence suggests that pre-contact community-based birthing care had low infant mortality, and that the resource base could support a large population.<br>• Contact with industrialized civilization resulted in a concentration of Inuit peoples within settlements without their traditional resource bases, and the introduction of epidemic disease caused mortality rates to increase dramatically. This led to an increasingly discredited traditional birth practices<br>• Training programs were eventually established in which 'southern' midwives (midwives from the developed world) were hired to train Inuit peoples. | | |
| Fallis G, Dunn E, Hilditch J. Small Hospital Obstetrics: Is small Beautiful?. The Journal of Rural Health 1988; 4(2) | Newfoundland, Saskatchewan, Ontario, Quebec | • How do small hospital outcomes (<400 births per year) compare to those of larger hospitals? | • 15% of all deliveries (at the time of this study) occurred in small hospitals (<400 births per year)<br>• Over the 15 year period in the provinces studied, PNMR fell significantly although the number of small hospitals remained the same. | Cross sectional study | • There were no significant differences in PNMR in small hospitals vs larger hospitals for low-risk infants (newborns weighing <2500 grams)<br>• Saskatchewan, the province with the highest proportions of birth in small hospitals (33%), had the lowest PNMR in all weight categories. PNMR was lowest in small hospitals<br>• Overall, small hospitals are safe in Canada, and outcomes for all weight categories are good and comparable with those of larger hospitals. |

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| Finnström, O., Berg, G., Norman, A., & Olausson, P. O. (2006). Size of delivery unit and neonatal outcome in Sweden. A catchment area analysis. Acta Obstetricia et Gynecologica Scandinavica, 85(1), 63–67. | Sweden | What is the quality of perinatal care in relation to size of delivery unit and size of catchment area for deliveries? | The impact of the size of obstetric and neonatal units on perinatal outcome has been studied extensively, but with conflicting results. Little controversy concerns the results for very preterm babies. Several hospital-based studies have shown higher survival rates in hospitals with larger volumes and/or a higher level of obstetric and neonatal care. When analyzing outcome according to residency of these mothers, there is still a difference between smaller and larger units regarding neonatal survival (3,4). Controversy still concerns full-term and/or low risk babies. While many hospital-based studies show clear-cut differences in perinatal or neonatal mortality, this is not obvious when outcome is based on catchment area. | Cohort study using the Swedish Medical Registry and the Hospital Discharge Registry. Odds ratios were estimated for the different outcomes in relation to size of delivery unit and the provision of a pediatric department at the hospital. | Neonatal mortality was significantly higher for infants in families living within the catchment area of the smallest units without a pediatric department. Small differences in the occurrence of respiratory disturbances and Apgar scores are probably due to diagnostic differences. There were no differences in the incidence of cerebral palsy. Neonatal mortality continued to decrease during the observation period. Differences were minor, pointing to a fairly homogeneous quality of perinatal care and an efficient referral system for risk pregnancies. Mortality continues to decrease in spite of a reduction in the number of units caring for deliveries. |
| Friedman A, Ananth C, Pendergast E, D'Alton M, Wright J. Are low volume hospitals low risk for maternal morbidity?. American Journal of Obstetrics | United States | • What is the relationship between birth volumes of hospitals and morbidity/mortality for women? | • Regionalization of maternal care and referral of parturient women with high risk factors has been proposed as a means of reducing maternal moribidity/mortality, but little data exists on the relationship between hospital | Cohort study | • Women who deliver in low-volume hospitals commonly have comorbid risk factors and experience severe morbidity.<br>• Women delivering across volume categories had similar rates of many risk factors (gestational diabetes and hypertension, mild preeclampsia, previous cesarean section, |

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| and Gynecology 2015; 212(1): S35-S36. | | | birth volume and outcomes. | | placenta previa, and fetal demise).<br>• Less common risk factors were more common at high volume hospitals, however many women with these conditions delivered at lower volume hospitals. |
| Gaff-Smith M. Are rural adolescents necessarily at risk of poorer obstetric and birth outcomes?.Australian Journal of Rural Health 20015; 13(2): 65-70. | Wagga Wagga base hospital, New South Wales, Australia | • What are the obstetric and birth outcomes in a sample of rural adolescents, and are rural adolescents necessarily at risk of poorer obstetric and birth outcomes? | • Adolescent mothers accounted for 5% of all births in New South Wales overall, but roughly double that proportion (>10%) in the Wagga Wagga base hospital.<br>• Adolescent mothers are generally considered 'at risk', and have higher rates of complications and interventions, although this concept is not universally accepted. | Cross-sectional | • Rural adolescents are at risk of delivery complications and are less likely to have a normal vaginal delivery<br>• Obstetric complications from the Wagga Wagga cohort did not significantly differ with those of the entire New South Wales group, but distribution of delivery method was significantly different. Far fewer had a normal vaginal birth, and the rates of intervention were significantly increased. |
| Giannella, L., Mfuta, K., Pedroni, D., Delrio, E., Venuta, A., Bergamini, E., & Cerami, L.B. (2013). Delays in the delivery room of a primary maternity unit: a retrospective analysis of obstetric outcomes. *The Journal of Maternal-Fetal and Neonatal Medicine*, 26(*6*), 593-597. | Italy | (objective) the aim of this study was to compare obstetric outcomes in women undergoing vaginal delivery with or without a prolonged 2nd or 3rd SOL at our primary maternity unit. | Delays in the delivery room are a very controversial and debated topic because the definition of this kind of obstetric complication during a labor is questionable. Classically, a prolonged 2nd stage of labor (SOL) varies according to parity and use of regional anaesthesia (in nulliparous women when it lasts for 3 h with epidural analgesia or 2 h without epidural analgesia; while in multiparous women when it lasts for 2 h with regional anaesthesia or 1 h without regional anaesthesia; while a prolonged 3rd SOL varies according to the use or non-use of an active management (with a prolonged | Observational retrospective study | Given the unpredictability of any labor, the meaning of "low obstetric risk" cannot exclude the occurrence of an emergency: in those cases you must be able to manage such an event in a setting with limited resources. In this regard, to date, we believe that only stringent admission criteria combined with the presence of a trained team, which routinely performs obstetric simulated emergencies, may be a further guarantee of safety for those women who choose to give birth at a primary maternity unit. |

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| | | | 3rd SOL longer than 30 min with an active management and longer than 1 h with physiological management). But, this definition does not include other ante and intra-partum confounders, such as maternal age, ethnicity, gestational age, labor induction, oxytocin usage, pregnancy disorders, making it difficult to apply a standard definition for a proper length of these stages. | | |
| Graham S, Jackson Puliver LR, Wang YA, Kelly PM, Laws PJ, Grayson N, Sullivan EA . The urban–remote divide for Indigenous perinatal outcomes. Medical Journal of Australia 2007; 186(10): . | Australia | • How do perinatal outcomes for indigenous populations vary with level of isolation? | • Perinatal outcomes of indigenous women and babies are considerably poorer than their non-indigenous counterparts. Australian research has typically focused on indigenous groups as compared to non-indigenous populations, treating them as a homogenous. The variation by levels of remoteness of indigenous populations was therefore not typically studied.<br>• A range of poor perinatal outcomes are affected by characteristics of the mother: age, nutrition, smoking etc., and so the distribution of these factors in differing levels of isolation may influence birth outcomes. | Cohort Study | • Different areas had different distributions of mothers at the extreme ends of the reproductive age. Higher proportion of teen mothers lived in remote areas than in regional or urban areas, and the highest proportion of mothers aged >35 years lived in cities.<br>• There was a much higher proportion of mothers in remote areas who had diabetes or hypertension, leading to poorer birth outcomes and a higher prevalence of low birthweights for newborns<br>• Outcomes were directly correlated to level of isolation. Remote indigenous populations had the worst overall perinatal outcomes, and urban indigenous populations had the best. |
| Graves L. New approaches for rural maternity | Canada | • What is an appropriate approach to | • Owing to a combination of factors including concerns about safety and a scarcity of health | Editorial | • Communities are heterogeneous and there is no single model of service that suits all<br>• For recruitment and retention concerns, |

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| care. *Canadian Family Physician* 2012; 58(10): | | proving accessible health care to rural/remote and aboriginal populations? | resources, many rural maternity services have been closed and family physicians' privileges have been reduced, especially with regards to maternity care<br>• Aboriginal and Inuit women are frequently among those who are forced to relocate to access services.<br>• Since the previous joint position paper on rural maternity care was published in 1997, evidence has been obtained that supports rural maternity care – with or without surgical backup – as being safe.<br>• | | access to ongoing education is essential<br>• Rural maternity services remain at risk of closures, and the updated Joint Position Paper on rural maternity care encourages local access and strategies for enhancing the skills and training of rural family physicians |
| Grigg, C.P., Tracy, S.K., Tracy, M., Schmied, V., & Monk, A. (2015). Transfer from primary maternity unit to tertiary hospital in New Zealand – timing, frequency, reasons, urgency and outcomes: part of the Evaluating Maternity Units study. *Midwifery*, X, XX-XX. | New Zealand | (objective) **T**o examine the transfers from primary maternity units to a tertiary hospital in New Zealand by describing the frequency, timing, reasons and outcomes of those who had antenatal or pre-admission birthplace plan changes, and transfers in labour or postnatally. | This New Zealand study is part of a larger prospective cohort study to evaluate primary freestanding midwifery-led maternity units and was undertaken in Australia and New Zealand in 2010-2012. The primary outcome is to compare the clinical outcomes for well ('low risk') women intending to give birth in either an obstetric-led tertiary level maternity hospital (TMH) or a free-standing midwifery-led primary level maternity unit (PMU) in Australia or New Zealand. A secondary outcome is to examine the transfers from primary maternity units to a tertiary hospital in New Zealand. | mixed methods prospective (concurrent) cohort study, which analysed transfer and clinical outcome data (407 primary unit cohort, 285 tertiary hospital cohort), and data from the six week postpartum survey (571 respondents). | Birthplace changes were not uncommon, with many women changing their birthplace plan antenatally or prior to admission in labour and some transferring between facilities during or soon after birth. Most changes were due to the development of complications or 'risk factors'. Most transfers were not urgent and took approximately one hour from the decision to arrival at the tertiary hospital. Despite the transfers the neonatal clinical outcomes were comparable between both primary and tertiary cohorts, and there was higher maternal morbidity in the tertiary cohort. |

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| Grytten J, Monkerud L, Skau I, Sorensen R. Regionalization and local hospital closure in Norwegian maternity care—the effect on neonatal and infant mortality. *Health Services Research* 2014; 49(4): 1184-1204. | Norway | • Is neonatal mortality, adjusted for differences in case mix, dependent on the type of hospital in which delivery occurs? | • Specialized medicine has placed a strong impetus on centralization of services, but closure of smaller hospitals is highly contentious<br>• In Norway, maternity care is decentralized. Low risk deliveries are carried out a local hospitals (Level I), while high risk deliveries are referred to regional hospitals with neonatal departments (Levels II and III) | Cohort Study | • There was a marked decrease in births in local hospitals between 1980 and 2005, with 35.2% occurring locally in 1980 and 19.5% occurring locally in 2005.<br>• There has been a significant shift in where births identified as high risk (based on low birthweight) occur. In 1980, 25% of low birthweight births occurred in local hospitals, but that figure dropped to 6.6% by 2005.<br>• When adjusted with propensity score weighting to account for rates of high-risk cases, no statistically significant difference was found in neonatal mortality between local and central hospitals for 22 of the 26 year studied. In 3 of the 4 years where there was a difference between the two hospital types, neonatal mortality rates were lower in the local hospitals.<br>• An analysis comparing service closures to neonatal mortality found that there was no significant correlation between the two respective rates. Rates of neonatal mortality did in fact decrease during the time interval in which many local services were closed. |

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| Grzybowski, S.C.W., Cadesky, A.S., & Hogg, W.E. (1991). Rural obstetrics: a 5-year prospective study of the outcomes of all pregnancies in a remote northern community. *Canadian Medical Association Journal*, 144 (8), 987-1080. | Southern regionof the Queen Charlotte Islands, BC and a medical clinice in Queen Charlotte City. | (objective) To determine whether a small, isolated hospital that has no facilities to perform cesarean section and handles fewer than 50 deliveries annually can provide acceptably safe obstetric and perinatal care. | Can a small, isolated hospital that has no facilities to perform caesarean section and handles fewer than 50 deliveries a year provide acceptably safe obstetric and perinatal care? In 1985-86 there were 3745 deliveries in 126 Canadian hospital that each handled between 16 and 49 deliveries a year.' Most of the hospitals were small, rural and without the facilities to provide safe cesarean section. | Cohort Study | The perinatal mortality rate is not a meaningful way to assess small populations; about 85 years of data would be required to decrease the 95% CIs from within 16 to within 4. The rate of adverse perinatal outcome in our study was consistent with the rate in other studies. Collaboration of small, rural hospitals is required to increase cohort size so that the correlation between the currently accepted standard, the perinatal mortality rate, and other outcome measures can be determined. |
| Grzybowski, S., Stoll, K., & Kornelsen, J. (2011). Distance matters: a population based study examining access to maternity services for rural women. BMC Health Services Research, 11(1), 147. | Canada, BC | How do newborn and maternal outcomes relate to distance to travel to access the nearest maternity services with Cesarean section capability? | Previous studies have shown a slightly increased level of risk for term newborns born to women who live in communities served by a small hospital (< 100 per year) compared to those in communities served by a large hospital (> 2000 births). While this slight but important difference supports the supposition that it may be safer to live in or near a facility | Retrospective record review / cohort design using odds ratios to compare neonatal outcomes for women located in different maternity care | Odds ratio of 3.17 (95% CI 1.45- 6.95) reached significance for perinatal mortality for births from level 1 communities (> than 4 hours from intrapartum services). Induction rates are the highest for women travelling 2 to 4 hours to access services. Looking specifically at induction for logistical reason, it is the highest in women travelling 2 to 4 hours to access services. The odds ratio for having an unplanned out of hospital birth is 6.41 (95% CI 3.69, 11.28) for women 1 to 2 hours away from services. |

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| | | | providing a larger volume of maternity services it does not address the potential adverse outcomes associated with having no access to elective local intrapartum services at all. | catchment areas. | |
| Grzybowski, S., Stoll, K., & Kornelsen, J. (2013). The outcomes of perinatal surgical services in rural British Columbia: a population-based study. *Canadian Journal of Rural Medicine : The Official Journal of the Society of Rural Physicians of Canada = Journal Canadien de La Medecine Rurale : Le Journal Officiel de La Societe de Medecine Rurale Du Canada*, *18*(4), 123–129. | Canada, BC | Are small surgical services supported by General Practitioners with Enhanced Surgical Skills (GPESS) a safe health services model to meet the needs of rural women and families? | • Rural maternity services are being discontinued in BC, usually due to a lack of local surgical services.<br>• A GPESS is a general practice physician who has undertaken advanced procedural training.<br>Although skill sets vary depending on the physician's practice, common procedures include cesarean delivery, appendectomy, endoscopy, hand surgery, dilation and curettage, and herniorrhaphy. In 2011, 40 GPESSs were practising in BC; about two-thirds of these were trained outside of Canada.9<br>The lack of Canadian-trained GPESSs could be due to the limited training opportunities in Canada. Currently, Canada has only one training program, based in Saskatchewan, which graduates 2 GPESSs per year. | retrospective population-based cohort study using perinatal data for singleton births in catchment areas across BC from April 1, 2000 to March 31, 2007. Outcomes were compared across catchments. | • 6 strata of services were compared, ranging from no local maternity services to services supported by obstetricians.<br>• 15 catchment areas served by GPESSs<br>• Only 25% of women delivered in their local hospital when no local surgical services were available<br>• Communities supported by GPESSs supported almost 80% of the population to deliver locally.<br>GPESSs provided safe maternity care to the populations they served |
| Gunnarsson, B., Smarason, A.K., Skogvall, E., & Fasting, S. (2014). Characteristics and | Norway | To study the incidence, maternal characteristics and outcome of | Unplanned births outside institutions are relatively common in Norway at 7/1000 deliveries since 1999. Women most likely to have unplanned | Register-based cross-sectional study | Unplanned births are associated with adverse outcome. Excessive mortality is possibly caused by reduced availability of necessary medical interventions for vulnerable newborns out-of- |

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| outcome of unplanned out-ot-institution births in Norway from 1999 to 2013: a cross-sectional study. *Acta Obstetricia et Gynecologica*, 93, 1003-1010. | | unplanned out-of-institution births (= unplanned births) in Norway. | deliveries are young, of higher parity and live in a remote area. Young multiparous women are at 20 times higher risk of experiencing unplanned birth, compared with older nullipara. The perinatal mortality rate for unplanned births of extremely low birthweight is very high, possibly due to limited access to specialized care. | | hospital. |
| Haraldsdottir, S., Gudmundsson, S., Bjarnadottir, R.I., Lund, S.H., Valdimarsdottir, U.A. (2015). Maternal geographic residence, local health service supply and birth outcomes. *Acta obstetrician et Gynecologica Scandinavica* 94, 156-164. | Iceland | • How can pregnancy complications, mode of delivery and neonatal outcomes by mother's residence be described? | Adverse birth outcomes include low birthweight (LBW) and preterm birth (PTB) which increase the risk of perinatal morbidity and mortality and are associated with later health risks (3). Birth and infant outcomes in Iceland are among the most favorable worldwide, even in comparison with the other Nordic countries (14), but studies on birth outcomes by maternal residence and healthcare service level are lacking. Among rural women of childbearing age higher BMI and smoking prevalence have been noted (15), but it is not known whether health services availability or distance from specialized health services is related to pregnancy complications or birth outcomes | Register-based cohort study. | The prevalence of preterm birth and low birthweight was not related to the mothers' area of residence. However, increased odds of perinatal death with lower odds of diagnoses of gestational diabetes, hypertension and congenital malformations were observed outside the Capital Area. |
| Hector M, LeFevre M, Williamson HA. | Missouri, USA | • How do levels of stress and social | • Associations with adverse outcomes for pregnancy have | Correlational Study | • Women whose LCS scores increased from the first measurement to the second had |

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| Association between life stress and serious perinatal complications. *Journal of Family Practice* 1989; 29(5): . | | support affect the likelihood of poor birth outcomes | been found for anxiety, life stress, low social support, and family dysfunction, however these effects have not been well explained<br>• Previous studies have demonstrated the effects of stress and social support on pregnancy outcome, but have used inappropriately broad definitions of 'poor outcomes' including things like threatened abortion, prolonged labour, and nuchal cord. | | significantly higher rates of perinatal complications. Overall, those who had an increase in stress had a 2.3 times higher incidence of adverse outcomes<br>• High LCS scores themselves were not an indicator of perinatal complications of the scores remained high between the two testing periods, and it only when scores increased from one testing to another that risk was indicated. A one-time finding of high stress is therefore not indicative of a likely poor outcome<br>• Although women with low social support had a higher rate of complicated pregnancy, there was no statistically significant relationship between pregnancy outcomes and level of social support<br>• Social support did not seem to buffer the adverse effects of increased stress<br>• Logistic regression indicated that the effect of stress was still present after controlling for biomedical risk factors |
| Heller G, Richardson DK, Schnell R, Misselwitz B, Künzel W, Schmidt S. Are we regionalized enough? Early-neonatal deaths in low-risk births by the size of delivery units in Hesse, Germany 1990–1999. *International Journal of Epidemiology* 2002; | Hesse, Germany | • How does the type and size of delivery unit affect early neonatal mortality in low-risk births | • While agreement exists about the benefits of regionalization for high-risk births, little evidence exists regarding regionalization of low-risk births. The objective of this study was to investigate the impact of regionalization on neonatal survival focussed on low-risk births<br>• It is possible that referral and screening systems for risk factors have made further regionalization unnecessary, but | Cohort Study | • Risk stratification resulted in a gradient in which the highest mortality rates were in the very small units, and the lowest rates were in the largest centers.<br>• Deliveries in very small delivery units had a more than threefold risk of early neonatal death compared with low-risk birth in large delivery units<br>• There is a substantial variation in the gradient, owing to the very small number of deaths |

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| 31(5): 1061-1068. | | | it is not proven. The goal of this study is to assess this hypothesis.<br>• Patients seem to prefer smaller delivery units that are more private and closer to home<br>• It is legally mandated that every low-risk birth in Germany must be managed by a midwife, and high risk births are managed by an obstetrician in collaboration with a midwife. | | |
| Hemminki E, Heino A, Gissler M. Should births be centralised in higher level hospitals? Experiences from regionalised health care in Finland. *Bjog: An International Journal of Obstetrics & Gynaecology*2011; 118(10): 1186-1195. | Finland | • What are the trends in centralization and unplanned out-of-hospital births, perinatal mortality by place of birth, and health and birth outcomes in areas served by hospitals of different levels? | • Various interest groups advocate concentrating birthing services in large hospitals where high levels of care and resources are available, and this has been the direction of present policy<br>• This trend is based on theoretical reasoning and evidence-based data are scarce. Potential negative consequences have not been measured.<br>• Research results for low-risk births are not clear, and ambiguous volume-to-outcome relationships have emerged. | Cross Sectional | • Over the 18 year period of the study the number of birthing hospitals declined by 31%<br>• In the 1990s unplanned out-of-hospital births were more common in northern Finland, and in the 2000s it increased in more densely populated areas. From 2006-2009 it equalized between the two areas.<br>• Among non-university hospitals, perinatal mortality did not vary by hospital size<br>• Among unplanned out-of-hospital births, perinatal mortality was 7 times higher than among those born in hospitals<br>• When comparing the capital area and other areas, fewer children in the non-capital area were treated in a special care unit, but there were more long stays in hospital for both children and mothers. When comparing the capital area with only the three areas served by small local hospitals, similar differences were found.<br>• No systematically better results were found in the capitol area vs areas served by smaller hospitals |

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| | | | | | • In areas outside the capitol area, there were more C-sections, less admissions to the special care unit, and more children staying for more than 5 days in the hospital |
| Hillemeier MM, Weisman CS, Chase GA, Dyer A. Individual and community predictors of preterm birth and low birthweight along the rural-urban continuum in central Pennsylvania. *Wome n's Health*2007; 23(1): 42-48. | 28 counties in central Pennsylvania, USA | • What is the relationship of individual and community level socioeconomic, health care, and health status-related characteristics to preterm birth and low birthweight outcomes among women living in urban and various types of rural communities. | • Preterm birth and low birthweight are important issues which are associated with risk of infant mortality and developmental problems<br>• Both of these adverse outcomes have increasing frequency and represent some persistent disparities associated with race, socioeconomic status, and geographic location<br>• Rural women's relative socioeconomic disadvantage and restricted access to health care could be expected to increase their risk of poor maternal outcomes. Rural women tend to have lower educational levels, higher rates of poverty, more limited employment opportunities, and more limited access to health insurance<br>• Rural women receive fewer screening and preventative services, less adequate prenatal care, and make fewer ambulatory visits<br>• Rural populations were recognized as a heterogeneous group based on population size, median income, and racial demographics. A | Cross Sectional | • The urban focused group from the sample lived in areas with populations ranging from 119,000 to 517,500. This group of women tended to be older, more educated, more ethnically diverse, and less likely to live in poverty than those living in any of 3 types of rural areas<br>• Women living in the most remote of the rural areas displayed trends opposite to those of the urban women<br>• Women residing in large rural city-focused areas had lower adjusted odds of preterm birth and low birthweight as compared to women from urban settings.<br>• Risks of adverse birth outcomes were not significantly lower among women living in more rural communities as opposed to those in urban communities |

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| | | | multidimensional classification system using rural-urban commuting area (RUCA) was used to circumvent a simple dichotomous rural-urban classification. | | |
| Hoang H, Kilpatrick S. Small rural maternity units without caesarean delivery capabilities: is it safe and sustainable in the eyes of health professionals in Tasmania. *Rural and Remote Health* 2012; 12(1941): | Tasmania, Australia | • What are the views of maternity healthcare professionals on women's needs and the primary-only model of care, | • Workforce shortages, safety and quality concerns and cost considerations are the three interrelated reasons that have led to the closure of over 50% of small rural maternity services over the past 20 years<br>• Rural and remote women have higher rates of maternal death than their urban counterparts, and rural women have higher rates of neonatal death. Further, remote women have higher rates of foetal deaths<br>• A few small maternity services without C-section capability have been introduced in an effort to mitigate the loss of local services | Case Study | • Three main themes emerged from the data: Women's difficulties in rural areas, women's expectations (of safety, access, quality), and maternity units without C-section<br>• Necessity of travel and being away from familiar environments causes women to experience increased anxiety (7.4 times more likely), as well as feelings of isolation and loneliness<br>• The travel related issues are not only about the transport and accommodation expenses but also the risk of giving birth en route due to the distance between the local hospital and a major hospital.<br>• The results indicate that low-intervention style birthing services in rural areas could reduce women's issues of access, distance to travel, stress/anxiety, and disruptions<br>• These low-intervention style birthing services are less likely to meet women's safety expectations, particularly in emergency services, although it would meet other needs such as ease of access<br>• 13 of the 20 participants of the study did not advocate delivery in small maternity services that do not have access to surgical backup, citing concerns of safety<br>• Evidence suggests that the absence of local maternity care services causes financial |

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| | | | | | burden to rural families and communities in the form of travel costs, accommodation, childcare costs, loss of income and other expenses |
| Hoang, H., & Le, Q. (2013). , *8*(943). Comprehensive picture of rural women's needs in maternity care in Tasmania, Australia. *Australian Journal of Rural Health, 21*(4), 197-202 | Tasmania, Australia | What are the needs of rural women in the full spectrum of maternity care from antenatal through to postnatal care, the services available to them, and the gaps between those needs and services, in Tasmania, Australia? | • Evidence of poor access and outcomes indicate that maternity services in Australia are not meeting needs of rural women (p.197)<br>o Rural women face health inequities such as higher rates of maternal and neonatal deaths<br>o Many of health inequities result from difficulties accessing health care services<br>• Accessing appropriate maternity services is of concern in Australian rural and remote areas where over 50% of small rural maternity units have closed since 1995, forcing thousands of rural pregnant women to leave their communities to access care. (p.197)<br>• Limited studies on social needs of rural women in maternity care covering full spectrum of maternity care (p.197) | • Cross-sectional<br>• Qualitative study using mixed methods (survey and semi-structured interviews) | • Two hundred ten women completed the survey (35% response rate of 35%), including 150+ written comments<br>• 48 survey participants consented to interviews and 22 follow-up interviews were conducted.<br>• Five main themes emerged from the data (survey and interviews): (i) access needs, (ii) safety needs, (iii) needs for rural birthing services, (iv) support needs and (v) needs for quality services.<br>• Results suggest a lack of maternity services in rural areas of Tasmania<br>• Participants expressed a desire for greater access to and support from local maternity services, and safety for themselves and their babies.<br>• Having to travel to hospitals outside of their communities caused challenges for rural women and their families associated with cost, transport, social disruption, risk of going into labour en route<br>• Most participants desired postnatal care and services within their community<br>• 19/22 participants interviewed believed hospital best place to deliver<br>• Some participants expressed a desire to be informed, have a greater, say in their care and be provided with quality services. |
| Hoang H, Le Q, Ogden K. Women's maternity care needs | Australia | • What are maternity care needs for women | • Over the past 20 years, developed countries such as Canada, England, and Australia | Systematic Review | • Three main themes were identified: women's expectations of maternity care, the challenges of accessing care, and the |

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| and related service models in rural areas: A comprehensive systematic review of qualitative evidence. *Elsevier* 20 14; 27(4): 233-241. | | in rural areas?<br>• What are women's experiences of existing models of maternity care in rural areas? | have experienced a widespread closure of small maternity services<br>• It has been suggested by many researchers that hospital closures are associated with worsened outcomes for birthing women and infants.<br>• Research has found a strong correlation between hospital size and intervention rates (based on Nesbitt study of 1997) | | features of four different models of care.<br>• Women's expectations of maternity care included safety (this was the foremost expectation), continuity of care, and quality of care.<br>• Challenges in accessing maternity care services was a recurring theme which consisted of 3 main subthemes:<br>o Access: Poor accessibility of prenatal care services occurred in Canada as a result of a lack of local maternity services<br>o Cost of travelling: these costs included time off work, long distance phone calls, child care, travel expenses, intrapartum transfer by ambulance, partner's lost income, as well as additional challenges such as a lack of immediate access to transportation or a lack of a driver's license<br>o Risks of travelling: Risks included laboring or even delivering en route<br>• Models of care consisted of medically-led, GP-led, midwifery-led, and home birth<br>o Medically led was considered to be the most trusted method, and many women perceived a hospital to be the best place to give birth<br>o GP-led care plays an important role for rural women, and is associated with personalized and continuous care<br>o Midwifery-led care was considered to be best suited to providing personal care, and this model is associated with the desire for local care in low resource environments.<br>o Home birth was identified by only a few women as the preferred method of care provision due mainly to safety concerns |

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| Hoang H, Le Q, Terry D. Women's access needs in maternity care in rural Tasmania, Australia: A mixed methods study. *Women and Birth* 2014; 27(1): . | Tasmania | • What are the maternity care issues in rural Tasmania, and what are women's access needs and the challenges of access? | • In Australia, 29% of the population lives in rural locations, and 3% lives in remote locations<br>• Over 50% of small rural maternity units have been closed since 1995<br>• The closure of rural maternity units is observed as an anticipated cost saving measure.<br>• Closures are also occurring due to a medical workforce shortage in rural/remote locations<br>• Women who must travel to access service face financial, logistical, social, cultural, and spiritual challenges<br>• The maternity access needs of rural communities in Tasmania are largely unknown<br>• There are five main dimensions of client-service interaction: acceptability, affordability, availability, physical accessibility, and accommodation | Case Study | • The majority of women thought that antenatal and postnatal checkups should be provided locally, and that local hospitals should have maternity care<br>• This study supports the claim that service closures shift costs from the health care system to women and families (16 of 22 interviewees identified this is a significant concern)<br>• Qualitative findings showed a lack of access, both to local birthing services and to antenatal education<br>• Transportation difficulties were a major source of concern, and access to a means of travel was assumed by the system. In many rural locations, no public transit options existed.<br>• Social disruption was a major side-effect of relocating for care<br>• Travel to care carries significant risk of having inadequate care and laboring en route.<br>• 26 respondents noted stress and anxiety associated with a lack of local service |
| Holmstrom ST, Phibbs CS. Regionalization and mortality in neonatal intensive care. *Pediatric Clinics of North America* 2009; 56(3): 617-630. | USA | • What are the costs and efficiencies of neonatal care within a regionalized system in the US? | • At the time of this study (2009), there were more than 850 NICUs and 4300 neonatologists in the united states<br>• The March of Dimes estimated that $45 billion was spent on care for preterm and low birth weight infants in 2001<br>• The rate of preterm births has increased in the US by 20% since 1990. | Literature review/ opinion | • The Heller 2002 and Moster 1999 studies are cited as probable evidence that volume-to-outcome relationships exist even for low-risk pregnancies, and that all births should therefore most likely be regionalized (transferred to secondary/tertiary care centers)<br>• Proposed increased transparency in outcomes reporting may serve to inform the likelihood that certain deliveries of certain risk-factors should have given birth at |

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| | | | • Since the 1960s the US has developed NICUs which serve the most high-risk births. Infants weigheing >1500g are still able to be treated at intermediate level facilities where assisted ventilation is not needed for anything beyond brief durations.<br>• At the time this article was written "a reasonable chance of healthcare reform" was cited as a factor that might bring costs under control<br>• This article cites some volume-to-outcome issues, namely that sufficient volume is needed to develop adequate systems and to maintain the skills of personnel who care for infants. Obstetrical services are specifically cited as services which need large volume in order to maintain continuous, on-the-unit anaesthesia coverage feasible | | hospitals of certain levels of care<br>• Payment incentives that reward performance are among the proposed actions |
| Holt J, Vold IN, Backe B, Johansen MV, Øian P. Child births in a modified midwife managed unit: selection and transfer according to intended place of delivery. *Acta Obstetricia et Gynecologica* | Norway | • What is the feasibility and the effectiveness of the case selection process involved with midwifery-managed care | • Since 1974 the total number of birth institutions in Norway has been reduced from 131 to 58<br>• Women at low obstetrical risk were delivered at this unit and women at high risk were referred to the central hospital<br>• Obstetrical care in local hospitals is usually shared between midwives and hospital doctors (usually obstetricians because | Cross Sectional | • Of the 628 women in study 435 (69.3%) gave birth at the midwife managed unit, 152 (24.2%) were selected to be delivered at the central hospital and 41 (6.5%) were transferred to the central hospital after admittance to the midwife managed unit<br>• Of the 24.2% of women were selected to be referred to the central hospital, and nearly 30% of these were due to obstetrical history reasons.<br>• Desired outcome occurred in 94% of |

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| *Scandinavica* 2001; 80(3): 206-212. | | | general surgeons no longer generally accept responsibility for delivery units)<br>• The Norwegian Board of Health has proposed splitting services into three categories: Level 1 is maternity homes run by midwives and general practitioners with 40–500 deliveries per year; Level 2 is small obstetrical departments with 500–1500 deliveries per year and obstetrician and anaesthesiologist on duty; Level 3 is obstetrical departments with more than 1500 deliveries per year and obstetricians, pediatricians and anaesthesiologists on duty all the time.<br>• The small obstetrical departments of Lofoten hospital was not be able to give second-level perinatal care following the regionalization of care, so the delivery unit at Lofoten hospital was for the years 1997–98 reorganized to a modified midwife managed unit.<br>• Prior to commencement of the study, a detailed list of selection and transfer criteria was agreed upon for the purposes of referral of high risk cases to the central hospital | | deliveries at the midwifery-managed unit, and only 50.3% in the central hospital (Note: desired outcomes in this context means spontaneous vaginal delivery)<br>• The proportion of operative delivery was much lower during the study period (in which the Lofoten hospital was reorganized as a midwifery-led center) than in the previous five years (16.4% vs 21.2%)<br>• Women who intended to delivery at the midwifery-managed unit required lower rates of intervention, and relatively few required transfer to a NICU<br>• 24.2% of women were selected to be referred to the central hospital, and nearly 50% of these were due to obstetrical history reasons.<br>• Only 8 of the 484 low-risk women who were offered delivery service at the local Lofoten midwifery center preferred to give birth in the central hospital |

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| Houd S, Qinuajuak J, Epoo B. The outcome of perinatal care in Inukjuak, Nunavik, Canada 1998-2002. *International Journal of Circumpolar Health* 2004; 63(): 239-241. | Nunavik, Canada | What are the outcomes and features of the system of local birth that was introduced to Nunavik in 1986? | • From 1960 until 1986 all pregnant women in the Inuvik region were transported south three weeks before the due date and stayed one to two weeks after the birth. They were alone and surrounded by people who did not speak their language.<br>• In 1985 a group of the Inuit women's association partnered with a multidisciplinary group of health workers to provide evidence-based guidelines for re-establishing local birth and training local midwives<br>• Now (at the time this article was written) the village of Povungnituk provides service for 125 births per year under the care of 7 midwives<br>• The population has a number of risk factors; nearly 100% of the population smokes and there are many drinking related problems<br>• Being born locally has an enormous cultural significance for being considered to be born Inuit and "born with a home" | Cross Sectional | • In 1996, 92.3% of women gave birth in Nunavik with no possibility for C-section or transfer, and the results were quite positive.<br>• The perinatal committee that services the region consists of doctors, nurses, and midwives working together, and joint decisions/recommendations for each woman are made and followed<br>• The establishment of more than one maternity service in maternity care has meant that women are not only given increased to delivery service within Nunavik, but also within or near their own communities, e.g. the rates of birth within the community of Inukjuak went from 44% in 1998 to 79% in 2002. |
| Hughes S, Zweifler JA, Garza A, Stanich MA. Trends in rural and urban deliveries and vaginal births: California 1998-2002. The Journal of Rural Health 2008; | California | • What are the maternal/neonatal mortality rates for rural women giving birth in rural hospitals, rural women giving birth in | • In 1995 more non-metropolitan hospitals provided obstetrical services than metropolitan hospitals (68% vs 63%), however 23% of rural patients bypassed local services to give birth in urban centers between 1991-1996. | Cross sectional | • During the study, fewer than 4% of hospital births occurred in rural hospitals, despite 6% of the population living in rural locations<br>• Close to 60% of rural women gave birth in urban hospitals, which is higher than the rates of obstetric intervention<br>• Nearly one third of rural deliveries were to women with an urban zip code |

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| 24(4): 416-422. | | urban hospitals, and urban women giving birth in urban hospitals? | • Infant mortality rates are influenced by poverty, insurance status, income, and race/ethnicity.<br>• Rural areas have fewer physicians per capita than urban areas<br>• Family physicians typically provide the bulk of obstetrical care in rural settings, however fewer family physicians offer obstetrical services now than in the past<br>• Between 1999 and 2001, total discharges at urban hospitals rose by 2.3%, but fell in rural hospitals by 17.8% | | • Mothers delivering in rural hospitals tended to be younger, less educated, smoke more, and have greater rates of complications, as well as fewer (often <6) prenatal visits<br>• Rural hospitals had the highest rates of normal births<br>• Neonatal death rates did not significantly vary between rural and urban hospitals. The only significant difference was found in rural mothers with no pregnancy complications who delivered a normal-weight baby vaginally at an urban hospital, compared to urban women under the same circumstances at an urban hospital. (0.2 deaths per 1000 births vs 0.1 deaths per 1000 births, respectively.<br>• Rural mothers delivering at an urban hospital had the highest mortality rates for all strata except cesarean deliveries with no pregnancy complications |
| Hulme PA, Blegen MA. Residential status and birth outcomes: is the rural/urban distinction adequate?. *Public Health Nursing* 1999; 16(3): 176-181. | Eastern Iowa, USA | • Do rural, rural adjacent to urban (rural-adjacent), and urban women differ by the following birth outcomes: gestational age, birthweight, Apgar scores, maternal complications, length of hospital stay, and costs of hospital care?<br>• Are there differences in maternal | • In comparisons of birth outcomes, a false dichotomy is often presented between rural and urban settings when in fact a continuum exists between the two.<br>• Previous studies have found that while rural women tend to receive less prenatal care than urban women, as a group rural woman's birth outcomes were comparable to urban women's birth outcomes. | Cross Sectional | • Rural women had worse birth outcomes overall and traveled the greatest distance for delivery<br>• Rural-adjacent women had the best birth outcomes of the three groups, yet were the youngest, least educated, least likely to be married, and the least likely to be privately insured |

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| | | characteristics (age, marital status, education, comorbidity, prenatal care, distances travelled for delivery, and insurance status) among the rural, rural-adjacent, and urban women who participated in this study?<br>• What are the relationships among the birth outcomes and maternal characteristics used for this study? | | | |
| Hundley VA, Cruickshank FM, Lang GD, Glazener CMA, Milne JM, Turner M, Blythe D, Mollison J, Donaldson C. Midwife managed delivery unlit: a randomised controlled comparison with consultant led care. *BMJ* 1994; 309(6966): 1400- | Aberdeen Maternity Hospital, UK | How does midwifery-led care differ from that of a consultant-led unit in terms out outcomes and interventions? | • Most people agree that close supervision of high-risk pregnancies is beneficial, however the application of the same criteria to low-risk pregnancies has been questioned<br>• There has been some evidence to suggest that greater rates of intervention and maternal morbidity occur as a result from referring low-risk women to consultant-led maternity units | RCT | • Of the midwifery-led unit, 46% of women actually gave birth in the unit while 34% were transferred to the labour ward antepartum and 16% were transferred intrapartum. (4% were lost to follow-up)<br>• Nulliparous women were significantly more likely to be transferred out of the midwifery-led maternity ward<br>• Significant differences between the midwives unit and labour ward were found in monitoring, fetal distress, analgesia, mobility, and use of episiotomy, but no significant differences were found in the method of delivery or outcome of birth<br>• Women in the midwifery group tended to use |

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| 1403. | | | | | more natural methods of pain relief, while women in the labour ward group were more likely to receive an epidural or anesthesia<br>• There was no difference in the number of women having a normal delivery between the two groups |
| Iglesias, S., Bott, N., Ellehoj, E., Yee, J., Jennissen, B., Bunnah, T., & Schopflocher, D. (2005). Outcomes of maternity care services in Alberta 1999 and 2000: *A population-based analysis. Journal of Obstetrics and Gynaecology Canada*, 27(*9*), 855-863. | Canada, Alberta | 1. How do the perinatal outcomes for populations served by small community hospitals compare with those for regional and metropolitan centres?<br>2. How do the outcomes of maternity care services with no capacity for Caesarean section compare with programs that do have capacity? That is, does the availability of local Caesarean section services affect outcomes?<br>3. How do the outcomes of limited local maternity care programs compare with outcomes from communities | There is considerable variation in the level of maternity care services provided by rural hospitals. Some communities with local surgical programs are able to offer extensive services, including CS. Others are restricted to offering a limited local maternity care program without CS. Still others have chosen to offer no elective local intrapartum maternity care and require women to travel elsewhere for care. Within these programs, women themselves are free to choose whether to seek care locally or to travel. Equally, their caregivers choose whether to recommend women travel for maternity care, depending on risk as well as the skills and comfort level of the care providers. There is consensus, but limited published evidence, that outcomes for this regionalized system are good. | Population-based retrospective study | The principal consequences of a limited scope of local maternity care services for rural women is an increased rate of induction of labour and, if they live in a community that delivers babies without local CS capability (IA), a lower CS rate. These category IA communities, with patient outflows of 78%, are largely unsuccessful in having women deliver locally, but women from these communities have a lower rate of CS wherever they deliver. The 18 rural Alberta maternity care programs where patient outflow is over 67% may not be sustainable. |

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| | | without such programs (whose residents are obliged to travel for care)? That is, is it important to offer a limited local maternity care program?<br>4. Are outcomes different or comparable between high and low outflow communities? | | | |
| Iglesias A, Iglesias S, Arnold D. Birth in Bella Bella: Emergence and demise of a rural family medicine birthing service. *Canadian Family Physician* 2010; 56(6): e233-e240. | Bella Bella, Canada | • What was the safety and sustainability of the Bella Bella hospital, and what contextual factors were associated with its existence and decline? | • The first hospital in Bella Bella opened in 1902 but, prior to the 1940s most births happened outside of a hospital setting. Paralleling a cross-Canada trend, 22 by the 1940s almost all of Bella Bella's births happened in the hospital.<br>• Following the norm in all of western Canada, family physicians who practiced in Bella Bella were trained as generalists who were skilled in obstetrics, surgery, and anaesthesia.<br>• Comprehensive maternity care (including C-section) was provided in Bella Bella until the 1990s when generalist care was replaced by specialist care, and family physicians were trained as specialists in primary care. | Cross Sectional | • 2462 deliveries occurred at the Bella Bella hospital from 1930-1999, 88 of which were C-sections. The first C-section was performed in 1933, far before it was commonly done in Canada<br>• When C-section rates reached their peak in the 1980s at 13.9%, the average rate in Canada ranged from 15%-20%.<br>• The rate of C-section in Bella Bella dropped to 3.2% in the 1990s while it rose overall in the rest of Canada<br>• PNMR in Bella Bella was comparable to the rest of Canada over the entire time range studied<br>• In the 1990s travelling outside the community for birth became increasingly common, overtaking local birth is as the dominant method |

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| | | | Secondary care fell under the purview of the Royal College of Physicians and Surgeons of Canada<br>• By 2004, only 13% of family physicians provided intrapartum care, and therefore generalists who had supported maternity care in Bella Bella for nearly a century could no longer be recruited<br>• Due to the inability to recruit and retain physicians who could provide maternity care with surgical backup, the surgical maternity services in Bella Bella closed in 2000, followed by the rest of the maternity service program in 2001. | | |
| Ireland S, Narjic CW, Belton S, Kildea S. Niyith Nniyith Watmam (the quiet story): Exploring the experiences of Aboriginal women who give birth in their remote community. *Midwifery* 2011; 25(7): 634-641. | Northern Territory, Australia | • What are the beliefs and practices of Aboriginal women who decline transfer to urban hospitals and remain in their remote community to give birth | • Aboriginal women place a deep spiritual significance on the location of childbirth, and there is a perception that to give birth on traditional lands is tied to the concept of inheritance of cultural identity and belonging<br>• In the remote community of focus in this study (pseudonym St. Gerard), health/maternity services were handed over from the local Aboriginal council to the territory government in the 1990s, during which time the services declined<br>• Eventually (still in the 1990s) | Case Study | • Based in their previous experiences of standard care, women were able to make conscious decisions and choices about managing their subsequent pregnancies and deliveries<br>• Previous experiences of maternity health services and institutional processes were related by all women. These women noted a lack of companionship and warm human interaction in these situations<br>• Birth in the institutional setting of Darwin was also associated with feelings of confinement and isolation, as well as a lack of familiarity with those who attended their deliveries<br>• Women in the community of St. Gerard have become familiar with the activities of the |

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| | | | women from all remote communities of the Northern Territory were being routinely relocated over 500km away to urban centers to receive maternity care<br>• Current standard practice in St. Gerard is to evacuate women even if they are in labour when they present to the local medical services. They are given drugs to stop/slow labour and they are evacuated via aeromedical service to the nearest urban center.<br>• Despite the practice of evacuation for birth, some women do give birth locally each year | | local health center and are able to predict the behavior and response of the nurses. As a result, they employ various strategies to avoid having relocation forcefully imposed on them.<br>• The cultural concept of shame that exists in this community of the NT territory greatly influenced women's feelings towards medicalized birth. The idea of having men involved in delivery was seen as incurring shame, as birth is something that is perceived to be women's business.<br>• Women who had chosen to remain in the community of St. Gerard for their labour/delivery expressed great pride in their decision. They also expressed feelings that it is/was the proper decision for the consideration of the needs of their other children<br>• Women's beliefs and practices surrounding community childbirth included the importance of traditional Aboriginal diet and exercise, as well as approaching the act of birth with feelings of introspection rather than fear or concern<br>• All women agreed that the local clinic was a better place to give birth than the home or the bush, mainly due to its accessibility of simple equipment |
| Jones P, Alberti C, Jule L, Chabernaud J-L, Lode N, Sieurin A, Dauger S. Mortality in out-of-hospital premature births. *Acta* | Paris, France | • Is the mortality for out-of-hospital premature births higher than for those of in-hospital premature births? | • The frequency of "out of hospital" (OOH) births has decreased during the 20th century as maternity services became more universally available<br>• Unplanned OOH births | Cohort Study | • Mortality was more than twice as high in out-of-hospital deliveries than for in-hospital matched controls (18% vs 8% respectively)<br>• The majority of the mortality in the out-of-hospital (OOH) group occurred after 28 weeks, a time period which accounted for 47% of the total out-of-hospital mortality |

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| *Paediatrica* 2011; 100(2): 181-187. | | | still do occur, unrelated to the growing trend of planned OOH births | | • 86% of the OOH group as a whole (and 93% of the OOH group who died) had hypothermia, whereas this was only the case for 3% of the in-hospital birth group.<br>• Many of the OOH newborns died as a result of (or with a diagnosis of) severe neurological complications. |
| Kildea, S., McGhie, A. C., Gao, Y., Rumbold, A., & Rolfe, M. (2015). Babies born before arrival to hospital and maternity unit closures in Queensland and Australia. Women and Birth : Journal of the Australian College of Midwives. | Australia | • What is the association between born before arrival (BBA) rates and maternity unit closures? | • Evidence suggests the closure of maternity units is associated with an increase in babies born before arrival (BBA). | A retrospective study utilised routinely collected perinatal data (1992–2011). Pearson correlation tested the relationship between BBA rate and number of maternity units. Linear regression examined this association over time. | • The closure of maternity units over a 20-year period across Australia and Queensland is significantly associated with increased BBA rates. The distribution is not limited to rural and remote areas. Given the high risk of adverse maternal and neonatal outcomes associated with BBA, it is time to revisit the closure of units.<br><br>During 1992–2011, the absolute numbers (N = 22,814) of women having a BBA each year in Australia increased by 47% (N = 836–1233); and 206% (n = 140–429) in Queensland. This coincided with a 41% reduction in maternity units in Australia (N = 623–368 = 18 per year) and a 28% reduction in Queensland (n = 129–93). BBA rates increased significantly across Australia, r = 0.837, n = 20 years, p < 0.001 and Queensland, r = 0.917, n = 20 years, p < 0.001 and this was negatively correlated with the number of maternity units in Australia, r = _0.804, n = 19 years, p < 0.001 and Queensland, r = _0.906, n = 19 years, p < 0.001. |
| Klein MC, Spence A, Kaczorowski J, Kelly A, Grzybowski S. Does delivery volume of family physicians | BC Women's Hospital and Health Center | • Does a volume-to-outcome relationship exist at the physician level within a large | • In many volume to outcome studies, either hospital size or physician procedural volume is used as a surrogate for physician experience | Cross Sectional | • Physicians were placed into one of three cohorts based on their volume of deliveries (<12, 12-24, 25+)<br>• There was no difference among the three volume cohorts of physicians in terms of |

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| predict maternal and newborn outcome?. *Canadian Medical Association Journal* 2002; 166(10): 1257-1263. | | urban hospital setting? | • The results of the volume to outcome studies have been mixed, with some showing a correlation while others do not.<br>• There are strong relationships between maternal/newborn outcomes and moking, maternal history of low birth weight (for previous pregnancies), pregnancy–induced hypertension, diabetes, pre-pregnancy weight, gestational weight gain, maternal height and age, multiple gestation, previous vaginal birth after caesarean section, history of previous delivery problems, parity, large-for-date fetus, ethnicity, and fetal sex | | maternal morbidity, Apgar scores, infant admissions to the NICU, or any other outcomes. These results held true both before and after adjustment for a number of risk factors.<br>• Medium and high volume physicians consulted obstetricians less often than low-volume physicians<br>• Inductions were performed by medium volume physicians more often than by low-volume physicians |
| Kornelsen, J., & Grzybowski, S. (2005). Safety and community: the maternity care needs of rural parturient women. Journal of Obstetrics & Gynaecology Canada: JOGC, 27(6), 554–561. | Rural BC, Canada | • What are the obstetrical care needs of rural parturient women to have a positive birth experience? | • Without local services, women face the system expectation of referral out of the community<br>• The health system often makes this decision on the basis of safety and risk, but the system definitions of those concepts can ignore how women view them<br>• Women will use resistance strategies to mitigate risks they experience in care, including financial burden of leaving the community, dangerous travel conditions, logistical barriers to accessing care outside their home community, and lack of stability and predictability in | Exploratory Qualitative study; two-phase emergent grounded theory analysis | • The authors found that the needs of rural women aligned in priority with Maslow's hierarchy of needs. Specifically:<br>o 1) Physical needs are subjectively operationalized.<br>o Faced with challenges to accessing care in a referral community, women sometimes choose options the health system deems 'least safe.' This demonstrates not a lack of awareness for the outcome risks of those options, but rather reflects a more nuanced and subjective understanding of risk and safety.<br>o 2) Safety: "The participants wanted a sense of stability, security, and predictability when they gave birth." (250)<br>o Lack of continuity of care(r) compromised |

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| | | | service (such as provider continuity)<br>• The loss of rural services presents a series of issues including preference, psychosocial risk, suboptimal outcomes, appropriateness of low intervention model in rural settings, outcome equality between primary and secondary units under regionalization, and travel as detrimental to outcomes<br>• Women face logistical challenges of not being able to drive or seasonal conditions as well as personal access barriers such as the financial burden of housing in the referral community, long distance phone calls, incidental expenses, lost wages for mother and partner and child care. All on top of greater psychosocial stress of the experience of evacuation for birth. | | this predictability and participants felt it was endemic to the services offered rural women, which often rely on locums and call groups.<br>o The lack of continuity even in prenatal care can lead to a feeling of insecurity as diagnostic priorities may change by provider.<br>o 3) Community and Belonging: Participants needed to share the experience with family and community, as well as birth in the tradition of their family (often meaning a local birth).<br>o 4) Self-Esteem Needs: Women wanted a birth experience that respected their expectations and values, even when it was inconvenient to the structure of the health system (e.g. not wanting logistic induction)<br>o Esteem needs were rarely met, but were key to a positive experience. |
| Kornelsen, J. A., & Grzybowski, S. W. (2008). Obstetric services in small rural communities: what are the risks to care providers. *Rural and Remote Health*, *8*(943). | BC, Canada | What is the experience of rural maternity care providers from the perspective of the social risks they perceive are incurred by practicing in a low-resource environment? | • Despite sharp decline since 2000 in the number of rural communities across Canada and in other jurisdictions offering local maternity care, there remain significant numbers of small rural maternity services that provide elective maternity care without on-site access to cesarean section. | Cross-sectional qualitative, exploratory study using in-depth interviews and homo-and heterogeneous focus groups logic model framework | • 26 care providers were interviewed across the three communities, including 15 nurses and 11 physicians.<br>• Participants identified elements of personal risk they perceived were assumed by offering intra-partum care in communities without local access to c/s back up, and the potential effects of these risks on themselves and their communities.<br>• participants further recognized the unique attributes of maternity care, which, when |

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| | | | • Literature does not definitively address whether or not rural maternity care services require c/s capabilities (p.3)<br>• Little is known about the experience of maternity care providers in environments with low resources. (p.2)<br>• For maternity care providers working in rural communities with small volume of local deliveries and limited capability for emergency intervention, rural obstetrical practice can be stressful1 (p.2)<br>• In rural communities with an elective maternity service without local access to c/s capabilities, providers must be prepared to respond to obstetrical emergencies and arrange urgent transfer if a c/s is indicated. (p.3)<br>• While restrictions on local delivery based on clinical evidence take place with an understanding of the social risks experienced by women who must leave their community to give birth, what is rarely articulated as a significant part of the decision-making process for some rural physicians' are the potential social consequences for the physicians themselves of | guided data analysis | juxtaposed with other aspects of primary care, led to a heightened sense of social risk in a rural environment<br>• study results discussed in terms of: (i) emotional risks to practitioners and community, (ii) effect of a 'bad outcome', and (iii) unique attributes of maternity care |

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| | | | unanticipated bad outcomes. (p.3) | | |
| Kornelsen J, Grzybowski S, Iglesias S. Is rural maternity care sustainable without general practitioner surgeons?. *Canadian Journal of Rural Medicine* 2005; 11(3): 218-220. | BC | • What is the sustainability of rural maternity services with or without GP surgeons and the capability for C-Section | • There have been widespread closures of small maternity services in BC<br>• A number of studies have shown (unsurprisingly) that services which have C-section capability are able to provide maternity care for a greater proportion of women<br>• The current 22.1% rate for operative deliveries Canada-wide leads many to feel that surgical capability is a core requirement for maternity services. | Editorial | • Based in the much higher proportion of women that are able to give birth locally when GP surgeons provide C-section services, the role of GP surgeons is pivotal in the sustainability of rural maternity services<br>• Evidence on the safety of maternity services in the absence of surgical back-up is scant, and emerging data from pilot projects of isolated services in Canada's northern regions suggest excellent outcomes in midwifery-led non-surgical services.<br>• The challenges to accessing local training are significant and stem from a lack of recognition of the role GP surgeons play in sustainable rural health. |
| Kornelsen, J., Kotaska, A., Waterfall, P., Willie, L., & Wilson, D. (2010). The geography of belonging: The experience of birthing at home for First Nations women. Health & Place 16, 638-645. | Canada, BC | • What are the implications of closure of a local maternity service from the perspective of local First Nation women. What are participants' perceptions of the importance of place and community in giving birth? | • The number of rural hospitals offering maternity care in BC has significantly declined since 2000, mirroring trends of closures and service reductions across Canada. The impact on Aboriginal women is significant, contributing to negative maternal and newborn health and social outcomes. | Qualitative case study. Data collection consisted of 12 interviews and 55 completed surveys. | From the perspective of losing local services, participants expressed the importance of local birth in reinforcing the attributes that contributed to their identities, including the importance of community and kinship ties and the strength of ties to their traditional territory. |
| Kornelsen, J., & Mackie, C. (2013). The role of risk theory in rural maternity services | BC, Canada and other jurisdictions in Canada and | What are the contemporary theories of risk?<br><br>How do they apply | • Precipitous closure of rural maternity services in many developed countries in the past decade due to confluence of factors: | Review and discussion of literature on risk theories and how | • Divergent risk perspectives and dichotomy of approached to risk and decision-making<br>o Social vs clinical perception of risk<br>o how divergent risk perspectives lead to a parallel discussion marked by |

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| planning. *Rural and Remote Health, 13*(2206). | international | to the pressing health service delivery issue of access to rural maternity care as a way of illuminating their usefulness in framing the discussion? | o Regionalization of health care services delivery to combat staggering healthcare system costs<br>o physician recruitment and retention challenges<br>o limited access to midwives and diminished<br>o access to nurses trained in obstetrics<br>• Most communities that still offer local maternity services to parturient women in the absence of surgical back-up are witnessing a high outflow of women leaving to give birth in larger centers to ensure immediate access to c/s<br>• minority of women choose to stay in their home communities to give birth in the absence of local access to c/s<br>• little data on population health outcomes for women who must travel to access care or on the safety of services without local surgical back-up | dichotomy of perceptions of risk between rural parturient women (with no local access to c/s) and physician care-providers impact decision-making (for example, about whether a women should leave the community or give birth locally) | conceptual dissonance, often resulting in an impasse: disagreements about whether the parturient woman should leave the community or give birth locally<br>• risk subjectivities - Intuitively, individuals will make risk judgments not based on what they think about a particular activity but on how they feel about it, premised on previous life experiences<br>• risk in childbirth - Growing field of scholars who recognize dissonant interpretations of risk in childbirth<br>• In context of shared decision making between a care provider and woman, contemporary risk assessment combines clinical judgment of care providers with policy guidelines and standardized risk assessment indices – tools that measure additive, quantifiable obstetrical risk factors that result in an overall score predicting adverse perinatal outcomes for a given patient<br>• See also author conclusions above |

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| Kornelsen, J., Stoll, K., & Grzybowski, S. (2011). Stress and anxiety associated with lack of access to maternity services for rural parturient women. *Australian Journal of Rural 19*(1), 9-14. | BC, Canada | • How does the level and experience of stress and anxiety compare between parturient women resident in rural communities with different levels of access to local maternity services? | • Many rural and remote regions in Canada and internationally have policies recommending women from communities without maternity services relocate to referral community between 36-38wks, which creates challenges of separation from home community<br>• Regionalization of health care services in the past 14 years, has led to a trend of closures of small rural community maternity care services across Canada.<br>• As a result of these closures, an increasing number of rural women are required to travel to access services<br>• Literature suggests that lack of access to local maternity care services can lead to increased stress and adverse outcomes for some rural parturient women, including increased rates of premature birth, increased need for intervention and increased costs of neonatal care<br>• Previous research indicates that lack of access to local maternity care particularly stressful for Aboriginal women who may have historical/stronger relationship | Cross-sectional; RPES, validated survey tool, used to measure extent of psychological stress and anxiety related to lack of local access to rural maternity services | • Women residing in rural communities with no access to local maternity services (within 60 min surface travel time) were 7.4 times more likely to experience moderate or severe stress and anxiety associated with remote birth compared to women residing in communities with access to local services provided by at least one specialist: OR 7.435 (CI 2.324-23.789, *P*=0.001)<br>• Women with no access to local maternity services experienced significantly more stress and anxiety than women with access to services (Pearson's **c**2 **=** 15.890 (d.f. **=** 2), P < 0.001).<br>  o 35.9% with RPES score >60 vs 12.7% (local service with generalist), 8% (local services with specialist)<br>• Women with independent predictors of stress and anxiety were more likely to experience stress and anxiety during pregnancy (OR associated with these variables *not significant*): household income below $25 000, education level, self-identified complication of pregnancy, ethnicity (FN women) |

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| Kozhimannil KB, Hung P, Prasad S, Casey M, McClellan M, Moscovice IS. Birth | USA | • What is the relationship between hospital birth volumes, | • Approximately 15% of all US infants are born in rural hospitals<br>• In the 1980s, half of all rural hospitals had maternity care. | Cross Sectional | • Compared to low-volume rural hospitals, women delivering babies in medium, medium-high, and high-volume rural hospitals were more likely to have diabetes, hypertension, |

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| Volume and the Quality of Obstetric Care in Rural Hospitals. *The Journal of Rural Health* 2014; 30(4): 335-343. | | obstetric care quality, and patient safety measures? | Since then, the available of rural obstetric services has diminished significantly. Since the early 2000s this proportion has fallen to less than 1/5th or rural hospitals.<br>• The possibility of volume-to-outcome relationships is an important concern for determining the viability of rural hospitals; however the existing evidence on these relationships is scattered and tenuous.<br>• The rates of C-section and intervention have risen steadily between 1996 and 2010, reaching 32.8% and 23.4% respectively, however rates of neonatal morbidity/mortality have stagnated and in some cases even risen during that time span. | | pre-eclampsia or eclampsia, multiple gestation, placental problems, malpresentation<br>• Unadjusted rates of low-risk C-section, nonindicated C-section, and nonindicated induction rose by 15%, 16.5%, and 12.1% respectively from 2002 to 2010.<br>• The largest volume hospitals had the lowest rates of low-risk C-sections, but the highest rates of nonindicated induction<br>• The rates of induction were significantly lower at low-volume hospitals than at high or medium volume hospitals |
| Kruske S, Schultz T, Eales S, Kildea S. A retrospective, descriptive study of maternal and neonatal transfers, and clinical outcomes of a Primary Maternity Unit in rural Queensland. *Women and Birth*2014; 28(1): 30-39. | Australia | • What are the reasons for transfer to and from a Primary Maternity Unit (PMU), transfer times, and the clinical health outcomes of all women (of all risk statuses) and their babies? | • A widely held view in maternity services in rural Australia is they require 24-h on-site surgical and anaesthetic capability to be considered safe, however many units are unable to maintain this capacity due to workforce and budgetary shortages<br>• Because of closures, women must travel long distances to receive appropriate care, and encounter difficulties of financial burdens, psychosocial consequences, and non- | Cohort Study | • The MDH provided care to much higher proportions of younger women; with over twice as many women aged under 20 years as compared to those aged over 20 years<br>• The MDH cared for five times as many Aboriginals and Torres Strait Islanders as the state average (27.5%MDHvs.5.7%QLD).<br>• The majority of women (85.3%) received midwifery group practice care. 12.8% were cared for by obstetric shared-care services, and fewer than 2% were cared for by GP-cooperative care<br>• Of the 593-woman study group, 65.9% gave birth at MDH, while 33.1% gave birth at the |

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| | | | favourable outcomes, and increased likelihood of accidental out-of-hospital births<br>• The majority of women want to give birth close to home, and approximately 10% of women in some communities give birth in level 1 facilities against the advice of medical professionals and without the infrastructure/staff to properly support them<br>• Having to travel long distances to receive care is particularly difficult/problematic for Aboriginal and Torres Strait Islanders<br>• Opening (or reopening) Primary Maternity Units (PMUs) has been offered as a potential solution to mitigating the challenges associated with distance for women. PMUs are able to offer maternity services (usually under the care of a caseload midwife) to low-risk women with limited obstetric, surgical, and laboratory support.<br>• PMUs are classified as level 2 services, and operate within a collaborative framework of risk-assessment and referral for higher-risk cases<br>• State Capability Frameworks state that Level 2 facilities provide ‘‘access to a functional | | referral hospital (Cairns Base Hospital), and 1% were born before arrival to any hospital.<br>• 94.2% of the women who delivered at MDH did so by a normal vaginal birth, and only 1% had a severe perinatal tear<br>• Of the women who originally planned to give birth at MDH, 74.5% were able to do so, while 24.5% were transferred to CBH and the remaining 1% were out-of-hospital.<br>• 47.8% of transfers occurred antenatally. Prolonged labor and the association of induction was the most common reason for antenatal transfer. 42.8% of transfers occurred during the intrapartum period. The remaining 9.4% occurred during the postnatal period either for the woman or for the neonate.<br>• A high proportion of women transferred antenatally had an induced onset of labour (40.9%), mostly for prolonged pregnancy, yet induction rates were low (7.8%) when compared to Queensland average (22.2% in 2010) |

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| | | | operating theatre (not necessarily on-site) and the anaesthetic capability to bring about a baby's birth in an unplanned caesarean section within 75 min of booking the procedure, in normal circumstances''.<br>• PMUs are uncommon in rural and remote Australia, but comparable service exist in Canada and New Zealand, which have been shown to provide safe and equitable care. At the time of this study, the MDH was the only PMU in Queensland. | | |
| Kyser, K.L., Lu, X., Santillan, D.A., Santillan, M.K., Hunter, S.K., Cahill, A.G., & Cram, P. (2007). The association between hospital obstetrical volume and maternal postpartum complications. *American Journal of Obstetrics and Gynecology*, 207(1), 1-19. | US (Arizona, California, Florida, Iowa, Massachusetts, Maryland, North Carolina, New York, New Jersey, Washington, and Wisconsin | • What is the association between hospital childbirth volume and important maternal complications (e.g. haemorrhage, infection, death) and how does the volume-outcome relationship might differ for vaginal and caesarean deliveries? | Over 4 million women give birth annually in the United States (U.S.), making childbirth the single most common reason for hospitalization among young women. Childbirth in the U.S. is generally safe with major complications rates (e.g. hemorrhage or infection) of less than 10 percent. At the same time, there is growing appreciation that the variation in hospital outcomes that have been observed in many medical and surgical diagnoses may also exist for childbirth. | We used administrative data to identify women admitted for childbirth in 2006. Hospitals were stratified into deciles based upon delivery volume. We compared composite complication rates across deciles | Women delivering at very low volume hospitals have higher complication rates, as well as those delivering at exceeding high volume hospitals. Most women delivering in extremely low volume hospitals have a higher volume hospital located within 25 miles. |
| Larson, E.H., Hart, L.G., & Rosenblatt, | US, nation-wide | The purpose of this study is to examine | Infant mortality is still thought of as a largely urban problem. The | Cohort study of all births in | Residence in a non-metropolitan county was not found to be associated with increased risk |

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| R.A. (1997). Is non-metropolitan residence a risk factor for poor birth outcome in the US? *Social Sciences and Medicine*, 45 (2), pp. 171-188. | | and compare non-metropolitan and metropolitan rates of poor birth outcome in the 50 states of the United States in order to assess the importance of non-metropolitan residence as a risk factor for poor birth care. | population of the United States is now predominantly metropolitan and most of the social ills associated with infant death and other poor birth outcomes are found in their most extreme and concentrated forms in cities--poverty, racism, detrimental lifestyles, lack of education and inadequate access to medical care. In the late twentieth century, however, non-metropolitan areas have lost much of their appeal as markers against which less privileged urban areas can measure progress in the area of infant mortality. Infant mortality rates in the United States have been increasingly driven by the success or failure of high risk infants in gaining timely and appropriate access to neonatal intensive care units of a type found only in tertiary urban hospitals. Assuring optimal outcomes for high risk non-metropolitan infants requires effective regionalized systems of perinatal care in non-metropolitan areas. Additionally, a shortage of obstetrical providers has resulted in a decrease in overall access to prenatal and obstetrical care providers in the rural United States. | the US | of low birth weight or neonatal mortality at the national level or in most states, after controlling for several demographic and biological risk factors. Non-metropolitan residence was associated with greater risk of post-neonatal mortality at the national level. Nonmetropolitan residence was strongly associated with late initiation of prenatal care at both the national level and in a majority of the states. Residence in non-metropolitan areas does not appear to be associated with higher risk of adverse birth outcome. Regionalization of perinatal care and other changes in the rural health care system may have mitigated the risk associated with residing in areas relatively isolated from tertiary care. High levels of late prenatal care among non-metropolitan residents suggest a continuing problem of access to routine care or rural women and their infants that may be associated with higher levels of post-neonatal mortality and childhood morbidity. |
| Larson, E. H., Hart, L. | US, | Is adequate | This study was designed to | Record review | Results indicate that rural residents in the |

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| G., & Rosenblatt, R. A. (1992). Rural residence and poor birth outcome in Washington state. The Journal of Rural Health : Official Journal of the American Rural Health Association and the National Rural Health Care Association, 8(3), 162–170. | Washington State | prenatal care being delivered to women residing in rural areas and how do their birth outcomes compare to women residing in urban areas? | evaluate whether adequate prenatal care is being delivered to rural residents and whether adverse birth outcomes are more common in this group of women. A residence based approach offers the chance to evaluate the effectiveness of the rural health care system in achieving satisfactory birth outcomes generally, rather than the effectiveness of rural hospitals or physicians. In this study, we treat birth weight and neonatal death as outcomes of interest and follow all rural residents, rather than just those delivering in rural hospitals. | of all infants born in Washington state to state residents in 1984 to 1988. | general population and in various subpopulations had similar or lower rates of poor outcome<br>than did urban residents but experienced higher rates of inadequate prenatal care than did urban residents. Rural residents delivering in urban hospitals had higher rates of poor outcomes than those delivering in rural hospitals. |
| Lee KS, Kwak JM. Effect of patient risk on the volume–outcome relationship in obstetric delivery services. *Health Policy* 2014; 118(3): 407-412. | Korea | • What is the volume–outcome relationship in delivery services, as measured by the rate of C-section (CS), differed depending on the risk status of delivery patients | • The Health Insurance Review and Assessment Service (HIRA) reported CS rates of over 35% in 2012<br>• Health care facilities with higher volumes of patients or specific procedures are commonly believed to provide a higher quality of care<br>• While some data have been published on the volume effects on patient outcomes for surgical procedures, the volume-to-outcome relationship on delivery services has produced inconsistent results (five good sources are cited in this article stating that volume to outcome | Cross Sectional | • A risk adjustment model was developed based on a set of risk factors, and roughly 2/3 of women delivered vaginally while the remaining 1/3 had C-sections<br>• Patient risk status had a significant effect on the relationship between the number of deliveries and CS rates in hospitals<br>• Simple comparison of risk-adjusted CS rates between high volume and low volume hospitals did not yield significant results. Instead, when patients were divided into three groups (low, medium, and high risk), the delivery volume of the hospital significantly affected CS rates<br>• Low and medium risk groups did not show a strong correspondence between hospital volume and CS rates, however medium risk groups had significantly higher CS rates in high- |

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| | | | relationships has not been shown in hospitals)<br>• CS rates have become an important indicator of quality, and there has been a large variation between rates in different regions and nations. The large variation may indicate that some delivery patients may not receive quality care depending on their risk status.<br>• Reducing CS rates has become a major health policy issue to improve patient outcomes | | volume hospitals as opposed to low-volume. |
| Lumley, J. (1988). The safety of small maternity hospitals in Victoria 1982–84. *Community health studies*, *12*(4), 386-393. | Victoria, Australia | What is the relative safety of small maternity hospitals recently reported for New Zealand, Helsinki and Washington State and what is the perinatal outcome by size of hospital in Victoria State for the years 1982-1984? | • Assessment of perinatal outcome by size of hospital in Victoria State, Australia from 1982-1984<br>• State of Victoria has no formal policy of regionalized perinatal care and at present no established policy of closing small maternity units<br>• Range of hospital sizes, number of births, levels of services and care providers | | • For infants <1500g, BSMR decreased significantly with increasing hospital size<br>• 1500-2499g, no diff in outcome by hospital size<br>• infants 2500-2999g, no overall trend but mortality rate significantly lower in hospitals with <100 births/yr<br>• infants =/>3000g, mortality rate increased significantly with increasing hospital size<br>• When BWMR by Hospital Size was adjusted for late transfers, after excluding lethal malformations:<br>o All LBW categories showed signif better outcome in largest hospitals with a significant linear trend<br>o Infants 3500-2999g still had significantly better outcome in smallest hospital<br>o Infants =/> 3000g still had signif trend to better outcome in small hospitals but inspections suggests that linear trend in inappropriate – largest and smallest |

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| | | | | | hospitals had significantly worse outcomes than intermediate categories<br>o Low PMR in small hospitals due to 2 factors: selections for delivery of normal weight infants and very low BWMRs for infants =/> 2500g |
| Luo, Z.-C., Kierans, W. J., Wilkins, R., Liston, R. M., Mohamed, J., & Kramer, M. S. (2004). Disparities in birth outcomes by neighborhood income: temporal trends in rural and urban areas, british columbia. Epidemiology, 15(6), 679–686. | Canada, BC | assess temporal trends in disparities in birth outcomes by neighbourhood income in urban compared with rural areas. | • Knowledge of socioeconomic disparities in health is of interest to both the general public and public health policymakers. It is unclear how disparities in birth outcomes by socioeconomic status have changed over time, particularly in settings with universal health insurance and favorable socioeconomic conditions. | Cohort of all births in BC from 1985-2000. | Moderate disparities in birth outcomes by neighbor hood income persist in urban areas (although not rural areas) of British Columbia, despite a universal health insurance system and generally favorable socioeconomic conditions. |
| Luo, Z.C. & Wilkins, R. (2008). Degree of rural isolation and birth outcomes. *Paediatric and Perinatal Epidemiology*, 22, 341-349. | Quebec, Canada | We hypothesise that birth outcomes may differ between rural and urban areas, and that such differences may be dependent on the degree of rural isolation and be partly explained by the associated differences in sociodemographic and socioeconomic characteristics. We aimed to assess the risks of adverse | Health research often focuses on *urban* residents, probably because of the convenience of data collection and study implementation in urban settings. Little is known about the degree of rural isolation in relation to birth outcomes; we are aware of only a few such studies which defined 'rural' and the degree of rural isolation using variable criteria but none has examined a broad range of birth outcomes including preterm birth, stillbirth and neonatal death. | Retrospective Cohort Study | Compared with urban areas, crude risks of preterm birth, small-for-gestational age birth, stillbirth, neonatal death and postneonatal death were similar in rural areas with strong metropolitan influence, but were significantly higher for preterm birth, stillbirth and postneonatal death in rural areas with weak or no metropolitan influence, and for neonatal death in rural areas with no metropolitan influence. Adjustment for maternal characteristics (age, mother tongue, education, marital status, parity, plurality and infant sex) attenuated the associations. Much higher neonatal death rates were observed for preterm or low-birthweight babies in rural areas with no metropolitan influence, suggesting inadequate access to optimal neonatal care. We conclude that birth |

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| | | birth outcomes in relation to the degree of rural isolation, and whether compositional differences in maternal sociodemographic and socio-economic characteristics may partly account for any differences across the rural areas. | | | outcomes in rural areas differ according to the degree of rural isolation. Fetuses and infants of mothers from rural areas with weak or no metropolitan influence are particularly vulnerable to the risks of death during the perinatal and postnatal periods. |
| Luo, Z. C., Wilkins, R., Heaman, M., Martens, P., Smylie, J., Hart, L., Fraser, W. D. (2010). Birth outcomes and infant mortality by the degree of rural isolation among first nations and non-first nations in Manitoba, Canada. The Journal of Rural Health : Official Journal of the American Rural Health Association and the National Rural Health Care Association, 26(2), 175–181. | Canada, Manitoba | • Does rural isolation affect birth outcomes and infant mortality differently for Indigenous verus non-Indigenous women population? | It is unknown whether rural isolation may affect birth outcomes and infant mortality differentially for Indigenous versus non-Indigenous populations. We assessed birth outcomes and infant mortality by the degree of rural isolation among First Nations (North American Indians) and non-First Nations populations in Manitoba, Canada, a setting with universal health insurance. | A geocoding-based birth cohort study of 25,143 First Nations and 125,729 non-First Nations live births to Manitoban residents, 1991–2000. | Preterm birth and low birth weight rates were somewhat lower in all rural areas regardless of the degree of isolation as compared to urban areas for both First Nations and non-First Nations. Infant mortality rates were not significantly different across areas for First Nations (10.7, 9.9, 7.9, and 9.7 per 1,000 in rural areas with no, weak, moderate/strong urban influence, and urban areas, respectively), but rates were significantly lower in less isolated areas for non-First Nations (7.4, 6.0, 5.6, and 4.6 per 1,000, respectively). Adjusted odds ratios showed similar patterns. |

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| Lynch, N., Thommasen, H., Anderson, N., & Grzybowski, S. (2005). Does having cesarean section capability make a difference to a small rural maternity service?. Canadian Family Physician Medecin de Famille Canadien, 51, 1238–1239. | Canada, BC, Bella Coola | • Does having caesarean section capability in an isolated rural community make a difference in adverse maternal or perinatal outcomes. | A Joint Position Paper on Rural Maternity Care affirms that "every woman in Canada who resides in a rural community should be able to obtain high-quality maternity care as close to home as possible."2 Across Canada, however, the practice of obstetrics in rural communities is undergoing profound change.3,4 Two surveys of rural community hospitals in northern Ontario revealed that the number of hospitals no longer offering obstetric care increased 500%, from three hospitals in 1981 to 15 hospitals in 1997, and that overall, anesthesia, epidural, and cesarean section services were less available | Retrospective record review comparing outcomes of two remote hospitals; one with caesarean section capability, one without. | • Having local cesarean section capability is associated with a greater proportion of local deliveries and a lower rate of preterm deliveries. |
| MacDorman MF, Declercq E, Menacker F, Malloy MH, . Neonatal Mortality for Primary Cesarean and Vaginal Births to Low-Risk Women. *Birth* 2008; 35(1):3-8 . | United States | • What is the relative safety of C-section vs normal birth for low-risk women? | • The percentages of C-section have risen steadily from 20.7% in 1997 to 31.1% in 2006. These rates have risen consistently even for women who are considered to be low risk and are considered to be 'medically elective' i.e. done without a known medical reason | Cohort Study | • The unadjusted neonatal mortality rate for caesarean deliveries with no labor complications or procedures was 2.4 times that for planned vaginal deliveries<br>• For low-risk women, the neonatal mortality rate of low risk women delivery via normal vaginal birth was (0.69 per 1000), and neonatal mortality for delivery via C-section after labour complications was 1.69 per 1000, resulting in a rate of 0.72 overall.<br>• Neonatal mortality rate for primary C-sections for women with no labour complications was 1.73. This is over twice the NMR of the unplanned C-section group.<br>• Three logistic regression models were used. |

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| | | | | | For the model in which total neonatal mortality was the dependent variable, the adjusted odds ratio for neonatal mortality associated with cesarean delivery with no reported labor complications or procedures compared with planned vaginal delivery was 2.34<br>• In the most conservative of the three models, accounting for many confounding factors, PNMR was still 69% higher for low-risk women with planned C-section as compared to those with planned normal birth |
| MacKinnon KA. Labouring to nurse: the work of rural nurses who provide maternity care. *Rural and Remote Health* **8: 1047**. (Online) 2008 | East Kootenay Region, BC | • To describe the work nurses do when providing maternity care in rural/remote settings (including local context and competencies); to describe how interactions with women and other professionals influences nursing work in rural; to identify institutional structures, resources, and work processes that influences nursing work; to identify possibilities for change that would | • Rural local provision of health care depends on the availability of health resources and skilled healthcare providers, including nurses trained in maternity care<br>• There is a shortage of healthcare providers, including nurses, in rural locations and so new models of collaborative practice are needed to provide adequate care<br>• Little is known about the experiences of RNs who provide maternity care in rural and remote settings<br>• Feminist researchers (DeVault 1999) have described "relationship work" as a kind of important yet invisible work that women perform in our society. This may therefore also influence the care and service that they may provide in rural settings | Case Study | • The work of nurses who provide maternity care was characterized as broad in scope, as requiring complex knowledge and skills<br>• Rural nursing was grounded in the idea of knowing their community to provide effective and personal care<br>• Nurses cited a personal connection to their patients and their community as a means of providing effective care and contributing to a sense of responsibility<br>• Rural nurses demonstrate significant creativity and leadership, often undertaking many responsibilities that would otherwise not be attended to.<br>• All participants identified an adequate number of skilled nurses as essential for providing quality care<br>• The skills for nurses to provide maternity care are/were hard to obtain in rural communities, so it is therefore necessary for them to have access to proper means of education and travel so that they can acquire the skills that are necessary<br>• Many new nurses reported experiencing |

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| | | support local nurses | | | 'moral distress', faced with the prospect of having to provide maternity care when they were not properly trained or confident in their abilities.<br>• There should therefore be affordable continued education and access to professional development opportunities |
| MacKinnon, K. (2010). Learning maternity: The experiences of rural nurses. *Canadian Journal of Nursing Research*, 42(1), 38-55. | Canada, rural BC | How do rural nurses learn to provide maternity care and the social organization of their learning experiences? | Working definition of a rural community as less than 10,000 people living beyond commuting distance of an urban setting. The second study (reported on here) included five communities that fit this definition. The study took place in a mountainous interior region of British Columbia near the Rocky Mountains where high mountain passes, snow and ice in the winter months, and deer on the highways make travel treacherous. In one of these communities the hospital had recently closed, forcing women to travel to a neighbouring community to receive hospital care during labour and childbirth. The four remaining hospitals ranged in size from eight acute-care beds (two hospitals with residential or long-term care provided in an adjoining building) to 20 acute-care beds (also two hospitals). Over the last 5 years the average number of births in these hospitals has ranged from 26 to 94 per year. | Institutional ethnography | One of the main challenges identified by rural nurses was ensuring that a knowledgeable/skilled maternity or perinatal nurse was always available at the local hospital. Learning how to provide safe and supportive maternity care is difficult for nurses working in small rural hospitals today due to declining birth rates, increased workloads, and a decrease in opportunities for mentoring. Decisions about the allocation of time off and resources for rural nurses' continuing professional education (CPE) were structured by discourses of personal responsibility for "continuing competence." These institutional work processes increase the burden on rural nurses, negatively affecting their opportunities for CPE and their experiences of providing maternity care, with implications for both patient safety and nurse retention. |

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| Mander, R., & Melender, H. L. (2009). Choice in maternity: rhetoric, reality and resistance. *Midwifery*, *25*(6), 637-648. | Scotland, Finland, New Zealand | • Can the choices and decision-making available to childbearing women in Scotland be enhanced by examining womens' decision-making experiences?<br>• What are the experiences of childbearing women of contributing to decisions at clinical, organizational and policy-making levels?<br>• How were the findings from the Finland site research able to come to understand the experience of making childbearing choices and decisions in that setting? | • A study of two broadly comparable countries was planned to learn from women's experiences<br>• countries involved were Finland and NewZealand, whose similar population to Scotland, with comparable health/maternity care systems, reduced the likelihood of disparities<br>• Focus of the paper was on a centre in Finland where the findings were particularly homogeneous (in the current study, the background to and data from the Finland site were scrutinized)<br>• Childbearing choices, which were the focus of this study, included clinical decisions as well as organizational and policy level decisions.<br>• Study population included 3 groups: childbearing women (mothers), midwives and other maternity care providers, midwife managers, policymakers in Finland<br>• Findings based on 12 conversations with mothers and all groups of staff at Finland centre site | • Qualitative research using herneneutic phenomenological approach | • Sample in Finnish site comprised 12 informants (4 women, 6 care providers – 4 MWs & 2 PHNs, 2 policy makers/managers)<br>• Findings set out as identified themes<br>o Overarching background theme = "trusting the system"<br>▪ General trust, pride, in FInnish health care system<br>o Sub-theme = "obtaining information"<br>▪ Ease of accessiong information necessary to make decisions felt by most women<br>o Sub-theme = "making changes"<br>o Sub-theme = "being strong/courageous"<br>▪ Stregth and courage regarded as Finnish characteristics<br>▪ However, women described feeling want of courage and needing to find courage to make a maternity-related decisions (eg.) place of birth<br>o MWs described feelings of vulnerability around legality of home birth<br>o Sub-theme = "being safe"<br>o Sub-theme = "playing the system" |
| McIlwaine, R., & Smith, S. (2000). | Canada, BC, Bella Coola | • What is the obstetrical | • Over a 4-year period, there was a cesearean rate of 17.8%, which | Retrospective review | • Of the 51 women who delivered outside of the community, 54% did so specifically because |

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| Obstetrics in a small isolated community : The cesarean section dilemma. Canadian Journal of Rural Medicine, 5(4), 221–223. | | experience of women who presented for prenatal care in the small isolated community of Bella Coola BC? | compares favourably to the provincial average; however 28% of women delivered outside of the community. Almost half of the out-of-community births were due to lack of cesarean section coverage at Bella Coola Hospital at the time of delivery. Previous research indicates that number of birth complications is strongly associated with the proportion of deliveries occurring outside the community. C section rates at Bella Coola's nearest hospital (in Williams Lake) are 29%. | | there was no c section coverage. If the community had continuous c section coverage, they could have delivered 87% of the women in the community. |
| McLelland, G., McKenna, L., & Archer, F. (2013). No fixed place of birth: Unplanned BBAs in Victoria, Australia. Midwifery, 29, e19-e25. | Victoria, Australia | | • While outcomes for mothers and babies associated with planned home births are similar to in-hospital births, they have been reported to be significantly worse after an unplanned BBA (Stotland and Declercq, 2002). Combining the data from both types of out of hospital births may unneces- sarily exacerbate the perceived risk for planned homebirth | Cohort Study | Multiple approaches should be adopted to manage unplanned BBAs. Antenatal screening should be undertaken to identify the women most at risk. Strategies can be developed that will reduce poor neonatal and maternal outcomes, including education for women and their partners on immediate management of the newborn; ensuring paramedics have current knowledge on care during childbirth; and maternity and ambulance services should develop management plans for care of women having unplanned BBAs. |
| Merlo, J., Gerdtham, U., Eckerlund, I., Håkansson, S., Pakkanen, M., Lindqvist, P., & Hdkansson, S. (2005). Hospital Level of Care and Neonatal Mortality in Low- the | Sweden | • What is the relevance of regionalization and the concentration of neonatal resources as determinants of | • In high-risk births, the availability and concentration of neonatal resources in larger regional hospitals increases the chance of survival. The advantages of regionalization for low-risk deliveries are still unclear, but some studies have suggested | Cohort study examining interhospital differences in 28-day neonatal mortality | Increased regionalization and concentration of neonatal resources for low-risk births is justified from a strictly medical point of view. From a public health perspective, closing small obstetrics units may prevent an appreciable number of deaths, but it would have only a very small impact on the risk of mortality from the individual's point of view. The cost-effectiveness of such a step remains to be |

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| Question in Sweden by Multilevel Reassessing Analysis. Medical Care, 43(11), 1092–1100. | | mortality in low- and high-risk deliveries in Sweden. | that regionalization also is beneficial for low risk deliveries. | | analyzed from a health economics perspective |
| Monk, A. R., Tracy, S., Foureur, M., & Barclay, L. (2013). Australian primary maternity units: past, present and future. Women and Birth, 26(3), 213–218. | Australia | • What are the various drivers and barriers to the sustainability of primary maternity units in Australia. What are the historical antecedents? How have PMUs been shaped by recent political events? | In Australia, 96.9% of women give birth in hospitals. There are very few primary maternity units (PMUs), that is, maternity units managed by midwives with no obstetric, anaesthetic, laboratory or paediatric support available on site. Primary maternity units provide care for women considered to have low risk pregnancies who transfer to another site to receive any medical intervention including caesarean section and epidural anaesthesia. In some other countries, PMUs (which are often referred to as freestanding or stand-alone midwifery units, as well as freestanding birth centres) play an important role in offering equitable and accessible maternity care to women with low-risk pregnancies. | This paper aims to encourage researchers, midwives and policy makers to understand the past and present political, professional and social influences on maternity care in order to manage the challenges facing the development and maintenance of primary maternity units in Australia today. | It is difficult to tell whether the emergence of PMUs in Australia since 2004 indicates a true shift towards confidence in midwives being able to govern and regulate their own practice, or whether this confidence will continue. PMUs emerged in a political climate where the voices of midwives and maternity consumers were heard. Their lobbying, combined with key obstetric and administrative support, influenced policies and legislation in regional and urban settings which were geographi- cally close to tertiary care. However medicine continues to strongly influence Australian maternity policy which often challenges midwifery-led care. PMUs may face closure due to the argument that giving birth in a location with no medical supervision on-site presents an unnecessary risk, and they may never flourish in rural and remote settings where women could benefit the most. In order to legitimise Australian PMUs in any setting this risk must be rigorously evaluated in order to balance consumer need with firmly entrenched concerns about giving birth without on-site obstetric and anaesthetic support. Con-sumers must also continue to have a voice. Without this voice, woman-centred care would be a hollow concept. |
| Monk, A., Tracy, M., Foureur, M., Grigg, C., & Tracy S. (2014). Evaluating Midwifery | New South Wales, Australia | (Objective) The aim was to compare the maternal and neonatal birth | | Prospective cohort study | The results of this study support the provision of care in freestanding midwifery units as an alternative to tertiary-level maternity units for women with low risk |

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| Units (EMS): a prospective cohort study of freestanding midwifery units in New South Wales, Australia. *BMJ Open*, 4. | | outcomes and morbidities associated with the 'intention to give birth' or 'booking at' the freestanding midwifery units in each health district compared with a reference cohort booked at the tertiary referral maternity hospitals integrated with the freestanding midwifery units. This paper reports the findings from the Australian arm of the study. | | | pregnancies at the time of booking. |
| Moster, D., Lie, R. T., & Markestad, T. (1999). Relation between size of delivery unit and neonatal death in low risk deliveries : population based study. Arch Dis Child Fetal Neonatal Ed, 80, F221–F225. | Norway | What is the risk of neonatal death after low risk pregnancies in relation to size of delivery units? | There is no consensus on the optimal conditions for delivery after a normal pregnancy. On the one hand, well equipped hospitals are thought to be the safest place for all deliveries, as no antenatal screening procedure can guarantee an uncomplicated delivery. On the other hand, a delivery with no known risk factors may actually be put at risk by the increased medical attention of technologically advanced maternity units, and low risk deliveries may benefit from the minimal intervention approach | Cohort study of live singleton births in Norway with birthweights of at least 2500 grams comparing neonatal outcomes of low-risk pregnancies across hospital volume. | The neonatal mortality rate for infants delivered after low risk pregnancies is extremely low irrespective of birth place compared with the total neonatal mortality |

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| | | | in small maternity units. | | |
| Moster, D., Lie, R. T., & Markestad, T. (2001). Neonatal mortality rates in communities with small maternity units compared with those having larger maternity units. British Journal of Obstetrics and Gynaecology, 108(September), 904–909. | Norway | | The question of whether advanced hospitals or small low technology maternity units are the optimal setting for delivery of low risk women has been discussed for many years. During the last few decades births have been centralised to larger units in many Western countries.<br>However, emphasis has recently changed to women's preferences8±10, and many low risk women want the experience of giving birth in low technology maternity units. This new trend again raises the issue of safety according to place of birth, and calls for reliable studies. | Population-based study using data from The Norwegian Medical Birth Registry. | We observed a small but significantly decreased neonatal mortality in areas where the great majority of births occurred in large hospitals. |
| Munro, S., Kornelsen, J., & Grzybowski, S. (2013). Models of maternity care in rural environments: Barriers and attributes of interprofessional collaboration with midwives. *Midwifery*, *29*(6), 646-652. | BC, Canada | What are the barriers to and facilitators of interprofessional models of maternity care between physicians, nurses, and midwives in rural British Columbia, Canada, and the changes that need to occur to facilitate such models? | • In recent years, increasing proportion of parturient women seeking care from midwives<br>• In parts of rural Canada the local care of parturient women is undertaken almost exclusively by family physicians with the support of specialists in referral communities<br>• Canada experiencing a health human resource crisis in rural – and urban - maternity care due to a confluence of | Qualitative, exploratory framework guided data collection and analysis | • significant barriers to such collaboration given the disciplinary differences between care provider groups including skill sets, professional orientation, and funding models<br>• interprofessional tensions are exacerbated in geographically isolated rural communities, due to the stress of practicing maternity care in a fee-for-service model with limited health resources and a small patient caseload<br>• Participants identified specific barriers to interpro collaboration, including physician and nurses' negative perceptions of midwifery and HB, inequities in payment |

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| | | | challenges including shortages in obstetrically trained nurses and the growing attrition of family physicians from rural practice<br>• Interprofessional primary maternity care has emerged as one potential solution to situation<br>• significant barriers to collaboration given the disciplinary differences between the groups such as scope of practice, professional orientation, and funding models.<br>• In isolated rural communities, challenges are exacerbated by the unique context of small birthing populations and limited hospital resources. | | between physicians and midwives, differences in scopes of practice, confusion about roles and responsibilities, and a lack of formal structures for supporting shared care practice<br>• Participants expressed that successful interprofessional collaboration hinged on strong, mutually respectful relationships between the care providers and a clear understanding of team members' roles and responsibilities |
| Nesbitt, T. S., Connell, F. A., Hart, L. G., & Rosenblatt, R. A. (1990). Access to obstetric care in rural areas: effect on birth outcomes. American Journal of Public Health, 80(7), 814–818. | US, Washington State | What is the extent to which local availability of obstetrics is related to perinatal oucomes? Specifically, what are the characteristics of rural communities in which the majority of women deliver at a facility other than their local hospital | Even in communities with adequate obstetrical care, a certain proportion of women either choose to leave these communities for obstetrical care, or are referred to different physicians or facilities because of specific complications of pregnancy. However, in towns with little or no obstetrical capacity, most women must travel to secure basic prenatal care as well as delivery. As a consequence it becomes less likely that those women will | Hospital discharge data from 33 rural hospital service areas in Washington State were categorized by the extent to which patients left their local communities for obstetrical services. | Out data demonstrate that women living in rural Washington state communities with little or no obstetrical care<br>available locally tend to deliver in hospitals outside the community. These women are more likely to have complicated labor and premature deliveries, and their infants are more likely to have longer and more expensive hospital stays than the children of their rural counterparts who deliver in local facilities communities with greater access to care. |

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| | | (outflow)? And, using outflow as a proxy for access to care, is there any difference in the outcom or cost of care for women living in communities with diminished obstetrical access as compared to women who have ready access to local obstetrical care? | obtain adequate prenatal care. Delays in care of early labor complications may also result. | | |
| Nesbitt, T. S., Larson, E. H., Rosenblatt, R. A., & Hart, L. G. (1997). Access to Maternity Care in Rural Washington: Its Effect on Neonatal Outcomes and Resource Use. American Journal of Public Health, 87(1), 85–90. | US, Washington State | • How is local availability of maternity services in rural areas associated with neonatal outcomes and use of health care resources for publicly and privately insured patients? | declining access to local maternity and neonatal services in the rural United States over the past decade raises significant health policy issues. Namely, to what degree should health policy and educational resources be directed at ensuring local access to maternity services instead of simply allowing an increasing number of women to travel to larger communities for care? | Retrospective record review | Poor local access to providers of obstetric care was associated with a significantly greater risk of having a non-normal neonate for both Medicaid and privately insured patients. However, poor local access to care was consistently associated with higher charges and increased hospital length of stay only if the patient was privately insured. |
| O'Driscoll, T., Kelly, L., Payne, L., St. Pierre-Hansen, N., | Canada, Northwestern Ontario; | What is the perinatal knowledge and | For many Aboriginal women, the loss of the community experience of birth is seen as | A qualitative study using semistructured | First Nations women who travel away from home to give birth often travel great cultural and geographic distances. |

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| Cromarly, H., Minty, B. & Linkewich, B. (2011). Delivering away from home: the perinatal experiences of First Nations women in northwestern Ontario. *Canadian Journal of Rural Medicine*, 16(4). | Sioux Lookout Meno Ya Win Health Centre | experience of First Nations women from northwestern Ontario who travel away from their remote communities to give birth? | a cultural loss, and forced evacuation is associated with colonial practices. The return of the birthing experience to remote Inuit communities has been very successful since 1986, and excellent outcomes have been demonstrated in the 3 existing birthing centres without the capability for cesarean delivery. The return of local birthing goes hand in hand with the development of an Aboriginal, community-based midwifery program and appropriate risk assessment and triaging. Inuit women have long been known to have low rates of shoulder dystocia and a rate of cesarean deliveries between 2% and 4%. | interviews and a systematic review of medical | Hospital-based maternity care programs for these women need to achieve a balance of clinical and cultural safety. Programs should be developed to lessen some of the negative consequences these women experience. |
| Orkin A, Newbery S. Marathon Maternity Oral History Project: Exploring rural birthing through narrative methods. *Canadian Family Physician* 2014; 60(1): 58-64. | Marathon, Ontario | • How is birthing and maternity care understood and valued in a rural community? | • In 2008, the National Birthing Initiative for Canada identified 7 top priorities for Canadian maternity care, and listed "Listening to Women's Voices" as the top priority in planning and developing Canada's birthing system<br>• Lack of local birthing services is an important feature of Canada's urban-rural health disparities. Although lack of proper access is established as a predictor of poorer outcomes, local | Grounded Theory qualitative study | • Regardless of where birth occurred, all women in the study identified the birth experience as being deeply valuable and formative in personal and community processes<br>• Interviewees identified the key importance of safety, family, familiarity, comfort, and relationships with birthing providers<br>• Travelling outside the community was associated with feelings of uprooting, isolation, disconnection, uncertainty, financial strain. Birthing locally was likewise associated with awareness and concern about access to backup surgical/anesthetic services<br>• Women asserted that giving birth inside the |

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| | | | maternity hospitals are nonetheless increasingly rare in rural Canada<br>• Marathon, Ontario is very representative of many rural communities in Canada, with the notable exception that it has had sustained and expanded maternity services<br>• For more than 10 years marathon has maintained a stable foundation of family physicians working together under a cooperative, consensus based, team-practice model | | community of Marathon was empowering |
| Overgaard, C., Moller, A.M., Fenger-Gron, M., Knudsen, L.B., & Sandall, J. (2011). Freestanding midwifery unit versus obstetric unit: a matched cohort study of outcomes in low-risk women. *BMJ Open*, 1. | Denmark | On the basis of previous research, we hypothesised that FMU care, with its emphasis on the physiological birth process and psycho-social well-being during childbirth, would entail a number of positive effects for the women, such as a higher rate of spontaneous vaginal birth, intact perineum, and use of non-pharmacological pain relief. FMU | The safety of birth in free-standing midwifery units (FMUs) is strongly debated, as acute complications may arise in a spite of a careful risk assessment of women. Prior studies suggest that FMU care for low-risk women is related to low perinatal and maternal morbidity, fewer interventions and a decreased use of medical pain relief compared with care from obstetric units (OUs) care, but some are limited by, for example, the inclusion of high-risk women, low number of participants, and inadequate control of bias and confounding. The present study aims to compare perinatal and maternal morbidity, birth interventions, | A cohort study with a matched control group. | No difference in perinatal morbidity was found among infants of low-risk women who intended birth in an FMU compared with infants of low risk women who intended birth in an OU. More studies on rare adverse outcomes are needed. FMU care had important benefits such as reduced maternal morbidity, reduced use of<br>birth interventions including caesarean sections and increased likelihood of spontaneous vaginal<br>birth compared with OU care. However, 37% of primiparas and 7% of multiparas transferred during or <2 h after birth. Care in FMUs may be considered as an adequate alternative to OU care for low-risk women, and women should be given an informed choice of place of birth, including information on transfer. |

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| | | women were hypothesised to experience fewer interventions and require less use of pharmacological pain relief compared with OU women. No differences in perinatal or maternal morbidity were predicted. | and pain relief in low-risk women giving birth in two freestanding midwifery-led units and two obstetric units (OUs) in Denmark. | | |
| Paranjothy, S., Watkins, W.J., Rolfe, K., Adappa, R., Gong, Y., Dunstan, F., & Kotecha, S. (2014). Perinatal outcomes and travel time from home to hospital: Welsh data from 1995 to 2009. *Acta Paediatrica*, 103, e522-e527. | Wales | Is there an association between travel time from home to hospital of birth and birth outcomes? Is there any association between travel time from home to the nearest hospital with maternity services, and these birth outcomes? Is the geographical location of maternity services is associated with perinatal mortality? | For all registrable births to women resident in Wales (1995–2009), we calculated the travel time between the mother's residence and the postcode-based location for both the birth hospital and all hospitals with maternity services that were open. Using logistic regression, we obtained odds ratios for the association between travel time and each birth outcome, adjusted for confounders. | Cohort Study that links travel time to hospital to birth outcomes. | Longer travel time to the birth hospital was associated with increased risk of neonatal deaths, but there was no strong evidence of association to the nearest hospital.. |

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| Pewitt, A. T. (2008). The experience of perinatal care at a birthing center: A qualitative pilot study. *The Journal of perinatal education*, *17*(3), 42. | Rural county, southeastern USA | What are the complete and valid accounts of women's experiences of care and satisfaction at a freestanding birth centre, and the meanings attached to those experiences? | • freestanding birth center located in a rural county in southeastern United States with CNMs in consultation with family practice physicians providing care at the centre<br>• OBs at nearby hospital available to perform c/s births for birth center clients when needed<br>• midwifery philosophy framed this investigation.<br>• Impact of midwifery care on outcomes, particularly women's antenatal care and birth experience | • Case study/pilot study<br>• qualitative descriptive pilot study<br>• semi-structured interviews | • All participants described overall experience as satisfying<br>• No participants expressed negative psychological outcomes, although some did experience physical complications (p.46-47)<br>• Three themes emerged during the analysis<br>o (1) Empowerment -Every woman expressed a changed attitude regarding her capacity to assume new challenges, from feeling uncertain of their own ability to succeed prior to the birth, to feeling empowered to face any task with confidence after the birth<br>o (2) Sense of motherhood -participants had concerns about childrearing, however, the care they received at the center gave them confidence in their ability as mothers<br>o (3) Establishing and strengthening relationships-formation of new human connections and the growth of existing relationships that occurred throughout the perinatal experience (p.47) |
| Pilkington, H., Blondel, B., Drewniak, N., & Zeitlin, J. (2012). Choice in maternity care: associations with unit supply, geographic accessibility and user characteristics. *International Journal of Health* | France | 1) How does context influence user choice? Context here refers to a given supply of maternity units in a given region at some distance from the woman's residence – it is a contextual level determinant in accessibility to | Despite national policies to promote user choice for health services in many European countries, current trends in maternity unit closures create a context in which user choice may be reduced, not expanded. Little attention has been paid to the potential impact of closures on pregnant women's choice of maternity unit. We study here how pregnant women's choices interact with the distance they | Case study using retrospective record review | Overall, about one-third of women chose their maternity units based on proximity. This proportion increased steeply as supply was constrained. Greater distances between the first and second closest maternity unit were strongly associated with increasing preferences for proximity; when these distances were ≥ 30 km, over 85% of women selected the closest unit (revealed preference) and over 70% reported that proximity was the reason for their choice (expressed preference). Women living at a short distance to the closest maternity unit appeared to be more sensitive |

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| *Geographics*, 11 (35). | | health care;<br>2) How do user characteristics affect the relationship between context and choice?<br>3) How may an indicator of choice be incorporated into an assessment of the impact of changes in access to health services when the supply of maternity services is restructured and in particular when maternity units are closed down? | must travel to give birth, individual socioeconomic characteristics and the supply of maternity units in France in 2003. | | to increases in distance between their first and second closest available maternity units. The preference for proximity, expressed and revealed, was related to demographic and social characteristics: women from households in the manual worker class chose a maternity unit based on its proximity more often and also went to the nearest unit when compared with women from professional and managerial households. These sociodemographic associations held true after adjusting for supply factors, maternal age and socioeconomic status. |
| Pilkington H, Blondel B, Drewniak N, Zeitlin J. Where does distance matter? Distance to the closest maternity unit and risk of foetal and neonatal mortality in France. *European Journal of Public Health*2014; 24(6): 905-910. | France | • What is the impact of distance to the closest maternity unit on perinatal mortality? | • The number of maternity units has declined in France for the past 40 years, raising concerns about the possible impact of increasing travel distances on perinatal health outcomes<br>• Previous studies regarding the reduction in maternity units have showed that there have not been any adverse effects on accessibility for most women.<br>• European countries have had decline in stillbirths and neonatal mortalities in the last 20 years, | Cross Sectional | • 7% of births occurred to women residing at >30 km from a maternity unit and 1% at >45 km<br>• Fetal and neonatal mortality rates were highest for women living <5 km from a maternity unit. Women in urban areas were on average older and were more likely to be <5 km from a maternity unit<br>• Hospitals in these settings may be better equipped to deal with emergencies and therefore treat higher-risk patients through a system of referral, but this was not controlled/accounted for in the study<br>• The authors note that a lack of control for |

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| | | | however the rates in France have not improved since 2004<br>• French maternity services do not include an option for home birth, although some midwives in the private sector offer this service. | | referral is due to the study's design as population-based, not facility-based<br>• Mortality was lowest for the 5-45 km range, and rates of fetal mortality increased again after >45 km from services<br>• Neonatal deaths associated with out of hospital births were very rare, but were more frequent at longer distances<br>• Both stillbirths and neonatal deaths were higher in urban and rural areas, and lower in peri-urban areas<br>• Out-of-hospital births were higher in rural areas. For the rare deaths accompanying out-of-hospital births, longer distance to maternity services did not seem to matter. |
| Pitchforth, E., van Teijlingen, E., Watson, V., Tucker, J., Kiger, A., Ireland, J., Farmer, J., Rennie, A.M., Gibb, S., Thomson, E., & Ryan, M. (2009). "Choice" and place of delivery: a qualitative study of women in remote and rural Scotland. *Quality Safety Health Care*, 18, 42-48. | North Scotland | ''What factors are important to women with regard to maternity service provision?'' and ''Do these factors vary according to service provided?'' | Women had varying experiences and perceptions of choice regarding place of delivery. Most women had, or perceived they had, no choice, though some felt they had a genuine choice. When comparing different places of birth, women based their decisions primarily on their perceptions of safety. Consultant-led care was associated with covering every eventuality, while midwife- led care was associated with greater quality in terms of psycho-social support. Women engaged differently in the choice process, ranging from ''acceptors'' to ''active choosers.'' The presentation of choice by health | Qualitative, focus groups | Provision of different models of maternity services may not be sufficient to convince women they have ''choice.'' The paper raises fundamental questions about the meaning of ''choice'' within current policy developments and calls for a more critical approach to the use of choice as a service development and analytical concept. |

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| | | | professionals, pregnancy complications, geographical accessibility and the implications of alternative places of delivery in terms of demands on social networks were also influential in ‘‘choice.’’ | | |
| Pitchforth E, Watson V, Ryan M, Teijlingen E, Farmer J, Ireland J, Thompson E, Kiger A, Bryers H. Models of intrapartum care and women’s trade-offs in remote and rural Scotland: a mixed-methods study. *BJOG: An International Journal of Obstetrics & Gynaecology* 2008; 115(5): 560-569. | Scotland | • What are women’s preferences for, and trade-offs between, key attributes of intrapartum care models | • Pressures to increase centralisation of acute obstetric and neonatal services have particular implications for rural populations, which account for around one-fifth of the UK population and one-third of Scotland’s population<br>• Sustaining acute medical service provision in small district general hospitals is difficult<br>• Although there is pressure toward centralizing acute services, policy recommendations generally support local community-based services for low-risk women | Mixed methods cohort study | • Women overall preferred birth in a delivery unit as opposed to home birth, and consultant-led care to midwifery-managed care.<br>• Focus groups originally identified midwifery-managed care as their primary choice, but as discussions evolved it became clear that women perceived consultant-led care (CLC) as the safer option in which every eventuality would be covered.<br>• Women did identify MMC as a model in which relationships could be built and maintained with their care providers<br>• Home births, particularly due to the isolation involved with living in a rural/remote community, was felt to be an unsafe option for childbirth<br>• Although women preferred short travel times to care, a trade-off was demonstrated in which women indicated a willingness to travel for ~2 hours to receive their preferred choice of care.<br>• Availability of various methods of pain relief was associated with differing opinions and preferences. Some felt that it was necessary to have all forms of pain relief available, particularly for first-time mothers. Its simple availability was seen as a source of |

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| | | | | | reassurance, even if it would not necessarily be used.<br>• Some women in focus groups explained that family circumstances could play an important part in decision-making about place of birth. Leaving family at home to give birth elsewhere was seen as an undesirable option<br>• Opinions identified by the questionnaire revealed that care provider preferences were influenced by geographic location; island residents preferred MMC, while mainland residents preferred CLC |
| Powell, J., & Dugdale, A. E. (1999). Obstetric outcomes in an Aboriginal community: A comparison with the surrounding rural area. *Australian Journal of Rura Health*, *7*(13-17). | Queensland, Australia | How do the ante-, intra- and postnatal features of Aboriginal women from Cherbourg Aboriginal Community compare to those of non-Aboriginal mothers delivered at Kingaroy?<br><br>What are the characteristics of the two groups and, what are the factors associated with differences between the two groups? | • Cherbourg Aboriginal Community in Queensland, Australia is about 270 km from Brisbane and 45 km from Kingaroy Base Hospital by road. Cherbourg has about 2000 people all of part-Aboriginal or part-Islander descent. The housing, basic infrastructure and facilities are similar to those of a Queensland country town. The health services are more extensive with a 15 bed hospital, a full-time medical officer, registered and enrolled nurses and a Health Team.<br>• Two separate and largely contradictory currents in obstetric services to Aboriginal communities:<br>o concern about the continuing poor | Cross-sectional | • data for 146 Aboriginal and 139 non-Aboriginal women were taken from the hospital records.<br>• Aboriginal women generally younger at delivery, had first antenatal visit later, and made fewer antenatal visits than non-Aboriginal women<br>• Aboriginal women more likely to be anaemic, have an STD, and drink alcohol<br>• After making an allowance for repeat c/s, was no significant difference in the proportion of abnormal deliveries between Aboriginal and non-Aboriginal women<br>• Birthweights of Aboriginal infants were significantly lower (most significant difference in outcomes between the two groups).<br>• lower incidence of jaundice in Aboriginal infants.<br>• Multifactorial analysis showed that birthweights were significantly decreased by primagravidy, alcohol intake and STD. It is likely that the effects of STD and alcohol on birthweight were due to associated lifestyle |

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| | | | outcomes for Aboriginal mothers (FN1–4) and their infants compared with the general Australian population. (p.13)<br>o desire of some Aboriginal mothers to give birth to their infants in their own communities (p.13)<br>• Since 1990, most mothers at Cherbourg Aboriginal Community had their early antenatal care at Cherbourg and late antenatal care and deliveries at Kingaroy Base Hospital. (p.13) | | factors.<br>• When these factors were allowed for, ethnic background had no significant effect on birthweight. |
| Powers JR, Loxton DJ, O'Mara AT, Chojenta CL, Ebert L. egardless of where they give birth, women living in non-metropolitan areas are less likely to have an epidural than their metropolitan counterparts. *Wome n and Birth* 2013; 26(2): e77-e81. | Australia | • Can differences in Australian birth intervention rates be explained by women's residence at the time of childbearing? | • Due to changes in geographical classifications over time, comparisons of birth intervention rates in metropolitan and non-metropolitan areas are difficult<br>• An Australian state-based study of births between 1990 and 1997 found that non-metropolitan women had fewer interventions during birth than metropolitan women, especially if giving birth at their local hospital. | Cohort Study | • Metropolitan women were older, more educated and more likely to have private health insurance than women living in nonmetropolitan areas.<br>• Compared with women aged 20–24 years, 25–29 year old women were twice as likely to have an instrumental birth, and 30–36 year old women were two to four times as likely to have a surgical birth, particularly an elective caesarean<br>• Women with private health insurance were more likely to have instrumental births<br>• Primiparous women residing in non-metropolitan areas of Australia experienced fewer birth interventions than women residing in metropolitan areas: 43% versus 56% received epidural analgesia; 8% versus 11% had elective caesarean sections; and 16% versus 18% had emergency caesarean sections |

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| | | | | | • The decreased likelihood of women living in non-urban areas to receive interventions remained true even when those women gave birth in urban settings<br>• Differences in maternal age and private health insurance status at first birth accounted for differences in surgical birth rates but did not fully explain differences in epidural analgesia |
| Quinn, E., Nobel, J., Seale, H., & Ward, J.E. (2013). Investigating the potential for evidence-based midwifery-led services in very remote Australia: viewpoints from local stakeholders. *Women and Birth*, *26*, 254-259. | Australia | • What are the perceptions, barriers and enablers to the delivery of non-medical primary maternity care models? What is the acceptability of these models? | Since the National Maternity Services Review, non-medical models of care involving midwives as the primary care giver are gaining prominence in urban settings in Australia. However, there remains a paucity of evidence about which non-medical primary maternity care models are best suited for rural and remote communities. | Purposive Sampling was used to conduct in-depth interviews with 24 clinicians and/or policy makers. | Local health service partners are demonstrably ready for further local improvement in providing midwifery-led models of maternity care to women who live in very remote communities in NSW, Australia. |

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| Renesme, L., Garlantezec, R., Anouilh, F., Bertschy, F., Carpentier, M., & Sizun, J. (2013). Accidental out-of-hospital deliveries: a case-control study. *Acta Paediatrica*, 102, e174-e177. | Finistere District, Brittany France | (Objective) The aim of this study was to evaluate the social and geographical factors associated with accidental OHDs, such as a long travel time from home to the delivery unit. | Accidental out-of-hospital deliveries (OHD) account for 0.5% of all live births in France. According to the current French legislation on perinatal organization, if a hospital does not perform >300 deliveries per year, the delivery unit will be closed. As a result, many maternities have been closed up and travel time from home to the nearest maternity (>45 min) has been increased for ome pregnant French women. For instance, in Brittany (a French region of 34 023 km2 with 37 000 births/year), the number of delivery units has decreased from 43 to 32 during the past 10 years. The impact of this organizational change on the rate and aetiology of accidental OHD is unknown. | Retrospective case–control study | Four risk factors for accidental OHD were identified. Setting up an anonymous registry of OHD cases could improve our knowledge and screening of women at risk. |
| Roach, S.M. & Downes, S. (2007). Caring for Australia's most remote communities: obstetric services in the Indian Ocean Territories. ACRRM 4th Scientific Forum Conference Paper. | The Indian Ocean Territories (IOT), Australia | The qualitative aspect of the study sought to add context and depth to the broader study. The aims of the qualitative study were to: Determine perceptions of IOT residents about their experiences of on-island and off-island birthing. | The Indian Ocean Territories (IOT) comprising Christmas and Cocos (Keeling) Islands are situated over 2500 km from Perth, Australia, and are accessible by commercial aircraft only twice a week. The IOT Health Service (IOTHS) is administered from the Department of Transport and Regional Services in Canberra, ACT, Australia. Since 1998, all pregnant women have been required to leave the islands by | Qualitative analysis of recorded interviews with 28 of the islands' women. | Many families expressed a desire for full obstetric services to be reinstated on the islands for low-risk pregnancies, particularly because of the difficulties they experience with the current service. Three recommendations were formulated in response to the social, economic, cultural and logistical difficulties faced by IOT women and their families. |

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| | | -Gain an understanding of the social, economic and cultural impacts of the obstetric service on IOT residents.<br>Identify possible areas for improvement in the current service and explore potential solutions. | 36 weeks gestation and travel to the mainland for birthing. Previously most women with low risk pregnancies were delivered on their island. Women and their partners regularly question medical staff as to reasons for the current obstetric service and, in particular, why they have to leave the Islands to give birth. While this is a common scenario in many remote parts of Australia, the vast distance involved and the cultural differences of the predominantly Chinese and Malay population make the IOT situation unique. | | |
| Roberts, C.L., Henderson-Smart, D., Ellwood, D.A., & the High Risk Obstetric and Perinatal Advisory Working Group (2000). Antenatal transfer of rural women to perinatal centres. *Australia and New Zealand Journal of Obstetrics and Gynaecology*, 40, 377-384. | New South Wales, Australia | (Objective) to quantify and describe antenatal transfers of rural women to perinatal centres, and among transferred women, to assess the use of selected evidence-based therapies and explore the potential predictors of preterm and imminent births. | Transfers are important but costly interventions which make specialized obstetric and neonatal *care* available to rural women and their health care providers, but involve considerable separation from family and community at a time of great stress. The magnitude and reasons for antenatal transfers in NSW are unknown. Ambulance officers and obstetricians report that antenatal transfers are increasing, while emergency transfer of neonates has decreased from approximately 900 in 1992 to approximately *600* in 1998 | Review of birth records, descriptive statistics | Although the main reason for antenatal transfer was the possibility of preterm birth, women presenting with preterm contractions only were less likely to deliver preterm (OR = **0.2,95% CI 0.1-0.4)** or = **7** days (OR = **0.3,95%** CI 0.2-0.5) than women with any other presenting symptoms. The overall usage of effective interventions (antenatal steroids, antibiotics for PPROM and β-mimeticto tocolysis to delay birth) among antenatally transferred rural women was high, but there is mom for increased uptake prior to transfer. |
| Rodie, V.A., | The | The purpose of the | Accidental out-of-hospital (OHD) | A retrospective | Accidental out-of-hospital deliveries account for |

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| Thomson, A.J., & Norman, J.E. (2002) Accidental out-of-hospital deliveries: an obstetric and neonatal case control study. *Acta Obstetricia Gynecologica Scandinavica*, 81, 50-54. | catchment area of Glasgow Royal Maternity Hospital | present study was to determine the prevalence of OHD in our population and to quantify the neonatal morbidity and mortality associated with such births. Further, we aimed to determine whether women at risk of OHD in our population could be identified antenatally. | deliveries are associated with high rates of perinatal morbidity and mortality. The ability of health care workers to identify women at risk of out-of-hospital delivery is limited. The purpose of this study was to determine the prevalence of these deliveries in our population and to quantify the neonatal morbidity and mortality associated with such births. Further we aimed to determine whether women at risk of accidental out-of-hospital delivery in our population could be identified antenatally. | case-control study. | less than 1% of deliveries in our population, but are associated with significant perinatal morbidity and mortality. Women should be educated regarding the importance of both antenatal care and a planned delivery. Since the majority of women who deliver accidentally out-of hospital are parous, there is an opportunity to do this in a previous confinement. |
| Rogers, C., Pickersgill, J., Palmer, J., & Broadbent, M. (2010). Informing choices: outcomes for women at a stand-alone birth centre. *British Journal of Midwifery*, *18*(1), 8-15. | Tasmania, Australia | What are the needs of rural women in the full spectrum of maternity care from antenatal through to postnatal care, the services available to them, and the gaps between those needs and services, in Tasmania, Australia? | • Evidence of poor access and outcomes indicate that maternity services in Australia are not meeting needs of rural women (p.197)<br>o Rural women face health inequities such as higher rates of maternal and neonatal deaths<br>o Many of health inequities result from difficulties accessing health care services<br>• Accessing appropriate maternity services is of concern in Australian rural and remote areas where over 50% of small rural maternity units have closed since 1995, forcing thousands of rural | • Cross-sectional<br>• Qualitative study using mixed methods (survey and semi-structured interviews) | • Two hundred ten women completed the survey (35% response rate of 35%), including 150+ written comments<br>• 48 survey participants consented to interviews and 22 follow-up interviews were conducted.<br>• Five main themes emerged from the data (survey and interviews): (i) access needs, (ii) safety needs, (iii) needs for rural birthing services, (iv) support needs and (v) needs for quality services.<br>• Results suggest a lack of maternity services in rural areas of Tasmania<br>• Participants expressed a desire for greater access to and support from local maternity services, and safety for themselves and their babies.<br>• Having to travel to hospitals outside of their communities caused challenges for rural women and their families associated with |

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| | | | pregnant women to leave their communities to access care. (p.197)<br>• Limited studies on social needs of rural women in maternity care covering full spectrum of maternity care (p.197) | | cost, transport, social disruption, risk of going into labour en route<br>• Most participants desired postnatal care and services within their community<br>• 19/22 participants interviewed believed hospital best place to deliver<br>• Some participants expressed a desire to be informed, have a greater, say in their care and be provided with quality services. |
| Rosenblatt, R.A., Reinken, J. & Shoemack, P. (1985). Is obstetrics safe in small hospitals? Evidence from New Zealand's regionalized perinatal system. The Lancet, Hospital Practice. | New Zealand | • How does the low volume of deliveries in small hospitals affect perinatal mortality, in the context of a regionalised system of care? | • Public and professional demands for less intervention in normal pregnancy have made it more difficult to reconcile optimum medical outcome with less intrusive obstetric practice. While it is clear that sick neonates and women with complicated pregnancies are best cared for in large and well-equipped medical centres, the degree of training or experience needed to practise normal obstetrics is unknown. | Record review comparing neonatal outcomes, level of hospital, maternal residence and associated socio-economic status of the community. | We were unable to detect a volume threshold below which obstetric care becomes unsafe. In New Zealand, women have the highest likelihood of bearing children who will survive the first week of life. This is strong evidence that in a regionalized system, the highest risk deliveries flow towards the larger, central hospitals. |
| Schmidt, N., Abelsen, B., & ØIan, P. (2002). Deliveries in maternity homes in Norway: results from a 2-year prospective study. *Acta obstetricia et gynecologica Scandinavica*, *81*(8), 731-737. | Norway | • What are the short-term outcomes for the mothers and newborns for all pregnancies accepted for birth at all maternity homes in Norway over a 2-year period | • strong centralization of births in Norway over the past 25 years (pre-2002)<br>• numbers of maternity homes have been reduced from 30 in 1980 to 10 (2002)<br>• 98% births occur in hospital in Norway<br>• maternity home defined as delivery unit run by midwives with a GP as the formal medical leader - no OBs, | • 2-year prospective study of all mothers in labor in maternity homes in Norway | • Study included 1275 women who started labor in the maternity homes in Norway (1% of all births in Norway during 2-year period)<br>• Of those women who started labor in a maternity home, 1217 (95.5%) also delivered there<br>• 58 (4.5%) women were transferred to hospital during labor<br>• 57 (4.7%) were post partum transferrals of mother and baby<br>• 9 women had a vacuum extraction, 1 had a forceps and 3 had a vaginal breech (1.1% |

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| | | from June 1995-Jun 1997?<br>• What is the practice at the maternity homes in Norway and do the maternity homes provide a safe delivery service for women in labor? | pediatricians, anesthetists or surgeons, no facilities for emergency c/s<br>• 3 levels of birth institu'ns three different levels:<br>• Level 1 is hospitals with > 1500 births/yr with OB, pediatric and anesthetic departs with doctors on duty 24/7<br>• Level 2 is hospitals with 500–1500 births/yr, 1 OB and 1 anesthetist on call duty<br>• Level 3 is maternity homes, 4–500 births/yr called maternity homes | | operative vaginal births in the maternity homes).<br>• 5 babies (0.4%) had an Apgar score below 7 at 5 min.<br>• 2 (0.2%) neonatal deaths; both babies were born with a serious GBS infection.<br>• median birth weight among the babies born in maternity homes was 3640g (2040–5240 g)<br>• 27 (2.2%) of the newborns had an Apgar score below 7 after 1min, 5 (0.4%) after 5 min, and 3 (0.2%) after 10 min<br>• blood loss of less than 500ml for 1114 women (91.5%), and 102 (8.4%) had a blood loss between 500 and 1000ml.<br>• 1 woman (0.1%) lost 1500ml of blood and was transferred to the obstetric unit of the county hospital after delivery |
| Serenius, F., Winbo, I., Dahlquist, G., & Kallen, B. (2001). Cause-specific stillbirth and neonatal death in Sweden: a catchment area-based analysis. *Acta Paediatricia*, 90, 1054-1061. | Sweden | The aim of this study was to analyse stillbirth (according to the Swedish definition of intrauterine death after 28 completed weeks) and neonatal mortality (up to 28 d of age) based on geographical areas of the mother's residency, grouped according to the degree of specialization of the local delivery hospital. In this | The impact of neonatal care on infant survival varies between different populations, partly because of the different organization of the delivery and neonatal care systems. The development of intensive neonatal care during the last few decades has improved the survival opportunities for very small newborn infants. The reduced facilities in small hospitals can be compensated for by referral of risk pregnancies. In order to reveal such effects, mortality should be studied not according to the care level of the delivery hospital, but on geographical analyses of | A register-based study of the impact of obstetric and neonatal care on stillbirth and neonatal death rate was performed on all births in Sweden in 1983–1995 | In areas with the lowest level of care of the primary delivery hospitals (with no or only basic neonatal care) the total mortality was not increased, indicating that the referral system works well. When the analysis was repeated for specific causes of death, more marked differences were noted, especially for death due to obstetric complications where the death risk increased with decreasing level of care of the primary delivery hospital. Even though no marked differences in total mortality were seen, a further reduction can be obtained by increasing referral for some specific conditions. |

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| | | way, the efficiency of the referral system, the efficiency of the referral hospital and the quality of the care of the local hospital were all taken into consideration. The analysis was extended to cause-specific mortality in order to reveal possible specific effects, perhaps hidden in figures of overall mortality. | residency, with the characterization of each delivery according to the level of care of the local hospital where an uncomplicated delivery should have taken place. | | |
| Sheeran, B. (2007). The journey to hospital. *AIMS Journal*, 9(*4*), 12-13. | Ireland | | This Irish policy mirrors the experience of centralisation policies internationally in the UK, the USA, Canada and New Zealand. Elsewhere, these policies were underpinned by the largely unsubstantiated claim to greater safety. | Commentary | Continued government policy on centralisation of services has led to the closure of local maternity facilities in Ireland, which in turn has necessitated greater travel distances to hospital for women, especially in rural areas. |
| Simonet F, Wilkins R, Labranche E, Smylie J, Heaman M, Martens P, Fraser WD, Minich K, Wu Y, Carry C, Luo Z-C. Primary birthing attendants and birth outcomes in remote Inuit communities—a | Nunavik, Quebec, Canada | • What is the relative safety of midwifery-led services as compared to physician-led services in remote Nunavik communities? | • There is a lack of data on the safety of primary (midwife-only) maternity care in remote/indigenous communities<br>• Although there is an increasing amount of data to support the safety of midwifery-led care, there are entrenched concerns about the lack of | Cohort Study | • Maternal characteristics were similar between the Hudson Bay and Ungava Bay mothers, except that there were a higher proportion of primiparious mothers in the former group.<br>• There were no significant differences in the rates of perinatal death (or other negative outcomes) between the two groups<br>• Note: The rates of perinatal and infant mortality are actually approx. 40% higher in the Hudson |

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| natural "experiment" in Nunavik, Canada. *Journal of Epidemiology and Community Health* 2009; 63(7): 546-551. | | | medical/surgical support in case of emergency. This is especially true in extremely remote communities, where emergency evacuation could be problematic and time consuming.<br>• The seven communities of the eastern portion of Nunavik (Hudson Bay communities) have adopted a midwifery-led care model since 1986 when the first birthing centre was opened in Puvirnituq, while the seven western communities of the western portion (Ungava bay communities) are still served by physician-led care.<br>• Midwifery care accounted for 73% of all births in the Hudson Bay communities during the study period, while physician care accounted for 95% of all births in the Ungava communities during the same period.<br>• The reason for the lower numbers on the Hudson Bay communities is due to the fact that midwives in those areas work with physicians and nurses in order to identify and refer high-risk pregnancies to other levels of care<br>• In case of emergency evacuation for Hudson Bay births, the closest evacuation destination is | | Bay group, but this is deemed to be not significant<br>• This difference was lowered when extremely preterm births (<28 weeks) were adjusted for, so the higher rates of perinatal mortality in the Hudson Bay group is likely due to this increased rate of extremely preterm birth.<br>• Perinatal and infant mortality rates for both the Hudson Bay and Ungava Bay groups was much higher than for French-speaking southern Quebec residents (approximately double the rates)<br>• There were no statistically significant differences in the cause-specific infant mortality rates |

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| | | | 4-8 hours away by air (depending on weather)<br>• Transfers south to tertiary care facilities are much more common in the Ungava Bay region than in the Hudson Bay region, 28% vs 9.4% respectively | | |
| Snowden, J.M., Cheng, Y.W., Kontgis, C.P., & Caughey, A.B. (2012). The association between hospital obstetric volume and perinatal outcomes in California. *American Journal of Obstetrics & Gynecology*, 207, 478.e1-7. | US, California | Does the effect of obstetric volume on perinatal outcomes may differ between rural and nonrural locations? | The effects of hospital volume and regionalization of obstetric care are complicated by geographical and socioeconomic factors, including variations in patient mix and the urban/rural character of a given region. When evaluating the ability of different-sized maternity units to provide high-quality care, we often make the assumption that patients could conceivably be referred to an alternative hospital with maternity services. In rural and frontier regions, that assumption may not hold. In this paper, we analyze the role of obstetric volume in perinatal outcomes in California. | Retrospective cohort study | Prevalence of asphyxia increased with decreasing hospital volume overall and among term, non-low-birthweight infants, from 9/10,000 live births at highest-volume hospitals to 18/10,000 live births at the lowest-volume hospitals (*P* _ .001). Similar trends were observed in rural hospitals, with rates increasing from 7-34/10,000 live births in low-volume rural hospitals (*P*_.001). These findings provide evidence for an inverse association between hospital obstetric volume and birth asphyxia. |
| Sontheimer, D., Halverson, L.W., Bell, L., Ellis, M., & Wilbanks Bunting, P. (2008). Impact of discontinued obstetrical services in rural Missouri: 1990-2002. *National Rural* | rural Missouri, US | (objective) To examine the potential relationship between loss of local obstetrical services and pregnancy outcomes. | The number of hospitals and physicians providing obstetrical services has declined in rural Missouri. Many factors have been cited for this change including increasing malpractice costs and claims, fear of litigation, lifestyle concerns, adversarial atmosphere, and loss of specialty back-up coverage. Evidence exists | Retrospective record comparison | Frequency of low birth weight babies originating from service areas where hospitals closed services was statistically increased in the first year after service closures. This effect was transient. Transient increases in the rate of lower birth weights may reveal difficulties in service access after closure. These outcomes merit further investigation into the consequences of disruptions in access to |

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| *Health Association*. | | | to support potential negative impacts of this change, ranging from economic losses to the community concerned6 to under-utilization of prenatal care and diminished access to overall health care. | | maternity care in rural communities. |
| Strutz KL, Dozier AM, Wjinggaarden EV, Glantz JC. Birth outcomes across three rural-urban typologies in the Finger Lakes region of New York. *The Journal of Rural Health* 2012; 23(2): 162-173. | Finger Lakes Region of NY state | • What disparity, if any, exists between rural and urban population birth outcomes. | • Infants with low birthweight or through preterm delivery account for 70% of deaths within the first year of life<br>• Rural women are more likely than urban women to live in poverty and have lower levels of education. Additionally, they are much more likely to be underserved by prenatal obstetric care, and they are generally more likely to have adverse birth outcomes<br>• NY State has a large number of different classifications of "rural" based on differing criteria. Three different typologies were used in this study: Census bureau, RUCA, and Primary Service Area typologies | Cross sectional | • In all three rural classification typologies, rural populations had the highest proportions of poor birth outcomes<br>• Rural women had higher odds of low birthweight and preterm delivery<br>• Results showed strong correlation between risks of low birthweight and preterm birth, but showed poor correlation for risk of the "small for gestational age" criteria<br>• Results from the RUCA typology showed that births from the most isolated locations actually had lower rates of being small for gestational age, although this result was not found in the two other typologies<br>• Levels of rurality (beyond simply being rural vs urban) were not found to significantly affect rates of low birthweight and preterm birth<br>• Contrary to the findings of Nesbitt et al. 1997 which stated that the highest outflow communities were the most isolated ones which had the highest risk of adverse outcomes, the Finger Lakes region of this study had the highest rates of adverse outcomes in the lowest-outflow communities. Therefore in contrast to the Washington state setting of Nesbitt et al, most residents in the Finger lakes region of NY state gave birth in a local hospital |
| Sutcliffe K, Caird J, Kavanagh J, Rees R, | UK | • What is the impact and relative safety | • Given rising birth rates and increased frequency of complex | Review of Systematic | • Midwife-led care for low-risk women was found to be better for a range of maternal outcomes, |

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| Oliver K, Dickson K, Woodman J, Barnett-Paige E, Thomas J. Comparing midwife-led and doctor-led maternity care: a systematic review of reviews.*Journal of Advanced Nursing* 2012; 68(11): 2376-2386. | | of having midwifery-led care for low-risk women? | births, nurses and midwives are facing increased pressure and challenges<br>• Some argue that philosophies of care that privilege childbirth safety are diametrically opposed to those that privilege normalized and humanized childbirth with minimal intervention (the latter being more associated with midwives) | Reviews (meta-analysis) | reduced the number of procedures in labour, and increased satisfaction with care<br>• Reviews found no evidence that care led by midwives is different to that led by physicians for some maternal, fetal, and neonatal outcomes<br>• The only outcome for which evidence was mixed was low birthweight. A 1995 meta-analysis found that women in midwifery-led care gave birth to fewer low-birthweight babies, whereas a 2008 meta-analysis found no difference.<br>• No adverse outcomes associated with midwife-led care were identified<br>• For low-risk women, health and other benefits can result from having their maternity care led by midwives rather than physicians. There also appear to be no negative impacts on mothers and infants receiving midwife-led care.<br>• Midwife-led care was found to have a statistically significant positive effect on some physiological outcomes for women when compared with physician-led care<br>• Midwifery-led care was also associated with a number of non-physiological outcomes including higher levels of satisfaction with service and higher rates of confidence. Women in the midwifery-led model also had less fetal monitoring and were more likely to have their birth attended by a known-midwife.<br>• Women in the midwifery-led model were less likely to experience antenatal hospitalization |
| Tarlier, D.S., Johnson, J.L., Browne, A.J., & Sheps, S. (2013). Maternal-infant health outcomes and nursing practice in a | First Nations community, Northern Canada | | This article reports those findings related to maternal-infant health outcomes of an ethnographic study that explored nursing practice, continuity of care, and health outcomes in one remote | Use of multiple data sources within an ethnographic design ensured that | The findings suggest suboptimal maternal-infant health outcomes on several of the health indicator criteria identified for the purposes of this study. The authors discuss long-term sequelae of prenatal and infant health in terms of diabetes and other chronic health conditions in |

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| remote First Nations community in northern Canada. *Canadian Journal of Nursing Research*, *45*, 76-100. | | | First Nations community in northern Canada. | quantitative health outcomes data were interpreted within a contextualized understanding of the remote First Nations community. The sample comprised the charts of 65 mothers and 63 infants randomly selected for retrospective chart review. | First Nations populations. They explore the implications of these findings in relation to nurses' preparation to offer prenatal and infant primary care in remote First Nations communities. |
| Thommasen HV, Klein MC, Mackenzie T, Lynch N, Reyes R, Grzybowski S. Obstetric maternal outcomes at Bella Coola General Hospital: 1940 to 2001. *Canadian Journal of Rural Medicine* 2005; 10(1): 1-9. | Bella Coola General Hospital, BC, Canada | • What are the obstetric procedures and maternal outcomes for patients who gave birth in an isolated rural hospital? | • Few new family physicians who are beginning their practices are offering obstetrical services. The average age of Family Practitioners who are still offering obstetrical services is close to retirement.<br>• There is a widespread belief among rural practitioners that competency in obstetrics is related to the number of babies that are delivered per year. Since the number of deliveries are lower in small rural environments, there is a tendency for rural physicians to | Cohort Study | • There were 2373 births and no maternal mortalities. Aboriginal women accounted for 47% of deliveries.<br>• C-sections were not routinely performed until the 1970s. Rates rose until the 1990s when they reached 11%<br>• Rates of interventions such as episiotomies and forceps fluctuated over the years. The changes in procedure rates seem to indicate that rural physicians are capable of rapidly incorporating recent recommendations and best practices.<br>• The track record of no maternal mortalities for women delivering in BCGH, despite it being a low-resource environment, fits with the assertions made in the joint position paper by the SOGC and the CFPC that birth for low-risk |

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| | | | simply refer patients to higher resource environments | | women in their own community is safe and correlates to better outcomes<br>• The WHO recommends C-section rates of approximately 10-15%, which is exactly the range of the Bella Coola General Hospital (in contrast to the rest of Canada which is significantly higher) |
| Tracy, S.K., Sullivan, E., Dahlen, H., Black, D., Wang, Y.A., & Tracy, M.B. (2006). Does size matter? A population-based study of birth in lower volume maternity hospitals for low risk women. *British Journal of Obstetrics and Gynecology*, 113, 86-96. | Australia | (Objective) To study the association between volume of hospital births per annum and birth outcome for low risk women. | Previous studies have shown that high risk newborns have a better outcome in hospitals providing sophisticated neonatal intensive care support. The relative safety of smaller units has been reported where proper referral systems are in place and the screening processes for transfer are sensitive. However, there is no consensus on the safest place for women to give birth to normal birthweight infants following an uneventful pregnancy. It is unknown whether the actual gains match the expected gains of concentrating all low risk births in large tertiary hospitals. | Population-based study using the National Perinatal Data Collection (NPDC). | In Australia, lower hospital volume is not associated with adverse outcomes for low risk women. |
| Tracy, S.K., Dahlen, H., Caplice, S., Laws P., Wang Y.A., Tracy, M.B., & Sullivan, E. (2007). Birth centers in Australia: a national population-based study of perinatal mortality | Australia | What is the relative safety of delivering in a birth centre compared to a hospital in urban areas of Australia for low-risk pregnancies? | Perinatal mortality is a rare outcome among babies born at term in developed countries after normal uncomplicated pregnancies; consequently, the numbers involved in large databases of routinely collected statistics provide a meaningful evaluation of these uncommon | Population/cohort study | This study using Australian national data showed that the overall rate of perinatal mortality was lower in alongside hospital birth centers than in hospitals irrespective of the mother's parity. |

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| associated with giving birth in a birth center. *BIRTH*, 32(3), 194-201. | | | events. The National Perinatal Data Collection records the place of birth and information on the outcomes of pregnancy and childbirth for all women who give birth each year in Australia. | | |
| Tracy SK, Hartz DL, Allen J, Farti A, Hall B, White J, Lainchbury A, Stapleton H, Beckmann M, Bisits A, Homer C, Foureur M, Welsh A, Kildea S. Caseload midwifery care versus standard maternity care for women of any risk: M@NGO, a randomised controlled trial. *The Lancet* 2013; 282(3906): 1723-1732. | Australia | • What is the safety of caseload midwifery services in a tertiary care setting when women are not selected based on risk factors? | • While Australia has a good record of childbirth safety, there is concern over the growing rates of C-sections and the potential for long-term associated morbidity<br>• Caseload midwifery has been proposed as a type of service which offers superior continuity of care as compared to the standard care models<br>• Women at low risk of pregnancy complications benefit from continuity of midwifery care, but no trial evidence exists for women with identified risk factors | RCT | • The proportion of C-sections did not differ significantly between the two groups (21% in midwifery group and 23% in standard care group)<br>• Both groups are approximately 10% below that national average for C-section. This might be attributable to the Hawthorne effect (influence of observation)<br>• The proportion of women who had elective C-sections before the onset of labour did differ significantly (8% midwifery vs 11% standard)<br>• The proportions of both instrumental births and unassisted births did not differ significantly between the two groups, nor did the rates of epidural use<br>• In the caseload group, 87% of women had their known midwife or backup midwife with them during labour, while only 14% of women in the standard care group had met their midwife before labour<br>• For the secondary outcomes, women in the caseload midwifery group were more likely to have a spontaneous onset of labour, less likely to have their labour induced, and more likely to have augmentation of labour<br>• Women from the caseload group were significantly more likely to be released from the hospital within 2 days of birth, and had shorter median postnatal stays<br>• Perinatal mortality was similar between the two |

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| | | | | | groups, both being less than 1%. There were no maternal deaths<br>• Caseload midwifery for unassisted normal births cost significantly less than the standard model of care (with several high cost outliers greater than $30,000 due to complications and surgical intervention) |
| Tucker, J., McVicar, A., Pitchforth, E., Farmer, J., & Bryers, H. (2010). Maternity care models in a remote and rural network: assessing clinical appropriateness and outcome indicators. Quality & Safety in Health Care. | Scotland, North Region | What is the clinical appropriateness of proportions of women delivering locally by different staffing models of maternity care in one rural NHS Scotland Region. | Little is known about performance of small rural maternity units, including stand-alone midwife units. | Retrospective record review. 1400 deliveries to women from the catchments of 8 rural units and grouped by staffing model | Rural women were generally referred appropriately for specialist care. These stand-alone midwife units provided intrapartum care for approximately one-third of rural women who remained without complications. Further evidence is needed about outcomes by staffing models of care. |
| VanWagner V, Epoo B, Nastapoka J, Harney E. Reclaiming birth, health, and community: Midwifery in the Inuit villages of Nunavik, Canada. Journal of Midwifery & Women's Health. 2007; 52(4): 384-391. | Canada, Northern Quebec, Nunavik | • Does returning birth to remote communities improve birth outcomes? | the Inuulitsivik midwifery service and education program, an internationally recognized approach to returning childbirth to the remote Hudson coast communities of Nunavik, the Inuit region of Quebec, Canada. The service is seen as a model of community-based education of Aboriginal midwives, integrating both traditional and modern approaches to care and education. Developed in response | Richly describes culturally-guided, mid-wifery led program and supports theory with a small cohort outcomes analysis. | Evaluative research has shown improved outcomes for this approach to returning birth to remote communities |

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| | | | to criticisms of the policy of evacuating women from the region in order to give birth in hospitals in southern Canada, the midwifery service is integrally linked to community development, cultural revival, and healing from the impacts of colonization. The midwifery-led collaborative model of care involves effective teamwork between midwives, physicians, and nurses working in the remote villages and at the regional and tertiary referral centers | | |
| Van Wagner, V., Osepchook, C., Harney, E., Crosbie, C., & Tulugak, M. (2012). Remote midwifery in Nunavik, Quebec, Canada: outcomes of perinatal care for the Inuulitsivik health centre, 2000–2007. *Birth*, *39*(3), 230-237. | Nunavik, Quebec, Canada | By examining outcomes of midwifery care in the Inuulitsivik birth centers from 2000 to 2007, this study aims to contribute to greater understanding of northern and remote maternity care and to the improvement of perinatal care in this and other remote regions. | • The Inuulitsivik midwifery service (IMS) is a community-based, Inuit-led initiative serving the Hudson coast of the Nunavik region of northern Québec<br>• Nunavik is a vast region of Arctic tundra where the primarily Inuit population lives in small coastal villages<br>• The Inuulitsivik Health Centre (IHC) consists of a small hospital in Puvirnituq and a health center in each of the seven Hudson coast villages<br>• The Inuulitsivik birth centers were established as a result of community activism by Inuit women and concerned health workers, with the goal ending the routine evacuation of | Retrospective review was conducted of prospectively collected perinatal outcome data | • Findings revealed low rates of intervention with safe outcomes in this young, largely multiparous “all risk” Inuit population<br>• 97% of births were documented as SVDs, and 85% of births were attended by midwives.<br>• 86% of the labors occurred in Nunavik, whereas 13.7% occurred outside Nunavik.<br>• The preterm birth rate was found to be 10.6%.<br>• PPH was documented in 15.4% of women; of these, 6.9% had blood loss >1,000 mL. (p.230)<br>• 4 fetal deaths (2.9 per 1,000) and 5 neonatal deaths (< 3.6 per 1,000) were documented.<br>• Nine percent (9%) of births involved urgent transfers of mother or baby<br>  o The most common reasons for medical evacuation were preterm labor and preeclampsia, and preterm birth was the most common reason for urgent neonatal transfer |

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| | | | pregnant women to southern hospitals.<br>• evacuation has been associated with loss of autonomy, poor health, family stress, and medicalized birth, and recreated the trauma and social dislocation of the residential school experience<br>• Inuulitsivik has developed a set of best practices based on Inuit leadership, midwifery-led care, and local education of midwives. | | |
| Varcoe, C., Brown, H., Calam, B., Harvey, T., & Tallio, M. (2013). Help bring back the celebration of life: A community-based participatory study of rural Aboriginal women's maternity experiences and outcomes. *BMC Pregnancy and Childbirth*, 13 (*26*). | Alert Bay, Bella Coola, Old Massett and Skidegate, BC, Canada | The purpose of this study was to understand rural Aboriginal women's experiences of maternity care, their desires for future care and what shaped their birth experiences and outcomes. | Despite clear evidence regarding how social determinants of health and structural inequities shape health, Aboriginal women's birth outcomes are not adequately understood as arising from the historical, economic and social circumstances of their lives. The purpose of this study was to understand rural Aboriginal women's experiences of maternity care and factors shaping those experiences. | Critical ethnographic approach within a participatory action framework | Women's experiences and birth outcomes could be significantly improved if health care providers learned about and accounted for Aboriginal people's varied encounters with historical and ongoing colonization that unequivocally shapes health and health care. Practitioners who better understand Aboriginal women's birth outcomes in context can better care in every interaction, particularly by enhancing women's power, choice, and control over their experiences. Efforts to improve maternity care that account for the social and historical production of health inequities are crucial. |
| Viisainen, K., Gissler, M., & Hemminki, E. (1994). Birth | Finland | To study whether hospitals of different levels are | It has been argued that births should be moved away from small primary level places of care | This was a population based, | In a regionalised system of birth care with a proper referral system, small local hospitals are as safe places to give birth as tertiary care |

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| outcomes by level of obstetric care in Finland: a catchment area based analysis. *Journal of Epidemiology and Community Health*, 48, 400-405. | | equally safe places to give birth in a regionalised system of care. | because these hospitals and maternity centres are unsafe places to give birth.' The question of safety has been presented as an argument for closing down small maternity hospitals in various countries and it has provoked numerous studies about the relative safety of different places of birth. | cross sectional survey comparing birth outcomes in nationwide catchment areas of different levels of hospital care. All women and low risk women were examined separately. | hospitals. |
| Viisainen, K., Gissler, M., Hartikainen, A., & Hemminki, E. (1999). Accidental out-of-hospital births in Finland: incidence and geographical distribution 1963-1995. *Acta Obstetricia et Gynecologica Scandinavica*, 78, 372-378. | Finland | The purpose of this study was, first, to describe changes in the maternity unit network and in the incidence and geographical distribution of accidental out-of-hospital births in Finland between 1963 and 1995, and, secondly, to examine the perinatal outcomes of accidental out-of-hospital births in comparison to | The study aims to describe the incidence and geographical distribution of accidental out-of-hospital births (accidental births) in Finland in relation to the changes in the hospital network, and to compare the perinatal outcomes of accidental births and all hospital births. | Record review | A temporal correlation between closing of small hospitals and an increase in accidental birth rates was detected. Due to the poor infant outcomes of accidental births, centralization policies should include measures to their prevention. |

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| | | those of all hospital births in the period from 1991 to 1995. | | | |