The Safety of Rural Perinatal Services without Local Access to Caesarean Birth: A Realist Review of the Literature

Sécurité des services périnatals ruraux ne disposant pas d'accès local à la césarienne : revue réaliste de la littérature

Jude Kornelsen, PhD, Kathrin Stoll, PhD

Department of Family Practice, University of British Columbia, Vancouver, British Columbia, Canada

Corresponding author: Jude Kornelsen: jude.kornelsen@familymed.ubc.ca

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ABSTRACT

Introduction: Rural jurisdictions worldwide are challenged with maintaining an appropriate level of perinatal care as close to home as possible to meet population need. A growing concern among care providers and birthers alike is the safety of perinatal care in the absence of local access to caesarean birth (LACB).

Objectives: We conducted a realist review to find evidence about the *safety of rural perinatal services without LACB.*

Design: Only primary published studies were included, and results were divided into evidence on physician-led and midwife-led perinatal services and restricted to hospitals without cesarean birth capacity and freestanding birth centers at least one hour surface travel time away from a hospital with a higher level of service.

Findings: We identified 14 studies from 5 high income countries. Rates of perinatal death and prematurity were similar or lower among childbearing people from communities without LACB, compared to referral facilities or regional rates of adverse neonatal outcomes. Evidence on effective midwifery-led primary perinatal care shows lower intervention rates while maintaining good outcomes for birthers in remote environments.

***Discussion & Conclusion*:** These findings support the safety of rural maternity services without LACB, and that these services should be considered within the context of cultural, social, and personal safety in addition

to physiological safety. Minimum criteria for safe services include proper selection of cases appropriate for local care, and a regional network model of perinatal care, with clear referral lines for triage to higher levels of care when necessary and efficient emergency transport.

RÉSUMÉ

Introduction: Les régions rurales du monde entier doivent relever le défi de maintenir un niveau adéquat de soins périnatals aussi près du domicile que possible afin de répondre au besoin de la population. Le personnel fournisseur de soins de santé, tout comme les personnes parturientes, se préoccupent de plus en plus de la sécurité des soins périnatals en l'absence d'un accès local à la césarienne (ALC).

Objectifs: Nous avons effectué une revue réaliste de la littérature en quête de données probantes sur la *sécurité des services périnatals ruraux sans ALC*.

Méthodologie: Seules les études primaires publiées ont été incluses. Les résultats ont été répartis selon que les services périnatals étaient dirigés par un médecin ou une sage-femme. Ils ont aussi été restreints aux hôpitaux sans capacité de césarienne et aux maisons des naissances autonomes qui se trouvent à au moins une heure de route d'un hôpital offrant un niveau de service plus élevé.

Constatations: Nous avons trouvé 14 études provenant de 5 pays à revenu élevé. Les taux de décès périnatal et de prématurité étaient semblables ou plus faibles chez les personnes enceintes de collectivités sans ALC par rapport à celles desservies par des établissements d'aiguillage ou aux taux régionaux d'issues néonatales indésirables. Les données probantes sur les soins périnatals primaires efficaces dirigés par les sages-femmes font état de taux d'intervention plus faibles tout en maintenant de bons résultats pour les femmes de milieux éloignés.

Discussion et conclusion: Ces constatations soutiennent l'argument selon lequel les services de maternité ruraux sans ALC sont sûrs et ils doivent être envisagés dans le contexte de la sécurité culturelle, sociale et personnelle en plus de la sécurité physiologique. Parmi les critères minimums en matière de services sécuritaires, on trouve la sélection adéquate de cas appropriés pour les soins locaux et un modèle de réseau régional de soins périnatals comportant des voies d'aiguillage claires pour le triage vers des niveaux de soins plus élevés au besoin et un service de transport d'urgence efficace.

KEYWORDS

perinatal care, safety, rural, caesarean birth

BACKGROUND

Rural jurisdictions worldwide are challenged with maintaining an appropriate level of perinatal care as close to home as possible to meet population needs. Challenges are well-documented and include difficulty recruiting and sustaining care providers to low-volume sites and the lack of a clinical 'safety net' should providers experience unanticipated difficulties during birth. A growing concern among care providers and birthers alike is the safety of perinatal care in the absence of local access to caesarean birth (LACB). These concerns are a counterpoint to recognizing the importance of meeting the perinatal care needs of rural birthers, their families, and communities and the consolidated evidence on the health, psychosocial, and cultural consequences of not providing this care.[1] Governments and health professional associations have endorsed the need to give birth closer to home.[2–4] Consolidated health service responses, however, have been less forthcoming as the cost-benefits of such services are largely unknown and the imperative of economies of scale in health care in general moves us toward the centralization of services. As with all healthcare planning, patient (and provider) safety is paramount to the discussion.

To this end, this paper provides the results of a review of the literature on the safety of rural perinatal care without local access to cesarean birth as a starting point in the discussion of how to sustain local access to perinatal care for rural communities. A clear understanding of existing evidence on safety is necessary to underscore system interventions that may be adopted to reinvigorate care in our rural communities.

Ideally, perinatal care is provided within an environment that supports operative birth capability when necessary. Where the size of the 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 perinatal services without local access to caesarean births (CB)*? Although both options require travel by at least some childbearing people, no local intrapartum services requires a significantly higher number of pregnant people to travel from their home communities for care. There is a growing body of evidence attesting to the psychosocial consequences of traveling to access care,[5] evidence that suggests higher levels of stress incurred, disruption to family and wider social relationships, and, for Indigenous communities, detachment from sacred territorial lands with the attendant socio-cultural consequences.[6–8] Historically, this evidence has been 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. However, the challenge of meaningfully weighing and appropriately integrating both into decision-making remains. In 2015, a report that comprehensively summarizes the evidence on the safety of births without CS backup was commissioned by BC Women's Hospital, Perinatal Services BC, and Australia's University Centres for Rural Health to guide decision-makers.[9] In the current paper, we built on the findings from the 2015 realist review, updated the search to capture an additional seven years of published literature and focused on a subsection of the original review, such as. the perinatal outcomes associated with physician or midwife led models of care in communities without CS access.

METHODS

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.[10] 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.[11]

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. 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.

Context, Mechanism and Outcome ('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. Clear framing of the CMO supports the transferability of the findings to other jurisdictions by applying local expert knowledge.

Context: Rural, primary birthing services without access to local surgical care in Canada and elsewhere 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 birthers evacuating their home community and traveling to care in a referral centre, in some instances before the onset of labour. Fiscal, logistic and efficiency constraints that appropriately centralize high levels of care in dense urban areas confront the geographic constraint that birthers 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 *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. 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: We focused the review on adverse perinatal outcomes, including perinatal death, preterm birth, low birth weight, low Apgars scores and other perinatal complications.

Search Strategy

There were two distinct phases to the search structure including (1) electronic bibliographic database searches and (2) citation chaining. The search strategy for phase one is described in Table 1. Databases and citation chaining was conducted on April 8, 2022. Phase two included citation chaining using Google Scholar. In this phase, key papers in the review area were used as centring 'nodes' by examining papers that cited these publications. 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 following articles were used for citation chaining: (1) Safety of physician-led services without LACB: Lynch et al. 2005 (cited 32 times) and (2) Safety of midwife-led services without LACB: Van Wagner et al. 2007 (cited 164 times).

Table 1. Search concept and terms used

Concept	Keywords	Reasoning
Perinatal services	Birthing/ or returning birth / or Birthing on country / or pregnancy / or maternal health services / or perinatal services / or obstetric * Pregnancy (exp) Delivery, Obstetric	Appropriate terms were furnished to limit the search to perinatal care. Terms were sought to maximize sensitivity. “Returning birth” and “birthing on country” are terms specific to literature subsets (post-colonial Indigenous perinatal and Australian rural perinatal literature respectively).
Rural and remote health services	Rural/ or remote Rural Health Hospitals, Rural 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* (exp) Pregnancy Outcome	The use of the ‘Pregnancy Outcome’ MeSH term showed equivalent sensitivity to a keyword search and made the perinatal 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 perinatal terms where appropriate.
Patient safety	Safe* Patient Safety Safety	It was found that outcomes from utilization or case-specific data will often include safety as a keyword in cultural safety, subjective safety and holistic risk literature subsets. Index terms were ineffective in this search in most databases.

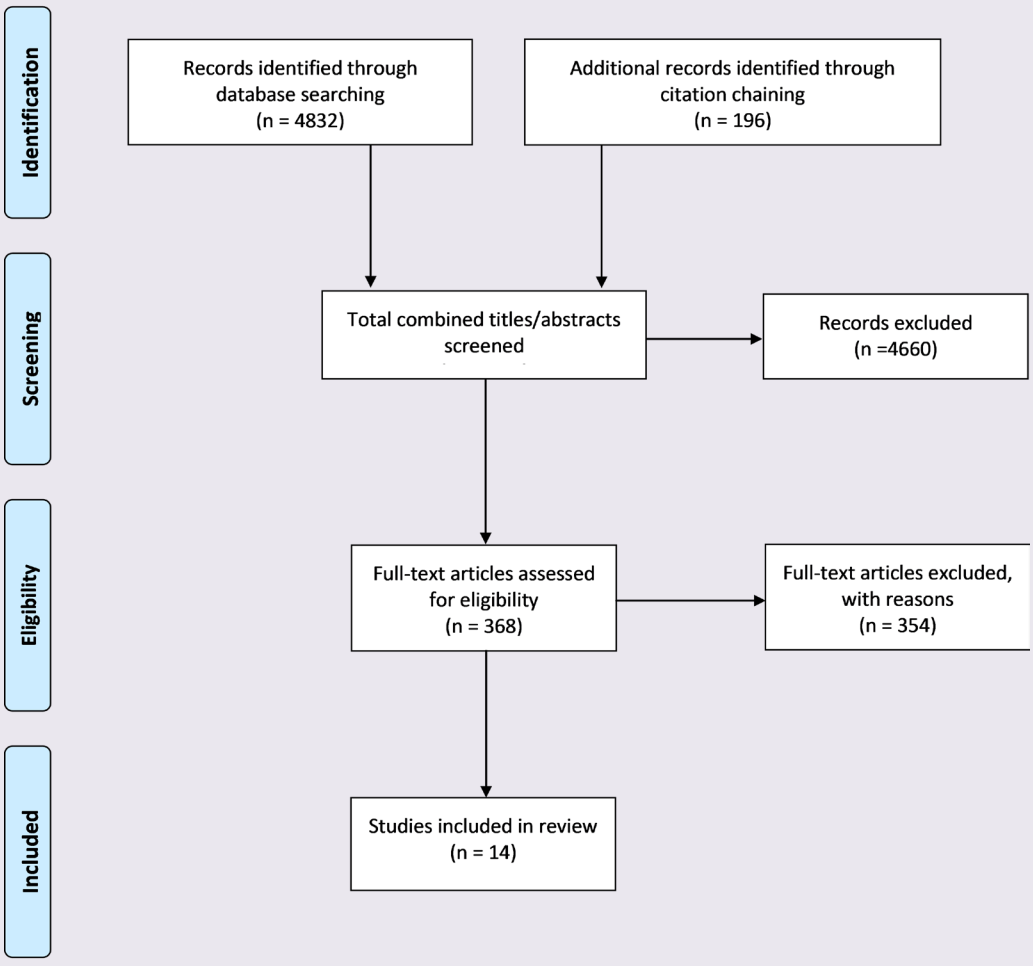
Inclusion criteria

Only primary published studies were included, and results were divided into evidence on physician-led and midwife-led perinatal services and restricted to facilities without LACB, including hospitals and freestanding birth centres at least one hour surface travel time away from a hospital with a higher level of service. Only articles written in the English language in high-resource countries were included.

There were no publication date restrictions for this review, although consideration was given to the potential for strained applicability due to age of the data and the system context at the time of analysis. A large majority of the results (n=5014) were excluded for lack of fit. Primarily, these articles were from low and middle income countries where progress toward the Millennial goals for maternal and child health frame a large body of research. 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.[5] However, the expectation in many high-resource countries is that home birth takes place within thirty minutes of surgical services. The nature of this question – the safety of services an hour or more from surgical support – precludes inclusion of this literature.

Several population studies of physician or midwife-led perinatal services in rural areas could not be included because data were not disaggregated by level of service, the distance of the service to a hospital with caesarean section (CS) capacity was not noted, or less than one hour surface travel time. The numbers of records identified, screened, eligible, and included in this review are depicted in a PRISMA flowchart in Figure 1.

Figure 1. PRISMA Flowchart



Data abstraction

We abstracted data from the articles according to the following column headings: Study rationale or objective, model of care (to determine whether to assign the outcomes to midwife or physician-led services), setting and definition of service levels (to describe how primary services without LACB and comparison groups were defined), cohort (i.e. a description of the study sample), study design and definition of key outcomes and results. In the results column, we abstracted rates of adverse perinatal outcomes in communities (catchment level) and/or hospitals (facility level) without CB capacity and also noted comparison rates. Rates of outcomes are reported per 1000 for all included studies in Table 1 to facilitate comparisons across regions. All abstracted data in Table 2 was double-checked by one author. Within the context of perinatal services without LACB, we also attempted to identify which mechanisms work at what levels of the system to produce safe care for rural and remote birthers, neonates, and their families.

RESULTS

Summary

Fourteen studies met inclusion criteria (see Table 2). Included studies were published between 1984 and 2015; nine studies were conducted in Canada[12–20] one in the USA,[21] two in Australia,[22,23] one in New Zealand,[24] and one in Norway.[25] Thirteen papers described cohort studies and one described a set of internal and external evaluation studies.[18] In nine studies, perinatal outcomes were analyzed by maternal residence, such as based on the hospital catchment or community where the childbearing person resided,[12,14-20,23] in three studies outcomes were analyzed by facility[21,22,25] and two studies reported both catchment and facility outcomes.[13,24] Authors ascertained maternal residence in different ways. For example, some authors calculated the surface travel time from the centroid of a mother's postal code to the nearest hospital and assigned that hospital a level of service.[15,16]

Neonatal outcomes of childbearing people residing in communities without CS capacity were often compared to outcomes from hospital catchments where obstetricians perform CS or to outcomes in communities without any intrapartum services.[15,16] Several authors presented descriptive cohort studies and compared their findings to regional, provincial or state statistics.[18,20,24]

There is a strong association between low birth weight, premature birth, congenital anomalies and perinatal mortality, and most authors addressed this source of bias. Some opted to exclude infants with congenital anomalies and/or very low birth weights, others stratified results by birthweight[22,24] and offered results for term versus preterm babies separately. Studies that included all births described the circumstances of each fetal or neonatal death, including birth weight, gestational age and presence of congenital anomalies.[13,19]

Physician-led perinatal services without LACB

Perinatal death rates for childbearing people residing in communities with physician-led intrapartum services without LACB were 10 per 1000,[15] 12 per 100,[14] 15 per 1000,[12] and 21 per 1000.[13] The perinatal death rate was highest in the most remote Island community (Haida Gwaii) with the lowest level of resources where no exclusions to the study cohort were applied. Gryzbowski et al.[13] reported six perinatal deaths among 286 birthers; all six infants who died weighed less than 1500 g, and only one was born on the island (at the hospital without LACB). The person who gave birth on the Island delivered a baby weighing 1200 grams at 36 weeks. The cause of death was congenital anomalies.

In another study babies with congenital anomalies were excluded from the analysis and a perinatal death rate of 10 in 1000 was detected.[15] A facility-based perinatal death rate of 3 per 1000 was reported by Chaska et al.[21] Lumley et al.[22] offer a facilty level analysis of outcomes, stratfified by birthweight. The perinatal mortality rate for babies born at hospitals with less than 100 births and no operative capacity differed by birthweight. For example, 125 per 1000 for babies weighing 1500-1999 grams, and 2 per 1000 for those weighing 2500-2999 grams. Facility-level rates of perinatal mortality tend to be smaller than catchment-level rates as higher-risk birthers are referred to hospitals with a higher level of care.

See Table 1 for other perinatal outcomes reported in each study and the section below which

Table 2. Summary of included studies

Reference	Rationale/ objectives	Model of care	Setting & definition of service levels	Cohort, study design & definition of outcomes	Results
PHYSICIAN-LED MODELS OF CARE					
Black & Fyfe (1984)	More information about the safety of small obstetric units is needed before recommending that they either upgrade their services or close.	This study was conducted prior to the regulation of midwives in Ontario in 1994, hence most childbearing people were cared for by family physicians.	Canada; small communities in northern Ontario Results divided into 6 service levels (median distance to level II centre is specified in brackets). Level 0: no deliveries handled electively (59 km); Level IA: deliveries handled electively, but anesthesia not available (249 km); Level IB: anesthesia available, but caesarean sections not done or done fewer than five times per year (197 km). Level IC: caesarean sections done regularly (five or more times per year), but specialists in obstetrics or pediatrics not on staff (229 km). Level ID: at least one specialist in obstetrics or pediatrics on staff, but fewer than 1000 deliveries per year (249 km). Level II: two or more specialists in both obstetrics and pediatrics on staff, and more than 1000 deliveries per year.	Cohort study, Catchment level analysis of 40 communities in Northern Ontario between April 1, 1980 and March 31, 1982 (n = 24,524) Perinatal loss = Number of stillbirths and death within 28 days of birth (in hospital) per 1000 newborn admissions.	Perinatal loss rate: 14.66 per 1000 (95% CI: 9.58–20.8) in catchments served by hospitals where caesareans are not done or fewer than 5 Caesareans are performed each year, anesthesia services are available (level IB). The perinatal death rate among residents of reserves (many of them fly-in reserves) more than an hour away from services = 10.26 per 1000 Non-reserve residents more than an hour away had a perinatal death rate of 25.15 per 1000. This compared to a rate of 14.25 for Northern Ontario and 14.05 for Southern Ontario in 1980.
Chaska, Mellstrom & Grambsch (1988)	Is immediate access to perinatal subspecialists on-site superior to delayed access to perinatal subspecialists at a distant site when babies are delivered by certified family physicians?	Family physicians	USA Urban-urban (UU) site is family physician-led (FP) in city of 60,000 where practice shares a building with obstetrics specialists Rural-urban (RU) site is in a town of 3,100 located 30mins drive time from OB specialists, and all deliveries take place in UU site Rural-rural (RR) site has pop. 2,100, 30 minutes from OB consult. Births occur locally unless transferred for operative intervention. Decisions made by FPs with access to OB consultation by telephone only.	Retrospective cohort study; years 1981-1984, facility level analysis Intention to treat design where initial site of physician contact (RR,UU or RU) was attributed to pregnancy outcomes. (n=863) Inclusion criteria: singleton pregnancies, gestation 20 weeks or more, birthweight over 500 grams	Perinatal mortality (stillbirth plus neonatal death) rate across 3 sites was 4.6 per 1000 live births: 0 at UU, 11 per 1000 at RU and 3 per 1000 at RR. Gestational age and birthweight were not different across three sites Equivalent outcomes found between sites, providing no evidence that on-site access to specialists and surgical care is necessary for high quality perinatal outcomes by physicians. - RR physicians referred patients significantly earlier in labour on average than physicians at the RU or UU sites, showing a tendency to compensate for the geographic distance to specialists. - 1 and 5 minute Apgar significantly lower at UU and RU than RR. In adjusted logistic regression, OR of 1min Apgar <7 at UU 2.48 times more likely (95% CI-4.27) and at RU, 2.17 times more likely (CI 1.24–3.78) compared to RR.

Lumley (1988)	What are perinatal outcomes by size of hospital in Victoria State for the years 1982–1984?	General Practitioners provide perinatal care at country hospitals with less than 100 births	Australia (Victoria) Hospitals grouped into 6 categories by number of births/yr reported in 1982: <20, 20–49, 50–99, 100–999 and >2000 Categories were chosen to review perinatal outcome in the 3 groups where closure had been suggested on safety grounds (<20, <50, <100 births/yr) 3 groups with <100 births were all country hospitals with L1 perinatal services; care provided by GPs Other hospital categories were: hospitals with 100–999 births/yr include regional country hospitals; care is provided by GPs and OBs hospitals with 1000–1999 births/yr almost all metropolitan; care mostly provided by OBs largest hospitals (>1999 births/yr), all in capital city, with care mostly provided by OBs	Cohort study; all public and private hospitals in state were included in study (n = 179,628), facility level analysis Analysis was restricted to stillborn and liveborn infants of 500g or more in first 28 days of life	Perinatal mortality rates were examined for different birthweights and 4 hospital categories. For hospitals with less than 100 births per year the perinatal mortality rate was as follows: 500-999 grams: 1000 per 1000 1000-1499 grams: 667 per 1000 1500-1999 grams: 125 per 1000 2000-2599 grams: 21 per 1000 2500-2999 grams: 8 per 1000 3000 or over: 2.2 per 1000 -For infants <1500g, perinatal mortality (PM) decreased significantly with increasing hospital size -1500-2499g, no difference in outcome by hospital size -infants 2500-2999g, mortality rate significantly lower in hospitals with <100 births/yr -infants =/>3000g, mortality rate increased significantly with increasing hospital size In a separate analysis, authors excluded all infants with lethal malformation, but this made little difference to findings except for significant trend to better outcome for infants 2000-2499g with increasing hospital size -Reduced risk of Apgars of 0-3 at hospitals with less than 20 birth and 50-99 birth and no difference for hospitals with 20-49 births (compared to hospitals with 2000+ births) -Significantly increased risk of Apgars between 4-6 for all three hospitals groups under 100 births.

(*Continues*)

Table 2. (Continued)

Reference	Rationale/ objectives	Model of care	Setting & definition of service levels	Cohort, study design & definition of outcomes	Results
Grzybowski, Cadesky & Hogg (1991)	To determine whether a small, isolated hospital that has no facilities to perform caesarean section and handles fewer than 50 deliveries annually can provide acceptably safe obstetric and perinatal care.	Queen Charlotte hospital and clinic are staffed by five family practitioners without local obstetric, pediatric, anesthetic or surgical support.	Canada, Queen Charlotte Islands, a remote,sparsely populated archipelago about 150 km off the northwest coast of British Columbia. Three of the five physicians have each completed 3 to 6 months of additional postgraduate obstetric training; all five physicians practise obstetrics and cover the emergency department. An obstetrician visits the community once every 3 months. Distance to nearest hospital with CS capacity > 150 kilometres (at least 2 hours by float plane).	Five-year prospective cohort study of childbearing people who resided in the Queen Charlotte city hospital catchment and gave birth between Jan. 1, 1984, to Dec. 31, 1988 Perinatal mortality' (PM) rate = number of deaths of fetuses (weighing more than 500 g) and neonates (weighing more than 500 g and less than 8 days old) per 1000 total births. Adverse perinatal outcomes = death, birth weight of less than 2500 g, neonatal transfer or Apgar score of less than 7 at 5 minutes.	Catchment level analysis: PM rate: 20.8 (95% CI: 4.4 to 37.2) per 1000. There were six perinatal deaths; all six infants who died weighed less than 1500 g, and only one was born on the island. 3 birthers had no maternal complications (including the person who gave birth on the Island; cause of death was placental transfusion disorder in two cases and congenital anomalies in the case of the person who delivered on the island). Facility level analysis: The hospital-based rate of adverse perinatal outcome was 6.2% (12 of 193 newborns) (95% CI 2.8% to 9.6%).
Lynch, Thommasen, Anderson, Grzybowski (2005)	Compare obstetric outcomes between birthers at Bella Coola (BC) Hospital (c-section capable) and Queen Charlotte City (QCC) Hospital (no c-section ability), two communities with the same degree of rurality	QCC: family physicians who offer obstetric services BC: family physicians	Canada Bella Coola: Closest referral hospital 450 kms away (by road) Queen Charlotte: Closest referral hospital 150 kms away, 6 hours by ferry or 2 hours by float plane.	Retrospective study comparing population-based obstetric outcomes of two rural remote hospitals in northwestern British Columbia. Births were assigned to hospital catchments. Birthers who carried pregnancies beyond 20 weeks' gestation and who gave birth between January 1, 1986, and December 31, 2000. study population included birthers who delivered in their communities, birthers who were transferred while in labour as a result of unforeseen emergencies, and birthers who chose to deliver in larger centres. Adverse outcomes composite: Perinatal death, birth weight <2500 g, Apgar score <7 at 5 minutes, newborn transfer to secondary or tertiary care facility	Overall, significantly more birthers in Bella Coola delivered locally throughout the 15- year period (69.8% vs 50.2%) ($p < .001$). No maternal deaths were reported in either population. Neonatal outcomes for QCC (no CS capacity): PM rate: 10 per 1000 (same as Bella Coola) Premature birth rate: 88 per 1000 compared to 62 per 1000 in Bella Coola (significant difference) Otherwise, there were no differences in adverse maternal or perinatal outcomes in the two populations.

Grzybowski, Stoll, & Kornelsen (2013)	Are small surgical services supported by General Practitioners with Enhanced Surgical Skills (GPESS) a safe health services model to meet the needs of rural birthers and families?	16 primary care catchments (i.e. with hospitals without CS access) were included (n=4569) where family physicians deliver babies. Midwives attended a small number of births in BC during the study period.	British Columbia, Canada, Six strata of services were compared, ranging from no local perinatal services to services supported by obstetricians. 1-No local services (>60 min from hospital w/ perinatal services) 2-Primary care -No local caesarean section (perinatal care provided by family physicians) 3-GPs with enhanced surgical skills- CS provided by GPESS only 4-Mixed model - CS provided by GPESS or specialist 5-General surgeon- CS provided by general surgeon 6- Ob/gyn; CS provided by obstetrician	Retrospective cohort study of births from April 1, 2000 to March 31,2007 (n=87,294) Births were assigned to hospital catchments. Twins and babies with congenital anomalies were excluded.	Childbearing people residing in primary care catchments had the following outcomes: PM rate: 10 per 1000 Stillbirth: 9 per 1000 Birthweight < 2500 gr: 40 per 1000 Gestational age < 37 weeks: 66 per 1000 NICU 2 admissions: 38 per 1000
Grzybowski, Fahey Lai et al. (2015)	To examine the safety of rural Canadian perinatal services stratified by service delivery level across three Canadian provinces (British Columbia, Alberta and Nova Scotia).	Care at hospitals without CS capacity is provided by family physicians; a small number of births were attended by midwives during the study period.	Three Canadian provinces Eight strata of services were compared: 1-Perinatal services > 4 h away 2-Perinatal services within 2 to 4 h 3-Perinatal services within 1 to 2 h 4-Primary care perinatal services (without local surgical care) (n=6691 for AB; n=2976 for BC; service level not applicable in NS) 5-Perinatal services provided by General Practitioner(s) with Enhanced Surgical Skills (GPESS(s) 6-Perinatal services provided by a mixed model (GPESSs & specialist surgeon(s)) 7-Perinatal services provided by general surgeons 8-Perinatal services provided by obstetricians	Multi-jurisdictional, cohort study, births assigned to hospital catchments Births between April 1st 2003 to March 31st 2008- (n=150,797) of which 70,037 occurred in Alberta, 61,991 in BC, and 18,769 in Nova Scotia. PM = stillbirths + neonatal deaths up to 7 days Very low birth weight (< 1500 grams) Premature birth (< 37 weeks)	Childbearing people residing in communities that are more than 4 hours away from obstetric services had the highest rate of PM (based on 150,797 singleton births). Childbearing people living in communities without local access to caesarean section had elevated rates of PM (BC: adjusted OR= 1.23, 95% CI: 0.92, 1.64 ; AB= 1.12, 95% CI 0.73, 1.70) compared to rural communities with CS access where obstetricians practice (highest level of service) but the association was not significant. Rates of premature birth and low birth weight (< 1500 grams) were similar or lower among childbearing people residing in communities without CS access compared to communities with the highest level of obstetric service. ORs were adjusted for maternal age (<18, >35), parity, previous C-section, prior neonatal death, prior still birth, diabetes (existing & gestational), hypertension (existing & gestational)

(*Continues*)

Table 2. (Continued)

Reference	Rationale/ objectives	Model of care	Setting & definition of service levels	Cohort, study design & definition of outcomes	Results
MIXED MODEL OF CARE or DIRECT COMPARISON OF MIDWIFE LED VERSUS PHYSICIAN-LED MODELS					
Rosenblatt, Reinken & Shoemack (1985).	How does the low volume of births in small hospitals affect perinatal mortality, in the context of a regionalized system of care?	Small rural hospitals (level 1) staffed by general practitioners and midwives	All public hospitals in New Zealand: Five hospitals were categorized as level 3, or tertiary care units for both obstetric and perinatal care. Nineteen hospitals were designated as level 2, reflecting their subregional referral role for complicated obstetric and neonatal care not requiring the more specialised equipment and personnel available in the five regional centres. Eighty-nine perinatal units were designated as level 1; in general these are much smaller units,usually in rural settings, where virtually all births are carried out by general practitioners working with midwives.	Catchment level & facility level analysis of 206 054 births during the years 1978–1981.	Perinatal death rate for all public hospitals in NZ = 12 per 1000 Perinatal death rate for level 1 hospitals was 3.2 per 100 among newborns weighting 2500 grams or more, 46.9 among newborns weighting 1500-2499 grams and 547.8 for babies weighting less than 1500 grams. For babies weighing more than 1500 grams perinatal death rates were lower at hospitals with low volumes. Authors were unable to detect a volume threshold below which obstetric care becomes unsafe.
Simonet, Wilkins, Labranche, Smylie, Heaman, Martens Fraser, Minich, Wu, Carry, Luo. (2009)	What is the relative safety of midwifery-led services as compared to physician-led services in remote Nunavik communities?	Comparison of Inuit midwife led and physician-led perinatal care in remote Indigenous communities.	Nunavik, Quebec, Canada Flying time to Montreal is 4–8 hours, depending on weather.	Retrospective Cohort Study 14 Inuit communities of Nunavik, Canada, 1989–2000: primary birth attendants were Inuit midwives in the Hudson Bay (1529 Inuit births) vs western physicians in Ungava Bay communities (1197 Inuit births Excluded births with missing data on birth weight or gestational age, and births of extremely low reported birthweight (<500 g) or gestational age (<20 weeks). Birth assigned to catchments using geocoding. PM = stillbirth & neonatal death preterm birth (< 37 completed weeks of gestation), low birthweight (< 2500 g)	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. No significant differences in the rates of perinatal death (or other adverse outcomes) between the two groups Preterm birth rate: Midwife group: 103 per 1000 Physician group: 108 per 1000 Low birth weight rate: Midwife group: 53 per 1000 Physician group: 60 per 1000 Perinatal death rate: Midwife group: 14.4 per 1000 Physician group: 10.9 per 1000 Stillbirth rate: Midwife group: 5.9 per 1000 Physician group: 5.8 per 1000 Neonatal death rate: Midwife group: 8.6 per 1000 Physician group: 5.0 per 1000 Perinatal death rates for births at or over 28 weeks were 9.2 per 1000 in midwife group and 8.4 per 1000 in physician group. Neonatal death rates for births at or over 28 weeks were 4.0 per 1000 in midwife group and 3.4 per 1000 in physician group.

MIDWIFE LED MODELS OF CARE					
Schmidt, Abelsen, & Ølan (2002)	What are the short-term outcomes for all pregnancies at all perinatal homes in Norway ?	Midwives are responsible for monitoring births in perinatal homes, and they also accompany labouring birthers to hospital and do the majority of prenatal care Chief GPs run perinatal Homes but are seldomly involved in the birth but routinely examine newborns.	Norway. Study included all 10 perinatal homes in Norway, distance to nearest hospital ranged from 70–240 kilometres (between 2–3.5 hours surface travel time by ambulance)	2-year prospective cohort study (1995–1997); 1275 birthers who started labour in the perinatal homes in Norway; 1% of all births in Norway during this period. Facility-based analysis.	Of childbearing people who started labour in a perinatal home, 1217 (95.5%) also delivered there; 58 (4.5%) birthers were transferred to hospital during labour; 57 (4.7%) were transferred post partum. Two (0.2%) early neonatal deaths in two different perinatal homes during study period. Both babies were born with a group B streptococcal infection. Neither of the mothers had any sign of intrauterine infection. Early neonatal death: 2 per 1000 Apgar score 7 at 5 min: 50 per 1000
VanWagner, Epoo, Nastapoka & Harney (2007)	This article describes the Inuulitsivik midwifery service and education program, an internationally recognized model of care, which has returned childbirth to the remote communities of Nunavik, Quebec, Canada.	Midwives are lead caregivers for perinatal, well birthers, and newborn care for the population, regardless of risk status. They work collaboratively with physicians, and nurses in the remote villages and at the regional and tertiary referral centres.	Canada, Northern Quebec, Nunavik Inuulitsivik Health Centre serves seven communities on the Hudson Bay and Hudson Strait coasts, with a population of about 5500 (approx. 200 births per year). There is a small, 25-bed general hospital in Puvirnituq. All of the communities are remote fly-in villages, with transfer for tertiary care more than 1000 kilometres to the south, in Montreal.	Summary of internal and external evaluation studies of midwife led birthing services in Inuit Villages of Nunavik; Included: births during 1986 and 2004 that were planned for or occurred in Nunavik (n = 2253). Catchment level	In total, there were 21 perinatal deaths, including 12 antepartum or intrapartum deaths, and nine neonatal deaths, which resulted in a PM rate of nine per 1000 (0.9%). Perinatal outcomes were similar to those from Western Arctic and Canada as a whole, which has a PM rate of 8 to 10 per 1000 (0.8%–1%).In addition, the outcomes from Nunavik are lower than the combined rates of fetal and neonatal mortality in comparable populations of the Northwest Territories (19/1000; 1.9%) and Nunavut Territory (11/ 1000; 1.1%), as reported in the 2003 Canadian Perinatal Health Report.

(*Continues*)

Table 2. (Continued)

Reference	Rationale/ objectives	Model of care	Setting & definition of service levels	Cohort, study design & definition of outcomes	Results
Van Wagner, Osepchook, Harney, Crosbie & Tulugak, (2012).	Study aims to contribute to greater understanding of northern and remote perinatal care and to the improvement of perinatal care in this and other remote regions.	Midwife led birthing centres in remote location Midwives are lead caregivers for perinatal, well birthers, and newborn care for the population, regardless of risk status. Inuulitsivik midwives have an expanded role in community health and emergency care.	Nunavik,Quebec, Canada Care is midwife led and family physicians work in the three largest villages and are on call by telephone to the other villages. Nurses are on call on-site in all of the villages. Specialists from referral hospitals are consulted by telephone.	Retrospective review of perinatal outcomes data for 1,382 babies from 2000 to 2007, Catchment level analysis: all babies born in the Hudson villages, and those who were transferred during pregnancy, during or after birth	Findings revealed low rates of intervention with safe outcomes in this young, largely multiparous “all risk” Inuit population; 86% of the labours occurred in Nunavik, attended by Inuit midwives whereas 13.7% occurred outside Nunavik. Nine percent (9%) of births involved urgent transfers of mother or baby Nearly 50 percent of births occured in the woman’s home village. Mean maternal age =24.9 99% of births to Inuit birthers Preterm birth rate = 106 per 1000 Low birth weight = 49 per 1000 Fetal death rate: 2.9 per 1,000 Neonatal death rate: 3.6 per 1,000 2 of the 3 neonatal deaths were babies born before 26 weeks weighing less than 800 grams. 2 of the neonatal deaths were linked to abnormalities incompatible with life.
Stoll & Kornelsen (2014)	To examine outcomes of midwife-involved births in rural British Columbia in the post-regionalization era.	Midwifery-led care, case load continuity model	Canada (British Columbia) Results analyzed by six obstetric service levels. 1-Lives 2 or more hours away from perinatal services 2 - 1-2 hours away from perinatal services 3 -Primary perinatal care without caesarean/no local caesarean availability (n=366) 4 -General practitioner surgery; CS provided by GP surgeons only 5 -Mixed Model; CS provided by GP surgeon or obstetrician 6 -General surgeon or obstetrician gynecologist; CS provided by general surgeon or obstetrician	Retrospective cohort study including all women who resided outside of the core urban areas of the province; who gave birth to a singleton after 20 weeks’ gestation between April 1, 2003, and March 31, 2008; and who had a midwife involved in their care. Late terminations and infants with any recognized congenital anomalies were excluded from the analysis. Catchment level analysis PM =Stillbirth and early neonatal death up to 7 days:	Between 2003 and 2008, 63,277 birthers who gave birth to singletons resided outside of the core urban areas of the province. Of these birthers, 5031 (8.0%) had a midwife involved in their care. 366 childbearing people with midwifery care resided in communities with hospitals without CS back up. This group had the following outcomes: Rates of: PM: 0 per 1000 Prematurity (< 37 wks gestation): 80 per 1000 Low birth weight (< 2500 g): 70 per 1000 Apgar scores <7 at 5 minutes: 30 per 1000 Perinatal death rates for midwife-attended births in British Columbia = 0.5 per 1000 (for the time period 2000 to 2004).

Kruske, Schultz, Eales & Kildea, (2015)	What are the reasons for transfer to and from a Primary Perinatal Unit (PMU), transfer times, and the clinical health outcomes of all birthers (of all risk statuses) and their babies?	Depending on risk profile at the first prenatal appointment birthers were allocated to one of three models of care: Midwifery Group Practice (MGP) care, GP co-operative care or obstetric shared-care. In the MGP model, birthers are allocated a primary midwife who provides antenatal, intrapartum and postnatal care to a caseload of 30–40 birthers per year. 85% of birthers received midwifery care	Australia Primary perinatal unit in rural Queensland approximately 1 hour travel time (by car) from higher level of care. Unit provides all risk prenatal and postpartum care and low-risk birth services. During duration of study unit was mostly classified as level 2 (no CS capacity) and infrequently as level 3 (CS capacity).	Retrospective Cohort Study, 2009-2011, n=593 Outcomes included: the number and primary reason for all antenatal, intrapartum and postnatal transfers; the progression of care; intrapartum inter-hospital transfer times and the clinical outcomes of all birthers and neonates including mode of birth, preterm birth, induction of labour Apgar score at 5 min and special care nursery (SCN) admissions. Data were analyzed based on the model of care that birthers were booked into at the time of the first prenatal visit & the birth location (facility level analysis).	The PMU cared for five times as many Indigenous and Torres Strait Islanders as the state average (27.5% vs.5.7%). The majority of birthers (85.3%) received MGP care. 65.9% gave birth at PMU, while 33.1% gave birth at the referral hospital Neonatal outcomes for all 593 birthers: Preterm birth: 87 per 1000 Full term fetal death: 0 Preterm fetal death: 56 per 1000 Full term SCN admissions: 34 per 1000 Preterm term SCN admissions: 500 per 1000 Clinical outcomes among people birthing both at the PMU and those transferred were comparable or better than Queensland population data.

describes some of the included studies in more detail.

In a study from British Columbia (Canada), rates of prematurity (<37 weeks gestation) among rural birthers living in communities with perinatal services without LACB were comparable to the rates found among birthers with local surgical care models, and considerably better than the rate found among birthers with no local access to any services.[15] Further, newborns of birthers from communities with no local perinatal care had a 50% higher rate of admission to tier-three neonatal intensive care units (NICU-3; high acuity): 6 per 1,000 compared to 4 per 1000 for both perinatal services without LACS and those services with access to local specialist care.[15]

A case study by Simonet et al.[17] (2009) from the remote arctic setting of eastern Nunavik (Canada) provides evidence that physician-led primary care can be safe in a remote environment. In this study, an examination of nearly 1,200 Inuit births from seven communities around Ungava Bay between 1989-2000 showed that the rate of neonatal mortality was well below regional standards. With just over 100 births per year in a remote area of exclusively fly-in communities, the other most feasible perinatal care model is complete evacuation (no local services), the historic reality for Nunavik.[17]

Controlling for late transfers, larger centres in Australia in the 1980s showed a gradient of improving outcomes for all low-birthweight babies as well as an increasing proportion of low, very low- and extremely low-birthweight infants despite Australia not having the formal regionalization policy found in New Zealand at the time.[22] However, early transfer of low-birthweight neonates to higher-resourced units was not as consistent in the de facto Australian system examined by Lumley.[22] Lumley concluded in 1988, "[it] is also of interest that effective regionalization need not involve the closure of small perinatal units on the grounds of safety" (p. 392).

One smaller American study from the same period provides additional evidence that rural family physicians employed earlier transfer and more aggressive risk screening to ensure good outcomes than their urban family physician counterparts.[21] The data on physician-led service safety clearly shows the importance of referral and transfer of higher-risk birthers and newborns while providing some evidence on 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.

Midwifery-led perinatal services without LACB

Much of the literature about midwife-led primary intrapartum services comes from very remote jurisdictions – the Canadian Arctic prominently, as well as the Norwegian Arctic and the Australian outback. In Australia, childbearing people who received caseload midwifery and delivered at a primary care unit (that operated without access to CS for most of the study period) had a fetal death rate of 0 per 1000 both for full-term and preterm babies.[23]

A catchment-level perinatal mortality rate of nine per 1000 was reported by Van Wagner about a remote area in Northern Quebec.[18] In the same region but for a different time frame, a fetal death rate of 2.9 per 1,000 and a neonatal death rate: 3.6 per 1,000 was reported. Of the 5 neonatal deaths 2 were babies born before 26 weeks weighing less than 800 grams and 2 had abnormalities incompatible with life. The study cohort included five sets of twins and one set of triplets.[18] In another catchment-level analysis,[20] a perinatal mortality of 0 per 1000 was recorded for midwifery clients residing in communities with hospitals without CS capacity. Babies with congenital anomalies, twins and those born at home were excluded.

Several of the included studies 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 of the Innulitsivik midwifery services along the Hudson Bay coast of Nunavik in Canada describe outcomes at three Innulitsivik birthing centres that provide birth services for roughly 200 birthers annually without local surgical capacity and more than 1500km from the referral hospital in Montreal.[18,19] Between 1986-2005, 80% of local births took place in Nunavik and

up to 86% in the years 2000-2007.[18,19] 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).[18] 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.[19]

Stoll and Kornelsen[20] used a catchment-level analysis to study birth outcomes of 5,031 rural birthers who had a midwife involved in their perinatal care for a singleton birth without congenital anomalies between 2003–2008. The authors 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.[20] No stillbirths or neonatal deaths were recorded among birthers with local primary care who had a midwife involved in their care and rates of prematurity were much lower for midwife-involved births in communities without LACB, compared with communities with no local services and compared with communities with a hospital with CB capacity.[20] Rates of low birth weight and 5-minute Apgars below 7 were similar across strata.

A study of all primary perinatal homes in Norway between 1995-1997 found good outcomes, including better than average 5-minute Apgar scores, low intervention rates, low blood loss rates, and just 2 neonatal deaths across 1275 births studied.[25] In these homes, midwives provided the majority of care, and worked collaboratively with GPs, who were called when needed. These remote services without LACB were between 2 and 3.5 hours from the nearest hospital.[25] One of the fourteen studies compared midwife with physician-led care in the remote Canadian Artic[17] and another study described the on-site model of care as collaborative.[24] See Table 2 for details about these studies.

DISCUSSION

This review identified fourteen studies, most utilizing a retrospective cohort design and catchment-level analysis. Catchment level analysis is necessary to calculate rates of local births and transfers to referral centres and reduces referral bias, a type of selection bias that results in higher acuity cases being transferred to higher levels of care. In other words, higher rates of adverse outcomes at referral centres are expected and indicates a well-functioning system of risk screening and referral.

Perinatal death rates for childbearing people residing in communities with physician-led intrapartum services without local access to CS ranged from 10 -21 per 1000,[12–15] and 0-9 per 1000 for childbearing people residing in communities with midwife-led intrapartum services without local access to CS.[18,20] Perinatal loss rates from these catchment-level analyses were similar to those reported for Canada as a whole and those reported in Canadian provinces and territories with large rural and remote areas (6 per 1000 for Canada, 10.2 per 1000 in Nunavut and 16.8 per 1000 in the North West Territories).[26] The rates were often lower when compared to communities without any intrapartum services or communities where obstetricians perform caesarean sections.

Although not the focus of this review, lower intervention rates for birthers in remote environments and the ability of more childbearing people to give birth in their home communities are additional benefits of giving birth in communities without LACB. [27,28] In one Australian study found that over 74% of local births were able to be delivered in a midwife-led primary perinatal unit.[23]

In this review, we set out to answer whether small, low-volume perinatal services in rural communities are safe and how outcomes compare with those at highly resourced, specialist-led services in larger centres. The pertinent question is not whether a given perinatal service or model of care is safer, but whether it is safer for rural and remote birthers 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 contention that higher-resourced units have better outcomes speaks to a comparison by unit. Evidence both indicates and counter-indicates that such a relationship exists in perinatal care

in high-income countries 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 datasets, more precise data on why and how mortality occurred, and an 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 answer to the difference in outcomes according to the volume and resources of the perinatal unit.

When seen from the rural patient's perspective, the claim of more safety in larger centres – if it were found – creates a system imperative that necessitates birthing individuals travel for their care (at least intrapartum). That presumed safety represented by volume then must surpass the threshold of increased risk represented by greater distance to care. 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. We have strong evidence that distance to care, accidental, out-of-hospital births, increased psychosocial stress, social and cultural vulnerability, and unstable services lead to worsened outcomes for birthers and their babies.[29–35]

The centralization of services has the stated intention of improving outcomes. The onus of proof of safety for services has been on small volume, rural, generalist perinatal services. If reconsidered in the light of this review, the burden of proof shifts. Centralizing to higher tiers of care must show that it improves outcomes beyond the threshold of increased morbidity and mortality witnessed as a consequence of evacuation. Proof must be weighed in relation to the other tenets of the Triple Aim value framework of improved care experiences and lower per capita costs.[36]

At the same time, we must recognize that emergency transfer will, at times, be necessary and there will be cases in which unpredictable events will raise the risk level of a woman intrapartum or immediately postpartum. Emergent situations include preterm births, hemorrhage, cord prolapse, failure to progress with non-reassuring fetal heart tones, and even birthers of high risk who have chosen to arrive in labour without warning. When situated in the real-world phenomenon, we find that those small communities with perinatal services with emergency skills and regionalized transfer and referral support will do better in those emergent situations than will communities without *any* level of local services.

The implications for policy and planning are thus similarly clear. Perinatal services in rural and remote communities without LACB are not a solution for all of the birthing population – some of whom will have or develop complex health risks that indicate a higher level of care – but do improve maternal-child outcomes for a low-risk cohort. For those birthers who are a poor fit for a primary service but end up giving birth in their home community anyway, the presence of primary perinatal service knowledge and perinatal providers is better than the real-world alternative of undertrained emergency staff or no medical personnel at all.

Although most of the literature assessing the safety of rural primary perinatal 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 perinatal 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. Birthers with a likelihood of an uncomplicated vaginal birth are suitable candidates for local birth. Avoidable clinical risk is incurred for low-risk childbearing people who may be required to leave their communities due to the lack of local infrastructure. Greater attention has been given to measurable clinical outcomes related to labour and birth with less attention given to outcomes resulting from system circumstances that engender psychosocial stress. A confluence of psychosocial stressors related to traveling to care compound with both personal anxiety and logistical risks associated with being distant from care.(6) Greater distance to

care, reduced prenatal and postnatal care access, and higher rates of psychosocial stress are reflected in worsened clinical outcomes. This demands attention to a holistic characterization of risk.

Mechanisms for safe perinatal care without LACB

The mechanisms of safe perinatal care without LACB are complex and include appropriate case selection for local births (those who are likely to give birth without the need for additional resources), support for local care providers from regional specialists, and access to effective high-acuity transport to larger centres should it be needed.

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 by care providers during labour and ultimately led to low intervention rates while maintaining good outcomes.[37] 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.[24]

In considering physician-led models of rural perinatal services without LACB, included studies revealed the importance of referral and transfer for higher-risk birthers and newborns in multiple settings and time periods. Similar to physician-led models, the success of midwife-led models depends on active collaboration between all health professionals, appropriate risk screening, functional regionalized referral, and the availability of emergency transfer. Interprofessional relationships are vital to any practicing clinician operating at a distance and especially highlighted for midwives who have birth philosophies that are different form generalist physicians. Openness to value-sharing is essential for the birth philosophies of midwifery to be upheld while maintaining a strong interprofessional support system for referral and transfer.

In other words, good perinatal outcomes are dependent on system support. 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.

Service providers must be engaged in a continuous quality improvement 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 perinatal emergency course preparation.

Additional recommendations arising from this review are listed below and are separated into recommendations for health planners, clinicians and evaluators (see Table 3).

CONCLUSIONS

Findings from our review support the safety of rural perinatal services without LACB within the context of the following caveats: attending to appropriate case selection, access to efficient intrapartum emergency transport and a networked relationship with regional referral colleagues, which assumes clear referral lines for triage to higher levels of care when necessary. Guidelines for the identification of candidates for birth in a low-resource environment (those likely to have an uncomplicated vaginal birth) need to be refined and adopted across rural and remote settings, and innovative models of midwifery services, when supported, are an effective way to meet population needs. As perinatal services without LACB must take place within the context of a well-functioning interdisciplinary local team including care providers, allied health providers and local administrators, attention to team development with enhance both the sustainability and safety of these services. Effective and efficient perinatal transport systems must be in place for instances when emergency transport is necessary and individuals providing rural perinatal services must be well-qualified and work within a Continuous Quality Improvement monitoring framework with adequate opportunities for Continuing Medical Education. Finally, consideration of the safety of perinatal services without LACB must take place within recognition of an expansive definition of safety to include cultural, social and personal safety in addition to physiological safety.

Table 3. Recommendations

Planners 1. Maternity and Midwifery 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 Indigenous populations; 3. Rural primary maternity and midwifery 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.
Providers 1. Individuals providing rural maternity services must be well-qualified and work within a Continuous Quality Improvement monitoring framework with adequate opportunities for Continuing Medical Education; 2. Innovative models of midwifery services for rural communities with planned primary maternity and midwifery 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.
Evaluators: 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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CONFLICT OF INTEREST

The authors have no conflicts of interest to disclose.

AUTHOR CONTRIBUTIONS

JK supervised all aspects of this project, reviewed articles for inclusion and drafted and revised the paper. KS led the literature review update, created summary Table 2 and contributed to the writing and editing of the manuscript

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AUTHOR BIOGRAPHIES

Dr. Jude Kornelsen is a health services researcher and assistant professor in the Department of Family Practice at the University of British Columbia. As co-director of the Centre for Rural Health Research, her primary research focus is on rural health issues, particularly the investigation of appropriate levels of services for rural maternity care and the role of midwifery in contributing to such care. Since 2005, Dr. Kornelsen has led multiple mixed-method investigations in rural BC exploring women's experiences traveling to give birth. Some of such investigations have helped provide better understanding in the maternity care needs of women and Indigenous groups in BC Dr. Kornelsen also has a more general interest in modalities of birth, specifically women's choices that are outside the norm of experience. To this end she has conducted studies on patient-initiated elective caesarean section and unassisted home birth.

Dr. Stoll is a social scientist with degrees in psychology, family studies and interdisciplinary studies. Her PhD spanned three disciplines (public health, nursing and midwifery) and she completed a five-year postdoctoral fellowship in Population and Public Health at the University of British Columbia (UBC) and a one-year CIHR fellowship in primary health care research. Since 2005 Dr. Stoll has held various research positions in the Midwifery Education Program at UBC and worked closely with epidemiologists, clinicians, community members and researchers, on various research and knowledge implementation projects in the area of reproductive health. Kathrin is currently affiliated with the Birth Place Lab at UBC and a fellow at the Centre for Rural Health Research.