Purpose of the Report

The purpose of the report is to consider the recommendations from the Independent Review Group regarding the sustainability of a consultant-led maternity unit at West Cumberland Hospital. This follows a period of review involving independent clinical experts and work involving members of the community.

The period of review was agreed as part of the decisions made in March 2017 following the Healthcare For The Future Consultation, and was supported by the Secretary of State for Health and Social Care following referral by the Cumbria Health Scrutiny Committee.

The Governing Body is responsible, on behalf of the local NHS, to determine the future provision of maternity services at West Cumberland Hospital following the public consultation and decisions made in March 2017. The report is a key document in informing the decisions of the Governing Body.

Outcome Required: Approve x Ratify For Recommendation For Information

Assurance Framework Reference:
As detailed in the Strategic Objectives below.

Recommendation(s):

1) The Governing Body is requested to approve, in full, each of the three recommendations included in the Independent Review Group report. For completeness, those recommendations are:

   i. The existing pattern of maternity services with consultant-led units in Whitehaven and Carlisle is operating effectively at present and is proving innovative and adaptable in overcoming challenges. A commitment should be given to sustain this service pattern.

   ii. Midwifery-led services operating alongside these units are important in offering choice
of birth setting in line with Better Births. A commitment should also be given to sustain this element of the service pattern.

iii. There will be challenges to sustaining this service pattern. It is important that a decision about Option 1 does not lead to any sense of complacency or ‘job done’. It is also important, however, that the stability of Option 1 is not undermined by a perception of crisis every time a challenge arises. A commitment should be given to maintaining vigilance and supporting innovative measures to counter these challenges in future, continuing the collaborative Working Together approach between the community and the NHS.

Executive Summary:

The purpose of the report is to enable members of the NHS North Cumbria Clinical Commissioning Group’s Governing Body to consider the papers and recommendations as described relating to the sustainability of consultant-led maternity services at the West Cumberland Hospital (WCH) in Whitehaven. This follows a period of review involving clinical experts and work involving members of the community.

The period of review was part of the decisions made in March 2017 following the Healthcare For The Future Consultation, and was supported by the Secretary of State for Health and Social Care following referral by Cumbria’s Health Scrutiny Committee.

There are supporting documents to consider. They are:

1) A report from the Independent Review Group (IRG) chaired by Dr Bill Kirkup CBE

2) A response from North Cumbria University Hospitals Trust (NCUH) regarding the implementation of the recommendations

3) The power point presentation developed by the Working Together Steering Group for a workshop with Dr Bill Kirkup CBE on 7 June 2019

4) Evidence review of impact of distance / time travelled and outcomes by SPH - Solutions for Public Health. This was commissioned to inform the work of the Independent Review Group, and is included in the Governing Body papers to ensure transparency and to share information with members of the public.

Background to consultation

The provision of consultant-led maternity services at West Cumberland Hospital (WCH) in Whitehaven has been challenging for many years. Both WCH and the Cumberland Infirmary Carlisle (CIC) are two of the seven 7 smallest consultant-led units (CLUs) in England in terms of the number of births at each hospital each year.

The Royal College of Obstetricians and Gynaecologists (RCOG) was commissioned by (the then)
NHS Cumbria CCG to review the provision of maternity services across the whole county in Autumn 2014. This was partly in response to the significant challenges in sustaining the required clinical workforce, particularly the recruitment of anaesthetists, paediatricians and middle grade obstetricians.

The purpose was to provide independent and expert advice on the best way to arrange high quality, sustainable maternity services for Cumbria in the future. The review took place in November 2014 and reported in March 2015.

The countywide review favoured maintaining 4 CLUs as currently configured as long as it was safe and sustainable to do so - this was favoured due to the distance between the units and the deprivation along the west coast of the county. It also recommended restructuring medical working practices and the development of alongside midwife-led units (AMLUs) at WCH, CIC, Furness General Hospital (FGH) and the Royal Lancaster Infirmary (RLI). Note: This report does not consider FGH or RLI.

In the summer of 2015 north Cumbria was named as one of three areas to be placed in the national Success Regime programme to look at the long standing, deep-rooted problems affecting the sustainability of services and significant system financial overspend.

Maternity was one of six service areas included in the public consultation Healthcare For The Future held between September and December 2016.

The consultation outlined three options for the future of maternity services. They were:

**Option 1** involves the provision of a consultant-led maternity unit at both Cumberland Infirmary Carlisle and at West Cumberland Hospital, an alongside midwife-led maternity unit at both sites, a full range of antenatal and postnatal care at both sites and the continued option of giving birth at the Penrith Birthing Unit or at home. There would be a special care baby unit at both Cumberland Infirmary Carlisle and West Cumberland Hospital but the reduced availability of paediatric expertise at West Cumberland Hospital would mean that some higher risk births would take place in Carlisle.

**Option 2** involves the provision of a consultant-led maternity unit, an alongside midwife-led maternity unit and a special care baby unit at Cumberland Infirmary Carlisle along with a full range of antenatal and postnatal care. At West Cumberland Hospital in Whitehaven it would involve a standalone midwife-led maternity unit for low risk births, with antenatal and postnatal care delivered by both consultants and midwives and with consultants on site between 8am and 8pm. Women would continue to have the choice of giving birth at the Penrith Birthing Unit or at home.

**Option 3** involves the provision of a consultant-led maternity unit at Cumberland Infirmary Carlisle along with a special care baby unit, an alongside midwife-led maternity unit and a full range of antenatal and postnatal care. There would be no births at West Cumberland Hospital in Whitehaven but consultants and midwives would give antenatal and postnatal care at West Cumberland Hospital. As with option 1 women would continue to have the choice of giving birth at the Penrith Birthing Unit or at home.
Option 2 was the stated preferred option in the consultation document.

**Governing Body Decision made in March 2017**

Feedback from the consultation was considered carefully by the Governing Body which in March 2017 made the following decision:

Recommendation 2.1: To test the viability of Option 1 over a 12 month period

Recommendation 2.2: If Option 1 is not proven to be deliverable or sustainable then implement Option 2 at the end of the 12 month period

Recommendation 2.3: Whilst testing Option 1, to prepare for Option 2 by implementing a Midwifery Led Unit (MLU) in Whitehaven alongside the Consultant Led Unit, in order that the MLU can be audited as if it was freestanding

Recommendation 2.4: To implement Option 3 if Option 1 is not proven to be deliverable or sustainable and, following audit of the MLU, Option 2 is not deemed to be safe.

This decision was referred to the Secretary of State by Cumbria’s Health Scrutiny Committee and considered by the Independent Reconfiguration Panel (IRP). The IRP and Secretary of State endorsed the approach taken by the CCG.

**Work since March 2017**

Since the decisions were made in March 2017 we have established:

- The Independent Review Group – chaired by Dr Bill Kirkup CBE and made up of clinical leaders in Anaesthetics, Obstetrics, Paediatrics, Neo-Natal and Midwifery

- The Working Together Steering Group – chaired by the Venerable Richard Pratt the Archdeacon of West Cumberland and several other working groups encompassing the already active Maternity Voices Partnership and Children, Telehealth, Recruitment and Retention and Care at Distance involving members of the community, staff, the Third Sector and Healthwatch Cumbria

- The Implementation Reference Group (IRefG) chaired by Dr Kevin Windebank to consider progress to implement any change decided as part of this process.

Since March 2017 alongside midwifery-led care has been established on both sites by using designated rooms. This work has been developed with substantial input from the Maternity Voices Partnership (MVP).

Considerable work is ongoing to develop the wider Better Births agenda. The Local Maternity System (LMS) is well advanced with the first draft plan submitted in line with national deadlines. Work on development of community maternity hubs will be co-produced with women and
midwives. It is being delivered with significant national investment.

Work has also been undertaken to co-produce the questions for MLU review which was agreed with the Health Scrutiny Committee (HSC) as part of the CCG decision in March 2017. This included the MVP and other members of the Working Together Group, Health Scrutiny Committee. The IRG will give further feedback on the findings.

The resulting clinical review contains small numbers of patients and as such contains patient identifiable information and will not be published in full.

**Key Issues and Key Risks:**

These are discussed in the report from the Independent Review Group. The key risk to the CCG as a commissioning organisation is to ensure the CCG commissions sustainable services to meet the needs of the population.

The Governing Body is requested to note each of the following:

- The Governing Body may need to formally consider any further implications from the recommendations from the Independent Review Group listed above in future months, particularly in relation to the interdependent Paediatric services at West Cumberland Hospital. This will be within the framework of the outcome of the public consultation

- The intention to accept the offer from the Independent Review Group to provide further support regarding the clinical review of midwifery-led care

- That, dependent on their individual clinical circumstances, some women who live in west Cumbria may be advised to book to give birth in Carlisle, or Newcastle as the tertiary centre, due to additional risk factors for the expectant Mum or their baby.

**Implications/Actions for Public and Patient Engagement:**

There has been considerable work which remains ongoing with the community and as identified in the Independent Review Group Report recommendation 3 should continue.

**Financial Impact on the CCG:**

Current contractual arrangements include the consultant-led unit at West Cumberland Hospital and as such there are no immediate financial implications for the CCG.

<table>
<thead>
<tr>
<th>Strategic Objective(s) supported by this paper:</th>
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<tbody>
<tr>
<td>Support continuous quality improvement within existing services including General Practice</td>
<td>(X)</td>
</tr>
<tr>
<td>Commission a range of health services, including an increasing range of integrated services, appropriate to our population’s needs</td>
<td>X</td>
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**Strategic Objective(s) supported by this paper:**

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<tbody>
<tr>
<td>Develop our system leadership role (in the context of an integrated health and care system) and our effectiveness as a partner</td>
</tr>
<tr>
<td>Continuously improve our organisation and support our staff to excel</td>
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**Impact assessment:**
(Including Health, Equality, Diversity and Human Rights) X

**Conflicts of Interest**
Describe any possible Conflicts of interest associated with this paper, and how they will be managed

| No conflicts have been identified at this time |

| Lead Director | David Rogers, Medical Director |
| Presented By | David Rogers, Medical Director |
| Report Author | Peter Rooney, Chief Operating Officer |
| Contact Details | Julie.clayton@northcumbriaccg.nhs.uk |
| Date Report Written | 27 June 2019 |
The Independent Review Group was established to advise the North Cumbria Clinical Commissioning Group on the future pattern of maternity services in the north of the county. Recruitment of staff to the existing consultant-led units in Whitehaven and Carlisle had proved difficult, and concern had been voiced over whether both units could be sustained safely. A series of options had been drawn up, Option 1 being to continue the existing pattern of two consultant-led units with midwife-led units alongside, Option 2 to withdraw the consultant-led unit at Whitehaven but continue a freestanding midwife-led unit there, and option 3 to withdraw all hospital birthing services from Whitehaven.

The Independent Review Group considered that there were good reasons to look at these options in turn rather than together: only if there was evidence that Option 1 was unsustainable would the question of the desirability of Option 2 arise, and so on. Most of the population would prefer Option 1, there are significant travel and transport difficulties in accessing more distant services, and the importance of local hospitals to their communities has been well brought out in the impressive Working Together approach. We took the view that there should be a presumption in favour of Option 1 if it can be staffed safely and sustainably, taking account of future risks.

We have systematically examined staffing in obstetrics, paediatrics, anaesthetics, midwifery and neonatal nursing in both hospitals, looking at national standards, trends over time and potential future threats. We were impressed by the commitment shown by the Trust to overcome the recruitment challenges, including some innovative approaches in all of these areas. The services are being maintained, and given the same commitment and ingenuity to overcome future challenges they can be sustained in future.

The Independent Review Group therefore recommends that a commitment should be given to sustain the current pattern of consultant-led units in both Whitehaven and Carlisle.

In addition, we recommend the continuation of both alongside midwifery-led units to offer a choice of birth setting in line with the Better Births report.

Finally, there will be future challenges to these services, but they also need stability. It is important that there is a commitment to maintaining vigilance and supporting innovative measures to counter these, continuing the collaborative Working Together approach between the community and the NHS.
IRG Establishment

The Independent Review Group (IRG) was established from July 2017 to make recommendations to the North Cumbria Clinical Commissioning Group (CCG) Governing Body on the sustainability of maternity services that the CCG is responsible for commissioning.

Membership of the IRG comprised:

- Dr Bill Kirkup (Chair)
- Dr Anthony Falconer (Obstetrics)
- Lynne Paterson (Nurse Consultant)
- Dr Nigel Penfold (Anaesthetics)
- Dr David Shortland (Paediatrics)
- Sue Townend (Consultant Midwife)

The IRG met nine times between 2 October 2017 and 20 May 2019 as well as exchanging emails and telephone calls over that period and beyond. Meetings were attended by The Venerable Richard Pratt, Chair of the Working Together group, and Dr Kevin Windebank, Chair of the Implementation Reference Group. Support and secretariat functions were provided by Dr David Rogers, Eleanor Hodgson and Sally Rushton.

Background

The pattern of maternity services in the north of Cumbria has been established for many years, with consultant-led units in Carlisle and Whitehaven and a midwife-led unit in Penrith. West Cumberland Hospital (WCH) in Whitehaven serves a smaller population, and Cumberland Infirmary, Carlisle (CIC) has developed more specialist services as a result; tertiary referrals generally travel to Newcastle.

The geography of Cumbria is a key factor. The population is predominantly distributed in a ring around the sparsely populated rugged terrain of Lakeland. Transport links mainly run around the periphery, and are not well developed, meaning long journey times even for the distances involved. The population around Whitehaven shows generally high levels of deprivation, including low car ownership.

These features offer significant challenges for health care. WCH serves an isolated, relatively deprived population that faces significant difficulties in accessing services in Carlisle placing an increased premium on the need for a local service. However, it has proved difficult to recruit medical staff, particularly to work in Whitehaven, and changing national training policies have made it more difficult to keep training posts to cover rotas. There have been acute staffing crises that have threatened service provision. This has raised real questions about the sustainability of the current
pattern of maternity services and rightly prompted consideration of the benefits and drawbacks of alternatives.

At the same time, national maternity policy has been evolving significantly. Safer Maternity Care brought forward the ambition to reduce stillbirths by half, while Better Births also emphasised the option of a range of birth settings including midwifery-led units and home birth as well as obstetric-led services.

In response to all of these factors, three options were developed for the future pattern of maternity services.

**Options for Maternity Services**

Option 1 involved the provision of a consultant-led maternity unit at both CIC and at WCH, an alongside midwife-led maternity unit at both sites, a full range of antenatal and postnatal care at both sites and the continued option of giving birth at the Penrith Birthing Unit or at home. There would be a special care baby unit at both CIC and WCH but the reduced availability of paediatric expertise at WCH would mean that some higher risk births would take place in Carlisle.

Option 2 involved the provision of a consultant-led maternity unit, an alongside midwife-led maternity unit and a special care baby unit at CIC, along with a full range of antenatal and postnatal care. At WCH it would involve a standalone midwife-led maternity unit for low risk births, open 24 hours a day 365 days a year, with antenatal and postnatal care delivered by both consultants and midwives and with consultants on site between 8am and 8pm. The consultants would not provide care during labour. It may be possible to offer low risk, planned caesarean sections at WCH, once the midwife-led unit was fully established. Option 2 would also involve the provision of a dedicated ambulance, based at Whitehaven, to transfer any women who experience complications during labour or who need further pain relief, to the consultant-led unit at Carlisle. It anticipated that between 300 and 400 women a year would use the stand alone midwife-led maternity unit at WCH once it was fully developed. As with Option 1, women would continue to have the choice of giving birth at the Penrith Birthing Unit or at home.

Option 3 involved the provision of a consultant-led maternity unit at CIC together with a special care baby unit, an alongside midwife-led maternity unit and a full range of antenatal and postnatal care. There would be no births at WCH but consultants and midwives would give antenatal and postnatal care there. As with Option 1, women would continue to have the choice of giving birth at the Penrith Birthing Unit or at home.
Terms of Reference

The NHS North Cumbria CCG Governing Body is responsible for approving the implementation of the service proposals included within the Healthcare for the Future public consultation. The Governing Body has established the Independent Review Group to apply independent critical professional review which will agree the success criteria for each of the milestones with respect to maternity services and agree on how these will be measured this will include signing off the audit/case review proposal around the MLU and will also advise the CCG on if they have been achieved or the likelihood of them being achieved and the sustainability of these.

The scope of the Independent Review Group (IRG) is limited to:

i) 2 of the 5 service areas included within the Healthcare for the Future public consultation being:
   - Maternity Services
   - Paediatric Services

   However they will need to be mindful of and take into consideration in their report the co-dependency of a range of support services.

ii) Agree the success criteria for the milestones and provide Critical Appraisal of Plans including:
   - The proposed patient pathway – is there a clear and robust patient pathway and standard operating protocols/policies
   - Capacity – are there clear and robust plans for workforce capacity, operational capacity, and patient flow
   - Quality – are any issues relating to clinical safety, clinical outcomes, ability to achieve accepted clinical standards and patient experience clearly and robustly addressed
   - Governance – is there a clear audit trail of decision making governance, and ongoing governance for the service change

The IRG is not responsible for developing the implementation plans. The Group is intended to ensure that there is reasonable assurance that material issues have been considered and planned for, and that any significant risks have clear mitigations.
iii) Recommendations to the Implementation Reference Group and NHS North Cumbria Governing Body

- To advise if the success criteria for the different recommendations as described in the NHS Cumbria Decision making meeting on March 8th 2017 have been achieved. If they have been achieved are they sustainable in the medium to long term. If the success criteria have not been achieved what is the likelihood of them being achieved and will they be sustainable into the future. The Independent Review group will also make clear their opinion on the evidence around distance and risk and also give clear opinion on the proportion of locum cover that would be seen as expected safe and sustainable with the current staffing issues both regionally and nationally with respect to maternity and the support services.

- Any material risks requiring additional mitigation

- Any material clinical interdependencies which require further consideration

The report will give a clear recommendation to the CCG on which of the options for maternity services are sustainable into the future and will provide the best outcomes for our patients.

The Work of the IRG

To address the terms of reference, the IRG has spent time looking at the evidence of how the existing services have been functioning, how they have sought to improve existing shortcomings, and how they are mitigating the risks to maternity services. We sought to place the local evidence in the context of the evidence that is available nationally and internationally on the quality of maternity services and the potential impact of local availability of services, as well as the relevant policy trends.

We quickly came to the view that there were three sequential questions which cut to the root of the decision.

(a) Can the existing pattern of service with consultant-led units at both WCH and CIC (Option 1) be staffed safely and sustainably, taking account of future risks?

(b) If the difficulties of staffing the existing pattern are too great to recommend Option 1, could a freestanding midwife-led unit be sustained at Whitehaven
(Option 2), taking into account the drawback of significant travel times between Whitehaven and Carlisle?

(c) If a freestanding midwife-led unit at Whitehaven was judged to be unsustainable, what would be the risks of withdrawing all maternity services from Whitehaven (Option 3), and how could they be mitigated?

It should be clear that we have inherently applied an order of preference in considering the questions sequentially like this: the existing service pattern is preferable unless it cannot be sustained safely; and the option of withdrawing all maternity services from Whitehaven is least preferable. This order of preference depends crucially on two arguments.

First, maintaining the existing pattern is clearly the wish of at least the great majority of the local population. Health services, not least maternity services, are important to local communities, especially those already stretched by post-industrial decline, deprivation and poor transport. Co-production with local community representatives has been a strong feature of the approach to date in North Cumbria, and we must listen to the clear messages that it has generated.

Second, the nature of the available evidence on the quality of maternity services, including the three key elements of safety, effectiveness and patient experience, makes it very difficult to be dogmatic about the exact point at which conditions would make a service unsustainable. In the absence of any evidence that the local services are currently of poor quality, there should be a presumption in favour of retaining them unless there is clear evidence to the contrary.

We therefore began by identifying the patterns of staffing in both consultant-led units, how the Trust is planning to maintain levels and how successful they have been over the year. We looked at obstetrics, paediatrics, anaesthetics, midwifery and neonatal nursing.

**Obstetric Staffing**

*Generic Considerations*

The challenges for appropriate medical staffing in small units are recurring and potentially threatening to the safe delivery of care for patients in many medical specialties. Currently, within Consultant based units, maternity care is delivered through a multi-disciplinary team with midwifery, obstetrics and gynaecology, paediatric, anaesthetic and other medical and non-medical specialists all contributing. Therefore separating obstetrics and gynaecology as one discipline in isolation is unhelpful and may distort the reality of the quality of care, as all these
disciplines are inter dependent. In contrast within midwifery led units care is provided exclusively by midwives.

Medical cover 24/7 throughout all types of units has become more challenging of late and simple solutions within the workforce constraints and financial envelope await clear solutions

Some potential solutions to staffing in obstetrics and gynaecology were addressed in an RCOG publication - Providing Quality Care for Women - Obstetrics and Gynaecology RCOG 2016.

The four key messages from that group that should underpin clinical care were:

- Delivery of a high quality service for women at all times is imperative
- All members of the MDT must have the appropriate competencies to deliver high quality care.
- Appropriate consultant presence should maximise training opportunities with the balance between direct and indirect supervision
- The expansion of resident consultant working needs to be monitored

Fourteen recommendations were described but the last one was the essential essence of this document:

- Units must ensure that high standards of care are maintained by having the appropriate workforce, with the necessary competencies in the right place at the right time

The highlighted word competence is central to delivery of safe care and in obstetrics must be available immediately.

Much of the above document was focused on the changing role of consultants in providing direct emergency care including out of hours resident care. Such discussions and implementation were an attempt to move away from the traditional models of on call care, appreciating that they were outdated and inappropriate.

The provision of clinical care throughout the UK should be uniform through the implementation of clinical guidelines, using NICE guidelines, the RCOG green top guidelines or through local guidelines. However, in distinct contrast staffing numbers, demography and risk profiles of populations and ease of access for women and their families to clinical care may be very different and vary from Trust to Trust.

Monitoring the standards of care have been facilitated by the development of the obstetric dashboard, but even this is subject to local interpretation and variation. Within obstetrics outcome data may reflect the social fabric of the population. The measured parameters do not include patient satisfaction which uses other methodologies - Friends and Family Test.

The traditional model of a non-resident consultant on call, a resident specialist trainee or equivalent and a more junior trainee is no longer the standard model for
emergency care. Units are very diverse but the essential requirement is the immediate presence of a doctor with the clinical competencies to deal with most common emergencies. For the Consultant on call (non-resident) the contractual requirement is to be located within 30 minutes of the unit.

Within the discipline of obstetrics and gynaecology there has been a reduction in the numbers within the specialist grade. As a result, rota gaps for this critical grade were becoming a common challenge resulting in the use of consultants to front the emergency services both at night and at weekends. This change has created very real tensions among the consultant grades, although it has been very strongly supported by national leaders. The evidence that such a system improves outcome for women is still awaited. The units using such a system are representative of very large and very small units and the reasoning behind the plans are varied.

The strategy for defining working structures should cover patient safety and training, but must include sustainability and providing a diverse and stimulating professional career with the maintenance of essential competencies, with a sensitivity for work life balance.

Sustaining such services in remote and small units is even more challenging given the small pool of appropriately trained individuals. In addition, maintenance of competencies in small units can be challenging for the infrequently occurring clinical presentations.

Local Workforce Data for Obstetrics and Gynaecology at West Cumberland Hospital and Cumberland Infirmary Carlisle

Data from 2014 and included in RCOG review

<table>
<thead>
<tr>
<th></th>
<th>consultant</th>
<th>Middle grade</th>
<th>Trainees</th>
<th>Rota/first on call</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Cumberland</td>
<td>5 (on call 1/5)</td>
<td>7 specialty doctors-all vacant-locums</td>
<td>Locum cover on call day and night</td>
<td></td>
</tr>
<tr>
<td>Cumberland Infirmary</td>
<td>6 (on call 1/5)</td>
<td>6- full rota</td>
<td>7 specialty trainees. One specialty grade doctor</td>
<td>1:8</td>
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Data from 18th January 2018 supplied to CCG

<table>
<thead>
<tr>
<th></th>
<th>Consultant</th>
<th>Substantive consultant</th>
<th>Locum consultant</th>
<th>Other grades (funded)</th>
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<tr>
<td>West Cumberland</td>
<td>5</td>
<td>5</td>
<td>0</td>
<td>8</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Cumberland Infirmary</td>
<td>6</td>
<td>5</td>
<td>1</td>
<td>16</td>
<td>21</td>
<td>0</td>
</tr>
</tbody>
</table>
Interpretation of these data is challenging as there are no accompanying data on age profile, competencies by grade and frequency of locum use in an emergency. The vital middle grade will include specialty trainees, locums, Trust grade doctors, MTI doctors, research fellows and post CCT fellows. There are no data on the use of consultants filling rota gaps.

However, the data suggest an improvement since 2014 for Obstetrics and Gynaecology, but such interpretation must be sensitive to national training numbers and other outlets for consultant recruitment.

**Strategic Challenges for North Cumbria CCG**

The critical strategic challenges for maintaining two consultant led units in maternity service provision in these remote services revolve around the sustainability of the workforce. Potential reduction in immigration will not help Trusts which historically have relied on many outstanding staff both from Europe and further afield. It is essential that any strategies involving recruiting overseas doctors are sustainable in the middle to long term. The challenges to anaesthetics and paediatrics appear greater than those for obstetrics and gynaecology.

Strategic thinking must break down the old practices of working in total isolation within one Trust. The commitment to working across Trusts in remote areas is essential if the number of centres is to be maintained. The Hub and Spoke concept originally proposed in the RCOG report has not resonated favourably with the current staff but should be re-explored.

There are potential risks at both consultant and middle-grade level. Currently in Obstetrics and Gynaecology consultants are recruited either through CSER or through CCT and any threat to such numbers will impact on all Trusts, but we would suggest that the potential impact could be greater in small units.

Exit from the discipline reflects the age profile, competencies and pension status of individuals and in some disciplines retirement and return to work on their terms has threatened stability of service provision. The current numbers within each Trust are very fragile if consultants are to provide 1st on call. Sickness or leave for other reasons will continue to be a major threat. Although the direct hands on work may be significant the experience of managing very serious but infrequent complications is a challenge

At middle grade level, the removal of substantive trainees from similar hospitals has created an environment of creating alternative contractual arrangements, which may prevent individuals aspiring to future consultant practice. This, perhaps coupled with reduced immigration restrictions, may render recruitment impossible. Many of these appointments have no promotion prospects and so are less attractive to many
Paediatric Staffing

The primary purpose of all child health departments in the United Kingdom is to provide a high quality and safe service for the children and young people that they are responsible for. There are three main challenges to meeting this objective. The first is in meeting the standards that are published by Medical Royal Colleges and other professional bodies. The second is in appointing sufficient numbers of appropriately trained doctors, nurses and other health care professionals. The third challenge is in meeting these objectives within the current financial restraints of the NHS.

Health Care Standards can be based around the structure, process or outcomes of a service and can be pragmatic, consensual or evidence based. The most “powerful” standards would be evidence-based outcome standards. Unfortunately, given the nature of paediatric medical care (and to some extent neonatal care) there are difficulties in defining evidence-based outcome standards and the majority of published standards, therefore, are consensually agreed standards that define the structures or processes of paediatric services. To meet these standards departments must have the right number of staff, with the right qualifications, in the right place and at the right time. Many of these standards define the timeliness and seniority of review for paediatric patients.

Paediatric rotas are generally divided into three tiers. The first (Tier 1), usually comprises of doctors within their first three years of training. Other healthcare professionals, such as nurse practitioners or physicians’ associates will often contribute to this tier of staff. The second tier (Tier 2) is mostly comprised of trainee paediatricians who have at least three years of experience but also comprises of non-training grade doctors (such as Trust grade or specialty grade doctors) and children’s nurse practitioners, who have considerable experience, can also work at this level. Consultants are the vast majority of doctors working on Tier 3 rotas. Historically, paediatric rotas consisted of relatively few doctors working very long hours. This system became unsustainable in the 1990’s and early 2000’s with the introduction of the New Deal arrangement and the European Working Time Regulations. Outside exceptional circumstances doctors and nurses are no longer able to work for, on average, more than 48 hours each week. These changes have made it increasingly difficult to staff paediatric departments in the United Kingdom and over the last 25 years approximately 25% of paediatric inpatient units have closed. The reason for the majority of these closures has been the inability to recruit appropriately trained staff to Tier 2 rotas. For Paediatrics the Tier 2 rota is the most important tier as it ensures that the resident-grade doctor will have advanced skills and knowledge. Without these resident skills it is judged by professional bodies that the care delivered would not be safe and that inpatient paediatric services should not be provided.
If there is closure of an inpatient paediatric service it is usual for some other paediatric services to remain on that site. This could be in the form of outpatient clinics, a 14-hour short-stay paediatric assessment unit, a 24-hour short-stay paediatric assessment unit or a Paediatric Advice & Decision Area (PANDA).

If a Paediatric Unit is to admit patients over night the Royal College Standards (Facing the Future) stipulates that these children must be seen by a health care professional with middle-tier competences within 4 hours of the admission and a consultant paediatrician within 14 hours of admission. If these competences cannot be achieved on a 24-hour basis a department would not be able to admit children to the paediatric wards. Without an inpatient facility, there are potential problems for local children and for other services within the hospital that rely on the support of paediatricians (for example the Emergency Department or the Maternity Unit): For example, a 14 hour short-stay paediatric assessment unit will close late each evening and any child requiring ongoing medical care will need to be transferred by ambulance to the nearest inpatient unit. These arrangements cause disruption for children and their families and result in children with unstable medical conditions being transferred in an ambulance and therefore not having access to immediate medical or nursing care if required. If a hospital does not have a paediatric presence throughout the whole of the 24 hours it is not possible to have a consultant led obstetric unit on that site as there would be periods throughout the day when staff did not have appropriate neonatal resuscitation skills. Recognising these difficulties there are paediatric departments in the United Kingdom that are looking at new model of care called the “Low Acuity Unit”. In these units it is proposed that there would be no new paediatric admissions over-night but those children requiring low acuity care could remain on that site. The inpatient wards would be supported by a resident hybrid rota providing appropriate skills for the acuity of patients and also appropriate skills for the maternity unit. Consultant paediatricians would be present in the hospital at times of peak-demand and would be available for recall to the hospital throughout the rest of the 24 hour period. The Royal College of Paediatric and Child Health Standards (Facing the Future) stipulates that there should be 10 doctors on a middle grade paediatric rota and where this is not achievable or sustainable, a low-acuity unit would provide a higher level of care to the local population than would a short-stay assessment unit. This was the original model that was proposed for the West Cumberland Hospital site.

When the independent review group for the North Cumbria CCG was first established, one the remits of this group was to assess the progress that was being made in moving from an inpatient unit to a low-acuity unit. In 2018, however, an additional model for paediatric services on the West Cumberland site was proposed. This was to maintain a 24-hour, 3 tier inpatient unit. Recognising the remoteness of the West Cumberland site from the nearest paediatric inpatient unit in Carlisle, we would support any robust plan to support this service. It is, however, important to
recognise that at the time of writing this report the model had not been fully recruited to.

Nationally, there are many vacancies on Tier 2 and consultant paediatric rotas. There do not appear to be any imminent plans to reduce the number of paediatric trainees in the UK but current Royal College of Paediatric and Child Health projections are that there will remain short-falls from these rotas for many years to come. Recognising these demographic trends the West Cumberland model has been to recruit the Tier 2 doctors mainly from overseas. The presupposition is that it will be possible to appoint sufficient numbers of doctors who have appropriate medical and language skills to function on Tier 2 rotas. The group has been advised that at all levels in the organisation there is confidence that this can be achieved.

A 3 tier service would have a lower requirement for whole-time equivalent (WTE) consultants. This model predicts a consultant requirement of 5.2 WTE at the WCH site. In April 2019 there were 4.7 WTEs. On the WCH site there were nine “other-grades” paediatricians with a requirement for ten. On the CIC site there is a requirement for 6 WTE consultants (in post there were 9.95 WTE) and for 12 “other-grades” (there were seven in post ). Not all of these posts are substantive. For the low-acuity unit the medical staffing predictions were for 12.5 WTE consultants at CIC and 7 WTE at WCH. For “other grades” it was 7 WTE at the CIC site and 8 WTE at the WCH site.

For the proposed model, in April 2019 there were sufficient consultants across the 2 sites and a short-fall of 6 “other-grades”.

The RCPCH has recommended that there should be a minimum of 10 doctors on each level of the rota. This number would ensure that the rotas are compliant with European Working Time Regulations (EWTR) and also would allow the doctors to have appropriate time for training. Rotas can, however, be managed with less than this number if the doctors are non-training grades or if the rotas have other types of health professionals contributing. The workforce modelling for this alternative medical model is that there should be 6 doctors on the tier 2 rota at CIC and 7 on the tier 1 rota. The equivalent numbers at WCH are 6 and 5 respectively. At the CIC site the 6 tier 2 doctors have been recruited (although not all are currently confirmed) and the IRG has been advised that the rotas will be compliant with EWTR. It is hoped that this rota will subsequently be enhanced with paediatric trainees. The tier 1 rota at CIC will consist of 2 paediatric trainees, 1 Trust Grade doctor, 4 GP trainees and, when fully trained, a paediatric nurse practitioner. At the WCH site there will be 5 substantive doctor posts and 1 paediatric nurse practitioner on the tier 2 rota. The tier 1 rota at WCH will have 5 trainee doctors and be supported by 2 paediatric nurse practitioners. It should be possible to provide sustainable rotas with this compliment
of medical and nursing staff provided that there are no future issues around recruitment to these posts.

**Anaesthetic Staffing**

Anaesthesia is the largest hospital specialty due to the multiple areas of practice required within a hospital, with approximately two thirds of patients having contact with an anaesthetist. Within a district general hospital setting, an anaesthetic department will primarily provide services for elective and emergency surgery, perioperative medicine, pain management and maternity services, while also supporting accident and emergency departments accepting critically ill patients. In addition, frequently, as is the case in the North Cumbria University Hospitals NHS Trust, the anaesthetic and intensive care departments are intrinsically linked, as the majority of intensivists nationally are also anaesthetists. Many of these demands on the anaesthetic services are time sensitive and frequently medically challenging, requiring the immediate availability of a suitably trained anaesthetist. This poses challenges for hospitals of all sizes to ensure that sufficient tiers of anaesthetic rotas are suitably staffed. Therefore, for these reasons and particularly from the point of this independent review, anaesthetic staffing for the maternity services cannot not be viewed in isolation.

The North Cumbria University Hospitals NHS Trust commissioned an Invited Review from the Royal College of Anaesthetists (RCoA) which reported in April 2017, and considered the three options under consideration for maternity services in North Cumbria, taking into account the other demands on the anaesthetic services. This report provides a detailed analysis of the staffing requirements required to enable a safe and high-quality service for all three maternity options. To provide a safe and high quality service all Trusts should meet national standards and these are best summarised within the Guidance for the Provision of Anaesthetic Services on the Royal College of Anaesthetists website ([https://www.rcoa.ac.uk/gpas](https://www.rcoa.ac.uk/gpas)). Regarding staffing, this can be summarised by having the right number of qualified staff in the right location at the right time.

For the West Cumberland Hospital (WCH), there is a 24/7 requirement for anaesthetic services from the consultant led maternity unit, the emergency medicine department and the intensive care unit. WCH is now focussed on low risk and day case surgery, with a minimal requirement for emergency surgery. In recent years no emergency general or orthopaedic surgery has been performed at WCH. This relieves some of the demand on anaesthesia at this site, but also removes general surgical support on-site to obstetricians out of hours. However, irrespective of the size or workload of hospital units, the same anaesthetic response requirements are necessary in order to maintain patient safety.
An in-depth review of the WCH rotas does show that the ability for a suitably trained anaesthetist to respond immediately to obstetric service demands during the working day exists. Currently the anaesthetic service provides out of hours cover to WCH by having a middle grade doctor on-site (tier 1) covering the whole hospital with an on-call consultant off site (tier 2). A third back up tier is provided by a hybrid off-site rota of middle grades or consultants. As there is only one middle grade out of hours on-site to provide anaesthetic services to multiple clinical areas, there is a significant potential for delays in responding to an unforeseen emergency if the anaesthetist is already attending to a patient who cannot be left. This situation was recognised as an area of concern by the CQC and also a commissioned anaesthetic review in 2014. In general, most hospitals provide separate on-call rotas for intensive care and anaesthesia both on and off site, which is the case at Carlisle.

Furthermore, there have been difficulties in recruitment and retention of staff over many years across the Trust, especially WCH despite the Trust attempting several different recruitment strategies. WCH has no anaesthetic trainees from the Northern School of Anaesthesia. The current situation is essentially unchanged from when the RCoA reviewed in 2017, with a constant reliance on locums to maintain the rotas. The frequency of use of locums to staff these rotas is higher than seen in the majority of Trusts in the UK. In general, the consultant gap on the WCH rota varies between 2-3 whole time equivalents, and the middle tier gaps are frequently higher. The working pattern for middle grade anaesthetists appears to be unattractive, being predominately on-call or intensive care/obstetric cover with minimal theatre work, which may affect both recruitment and retention. Furthermore, the age profile at consultant level is such that predictable and potential retirements will exacerbate this situation.

Accessing the Trust maternity dashboard and other data do not suggest that the quality of the obstetric anaesthetic services is a national outlier. However, given the reliance on locums on tier 1 in particular coupled with the low number of deliveries and hence obstetric anaesthetic interventions, the ability of all anaesthetists covering the tier 1 and 2 rotas to maintain their skills across the whole range of practice including emergency obstetric anaesthesia will be challenging.

The WCH site has not had anaesthetic trainees for many years from the Northern School of Anaesthesia and given that the School has one of the weakest recruitment fill rates in the UK and that the caseload at the WCH is restrictive, the likelihood of anaesthetic trainees rotating to WCH is remote. Across the UK, consultant recruitment from new CCT holders is commonly from the local School and thus is more likely to be successful on the Carlisle site. Recognising this, the Trust has introduced some cross-site working contracts. More generally, the recruitment situation for both anaesthesia and intensive care is challenging across the UK, both for the structural reasons predicted by the Centre for Workforce Intelligence in 2015.
and in reaction to newer concerns such as Brexit and the consultant pension situation.

Thus, the prospects for future recruitment at WCH are likely to be even more difficult. It must be recognised that the NCUH Trust has made significant efforts to maintain current anaesthetic and intensive care services and standards by many means, including embracing alternative workforce strategies in intensive care by employing three advanced critical care practitioners (ACCPs) and training two more. However, this particular initiative needs to be balanced by the predicted need of nine ACCPs to maintain a rota. For obstetric anaesthetic services, however, a similar alternative workforce solution is not possible.

The RCoA report in 2017 provides a full option appraisal to anaesthetic and intensive care services of the impact on maintaining or closing the consultant led obstetric unit at WCH and the institution of a midwifery led unit at either or both sites. Given that anaesthetic services provision has been under pressure for many years and may not be sustainable in the future given the complexities of recruitment and retention, the move to low risk surgery and low risk maternity services on the WCH site is understandable and sensible. Should the consultant-led unit remain at the WCH then it is essential that an anaesthetist is immediately available, for example for a category 1 caesarean section throughout the 24 hours. In addition, the movement of higher-risk mothers to the Carlisle site is appropriate. However, the continuation of the consultant led unit may need to be at the expense of a reduction in elective surgical provision during the working day in order to staff the necessary on-call rotas. The difficulty of providing anaesthetic cover for maternity and intensive care out of hours along with additional requests from elsewhere in the hospital, for example the accident and emergency unit, will remain. In summary the conclusions of the RCoA report remain unchanged and there has been no significant progress regarding solving the staffing situation despite the initiatives from the Trust.

Midwifery Staffing

We found clear evidence that the midwifery leaders in North Cumbria have a good understanding of their requirements for midwifery staffing, both to meet the demands of the service as it currently stands and also to determine transformation of services to be able to meet both the requirements of the national drivers for service development and local drivers for a sustainable service. The ongoing planning of services for North Cumbria takes into account the national and local drivers, and utilises this information appropriately.

There are a number of national drivers for maternity services improvement, including Each Baby Counts, Safer Maternity Care, and Better Births. Local drivers include the current and future workforce, the impact of the reconfiguration decision, learning
from incidents and reviews, and the local community. Standards for safe staffing include NICE Safe Midwifery Staffing (2015) and Birthrate Plus® (BR+). The latter is a framework for workforce planning and strategic decision-making that has been in use in UK maternity units since 1988.

BR+ has been used in maternity units ranging from stand-alone community/midwife units through to regional referral centres, and from units that undertake 10 births p.a. through to those that have in excess of 8000 births. In addition, BR+ caters for the various models of providing care, such as traditional, community-based teams and caseload working. It is sensitive to local factors such as demographics of the population; socio-economic needs; rurality issues; complexity of associated neonatal services.

The methodology remains responsive to changes in government policies on maternity services and clinical practices. Any maternity unit and service must be able to assess its staffing needs using a tried and tested system of workforce planning. BR+ is the most widely used system for classifying women and babies according to their needs, and using clinical outcome data to calculate the numbers of midwives required to provide intrapartum and postpartum care.

An individual service will produce a case mix based on clinical indicators of the wellbeing of the mother and infant throughout labour and delivery. Each of the indicators has a weighted score designed to reflect the different processes of labour and delivery and the degree to which these deviate from obstetric normality. Together with the case mix, the number of midwife hours per patient/client category is based upon the well-established standard of one midwife to one woman throughout labour.

In addition, BR+ determines the staffing required for antenatal inpatient and outpatient services, postnatal care of women and babies in hospital and community care of the local population birthing in either the main hospital or neighbouring hospitals. The method works out the clinical establishment based on agreed standards of care and specialist needs and then includes the non-clinical midwifery roles to manage maternity services.

BR+ assessment was completed in North Cumbria in July 2015 demonstrating that the staffing establishment at that time was below the recommended staffing levels for the activity and complexity of North Cumbria University Hospitals NHS Trust. The overall shortfall of around 16wte clinical staff against the BR+ recommendation indicates that with correct budget setting as described by NICE (2015) WCH is currently unlikely to require further investment, but CIC remains well under establishment as assessed by BR+.
It should be noted that the age profile of the midwifery workforce shows that 48% of midwives are age 46 and above, with 13% being over 55. With this in mind, there is an active and proactive approach recruitment for midwifery posts, but this is challenging, particularly since the cohorts of midwifery students going through training at North Cumbria are on the whole not from the local area and there is evidence to suggest that 80% of students are likely not to take up posts in the area, but to look for posts nearer to home.

*Changing Context for care*

The changing context of maternity services must however be taken into consideration, as nationally there is a challenge to transform services. North Cumbria has this to contend with as well as any uncertainty regarding the future sustainability of services. Within the Better Births review (2016), Continuity of Carer was the single biggest request from women. Women should have continuity of the person looking after them during their maternity journey, before, during and after birth. A systematic review by Sandall et al (2016), found that women who received models of midwife-led continuity of care were less likely to experience interventions and be more likely to be satisfied with their care with women being seven more times likely to be attended at birth by a known midwife. Within this systematic review there was evidence that clinical outcomes were much approved.

The options for transforming maternity services for North Cumbria will all require a commitment to ensuring correct staffing budget setting (NICE 2015) and a varying degree of investment, except the option to maintain current models and staffing. Doing nothing however will not meet any of the national goals required. This investment will not only need to be financial, but also in terms of workforce development, to ensure full skills and competence to provide a model of continuity of carer throughout the maternity journey.

The BR+ 2015 recommendation of ratio 22-24 births to 1 wte, could only be applied if the model of care remained the same. If there is transformation of services, then this would need to be recalculated. The Trust has put in a bid for monies from the LMS which is available to support major clinical change (culture change and clinical skills training) for a further BR+ assessment and await the outcome of this bid.

In summary, it seems that the midwifery service as currently organised could be maintained, but this would not take into account the transformation agenda or the opportunity for a more innovative service, which focuses staffing and care delivery around the woman rather than staffing buildings. It is difficult to assess the future sustainability of services given the change in culture and delivery of midwifery services necessary to meet national and local drivers of change. This challenge is, however, being faced by maternity units across the country, with levels of success that will only become clear over time. The age profile of the midwifery workforce is
again mirrored in many Trusts across the country along with difficulties in the recruitment and retention of staff. These challenges have all been acknowledged in North Cumbria and taken into consideration in the future planning for this service, utilising an active approach to recruitment. Investment in midwifery staffing will be required to meet the needs of any future service.

**Neonatal Nurse Staffing**

*Staffing Standards*

The nurse staffing standards set for all levels of neonatal care are chiefly governed by two publications: The DH Toolkit (2009) and the British Association of Perinatal Medicine (2010). These outline that there should be sufficient nursing staff available to care for infants in the ratio of:

- 1:1 for nurses caring for babies receiving intensive care
- 1:2 for babies receiving high dependency care
- 1:4 for babies receiving special care

Together with the staffing ratios outlined, at least 70% of the nursing establishment must be ‘qualified in specialty’ (QIS), which means that they have undertaken additional university based specialty specific training; there should be a minimum of two qualified nurses or midwives always on duty on any shift (with at least one of them with a QIS qualification) and in addition there should be a supernumerary team leader extra to those nurses caring for the babies. This can include non-registered staff but within the special care environment only at a maximum of 30% of the total staffing establishment; the remainder require professional registration. Staffing is calculated at occupancy levels of 80% with a 25% uplift to accommodate annual leave, sick leave, maternity and paternity leave, mandatory training and continuous professional development. Indicative banding is not included within the standards and so units are free to identify this on an individual basis.

*The National Staffing Picture*

Within the Cumbria area, CIC has eight cots designated for special care and WCH has nine cots designated for special care. Within the scope of the standards this means that both units should have a minimum of three staff on each shift and that two of these should be registered nurses with at least one with a QIS (though preferably two). This includes days as well as nights.

Staffing is calculated based on the designation of the unit and their annual activity. As cots have not always been commissioned at these standards there is currently a mismatch between cots and staff in many areas not just locally but nationally as historically this has been based on the budget and not on these specific standards.
There are also many areas within the United Kingdom where staffing levels are low due to an inability to recruit permanent staff in sufficient numbers. This has been the finding from a recent nursing survey undertaken by the Network Lead Nurses and highlighted in the soon to be published, Neonatal Critical Care Transformation Review led by Neil Marlow. However, the average nursing vacancy rate across England (including registered and non-registered staff) sits at 11.3%. This is lowest in the Northern Region with that figure reducing to 3.4%.

**Calculating Staffing**

Many units and networks use the ‘Dinning’ Tool in order to calculate the staffing required within their units (this formed part of the Toolkit in 2009). This utilises actual activity from the previous year to calculate staffing requirements based on a maximum of 80%. This therefore takes into account the times when units are busy together with the times that the throughput may be quieter and comes up with a general figure for all. The table below maps out the units at Carlisle and Whitehaven and accounts for the staff that they have currently, what their staffing establishment is set at, what the Dinning Tool has calculated this as using actual activity data from 2017/2018 and 2018/2019 and averages the shortfall.

**Current staffing situation across both units at Carlisle and Whitehaven**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Current WTE state of staffing</th>
<th>Staffing establishment (or budgeted)</th>
<th>Dinning suggested number as per activity for 18/19</th>
<th>WTE shortfall (as per Dinning estimation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIC (Carlisle)</td>
<td>16.25</td>
<td>16.41</td>
<td>16.84</td>
<td>0.59</td>
</tr>
<tr>
<td>WCH (Whitehaven)</td>
<td>10.88</td>
<td>16.00</td>
<td>14.80</td>
<td>3.92</td>
</tr>
</tbody>
</table>

The establishment number set for the Cumberland Infirmary at Carlisle is thus generally on par with what they are currently working to with a small uplift required to see staffing at the BAPM levels that are desirable. However, they are well staffed on paper.

Figures from WCH, however, are a few WTE staff away from what is required. Currently, using the Dinning estimated staffing tool, the vacancy rate at this site is 26.4%; higher than the average across England. This increases to 32% if their own establishment figure is used.

This situation becomes more problematic at times when there is unprecedented sickness or when there is maternity leave if these episodes are not sufficiently backfilled. This has occurred more recently across both sites in Cumbria.
Historical Nursing at Carlisle

The Cumberland Infirmary, Carlisle has had a nursing situation over many years whereby the senior nursing staff have had some enhanced training to enable them to undertake some more medical tasks such as cannulation and venepuncture. This has been partly due to the Trust not having any Tier 2 medical staff. However, these staff have not been appropriately trained and skilled in the same manner as other Advanced Neonatal Nurse Practitioners and instead provide a ‘hybrid’ model on the rota. This means that at times they are working both as clinical nurses on the shop floor with a workload of babies to care for as well as working in a more medical role. This is a rather confusing role for some and it means that staff are being utilized for two separate purposes at the same time. This is a practice that requires rationalisation to make it more efficient in the future.

Risks and Mitigations

Neonatal nurse staffing in Cumbria needs a long-term plan so that any peaks and troughs in activity can be supported as this is the nature of neonatal care. Any gaps in establishments should be recruited into as soon as is possible and practicable. It should be possible to fill nursing posts within the vacant slots particularly at the CIC site provided that there is an overall staffing strategy. This would include not being narrow in focus but embracing all possibilities for the qualification of these staff and that means not merely registered nurses with a Child qualification but those with Adult registrations as well as Midwifery ones. This should be aimed at the levels that are calculated within the Dinning Tool and the BAPM standards but like most units across England, should have safe staffing standards advocated failing meeting these specific targets and a plan developed as to how to get to the total figures in the future.

An escalation plan is useful at helping in such times when there are either too many sick babies or too few nursing staff. This should include plans for staffing to be shared across other areas and this has been done in both sites with the paediatric staff and this could also be done with midwifery, depending on their own staffing situations. The ability to staff a little over budget could also provide some further flexibility with a clear plan as to how this would work.

There should be a longer-term plan to change the current hybrid nursing model changes into one that is either a full ANNP model or one where the nursing staff are all included within the nursing numbers so that safety is maintained and nursing staff are better supported in their roles.
We also know that the age profile of the staff within SCBUs is more mature with 40% being aged fifty or more. This should also form part of the future-proofing of the Trust.

Overall if the staffing vacancies on both sites can be recruited into, there seems to be no reason that there cannot continue to be two SCBU units in North Cumbria provided that the appropriate medical support remains available.

Conclusions

The detailed assessments of staffing in each area – obstetrics, paediatrics, anaesthetics, midwifery and neonatal nursing – show a similar pattern. In each case there are difficulties, due both to the local challenges of size and geography and to national challenges of changing policy and recruitment difficulties. In each case, the Trust has exercised impressive commitment and ingenuity to mitigate the difficulties, and the service is currently being maintained.

This must not be taken to imply complacency. The challenges to recruitment and retention of key staff are considerable, arising from local geography, national staffing trends, and national policy which may be ill-adapted to circumstances outside a metropolitan setting. It may be that national trends can be reversed and national policy made more responsive to local circumstances – much effort is being directed at the former if not the latter – but it may be that neither will, and the worst-case view is that these pressures will only increase in future. The challenge for North Cumbria University Hospitals NHS Trust is to remain alert to emerging trends and policies and to find ways to head off their effects to sustain services, as they have during the past year.

The first question that we set out to address was whether the existing pattern of service with consultant-led units at both WCH and CIC (Option 1) can be staffed safely and sustainably, taking account of future risks. We have concluded that the existing pattern of service is currently staffed safely and sustainably. Future staffing risks are uncertain, but are likely to be significant and difficult. Nevertheless, the services have proved adaptable and innovative in overcoming problems to date, and it would be wrong to conclude that they will be unable to continue to do so in future.

Given that the questions set out above are sequential and that we have answered the first question affirmatively, we have not given our conclusion on the subsequent questions at this stage. We are conscious of the need to give as much certainty to the future of these services as possible, lest too much concern over future sustainability become self-fulfilling prophecy by further discouraging applications to work in the units. Should the recommendations in this report be accepted, however, we would be pleased to set out our findings in an addendum when complete, for information for those who will continue to run the services.
Finally, we have been impressed by the willingness of all concerned locally to engage in constructive dialogue about difficult issues and seek solutions, including particularly the Working Together Group. Some of the work undertaken in North Cumbria would be relevant to national policy on staffing, training, recruitment and other issues which affect service sustainability. Central NHS organisations have been slow to recognise that policies that fit well in metropolitan areas may not transfer elsewhere, and that resource and staffing may be different. It would be good to harness some of the local energy and experience to inform wider debates.

Recommendations

(1) The existing pattern of maternity services with consultant-led units in Whitehaven and Carlisle is operating effectively at present and is proving innovative and adaptable in overcoming challenges. A commitment should be given to sustain this service pattern.

(2) Midwifery-led services operating alongside these units are important in offering choice of birth setting in line with Better Births. A commitment should also be given to sustain this element of the service pattern.

(3) There will be challenges to sustaining this service pattern. It is important that a decision about Option 1 does not lead to any sense of complacency or ‘job done’. It is also important, however, that the stability of Option 1 is not undermined by a perception of crisis every time a challenge arises. A commitment should be given to maintaining vigilance and supporting innovative measures to counter these challenges in future, continuing the collaborative Working Together approach between the community and the NHS.

Independent Review Group
North Cumbria Maternity Services
June 2019
Our Ref: RT/JLS

Date: 27 June 2019

Mr J Rush
Chair
North Cumbria Clinical Commissioning Group
4 Wavell Drive
Rosehill
CARLISLE

Sent via email only

Email: robin.talbot@cumbria.nhs.uk

Dear Jon

Recommendations of the Independent Review Group regarding Maternity Services at West Cumberland Hospital

I refer to the letter from Peter to Stephen, dated 26 June, regarding the above.

The Trust welcomes the report and would like to take this opportunity to thank Dr Kirkup for all his help and support.

In relation to the implications for delivering the recommendations outlined in the report:

1. We acknowledge and welcome the report, especially the recommendations on page 22
2. The Trust commits to recommendation 1, page 22, to maintain the two consultant led units.
3. The Trust commits to recommendation 2, page 22, to provide alongside midwifery led units as part of choices of site for delivery and in line with “Better Births”.
4. Recommendation 3 is key to ensure stability of Option 1, given the workforce challenges.
Although not mentioned within the report, we need to be mindful of the financial impact of the two units.

Kind regards

Yours sincerely

[Signature]

Professor Robin Talbot
Chair

cc   Professor S Eames CBE
     Mr P Rooney
Working Together Group
Fri 7 June 2019
We want the IRG to know:

• Good understanding of risk
  – members of the community have a good understanding of the risks and challenges we face; (eg Sellafield etc); we know that each package of decisions has a package of risks – nothing is risk-free
  – though our view may be different from the NHS professional view, it comes from our lived experience of west Cumbria; so: we feel that our view of risk needs to be given weight equal to that of NHS professionals – coproduction!
  – “local” is really important to us! Most people in west Cumbria are “somewhere” people – they feel safer closer to home and family; those who are “anywheres” (David Goodhart) may not (cannot?) understand the strength and depth of these feelings
  – the concerns held are around the risks and experience of journeys to reach and return from care safely
  – we all need to have trust and confidence in services and to be included in design and decisions about them

• Domino
  – the community see the services at WCH (especially Maternity) as linked: if one part goes, all the others will be eroded; maternity is a cornerstone for many other services at WCH;
  – WCH is greater than the sum of its parts

• Change : coproduction : commitment
  – the conversations and relationships between the community and NHS system have changed from confrontational to shared; we are trying to get away from “them” and “us”
  – coproduction makes Option 1 more sustainable – this presentation will show that! Coproduction is the essence of what is required in this place
  – we are committed to supporting the NHS in coproducing Option 1 and healthcare generally
What have we learned?

• Share
  – it’s ok for the system to share information with the community early and openly – we can share challenges and risks
  – we have even held confidential information (eg about the closure of the Whitehaven surgery)
  – people in the community (including retired health professionals) can add value – time, extra energy, etc

• Flexible
  – we have been flexible…. : we came to talk about x but jointly decided y was more important
  – we have had to learn as we went along – no textbook; a coffee/tea break in the middle for chatting has been really good
  – we have had a steering group and five working groups; we think this may need to change after the Option 1 review and decision

• Honest
  – both sides are learning to be open and constructive
  – it’s been painful at times but we have persevered
  – people now don’t sit in blocks but mix

• Wider
  – better working with public health consultants / midwives (issues like breastfeeding support) is moving the conversation to “wellness”
  – not just health : also other public issues eg the health contribution to A595 consultation
A picture of change

Before: 4,000 worried and angry people at Whitehaven Rugby Football Ground

After: a group of people (one of many) working at coproduction
Maternity Voices Partnership

**Influential**
- impacting on how maternity teams work - the NHS mindset now seeks the involvement of service users
- key in perinatal mental health work, creating the approach of “first steps” type appointments at Happy Mums in case childcare is an issue
- other: family centred - needs of dads and partners on the agenda / improved breastfeeding support / expansion of public health services to include mental wellbeing in maternity (directly from feedback from service users in MVP workshops) / MVP surveys
- has influenced Co-production as a whole: Working Together Steering Group has matured to incorporate wider conversations (eg from Option 1 to NHS values [Kindness, Ambition, etc])

**Active**
- growing, thriving, engaging and has an active user membership (regional and national recognition)
- heavily involved in the Better Births agenda
- AMLU - tangible that MVP was driving the work - making the best of what we had
- MVP has secured funding for a second birthing pool

**Changing**
- moved from having an engagement wish list (via our Maternity Matters report) to things that are happening
Midwifery Led Rooms (West Cumberland Hospital)

- Active group of Service users/and midwifery manager involved
- Homelier less clinical feel to the space now
- More active birth equipment provided, parents designed posters to show use
- More colour in rooms
- Photo Wall art & Professional Photos donated via service user initiated contacts
- MVP with staff successful bid to Snowball charity for funds for new birth pool 2018 - awaiting installation
- MVP website providing info www.wnecumbriamvp.co.uk
Experience of care at distance

• Geography and Demography:
  the group wants the NHS / IRG to understand:
  – our geography; there are mountains, rivers, lakes to go round; the roads are not great: only one section of dual carriageway in west Cumbria; there are lots of communities further south than Whitehaven....
  – our emotional geography
  – our levels of car ownership / deprivation; there are estates where fewer than half the households have access to a private car
  – the challenges of using rural public transport

• Achievements
  – improving signage
  – creating appointment information maps for people travelling to WCH and CIC with links to timetables
  – supporting the development of remote consultation
Children

• **Specifics**
  – asthma pathway – feedback, advice, and ideas, from the Children’s Group are vital to reducing admissions and improving planned care
  – NHS Child Health App – supported plan for promotion

• **Change**
  – the community has better understanding about treatment appropriate in different places (eg poorly children in specialist centre) – though it is still difficult for poorer families with more than one child
  – SSPAU feels as if it working – there has been good feedback

• **Young people**
  – no children / young parents on the group - but good relationships between professionals that weren’t meeting regularly – and young people getting involved
  – growing links to youth groups
Recruitment and Retention

A more challenging area:

• What we have been able to try
  – **Tea with the Team** – both a success and a failure. It was to connect with new staff to help them connect into the community – it didn’t attract many staff (probably wrong place and time) BUT we found lots of goodwill from the community and created a video shared at recruitment fairs
  – members of group joined the recruitment day at WCH and supported encouraging people to accept jobs there

• Supporting innovation
  – raised awareness of support needed for **clinicians coming from other cultures** and started work to prepare for new clinicians coming from India. Welcoming new doctors is everyone’s responsibility: coproduction is committed to ensuring the community makes a success of this
  – more diversification of the workforce – understanding of impact of composite and **new roles**
  – work with UCLan / University of Cumbria – more awareness of **training our own**

• Understanding
  – more awareness of the challenge – before coproduction it was difficult to convey the issues, now there’s a wider understanding that it is a national problem

• Need focus on **retention** as well
Telehealth

• Remote Consultation Clinics
  – secured funding for remote consultation pilots in cancer, mental health, gastroenterology, paediatrics using Attend Anywhere technology
  – **NHS Near Me Services**: Remote Clinics to be established in 8 Community Hospitals or Community Hubs (providing a nurse supported consultation as close as possible to patients’ homes).
  – equipment to be established in both CIC and in WCH to provide remote consultation allowing any service to test delivery of Remote Consultation Clinics.

• Improving access
  – increasing links to specialist centres (paediatric nephrology, neonates)
  – Foetal ultrasound and teleconsultation WCH to Newcastle
  – perinatal mental health service

• Benefits for patient, families, NHS
  – collecting feedback about experience / miles saved/ carer time saved etc
  – this and other innovations will improve the outcomes for those living in deprivation and suffering poor health
Other things to think about

• Achievements / Positives
  – WCH is in a different position in 2019: £30m investment
  – nationally we are the experts in rural and remote medicine - look at the progress we are making
  – big improvements in the Trust: out of Special Measures / recruitment / etc
  – big improvements in trust and ownership - the strength of coproduction and the very positive culture that we have evolved underpins a potentially very successful health and care model.

• Issues
  – there is a fragility not only in the services, but also in coproduction and in the relationships between NHS and community;
  – but we are starting to think differently...... we want the NHS to always think to ask the community for help
  – and we are thinking about how to widen the involvement in coproduction
  – population health – obesity is a big issue, as is care of the elderly
  – more coproduction is needed in other areas: stroke / cancer care / ICCs

• Philosophy
  – both society and NHS are changing: more and more focusing on shared decision making with patients
  – increased resilience in communities / more creativity in finding solutions: better use of services
  – our collaborative, inclusive approach means that these remote communities are now more empowered and so in a stronger position to support their NHS
Co-production: A change in attitude
A manifesto for the system
It matters to you and it matters to us

<table>
<thead>
<tr>
<th>Population</th>
<th>Shared need</th>
<th>NHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physically and emotionally</td>
<td>To be safe</td>
<td>Effective services</td>
</tr>
<tr>
<td>By family and community as well as professionals</td>
<td>To feel supported</td>
<td>Skilled, compassionate professionals</td>
</tr>
<tr>
<td>Aids recovery</td>
<td>To have a positive experience</td>
<td>Supports retention, recruitment and progress</td>
</tr>
<tr>
<td>We can inform person-centred delivery</td>
<td>To be involved</td>
<td>Greater job satisfaction</td>
</tr>
</tbody>
</table>

We want the IRG & NHS to recognise a joint understanding of risk
Where we were....... Where we are

From public meetings to a shared ambition

https://youtu.be/x6uUPIMt-kI
https://youtu.be/SoBmzmW4z_o
Thank you for listening

• Good understanding of risk
• Domino
• Change : coproduction : commitment

➢ We hope you will ask us some questions
➢ May we ask you any questions?
Evidence review: the association between distance/travel time and obstetric or birth outcomes

Published September 2018
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Executive summary

Introduction

This evidence review was conducted by Solutions for Public Health (SPH) and commissioned by NHS North Cumbria CCG to inform local implementation of the national Maternity Transformation Plan. The primary research question for the review was: Is there an association between distance from/travel time to maternity delivery units (any type) and obstetric or birth outcomes? The question was to be addressed in the context of West North and East (WNE) Cumbria and in terms of (a) journeys from home to maternity delivery units and (b) journeys from planned place of birth in the community to a consultant-led delivery unit.

Background

West North and East (WNE) Cumbria has a total population of around 327,000 (around 65% of the wider Cumbria population). The three main population centres are: Carlisle (the largest conurbation), and Workington and Whitehaven (smaller towns), both on the west coast, and geographically isolated with poor transport links. The two towns are 30 and 39 miles (approximately 48km and 64km) respectively from Carlisle, and 93 miles and 99 miles (approximately 150km and 159km) respectively from Newcastle. Maternity services in 2016 (prior to plans for reconfiguration) comprised consultant-led delivery units and level 1 neonatal units in both Whitehaven and Carlisle, a standalone midwifery-led unit in Penrith, and tertiary level maternity services with level 3 neonatal care services in Newcastle. The average travel time by road from Whitehaven to Carlisle is 1 hour 15 minutes, and from Carlisle to Newcastle 1 hour and 18 minutes (distance 60 miles or 97km). For the purposes of this review, it was assumed that the maximum travel time from a woman’s home to maternity delivery unit of any type, taking into account poor road networks and conditions, would be no more than two hours and the maximum distance travelled would be no more than 60 miles (97km).

Methodology

A literature search was conducted on 23rd January 2018 of Medline, Embase, the Cochrane Library, TRIP and NICE Evidence. The search was limited to English language papers published from 1st January 2008 onwards reporting studies conducted in high-income countries. Publications identified in the search were screened via a three-stage process involving three independent reviewers to identify studies eligible for inclusion. The quality of individual studies was critically appraised and their applicability to Cumbria was assessed.

Results

Twelve studies were identified for inclusion in the review. All investigated the relationship between distance and/or travel time between women’s homes and maternity unit where delivery took place and/or nearest maternity unit, and obstetric or birth outcomes. One study (Ravelli, 2011) also considered travel time from planned place of birth in the community to actual location of birth in hospital. The studies were observational in design (ten cross-sectional and two case control studies), hence susceptible to weaknesses associated with bias and confounding. Most of the studies were not considered to be applicable to Cumbria due to differences in population characteristics, geography/setting, health services and/or health outcomes between the study population and that of Cumbria. One study (Paranjothy, 2014), conducted in Wales, was considered to be of ‘Good’ quality (in terms of internal validity) relative to the other studies and highly applicable to Cumbria. A second study (Combier, 2013), in the Burgundy region of France, also of ‘Good’ quality, was moderately applicable to Cumbria, and a third, by Ravelli (2011), conducted in the Netherlands, was of ‘Fair’ quality but low applicability to Cumbria. All other studies were considered to be of either ‘Fair’ or ‘Poor’ quality and of low applicability to Cumbria.

The Welsh study (Paranjothy, 2014) reported an increased risk of perinatal and neonatal death for singleton pregnancies (≥24 weeks) (n=412,827) with every 15-minute increase in estimated travel time to actual hospital of delivery (n=50 hospitals), compared with a travel time of less than 15 minutes, but no difference in risk when the analysis was repeated for travel time to the nearest maternity hospital open at the time of delivery (n=30 hospitals). No adjustment was made for the level
of healthcare provision at actual or nearest hospital. One explanation for the study findings is therefore that women at higher maternity risk were more likely to travel further to reach hospitals with more specialised facilities than those at lower risk.

The study carried out in Burgundy, France (Combier, 2013) (n=111,001 singleton births of ≥22 weeks) found that for women with longer estimated travel times to the nearest maternity unit (more than 30 minutes by rapid ambulance transport), their babies were more likely to experience foetal distress than those born to women with journey times of less than 15 minutes. There was also a higher risk of unplanned out of hospital (OOH) birth for women with estimated travel times of 16 to 45 minutes compared with travel times of less than 15 minutes, but no unplanned OOH births were recorded in women travelling more than 45 minutes to the nearest maternity hospital. Women living more than 45 minutes’ travel time from their nearest maternity unit had a higher risk of hospitalisation more than 24 hours before delivery compared with those living less than 15 minutes away. However, no follow up outcomes were reported for any women or babies and the study found no difference in risk of stillbirth or perinatal death associated with longer travel times to the nearest maternity hospital. As with the Paranjothy study, the analysis adjusted for potential confounders but did not adjust for level of health care provision.

Only one study (Ravelli, 2011 (n=751,926)), conducted in the Netherlands, investigated the relationship between travel times and outcomes for women transferred during labour from primary care (where delivery had been planned in a community setting (home or outpatient clinic) under the care of a midwife) to secondary care where delivery occurred in hospital (under the care of a consultant obstetrician). This study was of ‘Fair’ quality but considered to be of low applicability to Cumbria due to significant differences in the delivery of maternity services between the Netherlands and England. For women transferred during labour from primary to secondary care, the study found no difference in risk associated with transfer times of 20 minutes or more from a community setting to the hospital compared with travel times of under 20 minutes for the combined outcome of peripartum stillbirth and neonatal mortality or a composite adverse outcome of peripartum mortality and neonatal morbidity.

Taking into account the body of evidence from across all studies, we found that:

- Of the eight studies which reported perinatal/neonatal mortality as an outcome, four (Paranjothy, 2014; Pilkington 2014; Lisonkova, 2011, and Ravelli, 2011) reported an increase in mortality associated with travel times to hospital although, for one of these studies (Pilkington, 2014), the results were inconsistent.
- Amongst the four studies showing an increased risk, the study considered most applicable to Cumbria (Paranjothy 2014) reported an increase in mortality associated with travel time to actual hospital of delivery, but not when the analysis was repeated for travel time to nearest hospital. The other three studies were considered of low applicability to Cumbria.
- All six studies which measured out of hospital (OOH) births reported an increased frequency of OOH births with longer travel times and/or distances. Another study (Pilkington, 2014) reported outcomes following unplanned OOH birth in relation to distance from nearest maternity unit but its findings were inconsistent across different distance cohorts.
- All three studies which measured induction of labour reported no difference in risk with increasing travel time (Combier, 2013 and Grzybowski, 2011) or distance (Lisonkova, 2011) to hospital. Of the three studies reporting the association between caesarean section (CS) rates and travel time/distance to hospital, two (Grzybowski, 2011 and 2015) reported a lower risk of CS for women travelling 1 to 2 hours compared with those travelling less than 1 hour; the third study (Lisonkova, 2015) found no difference in risk of CS with increasing distance from hospital.
- No consistent findings were observed across studies for any other outcome measures.

Conclusions

We found insufficient evidence to provide a definitive answer to the research questions for this evidence review.
All of the identified studies had inherent design weaknesses with a high risk of bias and confounding, and few were applicable to Cumbria because of differences in service delivery, populations, health outcomes and geography/setting. One study (Paranjothy, 2014) which was both of good quality and in a setting with many similarities to Cumbria found conflicting evidence relating to travel times and outcomes, with some increased risk of worse perinatal outcomes when analysis was done by actual hospital of delivery, but none with analysis by nearest maternity unit. However the limited information about levels of care available and lack of adjustment for some important confounding factors make the interpretation of these findings difficult, although one explanation might be that women at higher maternity risk were more likely to travel further to reach hospitals with more specialised facilities than those at lower risk. A second good quality study (Combier, 2013) with moderate applicability to Cumbria found no evidence of increased mortality, but some evidence of an increased risk of foetal distress and of unplanned OOH birth associated with longer estimated travel time to the nearest maternity delivery unit, but did not report longer term outcomes for mother or baby.

The single, ‘Fair’ quality study (Ravelli, 2011) which investigated transfer during labour from primary care (with delivery planned in the community under the care of a midwife) to secondary care (with delivery in hospital) found no difference in risk of adverse outcomes, for this cohort, with estimated travel/transfer times of 20 minutes or more compared with those with travel times of less than 20 minutes.

Some of the remaining studies found an increased risk of some adverse outcomes associated with increases in travel time or distance from maternity facilities, or for those living in rural areas compared with those in urban areas, but these findings were inconsistent across studies, unreliable due to poor study quality, and of low applicability to Cumbria.

On the basis of these findings, it is reasonable to conclude that our review of the evidence base most applicable to Cumbria has not identified any evidence of an association between travel times to the nearest maternity delivery unit and mortality rates. However, this conclusion cannot be interpreted as a declaration that such an association does not exist for the reasons described above. With regard to other outcome measures, it is also possible to conclude that the current evidence is suggestive of an increase in the frequency of OOH births associated with longer travel times and/or distances to the nearest maternity delivery unit.
1. Introduction

This evidence review was conducted by Solutions for Public Health (SPH) and commissioned by NHS North Cumbria CCG to inform the Independent Review Group (IRG) whose role is to support ongoing implementation of the Local Maternity System (LMS) within the West, North and East Cumbria Health and Care Partnership (STP) area. The scope of the evidence review was to answer the following research questions:

Primary research question:
Is there an association between distance from/travel time to maternity delivery units (any type) and obstetric or birth outcomes?

This question was further refined into the following four questions:

1(a) Is increasing distance from/travel time from place of residence to maternity delivery unit (any type e.g. birth centre or freestanding midwife led unit (MLU/FMU) or consultant-led unit (CLU)) associated with any adverse impact on obstetric or birth outcomes?

1(b) Does the picture differ for high versus low risk mothers/maternities?

2(a) Is increasing distance from/travel time between standalone midwife led units (MLUs)/freestanding midwife units (FMUs) or place of residence (for planned home births) and obstetric (consultant) led units (CLUs) associated with any adverse impact on obstetric or birth outcomes?

2(b) Does the picture differ for high versus low risk mothers/maternities?

2. Background

2.1 Population and geography in West, North and East Cumbria

West, North and East (WNE) Cumbria has a total population of around 327,000, representing around 65% of the wider Cumbria population. The area is defined geographically as the four districts of Allerdale, Copeland, Carlisle and Eden, the first three located along the west coast of Cumbria. Cumbria is one of the most rural counties in England, with a total area of almost 6,800 km$^2$ and an average population density of 74 people per km$^2$. The largest urban centre in WNE Cumbria is Carlisle (population approximately 100,000), where Cumberland Infirmary Carlisle (CIC, a district general hospital) is located. The other two major conurbations (each with approximately 25,000 people) are adjacent towns of Workington and Whitehaven (where West Cumberland Hospital (WCH), also a district general hospital, is located). The two towns, on Cumbria’s west coast, are geographically isolated with poor transport links and are 30 and 39 miles (approximately 48km and 64km) respectively from Carlisle, and 93 miles and 99 miles (approximately 150km and 159km) respectively from Newcastle (where specialised tertiary NHS services are available). The average travel time by road from Whitehaven to Carlisle is 1 hour 15 minutes, and from Carlisle to Newcastle 1 hour and 18 minutes (distance 60 miles or 97km)\(^1\).

For the purposes of this evidence review, it was assumed that the maximum travel time from a woman’s home to delivery unit (whether CLU, MLU or birth centre), taking into account poor road networks and conditions, would be no more than two hours and the maximum distance travelled would be no more than 60 miles (or 97km).

\(^1\) Source of information on distances and travel times: West North and East Cumbria’s Better Births Plan (Local Maternity System), 2017-2021. Distances shown are by road between the hospital in each location; travel times are average travel times by non-emergency transport. These average figures do not indicate the full range of distances and travel times applicable to women in Cumbria who are accessing maternity care. Actual distances and travel times will depend on factors such as type of transport and time of day.
2.2 Health needs of mothers and babies in WNE Cumbria

Overall, the population of WNE Cumbria is more deprived than average for England, with 17 Lower Super Output Areas (LSOAs), in the districts of Allerdale, Copeland and Carlisle, within the 10% most deprived LSOAs in the country\(^2\). Cumbria also has a smaller proportion of residents from Black, Asian and Minority Ethnic (BAME) groups than the national average (3.5% vs 19.5%).

In England, in 2015, maternal mortality was 9 per 100,000 live births, the stillbirth rate was 4.4 per 1000 births (live and stillbirths), the neonatal mortality rate was 2.5 per 1000 live births and perinatal mortality rate was 6.3 per 1000 births.\(^3\) In the same year, the perinatal mortality rate for Cumbria CCG was 4.1 per 1000 total births (95% confidence intervals (CI) not reported so it is not clear if this is significantly different from the national average; data for the stillbirth, neonatal mortality and maternal mortality rates in Cumbria may be unreliable due to small numbers so are not shown here).

Compared with the national average, indicators of health needs of mothers and their babies in WNE Cumbria include the following (‘no difference’ indicates that the rate is not statistically significant from the national average; ‘higher’ or ‘lower’ indicates that, compared with the national average, the difference is statistically significant):\(^4\)

- no difference in infant mortality (2014-16)
- no difference in the proportion of low birth weight (LBW) babies (2016)
- a lower proportion of children under 16 living in low income families (2015)
- a lower rate of breastfeeding initiation (2016/17)
- a higher rate of smoking at time of delivery for Cumbria as a whole (2016/17)
- a higher rate of alcohol-related admissions in Copeland and Carlisle (and Cumbria as a whole) (2016/17)
- no difference in the proportion of overweight or obese adults (2016/17)
- a lower rate of flu vaccination coverage during pregnancy (49.7%) compared with a national target of 55% (2016/17).

2.3 Configuration of maternity services in WNE Cumbria

In 2016, CLUs and level 1 neonatal units were located in both Whitehaven (at WCH) and Carlisle (at CIC), with a birthing centre located in Penrith (a standalone MLU in a community hospital, 22.5 miles (36.5km) from Carlisle, equivalent to an average travel time by road of approximately 30 minutes); tertiary level services and level 3 neonatal care services were available in Newcastle (NRI). In developing plans for local implementation of the national Maternity Transformation Plan (based on the vision for maternity services in England from the national maternity review ‘Better Births’ published in February 2016), the following options were identified for configuration of maternity services in WNE Cumbria:

- Option 1 - Consultant-led Unit (CLU) and alongside Midwifery Led Unit (AMLU) at both CIC and WCH
- Option 2 – CLU and AMLU at CIC, standalone MLU\(^5\) at WCH
- Option 3 – CLU and AMLU at CIC, no births at WCH

Antenatal care, postnatal care, home births and births at the Penrith Birthing Centre were unaffected by these options.

After public consultation during 2016\(^6\), the following implementation plan was agreed:

- Test the viability of Option 1 over a 12 month period
- If Option 1 is not proven to be deliverable or sustainable then implement Option 2 at the end of the 12 month period

\(^2\) Source: Cumbria Intelligence Observatory – deprivation analysis using Index of Multiple Deprivation (IMD) 2010
\(^3\) Source: Office for National Statistics (ONS), 2015
\(^4\) Sources: PHE fingertips data (accessed May 2018); WNE Cumbria STP 2016-2021
\(^5\) Also known as Freestanding Maternity Unit (FMU)
\(^6\) ‘Healthcare for The Future’ public consultation which ran from 26 September to 19 December 2016
• Whilst testing Option 1, prepare for Option 2 by implementing a Midwifery Led Unit (MLU) in Whitehaven alongside the Consultant-led Unit, in order that the MLU can be audited as if it was freestanding.
• Implement Option 3 if Option 1 is not proven to be deliverable or sustainable and, following audit of the MLU, Option 2 is not deemed to be safe.

At the time of conducting this evidence review implementation of Option 1 was in progress.

2.4 National guidance

There is no national guidance which considers distances and/or travel time between home and delivery unit or between planned location of birth and consultant-led unit before or during labour.

The NICE clinical guideline ‘Caesarean Section’ (CS) (CG132) recommends the timeframe within which CS should be performed after the decision is made to perform CS (see extract below). The NICE clinical guideline ‘Intrapartum care for healthy women and babies’ (CG190) refers to the need for timely access to obstetric care if needed but does not define ‘timely access’ (see extract below).

Extract from NICE guideline on CS (CG132):
1.4.3 Decision-to-delivery interval for unplanned CS
1.4.3.1 Perform category 1 and 2 CS as quickly as possible after making the decision, particularly for category 1.
1.4.3.2 Perform category 2 CS in most situations within 75 minutes of making the decision.

Extracts from NICE guideline on intrapartum care (CG190):
1.1 Place of birth
1.1.15 Ensure that all women giving birth have timely access to an obstetric unit if they need transfer of care for medical reasons or because they request regional analgesia.

1.9 Pain relief in labour: regional analgesia
1.9.1 If a woman is contemplating regional analgesia, talk with her about the risks and benefits and the implications for her labour, including the arrangements and time involved for transfer of care to an obstetric unit if she is at home or in a midwifery unit (follow the general principles for transfer of care described in section 1.6).

1.13 Second stage of labour
1.13.34 If the birth needs to be expedited for maternal or fetal reasons, assess both the risk to the baby and the safety of the woman. Assessments should include:
- the degree of urgency
- clinical findings on abdominal and vaginal examination
- choice of mode of birth (and whether to use forceps or ventouse if an instrumental birth is indicated)
- anticipated degree of difficulty, including the likelihood of success if instrumental birth is attempted
- location
- any time that may be needed for transfer to obstetric-led care
- the need for additional analgesia or anaesthesia
- the woman’s preferences.

3. Methodology

We conducted a literature search on 23\textsuperscript{rd} January 2018 using the search strategy detailed in Appendix 1 and included the following databases: Medline, Embase, the Cochrane Library, TRIP and NICE Evidence. The search was limited to English language papers published from 1\textsuperscript{st} January 2008

\textsuperscript{7} Category 1 CS is when there is immediate threat to the life of the woman or foetus, and category 2 CS is when there is maternal or foetal compromise which is not immediately life-threatening.
onwards and focused on studies from high-income countries, defined by membership of the Organisation for Economic Cooperation and Development (OECD). Conference papers, letters, commentary, editorials and case reports were excluded. All abstracts were assessed by the lead reviewer, and were then subsequently assessed by two further independent reviewers, with three-way discussion to reach consensus on selection of publications for full paper review. Full papers were assessed by the lead reviewer to identify studies for inclusion. The rationale for study inclusion/exclusion was then reviewed by two independent reviewers followed by three-way discussion to reach consensus on final study selection.

Studies were deemed eligible for inclusion if they were within the defined scope of the review (see search strategy in Appendix 3) and investigated the impact of travel times of up to two hours and/or distances of up to 60 miles (97km) from home to delivery unit, or from planned location of birth (home or other location) to delivery hospital, on obstetric and/or birth outcomes.

The quality of included studies was critically appraised using the NICE Quality Appraisal Checklist for quantitative studies reporting association or correlation (see Appendix 4). The applicability of individual studies to Cumbria was considered using information, where reported by study authors, on population characteristics, geographical setting, health service provision, and/or health outcomes, supplemented with information on maternal mortality ratios (from 2015) and neonatal mortality rates (from 2016) published by the World Health Organisation (WHO) (see Appendix 5).

4. Results

4.1 Literature search output

The number of publications identified in the literature search are shown in the PRISMA diagram (see Figure 1). 1312 publications were identified in the search. Of these, 81 publications remained after initial screening to remove studies that were not conducted in high-income countries. Following assessment of abstracts by the review team, 32 of the 81 publications were selected for full paper review.

Of the 32 studies which involved full paper review, 20 studies were excluded on the following grounds: they did not analyse or report outcomes for travel times or distances within the parameters that were considered applicable to Cumbria (travel times of up to two hours or distances up to 60 miles); they focused on discrete communities or types of service for which study findings were considered not applicable to Cumbria, or they investigated the impact of travel time/distance from home to neonatal or perinatal care services, with no mention of distance or travel time to reach maternity services.

Twelve studies were considered eligible for inclusion in the review. All 12 investigated the relationship between distance and/or travel time between a woman’s usual place of residence (home) and actual or nearest delivery unit, and obstetric/birth outcomes. One of the studies (Ravelli, 2011) also investigated the relationship between travel time and obstetric/birth outcomes for women transferred during pregnancy or labour from a community setting (under the care of a midwife) to hospital for delivery (consultant-led care).

The summary evidence table (see Appendix 2) shows, for each included study, details of its methodology and results, with critical appraisal commentary on its strengths, limitations, and applicability to Cumbria.

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8 http://www.oecd.org/about/membersandpartners/
Figure 1: PRISMA Flow Diagram

Records identified through database searching  
(n = 1871)

Additional records identified through other sources  
(n = 1)

Records after duplicates removed  
(n = 1312)

Records after initial screening  
(n = 81)

Abstracts assessed for eligibility  
(n = 81)

Records excluded  
(n = 49)

Full-text articles assessed for eligibility  
(n = 32)

Full-text articles excluded as out of scope  
(n = 20)

Studies included in qualitative synthesis  
(n = 12)

Evidence Review: the association between distance/travel time and obstetric or birth outcomes
4.2 Description of included studies

The table in Appendix 1 shows a high level summary of the methodological characteristics of each study including its design, population, data period, exposure(s), outcome(s) and variables included in analysis.

Study location
The studies were conducted in seven different countries: Norway (Engjom, 2017), Canada (Grzybowski, 2015 and 2011, Lisonkova, 2011), the US (Featherstone, 2016), Finland (Ovaskainen, 2015), Wales (Paranjothy, 2014), France (Pilkington, 2014; Combier, 2013; Renesme, 2013; Blondel, 2011) and the Netherlands (Ravelli, 2011).

Study design
Ten studies were cross-sectional in design (with sample size ranging from 2,030 to 6.2 million); the other two (Ovaskainen, 2015 and Renesme, 2013) were retrospective case control studies (with sample sizes of 201 and 228 respectively) in which out of hospital (OOH) births/out of hospital deliveries (OHDs) were cases and in-hospital births were controls.

Population
Two cross-sectional studies (Engjom, 2017 and Pilkington, 2014) included both singleton and multiple births. All other studies were of singleton births. Two studied a defined subgroup of singleton births; one (Featherstone, 2016) included only premature, very low birth weight (VLBW) births, the other (Lisonkova, 2015) included births in women aged 35 years or more. Neither of the two case control studies referred to multiplicity of births in their inclusion criteria although one (Renesme, 2011) reported that all identified OOH births were singleton and the other (Ovaskainen, 2015) described the approach to selection of controls as ‘births immediately preceding and following each OHD case’, which suggests that all cases and controls were singleton.

Exposure(s)
The exposure was defined in terms of distance alone (three studies), travel time alone (six studies), or both (three studies). Studies measured travel time and/or distance from a woman’s home to either the nearest maternity facility (eight studies) or actual maternity facility where delivery occurred (three studies); one study (Paranjothy, 2014) measured travel time to both actual and nearest maternity hospitals (not further described).

Outcome(s)
Eight studies investigated the association between distance and/or travel time and perinatal mortality; all of these included both stillbirth and neonatal mortality except one (Featherstone, 2016) which measured only neonatal deaths. Seven studies investigated the association between distance and/or travel time and indicators of neonatal morbidity (such as Apgar scores, prematurity, and admission to neonatal care facilities). Nine studies reported obstetric care-related outcomes (such as OOH birth, induction of labour, caesarean section (CS), and hospitalisation during pregnancy). None of the studies reported mental health and/or quality of life outcomes.

Variables
All of the cross-sectional studies adjusted their analysis for potential confounding factors or effect modifiers in one or more of the following groups: socio-economic or environmental, maternal risk factors, neonatal risk factors, type/level of health care provided. The two case control studies (Ovaskainen, 2015 and Renesme, 2013) investigated the association between unplanned OOH births and a range of different variables including distance and/or travel time (using multivariate analyses involving adjustment for all other variables when investigating the effect of each variable).

4.3 Study methodology

The following paragraphs highlight some of the methodological issues associated with study design and important to interpretation of the body of evidence included in this review.
Evidence Summary Report

Study population

Inclusion/exclusion of multiple births

The risk profile of multiple births\(^9\) is likely to differ substantially from that of singleton births, so the inclusion of multiple births (by Engjom, 2017 and Pilkington, 2014) is likely to have been associated with a higher absolute risk of adverse outcomes in the study population compared with studies of only singleton births (for example, in England and Wales, early neonatal mortality for multiple births (which represent 3% of all births) was 14.4 per 1,000 live births vs 2.3 per 1000 for singleton births, 2005-2006\(^{10}\)). Since multiple births are more likely to involve planned delivery in a hospital with obstetric and neonatal care facilities rather than delivery in a community setting under the care of a midwife, the inclusion of multiple births may have been a confounding factor in these two studies, neither of which adjusted their analysis for type/level of health care provision.

Inclusion/exclusion of congenital anomalies

Studies varied according to whether births associated with congenital anomalies, a known cause of adverse neonatal outcomes, were included or excluded and, if included, whether they were adjusted for in analysis. Studies which excluded congenital anomalies were: Paranjothy (2014) (fatal anomalies only), Grzybowski (2015 and 2011) and Ravelli (2011). Congenital anomalies were included by Featherstone (2016), Pilkington (2014) and Lisonkova (2011), but only Lisonkova adjusted for them in analysis. The other five studies did not refer to congenital anomalies as one of their exclusion criteria or as a variable adjusted for in analysis. If a congenital anomaly is identified antenatally, delivery is more likely to have been planned at a hospital with a higher level of specialist expertise. This is a potential source of confounding in this group of studies because identification of a congenital anomaly antenatally may be associated with both distance from unit and higher risk of adverse outcome.

Exposure (travel time/distance)

Use of travel time vs distance

Studies measured distance and/or travel time between women’s homes (usual place of residence) and nearest or actual maternity unit where birth occurred (one study, Paranjothy (2014) measured travel time to both nearest and actual maternity unit). Where studies measured distance only (Lisonkova, 2015; Pilkington, 2014; Blondel, 2011), their findings are very difficult to apply to another setting with different geography and road networks.

Methodology for calculating exposure

Various methodologies were used to measure the exposure. None of the studies measured actual travel (journey) times/distances but instead calculated the exposure at either individual or community level, using a variety of approaches. Some studies used a combination of postal codes for women’s home and maternity facility addresses, geographical information system packages and/or local data on travel routes/times; others created zones/catchment areas around each maternity facility, which corresponded to different travel times/distances, and then assigned births to each zone or catchment area based on the mother’s home address. Some studies used an imprecise measure of distance and/or travel time calculated at area level rather than individual level. All studies measuring travel time assessed surface travel time. Travel time measures used were often the fastest time under optimal conditions. Mode of transport was not usually specified; one study (Combier, 2013) measured travel time via emergency vehicle so may have underestimated the time taken by a privately-owned vehicle in the same or other locations; Engjom (2017) calculated travel times based on non-emergency transport which included via ferry/boat. Three studies (Pilkington, 2014; Blondel, 2011; Lisonkova, 2011) measured outcomes in association with rurality as well as distance; definitions of rurality varied by country of study\(^{11}\).

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\(^{9}\) Maternities involving more than one foetus (e.g. twins or triplets)


\(^{11}\) Pilkington (2014) defined rurality according to employment and commuter travel; Blondel (2011) did not define rurality but it is likely that the study used the same definition as that used by Pilkington (2014), also conducted in France; Lisonkova defined rurality as less than 10,000 inhabitants.
Validity/reliability of exposure
All travel time and distance measures were based on the assumption that women were at home (or close to home) at the onset of labour and would travel from home to place of delivery. In some countries, for example in the UK and the Netherlands, it is usual for women to be on pregnancy leave and at home around their due date. In other countries, particularly those involving long distances to the nearest delivery hospital (for example Norway, Finland, Canada), the assumption may not be true for all women since some may stay with relatives closer to the delivery hospital and/or may have birth induced early (via planned CS) to avoid the risk of travelling long distances after the onset of labour. None of the studies measured time delays before setting out on the journey to the delivery unit, or after arrival at the unit before assessment by the maternity staff. This may have led to contamination of the exposure in the study by Ravelli (2011), in the Netherlands, where women with low-risk pregnancies whose delivery is planned in a primary care setting (at home or in a community outpatient clinic) are first assessed at home by their midwife and only begin their journey to the clinic (or hospital for women referred from primary to secondary care during labour) when the midwife is confident that labour has started; the same may not be the case for women whose deliveries are planned in a secondary care setting and who travel to the delivery hospital without prior assessment at home by a midwife.

Applicability of distances/travel times to Cumbria
Most of the studies in European countries (France, the Netherlands, and Wales) involved travel times which were generally shorter (for example, no more than 30 to 45 minutes) than travel times experienced currently by some women in Cumbria and that would apply to a larger cohort of women if the existing maternity service configuration were to change. The extrapolation of results from studies involving shorter travel times to cohorts of women with longer travel times would be based on assumptions around the relationship between the exposure and outcomes which may not be appropriate. Some studies, in Canada, US and Norway, involved much greater distances and travel times (for example, more than two hours) to reach maternity facilities which are not applicable to Cumbria.

Outcomes

Perinatal mortality
Most studies investigated stillbirth and/or neonatal mortality. Outcome definitions varied and were not always clearly defined (for example, some authors specified 'intrapartum' stillbirth, others specified the outcome as 'stillbirth', and definitions of stillbirth varied according to gestational age and/or birth weight). Amongst the studies investigating mortality, the definition for inclusion of neonatal deaths varied. Several studies counted neonatal deaths occurring within the first month of life; others restricted their analysis to early neonatal deaths (within the first week of life) or conducted separate analyses for early and late neonatal deaths. The studies investigating neonatal deaths within the first month of life may have overestimated mortality associated with distance/travel time between the mother's home and delivery hospital particularly if they did not take account of the level of neonatal care provided which is a potential confounding factor. One study of neonatal mortality (Featherstone, 2016) excluded stillbirths, so may have underestimated the level of association between distance/travel time during labour/delivery and total mortality (the study findings were negative).

Maternal morbidity and mortality
Only one study referred to maternal deaths, and reported that there were none (not surprisingly since it is a rare outcome). None of the studies reported indicators of maternal morbidity (such as admission to intensive care, eclampsia, puerperal sepsis, sepsis during delivery, thromboembolism, major postpartum haemorrhage) and none reported mental health or quality of life outcomes.

Neonatal morbidity
The most commonly investigated measures of neonatal morbidity were: prematurity (<37 weeks) and admission to a neonatal care facility (for which models of provision varied between study countries), and Apgar scores. Of these, prematurity is the most reliable and reproducible measure. Apgar scores (measured by Ovaskainen, 2015 and Ravelli, 2011) may be susceptible to variations in inter-observer reliability. Admission to a neonatal care facility will vary according to local admission thresholds, with
the decision to admit likely to be influenced by factors such as proximity of unit (same vs different site to delivery unit) and cot availability.

**Obstetric-care related outcomes**

The most commonly investigated obstetric care-related outcomes were CS rate and labour induction which, as with neonatal care admissions, will be influenced by local protocols and intervention thresholds.

**Unplanned OOH births/deliveries**

Six studies investigated the risk of unplanned OOH birth with increasing distance and/or travel time and found that the risk increased with longer distances/travel times. One study (Pilkington, 2014), conducted throughout France and involving a largely urban peri-urban population, reported outcomes associated with unplanned OOH birth in relation to distance from delivery unit but reported inconsistent findings for different distance cohorts. Also, since the study measured distance and not travel time, it is difficult to apply its findings to other countries/locations with different geography, road and transport networks where similar distances may be associated with very different journey times.

**Adjustment for bias and confounding**

All studies attempted to adjust for potential confounding factors and/or effect modifiers in the association between distance/travel time and outcomes. These included factors in four categories: socio-economic and environmental variables, maternal risk factors, neonatal risk factors, and health care provision (maternal and/or neonatal). Few studies considered all relevant confounding factors and/or effect modifiers; since all studies were conducted retrospectively, all were limited by the availability of routinely collected data on relevant variables for inclusion in analysis (see tables in Appendix 1 and 2 for further information on the types of variables adjusted for in each study). None of the included studies reported that adjustments had been made for multiple statistical comparisons, so it is possible that for studies which included multiple comparisons, some statistically significant results were due to chance.

### 4.4 Overview of study quality and applicability

For the purposes of this review, the quality (in terms of internal validity) of each study was graded as either 'Good', 'Fair' or 'Poor' to indicate its quality, with reference to the criteria defined by NICE (see Appendix 4), relative to other studies included in this review. Two studies (Paranjothy, 2014 and Combier, 2013) were considered to have 'Good' quality compared with the body of evidence in the review; five studies (Featherstone, 2016; Grzybowski, 2011 and 2015; Ovaskainen, 2015; Renesme, 2011) were considered to have 'Poor' quality; all other studies were considered to have 'Fair' (moderate) quality.

In the assessment of study applicability to Cumbria (based on factors including population characteristics, setting/geography, delivery of maternity/neonatal care services, and prevalence of relevant risk factors/health outcomes), studies were graded as 'High', 'Medium' or 'Low'. One study (Paranjothy, 2014) conducted in Wales, was considered to have 'High' applicability to Cumbria. A second study (Combier, 2013), conducted in the Burgundy region of France, was considered to have 'Medium' applicability to Cumbria. All other studies were considered to have 'Low' applicability to Cumbria.

Overall, two studies were considered to be of both better quality and higher applicability to Cumbria than the other studies: the study in Wales by Paranjothy (2014) ('Good' quality, 'High' applicability) and the study in the Burgundy region of France by Combier (2013) ('Good' quality, 'Medium' applicability).

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12 In two studies (Paranjothy, 2014; Ravelli 2011), this included a measure of rurality
13 The extent to which the study results can truly be attributed to the exposure being evaluated and not to flaws in study design or conduct.
### 4.5 Findings by individual study

Table 1 below shows, for each included study, its aims/objectives (as stated by the study authors) and findings relevant to the scope of this review, together with the overall quality and applicability grade assigned to each study.

<table>
<thead>
<tr>
<th>Study reference, design, country, size</th>
<th>Study aims (as stated by authors)</th>
<th>Outcomes</th>
<th>Key findings within review scope</th>
<th>Study quality relative to other included studies (‘Good’/ ‘Fair’/ ‘Poor’)</th>
<th>Study applicability To Cumbria (‘High’, ‘Medium’, ‘Low’)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engjom, 2017 Cross-sectional study</td>
<td>To assess PPM by place of birth and travel time to obstetric institutions, with hypothesis that centralisation reduces institution availability but improves mortality</td>
<td>Unplanned OOH birth Peripartum mortality (PPM) 15</td>
<td>Higher risk for 1-2h (by factor of 5.3) vs &lt;1h travel time to nearest maternity facility (of any kind). Higher risk in unplanned OOH births (by factor of 3.9) vs institutional births. Not reported in relation to travel times.</td>
<td>Fair</td>
<td>Low</td>
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<tr>
<td>Norway n=646,898</td>
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<tr>
<td>Featherstone, 2016 Cross-sectional study</td>
<td>To assess geographic access to delivery hospitals and risk of neonatal death amongst singleton VLBW infants born in South Carolina</td>
<td>Neonatal mortality 16 (0-27 days)</td>
<td>No difference in risk for 30-59mins or ≥60mins vs &lt;30mins travel time to actual delivery hospital.</td>
<td>Poor</td>
<td>Low</td>
</tr>
<tr>
<td>US (South Carolina) n=2,030</td>
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<tr>
<td>Grzybowski, 2015 Cross-sectional study</td>
<td>To examine the safety of rural Canadian maternity services stratified by service delivery level</td>
<td>Stillbirths + early neonatal deaths (0-6 days) Prematurity (&lt;37</td>
<td>No difference in risk for 1-2h travel time to nearest maternity service 17 vs &lt;1h to obstetrician-led service Higher risk for 1-2h travel time to nearest maternity</td>
<td>Poor</td>
<td>Low</td>
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14 ‘No difference’ indicates that the result was not statistically significant compared with the reference cohort; ‘higher’ or ‘lower’ indicates that there was a statistically significant difference in the result compared with the reference cohort.

15 Intrapartum stillbirth and neonatal death within 24h of birth

16 Stillbirths not included in analysis hence study may underestimate mortality associated with labour/delivery.

17 Not clearly described. No information on whether or not services had CS capability and, if so, whether this was provided by General Practitioner(s) with enhanced surgical skills, specialist surgeon or obstetrician
### EVIDENCE SUMMARY REPORT

<table>
<thead>
<tr>
<th>Study reference, design, country, size</th>
<th>Study aims (as stated by authors)</th>
<th>Outcomes</th>
<th>Key findings within review scope[^a]</th>
<th>Study quality relative to other included studies ('Good'/ 'Fair'/ 'Poor')</th>
<th>Study applicability To Cumbria ('High', 'Medium', 'Low')</th>
</tr>
</thead>
</table>
| Canada (British Columbia, Alberta, Nova, Scotia)  
 n=150,797 | across three Canadian provinces  | weeks)  
 VLBW (<1500g)  
 CS | service (by factor of around 1.2[^b]) vs <1h to obstetrician-led service  
 No difference in risk for 1-2h travel time to nearest maternity care vs <1h to obstetrician-led service  
 Lower risk for 1-2h travel time to nearest maternity care (by factor of around 0.8[^c]) vs <1h to obstetrician-led service | Good | High |
| Ovaskainen, 2015  
 Case control study  
 Finland (Tampere district)  
 n=201 (from 76,773 total births) | To evaluate trends and reasons for OHDs in the Tampere University Hospital catchment area  | Maternal or neonatal death  
 Travel distance and time to delivery unit  
 Neonatal morbidity[^d] in OOH births | No deaths reported  
 Median travel time and distance to delivery unit significantly higher (by factor of 1.57 and 1.73 respectively) for OOH births vs hospital births  
 Neonatal morbidity outcomes for cases vs controls not analysed by distance/travel time | Poor | Low |
| Paranjothy, 2014  
 Cross-sectional study  
 Wales  
 n=412,827 | To study the association between travel time from home to hospital and birth outcomes | Intrapartum stillbirth  
 Neonatal death (0-27 days)  
 Composite of both the above mortality measures | No difference in risk for every 15min increase in travel time to actual delivery hospital or nearest maternity hospital  
 Higher risk for every 15 min increase in travel time to actual delivery hospital (by factor of 1.13 to 1.15); No difference for travel to nearest maternity hospital open at time of birth.  
 Higher risk for every 15 min increase in travel time to actual delivery hospital (by factor of 1.15); NS difference for travel to nearest maternity hospital open at time of birth | Good | High |

[^a]: From forest plot; data not separately reported  
[^b]: From forest plot; data not separately reported  
[^c]: Included prematurity, Apgar scores, infection, admission to neonatal unit (NNU)
<table>
<thead>
<tr>
<th>Study reference, design, country, size</th>
<th>Study aims (as stated by authors)</th>
<th>Outcomes</th>
<th>Key findings within review scope (^{21})</th>
<th>Study quality relative to other included studies (‘Good’/ ‘Fair’/ ‘Poor’)</th>
<th>Study applicability To Cumbria (‘High’, ‘Medium’, ‘Low’)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilkington, 2014 Cross-sectional study France n=6,202,918</td>
<td>To investigate the impact of distance to closest maternity unit on perinatal mortality</td>
<td>Stillbirth (≥22 weeks or ≥500g) Neontal death (0-27 days) Neonatal death after OOH birth</td>
<td>No difference in risk for any distance cohorts vs &lt;5km from nearest maternity unit. (No difference in stillbirth rates (^{21}) for rural vs urban cohorts) Lower risk for 5-14km and 30-44km (by factor of 0.91 and 0.90 respectively). NS difference in risk for 15-29km and ≥45km vs &lt;5km. (No difference in neonatal death rates for rural vs urban cohorts) Higher risk for 15-29km (by a factor of 1.58) and ≥45km (by a factor of 3.68). NS difference for 5-14km and 30-44km vs &lt;5km. (Higher rate (^{22}) for rural vs urban cohort (by factor of 1.78)).</td>
<td>Fair</td>
<td>Low</td>
</tr>
<tr>
<td>Combier, 2013 Cross-sectional study France (Burgundy) n=111,001</td>
<td>To analyse the effect of travel time to the closest maternity ward on pregnancy outcome and prenatal management in Burgundy</td>
<td>Stillbirth (≥22 weeks) Perinatal death (0-27 days) FHR abnormalities Meconium-stained amniotic fluid Prenatal hospitalisation Hospitalisation ≥24h before birth OOH birth</td>
<td>No difference for all travel time cohorts No difference for all travel time cohorts Higher risk for 31-45mins (by factor of 1.28) and ≥46mins (by factor of 2.60) vs 0-15mins travel time Higher risk for 31-45mins (by factor of 1.59) and ≥46mins (by factor of 3.68) vs 0-15mins travel time Higher risk for 16-30mins (by factor of 1.11), and 31-45mins (by factor of 1.17); NS difference for ≥46mins vs 0-15mins travel time Higher risk for ≥46mins (by factor of 1.78) vs 0-15mins travel time Higher risk for 16-30mins (by factor of 1.73) and</td>
<td>Good</td>
<td>Medium</td>
</tr>
</tbody>
</table>

\(^{21}\) For rural vs urban analysis, only outcome rates reported (as opposed to relative risk or odds ratios)  
\(^{22}\) No 95%CI or p values reported for rural vs urban analysis
<table>
<thead>
<tr>
<th>Study reference, design, country, size</th>
<th>Study aims (as stated by authors)</th>
<th>Outcomes</th>
<th>Key findings within review scope*</th>
<th>Study quality relative to other included studies ('Good'/ 'Fair'/ 'Poor')</th>
<th>Study applicability To Cumbria ('High', 'Medium', 'Low')</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renesme, 2011 Case control study France n=228 (from circa 29,100 total births)</td>
<td>To evaluate the social and geographical factors associated with unplanned OHDs such as long travel time from home to delivery unit</td>
<td>Labour induction</td>
<td>31-45mins (by factor of 1.64) vs 0-15mins travel time. No OOH births recorded for travel time ≥46mins. No difference in risk for any travel time</td>
<td>Poor</td>
<td>Low</td>
</tr>
<tr>
<td>Blondel, 2011 Cross-sectional study France (one district in Brittany) n=1,349,751</td>
<td>To calculate the incidence of OOH births and to determine whether this incidence varied according to distance to the closest maternity unit and recent maternity closures</td>
<td>Unplanned OOH birth</td>
<td>Higher risk for &gt;45mins (by factor of 6.18) vs &lt;15 min travel time; no difference in risk for shorter travel times</td>
<td>Fair</td>
<td>Low</td>
</tr>
<tr>
<td>Grzybowski, 2011 Cross-sectional study Canada</td>
<td>To systematically document newborn and maternal outcomes as they relate to distance to travel to access the</td>
<td>OOH births (planned or unplanned)</td>
<td>Higher risk for women (parity ≤2) with increasing distance ≥5km from closest maternity unit (by factor of 1.14 at 5-14km to 2.47 at ≥45km) vs parity ≤2 and &lt;5km. Higher risk for women (parity ≥3) with increasing distance from closest maternity unit (by factor of 1.73 at &lt;5km to 6.46 at ≥45km) vs parity ≤2 and &lt;5km. Higher risk for those in rural (aOR 1.43 (1.29, 1.58)) vs urban (reference cohort); NS difference for periurban vs urban.</td>
<td>Poor</td>
<td>Low</td>
</tr>
</tbody>
</table>

* Stated as 9700 births per year over 3 year study period
** Called 'accidental' OHDs by study authors
## Evidence Summary

### Study Reference, Design, Country, Size

| Study reference, design, country, size | Study aims (as stated by authors) | Outcomes | Key findings within review scope<sup>14</sup> | Study quality relative to other included studies (‘Good’/ ‘Fair’/ ‘Poor’) | Study applicability To Cumbria (‘High’, ‘Medium’, ‘Low’)<br识字框:23br识字框:2022 |<p style="font-size:10px;">26 For services with CS capability, CS was provided by General Practitioners with enhanced specialist skills or by specialist general surgeons and/or obstetricians<br>25 Neonatal Intensive Care Unit (NICU) Level 2 is for newborns described by study authors as ‘transitioning’; NICU Level 3 is for newborns described as ‘most severely compromised’<br>27 Results not reported separately for 50-150km cohort or for subgroups within that cohort which may be more applicable to Cumbria<br>28 Wording used here reflects description of service by study authors (whereas Grzybowski et al refer to CS capability).<br>29 Odds ratios not reported for outcomes other than perinatal mortality</p> |<br>识字框:23br识字框:2022 |<p style="font-size:10px;">26 For services with CS capability, CS was provided by General Practitioners with enhanced specialist skills or by specialist general surgeons and/or obstetricians<br>25 Neonatal Intensive Care Unit (NICU) Level 2 is for newborns described by study authors as ‘transitioning’; NICU Level 3 is for newborns described as ‘most severely compromised’<br>27 Results not reported separately for 50-150km cohort or for subgroups within that cohort which may be more applicable to Cumbria<br>28 Wording used here reflects description of service by study authors (whereas Grzybowski et al refer to CS capability).<br>29 Odds ratios not reported for outcomes other than perinatal mortality</p> |
|---|---|---|---|---|---|
| (British Columbia) n=49,402 | nearest maternity services with CS capability | weeks) NICU Level 2<sup>25</sup> admissions Primary CS (excluding women with previous CS) Labour induction (excluding women with planned CS) OHDs (unplanned) | nearest maternity service with CS capability vs within 1h of CLU Higher risk (by factor of 2.20) for travel times 1-2h from nearest maternity service with CS capability vs within 1h of CLU Lower risk (by factor of 0.78) for travel times 1-2h from nearest maternity service with CS capability vs within 1h of CLU No difference in risk for travel times 1-2h from nearest maternity service with CS capability vs within 1h of CLU Higher risk (by factor of 6.41) for travel time 1-2h from nearest maternity service with CS capability vs within 1h of CLU | Fair | Low |
| Lisonkova, 2011 Cross-sectional study Canada n=29,206 | To examine the association between rural residence and birth outcomes in older mothers, the effect of parity on this association, and the trend in adverse birth outcomes in relation to distance to the nearest hospital with | Perinatal death (stillbirth ≥20 weeks and neonatal death 0-27 days) Neonatal morbidity indicators (preterm birth, NICU admission ≥1 day) | Higher risk (by factor of 1.53) with increasing distance<sup>27</sup> (>50km) vs <50km to nearest hospital with CS capacity<sup>28</sup>. (For rural vs urban cohort, higher risk of perinatal death (by factor of 1.47), no difference in risk of stillbirth). No difference in rates<sup>29</sup> for distance of 50-150km and >150km vs <50km to nearest hospital with CS capacity. (For rural vs urban cohort, no difference in risk). | Fair | Low |

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Evidencia de Resumen: la asociación entre distancia/viaje de tiempo y resultados obstétricos o nacimientos
<table>
<thead>
<tr>
<th>Study reference, design, country, size</th>
<th>Study aims (as stated by authors)</th>
<th>Outcomes</th>
<th>Key findings within review scope&lt;sup&gt;14&lt;/sup&gt;</th>
<th>Study quality relative to other included studies (‘Good’/ ‘Fair’/ ‘Poor’)</th>
<th>Study applicability To Cumbria (‘High’, ‘Medium’, ‘Low’)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ravelli, 2011 Cross-sectional study</td>
<td>CS capacity</td>
<td>Obstetric care-related indicators (labour induction, CS)</td>
<td>No difference in rates for distance of 50-150km and &gt;150km vs &lt;50km to nearest hospital with CS capacity. (For rural vs urban cohort, no difference in risk of labour induction, lower risk of CS (by factor of 0.84) and repeat CS (by factor of 0.75), no difference in risk of primary or emergency CS).</td>
<td>Fair</td>
<td>Low</td>
</tr>
<tr>
<td>The Netherlands n= 751,926</td>
<td>To study the effect of travel time, at the start or during labour, from home to hospital on mortality and adverse outcomes in pregnant women at term in primary and secondary care</td>
<td>Intrapartum death (stillbirth)</td>
<td>No difference in risk of intrapartum death with increasing travel time (15-19mins and ≥20mins vs &lt;15mins as reference level)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neonatal death (0-27 days)</td>
<td>Higher risk of early neonatal death (by factor of 1.51 for &lt;24h and 1.37 for 0-7 days), NS difference for late neonatal mortality (8-27 days) with travel time ≥20mins vs &lt;20mins.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Combined intrapartum stillbirth + neonatal death</td>
<td>No difference in risk of mortality for travel time of 15-19mins (vs &lt;15 mins) or for every 1 minute increase in travel time; marginal increase in risk for ≥20mins travel time (lower limit of 95%CI for aOR 1.002) vs &lt;15mins</td>
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<td>Adverse outcome (death +/- 5 min Apgar score &lt;4 +/- transfer to NICU at birth)</td>
<td>Higher risk of composite adverse outcome for travel times of 15-19mins and ≥20mins (by factor of 1.11 and 1.27 respectively) vs &lt;15mins</td>
<td></td>
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4.6 Study findings by outcome

This section describes study findings\(^30\) grouped by type of outcome measure (perinatal/neonatal mortality, neonatal morbidity, obstetric care-related).

**Perinatal/neonatal mortality**

**Stillbirth\(^31\)** – five studies

- All five studies (Paranjothy, 2014; Pilkinson, 2014; Combier, 2013; Lisonkova, 2011; Ravelli, 2011), including one that was considered of high and one of medium applicability to Cumbria, reported no difference in risk\(^32\) of stillbirth for women living longer distances and/or travel times to maternity delivery units compared with the reference cohort living shorter distances and/or travel times from delivery units. Two studies (Pilkinson, 2014; Lisonkova, 2011) reported no difference in risk of stillbirth for those living in rural areas compared with those in urban areas.

**Neonatal death** – four studies

- Paranjothy (2014) reported a higher risk of early (0-6 days) and late (7-27 days) neonatal death in singleton births (early neonatal death aOR\(^33\) 1.13 (95%CI 1.07, 1.20), late neonatal death aOR 1.15 (1.05, 1.28), p values not stated) for every 15 minute increase in travel time to actual hospital of birth; the difference in risk was not observed for increasing travel time to the nearest hospital open at time of delivery (early neonatal death aOR 0.99 (95%CI 0.86, 1.15), late neonatal death aOR 1.00 (95%CI 0.79, 1.25), p values not stated).

The remaining three studies were considered of low applicability to Cumbria.

- Featherstone (2016) reported no difference in risk of neonatal death (0-27 days) in preterm singleton VLBW babies for women living more than 30 minutes’ travel time to their delivery hospital compared with the reference cohort (living less than 30 minutes away).

- Pilkinson (2014) reported no difference in risk of neonatal death (0-27 days) in all births to women living 15 to 29km and 45km or more from their nearest maternity unit, and a lower risk for women living 5 to 14km (aRR 0.91 (CI did not include 1), p<0.01) and 30 to 44km (aRR 0.90 (CI did not include 1), p<0.01) from the nearest maternity unit, compared with those living up to 5km away. They reported no difference in risk of neonatal death for those living in rural areas compared with those in urban areas. The study reported a higher risk of neonatal death after unplanned OOH birth for women living 15 to 29km (aRR 1.58, CI did not include 1, p<0.01) and 45km or more (aRR 3.68, CI\(^34\) did not include 1, p<0.01) from the nearest maternity unit, but no difference in risk for those living 5 to 14km and 30 to 44km from the unit compared with those living up to 5km away. They reported a higher rate of neonatal death after unplanned OOH birth for those living in rural areas compared with those in urban areas (7.3/100,000 vs 4.1/100,000; statistical significance not reported).

- Ravelli (2011) reported a higher risk of neonatal death within the first 24 hours (aOR 1.51 (95%CI 1.13, 2.02), p value not stated and first 7 days (aOR 1.37 (95%CI 1.12, 1.67), p value not stated) for babies born to women with a travel time of 20 minutes or more to their actual delivery unit (outpatient clinic or hospital) compared with those living shorter travel times from the delivery unit. There was no difference in risk of late neonatal death (days 8-27) for babies born to women with longer travel times from the delivery unit.

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\(^{30}\) ‘No difference’ indicates that the result was not statistically significant compared with the reference cohort; ‘higher’ or ‘lower’ indicates that there was a statistically significant difference in the result compared with the reference cohort.

\(^{31}\) Individual studies used varying definitions (see evidence tables in Appendix for further details)

\(^{32}\) Lisonkova (2015) reported rates of perinatal mortality by distance, not odds ratio

\(^{33}\) Adjusted odds ratio

\(^{34}\) Confidence interval data and confidence level (95% or 99%) not reported
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### Perinatal death (stillbirth and neonatal death combined)\(^{35}\) – six studies

- Paranjothy (2014) reported a higher risk of perinatal death (intrapartum stillbirth and neonatal death 0-27 days) for every 15 minute increase in travel time to actual hospital of delivery (aOR 1.15 (95%CI 1.09, 1.20), p value not stated); the difference in risk was not observed for increasing travel time to the nearest hospital open at time (aOR 1.01 (95%CI 0.90, 1.13), p value not stated).

- Combier (2013) reported no difference in risk of perinatal death (stillbirth and neonatal death 0-27 days) with increasing travel time to the nearest maternity unit.

The remaining four studies were considered of low applicability to Cumbria.

- Grzybowski (2015) showed no difference in risk of perinatal mortality (stillbirth and early neonatal death 0-6 days) for births to women living 1 to 2 hours from the nearest maternity service (with or without CS capability) compared with the reference level of access to an obstetrician led service within a travel time of one hour.

- Grzybowski (2011) similarly reported no difference in risk of perinatal mortality for births to women living 1 to 2 hours from the nearest maternity service (with CS capability) compared with the reference level of access to a consultant (obstetrician or general surgeon) led service within a travel time of one hour.

- Lisonkova (2011) reported a higher risk of perinatal death (stillbirth ≥20 weeks and neonatal death 0-27 days) with increasing distance (>50km) to the nearest hospital with CS capacity compared with the reference level of less than 50km (aOR 1.53 (95%CI 1.10, 2.12), \(p=0.01\) for trend). Results were not reported separately for distances of 50-150km or for shorter distances (<100km) more applicable to Cumbria. They also reported a higher rate of perinatal death for those living in rural areas compared with those in urban areas (aOR 1.47 (95%CI 1.01, 2.14).

- Ravelli (2011) reported no difference in risk of perinatal death (intrapartum stillbirth or neonatal death 0-27 days) for women living 15 to 19 minutes’ travel time to their delivery unit (community outpatient clinic or hospital) compared with less than 15 minutes or for every one minute increase in travel time as a continuous variable. For women living 20 minutes or more from their delivery location, the risk was reported to be higher than for women living less than 15 minutes away, although this result was only just statistically significant (lower limit of 95%CI 1.002\(^{36}\), p value not stated\(^{36}\)). The authors reported that only a few women travelled for longer than 30 minutes. For women who were transferred during labour from primary care (with delivery planned at home or in an outpatient clinic) to secondary care for delivery in hospital, there was no difference in risk of perinatal death for those with a travel time of 20 minutes or more compared with less than 20 minutes.

### Indicators of neonatal morbidity

#### Prematurity – three studies

All studies were considered to have low applicability to Cumbria.

\(^{35}\) Definitions of perinatal death varied between studies so are specified where they differ from the following WHO definition: stillbirths and deaths in the first week of life with the perinatal period commencing at 22 completed weeks (154 days) of gestation, and ending seven completed days after birth; the perinatal mortality rate is the number of stillbirths and deaths per 1,000 total births.

\(^{36}\) Lower 95%CI here reported to three decimal places; all other results reported to two decimal places.

\(^{37}\) Authors stated that ‘overall p value for travel time for total mortality’ was \(p=0.037\); no other p values were reported.
Grzybowski (2015) reported a higher risk of prematurity for births to women living 1 to 2 hours travel time from the nearest maternity services (with or without CS capability) compared with access to an obstetrician led service within one hour (aOR +/- 95%CI greater than 1 on composite forest plot, data and p value not reported).

Grzybowski (2011) reported no difference in risk of prematurity for births to women living 1 to 2 hours’ travel time from the nearest maternity services (with CS capability) compared with access to a consultant-led (obstetrician or general surgeon) service within a travel time of one hour.

Lisonkova (2011) reported no difference in rates (odds ratio not published) of preterm birth with increasing distance (50-150km and >150km) to the nearest hospital with CS capacity compared with distance of less than 50km. They also reported no significant difference in risk of preterm birth for those living in rural areas compared with those in urban areas.

Admission to neonatal care – three studies

All of the studies were considered to have low applicability to Cumbria.

Grzybowski (2011) reported a higher risk of NICU 2 admission for babies born to women living 1 to 2 hours away from the nearest maternity service (with CS capability) (aOR 2.20 (95% CI 1.59, 3.05), p<0.001) compared with access to an obstetrician led service within a travel time of one hour.

Lisonkova (2011) reported no difference in rates (odds ratio not published) of admission to neonatal care with increasing distance (50-150km and >150km) to the nearest hospital with CS capacity compared with distance of less than 50km.

Ravelli (2011) (as part of composite adverse outcome measure - see below).

VLBW – one study

Grzybowski (2015) reported no difference in risk of VLBW with increasing travel time to the nearest maternity service (of any kind) compared with access to a consultant obstetrician led service within one hour.

Other indicators – two studies

Combier (2013) was considered to have medium applicability to Cumbria. The study reported a higher risk of FHR abnormalities and of meconium-stained amniotic fluid for babies born to women living 31 to 45 minutes (FHR abnormalities: aOR 1.28 (95% CI 1.01, 1.63), p=0.04; meconium-stained amniotic fluid: aOR 1.59 (95%CI 1.16, 2.19), p=0.01) and more than 45 minutes’ travel time to the nearest maternity unit (FHR abnormalities: aOR 2.60 (95%CI 1.95, 3.48), p=0.001; meconium-stained amniotic fluid: aOR 3.68 (95%CI 2.50, 5.40), p<0.001) compared with those living up to 15 minutes away.

Ravelli (2011), considered to be of low applicability to Cumbria, reported a higher risk of the composite adverse outcome (mortality and/or 5-minute Apgar score below 4 and/or admission to a neonatal intensive care unit at birth) for babies born to women living 15 to 19 minutes (aOR 1.11 (95%CI 1.02, 1.21), p value not stated) or 20 minutes or more travel time (aOR 1.27 (95% CI 1.17, 1.38), p value not stated) to the delivery unit (outpatient clinic or hospital) compared with women living less than 15 minutes away. For women who were transferred to hospital during labour from a primary care setting (home or outpatient clinic) where delivery had been planned, there was no difference in risk of this outcome for women who travelled 20 minutes or longer compared with those who travelled less than 20 minutes to reach the delivery hospital.
Obstetric care-related outcomes

**Caesarean section – three studies**

All studies were considered to have low applicability to Cumbria.

- Grzybowski (2015) reported a lower risk of CS for women living 1 to 2 hours’ travel time from the nearest maternity service (with/without CS capability) compared with those who had access to consultant obstetrician led maternity service within one hour of travel (aOR +/- 95%CI greater than 1 on composite forest plot, data and p values not reported).

- Grzybowski (2011) reported a lower risk of primary CS for women living 1 to 2 hours’ travel time from the nearest maternity service (with/without CS capability) compared with those who had access to a consultant (obstetrician or general surgeon) led maternity service within one hour of travel.

- Lisonkova (2011) reported no difference in rates (odds ratio not published) of CS with increasing distance (50-150km and >150km) to the nearest hospital with CS capacity. They also reported a lower risk of CS (aOR 0.84 (95%CI 0.78, 0.91)) and repeat CS (aOR 0.75 (95%CI 0.63, 0.88)) for those living in rural areas compared with those in urban areas, but no difference in risk of primary CS or emergency CS.

**Labour induction – three studies**

- Combier (2013), with medium applicability to Cumbria, reported no difference in risk of medical induction of labour with increasing travel time to the nearest maternity unit.

The other two studies were considered of low applicability to Cumbria.

- Grzybowski (2011) reported no difference in risk for women living 1 to 2 hours’ travel time from the nearest maternity services (with CS capability) compared with those living within one hour of a consultant (obstetrician or general surgeon) led maternity service.

- Lisonkova (2011) reported no difference in rates (odds ratio not published) of labour induction with increasing distance (50-150km and >150km) to the nearest hospital with CS capacity, and no difference in rates of labour induction for those living in rural areas compared with those in urban areas.

**Hospital admission – one study**

- Combier (2013), with medium applicability to Cumbria, reported that the risk of prenatal hospitalisation (consecutive to or separate from delivery) was higher for women living 16 to 30 minutes’ (aOR 1.11 (95%CI 1.01, 1.22), p=0.04) and 31 to 45 minutes’ (aOR 1.17 (95%CI 1.04, 1.32), p=0.01) travel time to the nearest maternity unit compared with those living up to 15 minutes away, but no difference in risk of prenatal hospitalisation was observed for women with travel times of more than 45 minutes (perhaps due to the small size of this cohort, n=337). There was a higher risk of hospitalisation more than 24 hours before delivery for women living more than 45 minutes away from the nearest maternity unit (aOR 1.78 (95%CI 1.07, 2.97), p=0.03) compared with those living up to 15 minutes away; no difference in this risk was reported for women with shorter journey times to the nearest maternity unit.

**Unplanned OOH births – six studies**

- Combier (2013), with medium applicability to Cumbria, reported a higher risk of OOH birth (planned or unplanned) for women with travel times of 16 to 30 minutes (aOR 1.73 (95%CI 1.23, 2.46), p<0.001) or 31 to 45 minutes (aOR 1.64 (95%CI 1.06, 2.54), p=0.03) to the nearest hospital. Study authors reported that planned OOH births are very rare in France.
nearest maternity unit compared with 15 minutes or less. No OOH births were recorded for travel times of more than 45 minutes.

The other five studies were considered to have low applicability to Cumbria.

- **Engjom (2017)** reported a higher risk of unplanned OOH births for women with a travel time of 1 to 2 hours (aRR 5.3 (5.0, 5.8, p value not stated) to the nearest maternity facility compared with less than one hour.

- **Ovaskainen (2015)** reported longer median distances and travel times from home to delivery unit for OOH births compared with in hospital births (controls). The median (range) for the shortest route from home to delivery unit was 23.0 (2.8, 208.8) km for cases and 13.3 (1.5, 125.4) km for controls; the median (range) for the fastest travel time for cases was 23.5 (4, 171) minutes compared with 15.0 (2, 107) minutes for controls (p<0.001).

- **Renesme (2013)** reported a higher risk of unplanned OOH births for women living more than 45 minutes' travel time to the delivery hospital compared with less than 15 minutes, although the odds ratio was unadjusted and the 95% confidence interval was wide due to the small number of unplanned OOH births associated with the travel time of 45 minutes or more (unadjusted OR 6.18 (95%CI 1.33, 28.65), n=9 of 76 cases vs 7 of 149 controls). No difference in risk was observed for shorter travel times (15-29mins and 40-44mins) compared with less than 15 minutes (p=0.14 for change in OR with increasing travel time).

- **Blondel (2011)** reported a higher risk of unplanned OOH birth for women, parity 2 or lower, living 5km or more from the nearest maternity unit compared with those living less than 5km away. The risk increased with every 15km increase in distance from the maternity unit (from 5-14km, aOR 1.14 (95%CI 1.03, 1.27) to ≥45km, aOR 2.47 (95%CI 2.02, 3.02), p values not stated). For women, parity 3 or more, the risk was higher for women in all distance cohorts measured in 15km intervals from less than 5km to 45km or more (<5km, aOR 1.73 (95%CI 1.57, 1.90); ≥45km aOR 6.46 (95%CI 4.92, 8.48), p values not stated) from the nearest maternity unit compared with women in the reference level of parity 2 or lower, living less than 5km away. They also reported a higher risk of unplanned OOH birth for women living in rural areas compared with those in urban areas (aOR 1.43 (95%CI 1.29, 1.58), with ‘urban’ as reference cohort).

- **Grzybowski (2011)** found a higher risk of OOH birth (excluding planned home deliveries) for women living 1 to 2 hours (aOR 6.41 (95%CI 3.69 to 11.28), p<0.001) from the nearest maternity service (with CS capability) compared with those living within one hour of a consultant (obstetrician or general surgeon) led service.

Three of these studies (Engjom, 2017; Ovaskainen, 2015; Renesme, 2013) reported outcomes for OOH births compared with hospital births but none reported outcomes following unplanned OOH birth in relation to distance or travel time from home to delivery unit. Only one included study (Pilkington, 2014) reported neonatal deaths following unplanned OOH birth in relation to distance from nearest maternity unit although its findings were inconsistent across different travel time cohorts (see earlier).

### 4.7 Subgroup analyses

- **Paranjothy (2014)** repeated their analysis on term births only and on nulliparous pregnancies only. For **term births**, there was a higher risk of intrapartum stillbirth (aOR 1.36 (95%CI 1.17, 1.59), p value not stated), late neonatal death (aOR 1.34 (95%CI 1.13, 1.59), p value not stated) and for intrapartum stillbirth and neonatal death combined (aOR 1.19 (1.06, 1.32), p value not stated), but no difference in risk for early neonatal death, for every 15 minute increase in travel time to actual delivery hospital. No differences in risk were found for increase in travel time to the nearest hospital open at time of delivery. For **nulliparous pregnancies**, there was a higher risk of intrapartum stillbirth (aOR 1.21 (95%CI 1.02, 1.44), p value not stated), early neonatal death (aOR 1.15 (95%CI 1.06, 1.25), p value not stated) and both intrapartum stillbirth and neonatal death combined (aOR 1.16 (95%CI 1.08, 1.24), p value not stated), but no difference in risk for late neonatal death for every 15 minute increase
in travel time to actual delivery hospital. As for term pregnancies, the differences in risk were not observed for travel to nearest hospital open at time of delivery.

The other two studies which conducted subgroup analyses were considered to have low applicability to Cumbria.

- Blondel (2011) reported higher risk of unplanned OOH birth for women with parity 3 or more at all distances (5-14km, 15-29km, 30-44km and ≥45km) compared with the reference level of less than 5km and parity 2 or less. At 45km or more, women of parity 3 or more had around twice the risk of unplanned OOH birth compared with women with parity 2 or less (aOR 6.46 (95%CI 4.92, 8.48) vs aOR 2.47 (95%CI 2.02, 3.02) respectively).

- Ravelli (2011) conducted a subgroup analysis according to the level of care at start of labour and at time of birth (primary care for both, primary care at start of labour with transfer to secondary care for delivery, or secondary care for both). The third group is outside the scope of this review. For the first two groups (women who received primary care throughout pregnancy, with delivery of their baby in a community outpatient clinic, and women transferred during labour from primary to secondary care for in-hospital delivery), there was no difference in risk of mortality or of the composite adverse outcome (mortality and/or 5-minute Apgar score below 4 and/or admission to a neonatal intensive care unit at birth) for those with a travel time of 20 minutes or more compared with less than 20 minutes.

5. Discussion

The studies identified for inclusion in this evidence review were all observational studies (cross-sectional and case control studies), hence susceptible to inherent weaknesses associated with bias and confounding which should be factored in to the interpretation of their findings. One study (Paranjothy et al, 2014), in Wales, was considered to be both well conducted relative to the other included studies and highly applicable to Cumbria; a second study (Combier et al, 2013), in the Burgundy region of France, also well conducted, was considered to have moderate applicability to Cumbria. All other included studies were considered of low applicability to Cumbria. Reasons for low applicability varied and included differences between the study populations and those of Cumbria/England, differences in configuration of maternity/neonatal services, maternity/neonatal health outcomes, local geography/setting, and distances/travel times to reach maternity services. This limits their usefulness in responding to the questions addressed by this review in the context of WNE Cumbria.

The following paragraphs provide more detailed discussion of the two studies by Paranjothy (2014) and Combier (2013) which, overall, were considered to be of higher quality and more applicable to Cumbria than the other included studies. We also provide further details of the study by Ravelli (2011), the only study to investigate the association between travel (or transfer) time from planned place of birth in the community to another location (outpatient clinic or hospital) for delivery. This study, conducted in the Netherlands, was considered to be of moderate (‘Fair’) quality but low applicability to Cumbria.

**Studies investigating impact of distance/travel time from home to maternity delivery unit on obstetric and birth outcomes**

Two studies (Paranjothy, 2014; Combier, 2013) were considered to be of better quality and more applicable to Cumbria than the other studies included in this review. Further details of other included studies are provided in earlier sections of this report and in the summary evidence table.

Paranjothy (2014) was a large (n=412,827), well-conducted, population-based cross-sectional study in Wales investigating the association between travel time from mother’s home to actual hospital of birth and nearest hospital open at time of birth.

After adjustment for possible confounding factors (including gestational age, gender, maternal age, parity, social deprivation quintile and urban/rural index), the study reported that the risk of both early
and late neonatal death, and the composite outcome of intrapartum stillbirth and neonatal death, increased with every 15-minute increase in travel time to actual hospital of birth (n=50 hospitals\[^{39}\], including 16 outside Wales). For intrapartum stillbirth alone, there was no difference in risk with increasing travel time to actual hospital of birth. In contrast, when the analysis was repeated for the nearest hospital open at time of birth (n=30 hospitals, including 4 outside Wales), involving re-analysis of data for 72,751 (15.6%) women who gave birth at a hospital further away from home than the nearest hospital, there was no increase in risk with increasing travel time for any of the four mortality outcomes. Subgroup analysis on term pregnancies alone showed an increased risk of intrapartum stillbirth and late neonatal death, but no difference in risk for early neonatal death, for every 15-minute increase in travel time to actual hospital of birth. As with analysis of the full study sample, no increase in risk was observed for travel time to the nearest hospital. For nulliparous women alone, there was a higher risk of intrapartum stillbirth, early neonatal death and both intrapartum stillbirth and neonatal death combined, but no difference in risk of late neonatal death, with every 15-minute increase in travel time to actual hospital of birth. As for all other analyses, the differences in risk were not observed for travel to nearest hospital open at time of delivery.

The study also reported cause of death by travel time for 726 (84.4%) of the 862 neonatal deaths recorded. The most frequently cited cause (n=451, 62%) was ‘conditions consequent upon preterm birth’\[^{40}\], for which the rate per 1000 live births increased with every 15-minute increase in travel time to actual hospital of birth (from 0.7 per 1000 live births at <15mins to 3.7 per 1000 at ≥45mins travel time, p<0.001 for trend). The two other causes of death shown were ‘infection’ (n=107, 15%) and ‘intrapartum events’ (n=168, 23%); for both of these causes of death, the rate also increased with increasing travel time (from 0.2 to 0.4 per 1000 for infection, p = 0.024, and from 0.3 to 0.6 per 1000 for intrapartum events, p=0.05) but the trend was less marked than for preterm birth as the cause of death.

Published data on pregnancy characteristics of the study population showed that preterm births occurred in a higher proportion of women in the cohort with the longest estimated travel time to actual delivery hospital (for ≥45mins travel time cohort, n=1802 preterm births (9.5% of cohort births) vs 5.4%, 6.1% and 6.8% for <15, 15-29 and 30-44mins travel time cohorts).

Overall, the study findings indicate that, during the study period (1995-2009), there was an increased risk of perinatal mortality associated with every 15-minute increase in travel time to actual hospital of delivery but there was no increase in risk associated with increasing travel time to the nearest hospital open at the time of delivery. No information was provided on the reasons for women travelling to hospitals further away or on differences between actual and nearest hospital groups in the level/type of service available. However, the above data suggest that the cohort of women with longer travel times may have had a higher risk profile (with a higher risk of prematurity and/or higher likelihood of planned delivery at less than 37 weeks’ gestation) than those in other travel time cohorts, such that their delivery was more likely to occur at a more specialised hospital further away than their nearest hospital. Although the study adjusted for potential confounding factors, such as gestational age and parity, the analysis did not take account of other maternal risk factors (such as pre-existing chronic conditions) and type/level of maternity/neonatal care provided. No outcomes were investigated other than mortality. These shortfalls in analysis limit our ability to interpret the study findings further.

The study was considered to be highly applicable to Cumbria due to the similarities between Wales and Cumbria in terms of population characteristics, geography, maternity/neonatal health outcomes, and approach to delivery of maternity/neonatal services. Most women in the study population (81.7%) travelled less than 30 minutes and only 4.1% had travel times of 45 minutes or more to reach their actual delivery hospital. In the study re-analysis of travel times to the nearest hospital, no data were published on the number or proportion of women in each travel time cohort and it may be the case that few or no women remained in the longest travel time cohort for the purpose of the analysis involving travel time to nearest hospital. The absence of published data regarding the size of each travel time cohort in this analysis limits the ability to translate the study findings to women in Cumbria, who may have travel times of longer than 45 minutes to reach their nearest hospital.

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\[^{39}\] Of the 50 hospitals where births occurred, 8 were described as having level 3 (NICU) neonatal care facilities with the rest able to provide acute resuscitation and stabilisation of infants prior to transfer, if necessary, to specialist centres.

\[^{40}\] Described as 24-36 completed weeks of gestation.
Combier (2013) was a large (n=111,001), well-conducted cross-sectional study in the Burgundy region of France investigating the impact of travel time to the nearest maternity unit on perinatal outcomes and care for deliveries occurring in the period 2000-2009. The study found no statistically significant increase in risk of stillbirth or perinatal death with increasing travel time from home to the nearest maternity ward either before or after adjustment for individual (maternal/neonatal) and area-level (deprivation and urbanisation) variables. There was a higher risk of showing signs of acute fetal distress (fetal heart rate abnormalities and/or meconium-stained amniotic fluid) for babies born to women with estimated travel times of more than 30 minutes to the nearest maternity ward compared with estimated travel times of up to 15 minutes, although the outcome of these cases was not reported further. There was also a higher risk of OOH birth (reported to be mostly unplanned since home births are rare in France) for women with estimated travel times of 16 to 45 minutes to the nearest maternity ward compared with 15 minutes or less, although no outcomes associated with OOH births were reported. No OOH births were recorded in women with estimated travel times of 46 minutes or more from the nearest maternity ward, which reflects the small number of births in this cohort (n=337, 0.3%). The study also reported a higher risk of prenatal hospitalisation (consecutive to or separate from delivery) for women with estimated travel times of 16 to 45 minutes from the nearest maternity unit; no difference in this risk was observed for women with travel times of 46 minutes or more (again perhaps due to the small size of this cohort). There was a higher risk of hospitalisation more than 24 hours before delivery for women living more than 45 minutes away compared with those living up to 15 minutes away; no difference in this risk was reported for women with shorter travel times (16 to 45 minutes). There was no difference in risk of medical induction of labour with increasing travel time.

The study was large and well-conducted, with adjustment for possible confounding and for bias associated with periods of significant change in local maternity service provision (involving closure of some units). However, it had several limitations; unstable provision of maternity services during the ten year study period (the number of maternity units reducing from 20 to 15 and bed capacity reducing from 702 to 395), imprecise measures of travel times to nearest maternity ward calculated at municipality rather than individual level, travel times based on rapid ambulance transport rather than by privately owned vehicle/car, relatively few births (0.3%) in the cohort travelling more than 45 minutes, failure to adjust for type of maternity/neonatal care provided and apparent absence of statistical adjustment for multiple comparisons. These limitations reduce the overall reliability of this study. The study was considered of medium applicability to Cumbria in view of likely similarities in population health outcomes, population density and geographical characteristics with road networks limited by hilly or mountainous terrain.

Studies investigating impact of distance/travel time from midwife led unit to obstetric/consultant-led unit on obstetric/birth outcomes

Only one study was found (Ravelli et al, 2011) which reported the impact of travel times on outcomes for women transferred before/during labour from primary care (where delivery was planned at home or in a community ‘outpatient’ clinic under the care of an independent midwife), to secondary care for delivery in hospital under the care of a consultant obstetrician. Several other studies were found which investigated outcomes associated with transfer of women in labour between midwifery-led units and consultant-led units (or their equivalent) but none reported outcomes in relation to distance/travel or transfer times so were not included in this review.

Ravelli et al (2011) was a large cross-sectional study of singleton term births (n=751,926) across 99 hospitals and outpatient clinics in the Netherlands investigating the relationship between travel time from home to delivery location and adverse outcomes. Two outcomes were selected: mortality (intrapartum and neonatal (0-27 days) mortality) and the composite ‘adverse outcome’ (mortality and/or 5-minute Apgar score below 4 and/or transfer of newborn to a NICU at birth). Home births (which represent 27.6% of all births in the total population of singleton births (n=1,091,496)) were excluded. The study population comprised three groups of women: (i) those managed in primary care throughout their pregnancy (n=120,896), with delivery of their baby in an outpatient clinic in the community under the care of an independent midwife; (ii) women managed in primary care from their first antenatal appointment but who, after a change in their risk status during labour, were transferred...
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to secondary care for delivery in hospital\(^{41}\) (n=142,824) and (iii) women who had been referred to secondary care during their pregnancy, before the onset of labour, and whose babies were delivered in hospital (n=488,206). For the second group of women, who were transferred from primary care to secondary care during labour and had a hospital delivery (n=142,824), no increase in risk was observed for estimated travel times of 20 minutes or more compared with less than 20 minutes for the mortality outcome or for the composite adverse outcome.

Overall, the study was moderately well conducted. Its strengths included adjustment for a wide range of possible confounding factors including socio-economic variables, maternal/neonatal risk factors, and level of health care facility (in terms of whether or not it was a tertiary perinatal centre and birth rate). Travel times were estimated for individual women to actual rather than nearest delivery location using home and delivery location addresses coupled with geographical information system and local travel time data.

However, there were several limitations to this study: travel times were based on optimal travel conditions which may have underestimated actual travel times; no information was provided on unplanned OOH births, and time between onset of labour and start of travel was not considered. For births planned as ‘primary care’ (for delivery at home or at an outpatient clinic under the care of an independent midwife), in the Netherlands, a midwife will visit the woman at home and only transfer her to the outpatient clinic for delivery when she/he is confident that labour has commenced. This may introduce delay prior to the journey to the delivery unit which is specific to this model of care in the Netherlands; the amount of delay may vary according to how far the woman lives from the delivery unit with the possibility that the delay may be shorter for women with further to travel. Also, no information was provided on whether any women travelled to an outpatient clinic before being referred to secondary care, with subsequent travel to hospital for delivery. Resulting time delays between onset of labour and start of the journey to the outpatient clinic or hospital were not counted in this study but may be a significant factor in the time delay between onset of labour and arrival at the delivery unit. The authors report that ‘only a few women travelled more than 30 minutes’; data were not reported separately for this cohort and are likely to be unreliable. This suggests that, whilst the study findings may be applicable to births in the Netherlands involving travel times of between 20 and 30 minutes, the results cannot reliably be extrapolated to births involving travel times of more than 30 minutes. The exclusion of home births\(^{42}\) (27.6% of the study population) also reduces applicability of the study findings to other populations. Since home births are planned in the Netherlands for women classed as ‘low risk’, the risk profile of the included sample (births occurring in an outpatient clinic or hospital), and associated adverse outcomes, is likely to have been higher than average for the total population. Thus, results from this study are only directly applicable to populations of equivalent risk profile to the 72.4% of women in the Netherlands who were included in the study sample (insufficient information was provided on the risk profile of included births to understand how this compared with the risk profile for the total population).

6. Conclusions

Is there an association between distance from/travel time to maternity delivery units (any type) and obstetric or birth outcomes?

The evidence found in this review was drawn from 12 observational studies of varying quality and applicability to Cumbria. One study (Paranjothy, 2014), involving births to women resident in Wales, was well-conducted, relative to the other included studies, and highly applicable to Cumbria in terms of population characteristics, health outcomes, geography and health care provision. A second study (Combier, 2013), conducted in the Burgundy region of France, was also well-conducted and of moderate (‘Medium’) applicability to Cumbria. All other studies were considered to have low applicability to Cumbria and were of ‘Poor’ or ‘Fair’ quality.

\(^{41}\) Although not stated by the study authors, their methodology suggests that this group included women who had a planned home birth but who delivered in hospital (number/\% not reported)

\(^{42}\) No information was provided on whether the home deliveries were planned or unplanned
There was a suggestion from the evidence reviewed that, for some healthcare systems, populations and geographies, distance/travel time may make a difference to pregnancy outcomes. However, the applicability of this evidence to Cumbria, with its different geography, population and healthcare systems, is mostly low, and the inconsistencies in the findings, together with the range of quality issues discussed, mean that the findings are of limited value in answering the questions of this review.

Responses to the four detailed research questions identified for this evidence review are shown below:

1(a) Is increasing distance/travel time from home to maternity delivery unit (any type e.g. birth centre or freestanding midwife led unit (MLU/FMU) or consultant-led unit (CLU)) associated with any adverse impact on obstetric or birth outcomes?

We found insufficient evidence to answer this question with any confidence. For example, the two studies that were considered of higher quality and high or medium applicability to Cumbria found the following:

**Paranjothy (2014)** (n=412,827) reported an increased risk of perinatal and neonatal death with every 15-minute increase in estimated travel time to actual hospital of delivery, compared with a travel time of less than 15 minutes, but no difference in risk of death was associated with every 15-minute increase in travel time to the nearest hospital open at the time of delivery. One possible explanation for this finding is that longer journey times contribute to a higher risk of adverse outcomes for women who travel to give birth at a delivery hospital further away than their nearest hospital. However, the cohort of women with estimated travel times of 45 minutes or longer to their actual hospital of delivery had a higher proportion of premature births which suggests that the overall risk profile for this group may have differed from the cohorts of women with shorter travel times. If this were so, the most plausible explanation for the study findings is that women with higher risk pregnancies, hence a higher risk of adverse outcomes, travelled further to give birth at hospitals with specialised obstetric and neonatal care facilities, whereas women with lower risk pregnancies travelled to their nearest hospital for delivery. It was not possible to consider the likelihood of this explanation further since the study did not adjust for, and no further information was available on, maternal/fetal risk factors or pregnancy-related conditions that may have resulted in mothers delivering at more specialised hospitals further away from their nearest delivery unit. The study measured only perinatal mortality as an outcome and did not investigate other indicators of maternal or obstetric care-related outcomes. Outcome data were not analysed by distance to more specialised hospitals or adjusted for level of care provided at the nearest hospital.

**Combier (2013)** (n=111,001) found that for women travelling 31 to 45 minutes and more than 45 minutes to the nearest maternity unit by rapid ambulance transport, there was a higher risk that their babies would experience fetal distress (indicated by fetal heart rate abnormalities and/or meconium-stained amniotic fluid) compared with those born to women with shorter journey times (less than 15 minutes); however, the outcomes for these babies were not reported. There was also a higher risk of unplanned OOH birth for women travelling 16 to 30 minutes and 31 to 45 minutes compared with those travelling less than 15 minutes; no unplanned OOH births were recorded in women travelling more than 45 minutes to the nearest maternity hospital. No follow-up outcomes were reported for unplanned OOH births. Women living more than 45 minutes’ travel time from their nearest maternity unit had a higher risk of hospitalisation more than 24 hours before delivery compared with those living less than 15 minutes away. Again, no follow up outcomes were reported for either the women or their babies. The study found no difference in risk of stillbirth or perinatal death for babies born to women with longer travel times to their nearest maternity hospital, although this finding may be related to the study size (n=111,001) and small number of women living more than 45 minutes from the maternity ward.
Taking into account the body of evidence from across all studies, we found that:

- Of the eight studies which reported perinatal/neonatal mortality as an outcome, four (Paranjothy, 2014; Pilkington 2014; Lisonkova, 2011, and Ravelli, 2011) reported an increase in mortality associated with travel times to hospital although, for one of these studies (Pilkington, 2014), the results were inconsistent.
- Amongst the four studies showing an increased risk, the study considered most applicable to Cumbria (Paranjothy, 2014) reported an increase in mortality associated with travel time to actual hospital of delivery, but not when the analysis was repeated for travel time to nearest hospital. The other three studies were considered of low applicability to Cumbria.
- All six studies which measured out of hospital (OOH) births reported an increased frequency of OOH births with longer travel times and/or distances. Another study (Pilkington, 2014) reported outcomes following unplanned OOH birth in relation to distance from nearest maternity unit but its findings were inconsistent across different distance cohorts.
- All three studies which measured induction of labour reported no difference in risk with increasing travel time (Combier, 2013 and Grzybowski, 2011) or distance (Lisonkova, 2011) to hospital. Of the three studies reporting the association between caesarean section (CS) rates and travel time/distance to hospital, two (Grzybowski, 2011 and 2015) reported a lower risk of CS for women travelling 1 to 2 hours compared with those travelling less than 1 hour; the third study (Lisonkova, 2015) found no difference in risk of CS with increasing distance from hospital.
- No consistent findings were observed across studies for any other outcome measures.

On the basis of these findings, it is reasonable to conclude that our review of the evidence base most applicable to Cumbria has not identified any evidence of an association between travel times to the nearest maternity delivery unit and mortality rates. However, this conclusion cannot be interpreted as a declaration that such an association does not exist for the reasons described above. With regard to other outcome measures, it is also possible to conclude that the current evidence is suggestive of an increase in the frequency of OOH births associated with longer travel times and/or distances to the nearest maternity delivery unit.

1(b) Does the picture differ for high versus low risk mothers/maternities?

We found insufficient evidence to answer this question. For example, in the two studies that were considered of higher quality and high or medium applicability to Cumbria:

Paranjothy (2014) conducted a subgroup analysis on term births only and on nulliparous pregnancies only. For term pregnancies alone, this analysis showed an increased risk of intrapartum stillbirth and late neonatal death, but no difference in risk for early neonatal death, for every 15-minute increase in travel time to actual hospital of birth. For nulliparous pregnancies alone, there was a higher risk of intrapartum stillbirth, early neonatal death and both intrapartum stillbirth and neonatal death combined, but no difference in risk of late neonatal death, with every 15-minute increase in travel time to actual hospital of birth. However, the magnitude of these differences in risk was similar to that for the full study cohort. As with analysis of the full study sample, the differences in risk for term births and nulliparous pregnancies were not observed for travel to nearest hospital open at time of delivery.

Combier et al (2013) did not conduct any subgroup analyses.

2(a) Is increasing distance/travel time between standalone midwife led units (MLUs)/freestanding midwife units (FMUs) or place of residence (for planned home births) and obstetric (consultant) led units (CLUs) associated with any adverse impact on obstetric or birth outcomes?

We found insufficient evidence to answer this question.

Only one included study (Ravelli, 2011) conducted in the Netherlands (n=751,926), investigated the relationship between travel times and outcomes for women transferred during labour from a community setting (home or outpatient clinic) to a hospital for delivery. The study found no increase in
risk associated with transfer times of 20 minutes or more from a community setting to the delivery hospital compared with travel times under 20 minutes for the combined outcome of peripartum stillbirth and neonatal (0-27 days) mortality or for the composite adverse outcome of mortality and/or low 5-minute Apgar score below 4 and/or transfer of a newborn to a NICU at birth.

However, the Ravelli study was considered of low applicability to Cumbria due to factors such as the higher population density in the Netherlands, shorter travel times (only a few women in the study population travelled more than 30 minutes to hospital for delivery) and approach to maternity service delivery (more than a quarter of women in the Netherlands have a home birth under the care of an independent midwife and were excluded from the study population, with the result that the included population were likely to have a higher than average risk profile).

2(b) Does the picture differ for high versus low risk mothers/maternities?

We found no evidence to answer this question.

Ravelli (2011) did not conduct any subgroup analyses within the cohort of women transferred from primary to secondary care during labour.
7. References


NICE Guidance: Intrapartum care for healthy women and babies - Clinical guideline [CG190] Published date: December 2014, Section 1.5 https://www.nice.org.uk/guidance/cg190/chapter/1-Recommendations#second-stage-of-labour


### 8. Glossary of terms and abbreviations

<table>
<thead>
<tr>
<th>Abbreviation (where applicable)</th>
<th>Term</th>
<th>Definition (UK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMU/AMLU</td>
<td>Alongside midwifery (led) unit</td>
<td>Maternity unit run by midwives located next to (alongside) a consultant-led hospital maternity unit.</td>
</tr>
<tr>
<td>CLU/OU</td>
<td>Consultant-led unit/obstetric unit</td>
<td>Maternity/obstetric unit where care is led by consultant obstetricians.</td>
</tr>
<tr>
<td>FMU/FMLU</td>
<td>Freestanding midwifery (led) unit</td>
<td>Maternity unit run by midwives without the medical facilities of a hospital nearby; also referred to as ‘standalone’ midwifery unit.</td>
</tr>
<tr>
<td>LGA</td>
<td>Large for gestational age</td>
<td>Newborns who are larger in size than normal for the gestational age, most commonly defined as a weight above the 10th percentile for the gestational age.</td>
</tr>
<tr>
<td>MLU</td>
<td>Midwifery-led unit</td>
<td>Maternity unit where care is led by midwives with no consultant obstetrician present.</td>
</tr>
<tr>
<td>NNU/NICU</td>
<td>Neonatal unit/neonatal intensive care unit</td>
<td>In the UK, units providing neonatal care are classified as follows: Level 1 units provide special care but do not aim to provide any continuing high dependency or intensive care. Level 2 units provide high dependency care and some short-term intensive care. Level 3 neonatal units provide the whole range of medical neonatal care but not necessarily all specialist services such as neonatal surgery. (International variations exist in the approach to delivery (and hence classification) of neonatal care services.)</td>
</tr>
<tr>
<td>PPM</td>
<td>Peripartum mortality</td>
<td>The number of intrapartum stillbirths (death of baby during labour) and neonatal deaths within the first 24 hours of birth per 1000 total births.</td>
</tr>
<tr>
<td>PNM</td>
<td>Perinatal mortality</td>
<td>The number of stillbirths and early neonatal deaths per 1000 total births. International variations in the precise definition of perinatal mortality exist, specifically concerning inclusion or exclusion of early fetal and late neonatal fatalities. The WHO defines perinatal mortality as the &quot;number of stillbirths and deaths in the first week of life per 1,000 total births, the perinatal period commences at 22 completed weeks (154 days) of gestation, and ends seven completed days after birth&quot;.</td>
</tr>
<tr>
<td>SES</td>
<td>Socio-economic status</td>
<td>In England, the Index of Multiple Deprivation (IMD) is used as a measure of socio-economic status for different populations and is based on data collected via the population census. (The variables used to derive SES measures differ between countries).</td>
</tr>
<tr>
<td>SGA</td>
<td>Small for gestational age</td>
<td>Newborns who are smaller in size than normal for the gestational age, most commonly defined as a weight below the 10th percentile for the gestational age.</td>
</tr>
</tbody>
</table>

**Terms without abbreviations**

<table>
<thead>
<tr>
<th>Definition (UK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antepartum stillbirth/death</td>
</tr>
<tr>
<td>Gravidity</td>
</tr>
<tr>
<td>Intrapartum stillbirth/death</td>
</tr>
<tr>
<td>Term</td>
</tr>
<tr>
<td>-------------------------------</td>
</tr>
<tr>
<td>Multiple pregnancy/birth</td>
</tr>
<tr>
<td>Neonatal death</td>
</tr>
<tr>
<td>Parity</td>
</tr>
<tr>
<td>Perinatal death</td>
</tr>
<tr>
<td>Plurality</td>
</tr>
<tr>
<td>Peripartum death</td>
</tr>
<tr>
<td>Singleton pregnancy/birth</td>
</tr>
<tr>
<td>Stillbirth</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

43 In 1992, the UK definition of stillbirth was changed from a death after 28 weeks to the current definition of after 24 weeks of pregnancy.
### Appendix 1: High-level summary of study characteristics

<table>
<thead>
<tr>
<th>Reference</th>
<th>Design</th>
<th>Population</th>
<th>Data period</th>
<th>Study sample size (after exclusions)</th>
<th>Exposure (travel time/distance)</th>
<th>Outcomes</th>
<th>Variables adjusted for in analysis$^{44}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engjom 2017 Norway</td>
<td>Cross-sectional</td>
<td>All births</td>
<td>1999-2009</td>
<td>646,898</td>
<td>Travel time to nearest unit</td>
<td>Peripartum death$^{45}$ OOH births (unplanned)</td>
<td>Yes (limited) Yes Yes No</td>
</tr>
<tr>
<td>Featherstone 2016</td>
<td>Cross-sectional</td>
<td>Singleton preterm VLBW births</td>
<td>2010-2012</td>
<td>2,030</td>
<td>Travel time to actual delivery unit</td>
<td>Neonatal death (0-27 days)</td>
<td>No Yes Yes Yes</td>
</tr>
<tr>
<td>Grzybowski 2015</td>
<td>Cross-sectional</td>
<td>Singleton births</td>
<td>2003-2008</td>
<td>150,797</td>
<td>Travel time to nearest maternity service (with/without CS capability)$^{46}$</td>
<td>Perinatal death$^{47}$ Prematurity (&lt;37 weeks) Low birthweight (&lt;1500g) Caesarean section</td>
<td>No Yes No No</td>
</tr>
<tr>
<td>Ovaskainen 2015</td>
<td>Case Control</td>
<td>OOH births (67 cases) and in hospital births (2 per case = 134 controls)$^{48}$</td>
<td>1996-2011</td>
<td>201 (out of 76,773 total births)</td>
<td>Distance and travel time to delivery hospital</td>
<td>Maternal deaths Neonatal deaths Neonatal morbidity: Hypo-glycaemia; Jaundice; Infection; Hypothermia; Apgar scores 7-10 at 1 and 5 mins; Treated in NNU; Length of hospital stay (not specified whether for mother or baby; days counted from date of infant birth)</td>
<td>Yes (limited) Yes Yes Yes</td>
</tr>
</tbody>
</table>

$^{44}$ For the case control studies (Ovaskainen, 2015 and Renesme, 2013) the variables listed in this column were those tested for their association with the outcome of interest (OOH births) along with travel time and/or distance (listed in the exposure column).

$^{45}$ Peripartum stillbirth (at least 22 completed weeks or birthweight ≥ 500g) and neonatal death (<24h).

$^{46}$ Cohorts were defined by both travel time and service level with potential for confounding associated with type/level of service provision. Cohorts with travel times >1h to nearest maternity facility (of any type) were compared with reference cohort with access to obstetrician-led maternity service within 1h.

$^{47}$ Stillbirth (not further defined) and neonatal death (0-6 days).

$^{48}$ Not specified whether singleton or multiple.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Design</th>
<th>Population</th>
<th>Data period</th>
<th>Study sample size (after exclusions)</th>
<th>Exposure (travel time/distance)</th>
<th>Outcomes</th>
<th>Variables adjusted for in analysis&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Socio-economic/ environmental</th>
<th>Maternal risk factors</th>
<th>Neonatal risk factors</th>
<th>Health care-related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paranjothy 2014 Wales</td>
<td>Cross-sectional</td>
<td>Singleton births (≥24 weeks)</td>
<td>1995-2009</td>
<td>412,827</td>
<td>Travel time to nearest and actual delivery hospital</td>
<td>Intrapartum stillbirth Neonatal death (0-27 days) Composite of both</td>
<td>Yes</td>
<td>Yes (limited)</td>
<td>Yes (limited)</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Pilkington 2014 France</td>
<td>Cross-sectional</td>
<td>All births (≥22 weeks or ≥500g birth weight)</td>
<td>2001-2008</td>
<td>6,202,918</td>
<td>Distance to nearest maternity unit Rural/urban status</td>
<td>Stillbirth (≥22 weeks or ≥500g) Neonatal death (0-27 days) Neonatal death after OOH</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Combier 2013 France</td>
<td>Cross-sectional</td>
<td>Singleton births (≥22 weeks)</td>
<td>2000-2009</td>
<td>111,001</td>
<td>Travel time to nearest maternity ward</td>
<td>Stillbirth (≥22 weeks) Extended perinatal death (stillbirth and neonatal death 0-27 days) FHR abnormalities Meconium-stained amniotic fluid Hospitalisation (during pregnancy); Hospitalisation for &gt;24h before delivery Induction of labour OOH births (unplanned)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (limited)</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Renesme 2013 France</td>
<td>Case Control</td>
<td>Unplanned OOH live births&lt;sup&gt;49&lt;/sup&gt; (76 cases) and in 2 hospital births per case (152 controls)</td>
<td>2007-2009</td>
<td>228 (out of approx. 29,100&lt;sup&gt;50&lt;/sup&gt; total births)</td>
<td>Distance and travel time to nearest delivery unit</td>
<td>Prematurity (&lt;37 weeks) Birth weight Admission to NNU</td>
<td>Yes (limited)</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Blondel 2005-2009</td>
<td>Cross-</td>
<td>Singleton live</td>
<td>2005-2009</td>
<td>1,349,751</td>
<td>Distance to OOH births (planned)</td>
<td></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> ≥22 weeks or ≥500g birth weight; no multiple OOH births were identified in the study period, hence study included only singleton births

<sup>50</sup> Stated as 9700 births per year over 3 year study period

Evidence Review: the association between distance/travel time and obstetric or birth outcomes
<table>
<thead>
<tr>
<th>Reference</th>
<th>Design</th>
<th>Population</th>
<th>Data period</th>
<th>Study sample size (after exclusions)</th>
<th>Exposure (travel time/distance)</th>
<th>Outcomes</th>
<th>Variables adjusted for in analysis</th>
<th>Socio-economic/environmental</th>
<th>Maternal risk factors</th>
<th>Neonatal risk factors</th>
<th>Health care-related</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011 France</td>
<td>sectional</td>
<td>births</td>
<td>2006</td>
<td>nearest maternity unit</td>
<td>and unplanned</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grzybowski 2011 Canada</td>
<td>Cross-sectional</td>
<td>Singleton births (&gt;20 weeks)</td>
<td>2000-2004</td>
<td>49,402</td>
<td>Travel time to nearest maternity service (with CS capability)&lt;sup&gt;51&lt;/sup&gt;</td>
<td>Perinatal death (stillbirth and early neonatal death 0-6 days)</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Lisonkova 2011 Canada</td>
<td>Cross-sectional</td>
<td>Singleton births to women aged ≥35y</td>
<td>1999-2003</td>
<td>29,206</td>
<td>Distance to nearest hospital with CS capacity</td>
<td>Stillbirth (&gt;20 weeks) Perinatal death (stillbirth or neonatal death 0-27 days) Preterm birth (&lt;37 weeks) SGA (&lt;10&lt;sup&gt;th&lt;/sup&gt; percentile) LGA (&gt;10&lt;sup&gt;th&lt;/sup&gt; percentile) NICU admission &gt;1 day Induction of labour CS (primary, repeat, emergency)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<sup>51</sup> As with 2015 study, cohorts were defined by both travel time and service level with potential for confounding associated with type/level of service provision. Study methodology differs from Grzybowski (2015) study where nearest maternity service may not have had CS capability.
<table>
<thead>
<tr>
<th>Reference</th>
<th>Design</th>
<th>Population</th>
<th>Data period</th>
<th>Study sample size (after exclusions)</th>
<th>Exposure (travel time/distance)</th>
<th>Outcomes</th>
<th>Variables adjusted for in analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ravelli 2011 The Netherlands</td>
<td>Cross-sectional</td>
<td>Singleton births (37 to 42 weeks)</td>
<td>2000-2006</td>
<td>751,926</td>
<td>Travel time by car to actual delivery unit</td>
<td>Intrapartum stillbirth Neonatal death (0-27 days) Composite of above (extended perinatal death) Composite of death and/or 5 minute Apgar score &lt;4, and/or transfer to NICU at birth</td>
<td>Yes (limited) Yes (limited) Yes</td>
</tr>
</tbody>
</table>
### Appendix 2: Summary evidence table for studies investigating association between distance/travel times and obstetric/birth outcomes

<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Exposure</th>
<th>Outcomes</th>
<th>Variables adjusted for in analysis</th>
<th>Results</th>
<th>Critical appraisal comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engjom 2017</td>
<td>All births (≥22weeks or birth weight ≥500g), 1999-2009</td>
<td>Travel zones created around each hospital to represent geographic areas in which women were estimated to reach nearest maternity facility in travel times of: &lt;1h (n=615,896), 1-2h (n=25,494), &gt;2h</td>
<td>OOH birth (unplanned) Peripartum mortality (PPM) (intrapartum death or neonatal death within 24 hours of birth, excluding antepartum stillbirths) Maternal: Age, parity, plurality, smoking status, chronic disease, severe maternal morbidity, previous CS, previous stillbirth Fetal: gestational age, major malformation, SGA Socio-economic:</td>
<td>OOH birth (unplanned) Crude and adjusted relative risk (cRR and aRR)(+-95% CIs) for 1-2h travel zone vs reference level (&lt;1h): cRR 5.9 (5.5, 6.4) aRR 5.3 (5.0, 5.8) (adjusted for all maternal and fetal risk factors) Peripartum mortality For unplanned OOH births (across all travel time zones, with institutional births as reference level): cRR: 3.5 (2.5, 4.9) aRR: 3.9 (2.7, 5.6), after exclusion of births with major malformations For individual risk factors, risk of peripartum mortality in unplanned OOH births was higher than for other risk factors in: women &lt;20y: 19.3 (8.6, 43.6);</td>
<td>Strengths: Large population based study using national registry data with linkage to maternal addresses. High level of ascertainment and completeness. Adjustment for potential confounding factors including socio-economic, maternal and fetal risk factors; took account of clustering of births to same mother registered to same institution. Limitations: PPM analysed by location of birth but not by distance/travel time. Imprecise measure of...</td>
<td></td>
</tr>
<tr>
<td>Cross-sectional study</td>
<td>Norway</td>
<td>After exclusions (births with missing data for travel time analysis) n= 646,898 (99.7% of total)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

54 For the case control studies (Ovaskainen, 2015 and Renesme, 2013) the variables listed in this column were those tested for their association with the outcome of interest.

55 Data sources: Medical Birth Registry of Norway and Statistics Norway.

56 Travel time estimates were based on registered speed limits for road travel and standard duration of ferry/boat journeys and represented the minimum time for non-emergency transport.

57 Two levels of maternity and newborn care based on categories defined in the WHO Handbook for Monitoring Emergency Obstetric and Newborn Care: basic obstetric care (BOC) institutions (equivalent to freestanding midwife-led units in England), and emergency obstetric and newborn care institutions (EmONC) (equivalent to consultant-led obstetric services in England).

58 Previous stillbirth at gestational age ≥24 weeks; 86,658 births with missing information on this variable were excluded from stratified analysis.

59 Small for gestational age; birthweight by gestational age classified according to Norwegian standards.
<table>
<thead>
<tr>
<th>Study</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Featherstone 2016 Cross-</td>
<td>Singleton births of preterm ((\geq20-36))</td>
<td>Travel time (derived from addresses using GIS(^{62}))</td>
<td>Neonatal death (0-27 days)</td>
<td>Maternal: age, ethnicity, previous live</td>
<td>Neonatal mortality: 17.64/100 live births (&lt;1500g) 11.03/100(^{64}) live births (500-1499g)</td>
<td>Strengths: Adjustment for potential confounders including maternal and newborn</td>
</tr>
</tbody>
</table>

\(^{a}\) Source: World Health Organisation statistics

\(^{62}\) Geographical Information System software package used to derive travel times between different locations

Evidence Review: the association between distance/travel time and obstetric or birth outcomes
### Evidence Summary Report

#### Evidence Review: the association between distance/travel time and obstetric or birth outcomes

<table>
<thead>
<tr>
<th>Study</th>
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</thead>
<tbody>
<tr>
<td>Sectional study</td>
<td>South Carolina (SC), USA</td>
<td>weeks, very low birth weight (VLBW) (500-1499g) infants, 2010-12</td>
<td>births, gestational hypertension/diabetes, smoking</td>
<td></td>
<td>Crude and adjusted odds ratios (cOR/aOR) with 95%CI (lower, upper) for predicting neonatal death amongst VLBW infants (with &lt;30 min as reference level):</td>
<td>Risk factors and level of health care. Exclusion of multiple births (which have a higher risk profile than singleton births).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n=2030 after exclusions (multiples, gestation &lt;20 weeks or term, birth weight &lt;500g, births with missing data)</td>
<td>Newborn: gestational age, gender, NICU admission at birth</td>
<td></td>
<td>Model I (crude model): 30-59min: 1.19 (0.86, 1.66) ≥60min: 0.83 (0.56, 1.22)</td>
<td><strong>Limitations:</strong> Small sample including only 64% of all VLBW infants of &lt;1500g after exclusions. No consideration of intrapartum stillbirths, so may underestimate mortality associated with longer travel times before/during labour. Congenital anomalies not excluded; if identified antenatally, these are likely to involve planned delivery at a specialist hospital (hence represent a potential confounding factor). Travel times derived from distance.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean maternal age 26.37y; 58.82%</td>
<td>Hospital characteristics: Level III delivery hospital63</td>
<td></td>
<td>Model II (adjusted for all possible confounding factors): 30-59 min: 1.19 (0.86, 1.66) ≥60 min: 0.83 (0.56, 1.22)</td>
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<tr>
<td></td>
<td></td>
<td>from mother’s home address to hospital of delivery (&lt;30, 30-59, ≥60min)</td>
<td>n% of births in each travel time category:</td>
<td></td>
<td>Model III (adjusted for variables with p&lt;0.1): 30-59 min: 1.21 (0.82, 1.79) ≥60 min: 0.86 (0.55, 1.36)</td>
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<tr>
<td></td>
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<td></td>
<td>&lt;30min (n=1153, 56.8%); 30-59min (n=477, 23.5%); ≥60min (n=400, 19.7%)</td>
<td></td>
<td>Model IV (adjusted for variables with p&lt;0.05): 30-59 min: 1.20 (0.81, 1.77) ≥60 min: 0.82 (0.52, 1.28)</td>
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<td></td>
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<td></td>
<td></td>
<td>Increase in gestational age by one week and mothers of non-Hispanic black ethnicity were associated with lower odds of neonatal death; non-NICU admission at birth was associated</td>
<td></td>
</tr>
</tbody>
</table>

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63 Perinatal level designations were based on the Division of Health Licensing Regulations at the Department of Health and Environmental Control (DHEC): levels I, II, II Enhanced, III and III Regional Perinatal Centre (RPC). Hospital level designations are regulated by the South Carolina DHEC and must meet both obstetric and neonatal requirements (which address annual birth volume, staffing and capacity to provide advanced care). In this study, levels II and II Enhanced were combined into one category for analyses, as were levels III and III RPC.

40 Error in published paper: neonatal mortality reported as 11.1/100 live births whereas data (224/2030) indicate 11.03/100.

65 aOR +/- 95%CI for Model II (after adjustment for all variables) is same as for Model I (crude model with no adjustment) which suggests a possible publication error for one set of figures; the authors report separately that they found no significant associations between travel time and neonatal death in any of the models.
## Evidence Summary

**Study**

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<td></td>
<td>non-Hispanic black ethnicity; 96.26% births very preterm (20-33 weeks); 87.04% admitted to NICU; 81.87% born in level III hospital</td>
<td></td>
<td>with increased odds of neonatal death.</td>
<td></td>
<td>measurements and may not reflect real travel times.</td>
<td></td>
</tr>
</tbody>
</table>

**Applicability to Cumbria:**
Study findings only applicable to singleton preterm VLBW (500-1499g) births (in 2015, live and stillbirths with birth weight <1500g represented 1.41% of live births in Cumbria CCG population, 1.26% in England). Population profile, geography, and health care provision likely to differ substantially between South Carolina (US) and Cumbria. Study population had higher neonatal mortality than England and Wales (neonatal mortality 17.64/100 in babies <1500g in study population vs 13.9/100 for England and Wales in 2014).

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61 Equivalent to tertiary level centre in England  
66 Source: PHE Public Health profiles, 2015; Cumbria CCG refers to pre April 2017 CCG boundaries  
67 ONS Live births, stillbirths and linked infant deaths: babies born in 2014, plurality and birthweight, numbers and rates, published April 2017
### Study Summary

**Evidence Review:** the association between distance/travel time and obstetric or birth outcomes

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<tr>
<td>Grzybowski 2015 Cross-sectional study 3 regions in Canada (non-metropolitan Alberta, British Columbia (BC), and Nova Scotia)</td>
<td>Singleton births, 2003-08 n=150,797 after exclusions (congenital anomalies, planned/unplanned OOH births) (Alberta 70,037, BC 61,991, Nova Scotia 18,769)</td>
<td>Women/births allocated to 8 cohorts according to: (i) type of nearest maternity provision, and (ii) travel time to nearest maternity facility (with/without CS capability). n of women/births allocated to each Level: Level 1 (n=955)</td>
<td>Perinatal mortality (stillbirths + early neonatal deaths 0-6 days) (PNM) Prematurity (&lt;37 weeks) VLBW (&lt;1500g) Caesarean section (CS)</td>
<td>Maternal: age, parity, prior neonatal death, prior stillbirth, previous CS, diabetes/hypertension (existing/gestational for both)</td>
<td>Results reported for Level 3 compared with Level 8 (reference level). Adjusted odds ratio (aOR) +/- 95%CI for each outcome (from composite forest plot; OR data not separately reported): PNM Composite forest plot: NS difference for Level 3 Prematurity Composite forest plot: aOR +/- 95%CIs &gt;1 for Level 3 VLBW (&lt;1500g) Composite forest plot: NS differences for Level 3 CS Composite forest plot: aOR +/- 95%CIs &lt;1 for Level 3 p values not reported</td>
<td>Strengths: Moderately-sized population-based cohort across 3 regions. Exclusion of congenital anomalies. Limitations: Excluded unplanned OOH births. No adjustment for mother’s ethnicity and/or socio-economic status or differences between cohorts in type of maternity provision (which differed between cohorts), all of which are potential confounding factors. No statistical adjustment for multiple comparisons in analysis hence some findings, particularly at level of individual regions, may be due to chance.</td>
</tr>
</tbody>
</table>

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68 In Alberta and BC, centroids of rural post codes were used to define population catchments surrounding each rural facility and the distance women needed to travel to access maternity services when no local hospital services were available; surface travel time by road was used to create 1hr catchments around each maternity facility as well as cohorts of rural women who travel 1-2h, 2-4h and >4h to access nearest maternity services; in Nova Scotia, actual travel time for each birth was calculated.

69 Level 1: nearest maternity services >4hrs away; Level 2: nearest maternity services within 2-4 hrs; Level 3: nearest maternity services within 1-2h; Level 4: primary care maternity services (without local surgical care) within 1h; Level 5: maternity services provided by GP(s) with Enhanced Surgical Skills (GPESS(s)) within 1h; Level 6: maternity services provided by a mixed model (GPESS(s) and specialist surgeon(s)) within 1h; Level 7: maternity services provided by general surgeons within 1h; Level 8 (reference level): maternity services provided by obstetricians within 1h. Levels 4 to 7 not comparable with service delivery in Cumbria so results are only tabulated here for Levels 1 to 3 compared with Level 8.

70 Composite forest plots (amalgamating data from all 3 regions) published for all four outcomes but data not separately reported.
### Evidence Summary Report

#### Evidence Review:

The association between distance/travel time and obstetric or birth outcomes

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<td>2 (n=2070)</td>
<td>3 (n=7024)</td>
<td>4 (n=14,947)</td>
<td>5 (n=33,000)</td>
<td>6 (n=17,022)</td>
<td>7 (n=3,543)</td>
<td>8 (n=85,548)</td>
</tr>
</tbody>
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<td>8 (n=85,548)</td>
</tr>
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</table>

Results by region where aOR for Level 3 cohort significantly different to reference Level 8 cohort (data not shown here):

- **PMN**: aOR +/- 95% CIs >1 in Alberta
- **Prematurity**: NS differences for Level 3
- **LBW**: NS differences for Level 3
- **CS**: aOR +/- 95% CIs <1 for Level 3 in Alberta and Nova Scotia

Imprecise measure of travel times for women in BC and Alberta (using centroids of rural post codes rather than travel times estimated for individual women/births in Nova Scotia).

Applicability to Cumbria:
Population profile, geography, health care services and outcomes likely to differ substantially between Canada and Cumbria eg Levels 4, 5 and 6 study cohorts not within scope of this review since travel time (<1h) same as for reference level 8: Levels 1 and 2 study cohorts (>4h and 2-4h from nearest maternity service) not applicable to Cumbria. Level 3 (1-2h to nearest maternity service of any type with/without CS capability) is the only cohort potentially equivalent to Cumbria. Maternal and neonatal mortality in Canada as a whole not significantly different to that for UK.
### Study Details

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<tr>
<td>Ovaskainen 2015</td>
<td>76,773 total births, 1996-2011</td>
<td>Travel distance and travel time between home address and delivery unit, calculated using web-based route planner, selecting fastest route option.</td>
<td>Maternal deaths</td>
<td>Pre-selected variables tested for independent association with OOH births via logistic regression</td>
<td>Distance from home to delivery unit (shortest route, km), median (range): Cases: 23.0 (2.8, 208.8) Controls: 13.3 (1.5, 125.4) p&lt;0.001</td>
<td>Strengths: Controlled study. Distance based on actual distance by road between home and delivery unit for individual women. Limitations: Small sample size. No information on whether any multiple births were included. Outcomes not analysed by distance or travel times. Included both planned and unplanned OOH births with no separate analysis (though in practice only 1.5% planned home birth was recorded). Missing data on maternal education, socioeconomic status, and alcohol/drug use (which are potential confounding factors) so these variables were excluded from analysis. No information</td>
</tr>
<tr>
<td></td>
<td>Cases: All OOH births (planned and unplanned), (n=67)</td>
<td>4 distance categories used: &lt;5, 5-19.9, 20-34.9 and ≥35km (corresponding travel times not reported apart from uppermost)</td>
<td>Neonatal deaths</td>
<td>Neonatal morbidity: Hypoglycaemia; Jaundice; Infection; Hypothermia; Apgar scores 7-10 at 1 and 5mins; Infant treated in NNU; Length of hospital stay (not specified whether for mother or baby; days counted from date of infant birth)</td>
<td>Travel time to delivery unit (fastest route, mins), median (range): Cases: 23.5 (4, 171) Controls: 15.0 (2, 107) p&lt;0.001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Controls: 2 hospital births (immediately before and after each case) per OOH birth (n=134)</td>
<td>Maternal age, parity &gt;0, smoking in pregnancy, duration of labour, living in partnership, parity &gt;0, maternal age,</td>
<td>Neonatal deaths</td>
<td>Neonatal morbidity indicators for cases vs controls not analysed separately by distance/travel time</td>
<td>No maternal or neonatal deaths reported</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No exclusions specified</td>
<td></td>
<td>Neonatal morbidity: Hypoglycaemia; Jaundice; Infection; Hypothermia; Apgar scores 7-10 at 1 and 5mins; Infant treated in NNU; Length of hospital stay (not specified whether for mother or baby; days counted from date of infant birth)</td>
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</table>

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71 Catchment area (population 521,700) of one university hospital (area includes one other delivery unit), 1996 to 2011

72 From Central Population Register

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Evidence Review: the association between distance/travel time and obstetric or birth outcomes
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<tr>
<td></td>
<td></td>
<td>quartile of ≥30mins</td>
<td>distance/travel time to delivery unit, prenatal visits, gestational age at birth, SGA and LGA</td>
<td></td>
<td></td>
<td>on whether university hospital was planned or nearest delivery unit for each case (at time of study there was one other delivery unit in the area).</td>
</tr>
</tbody>
</table>

Applicability to Cumbria: Population profile, geography, and health care provision likely to differ substantially between Finland and Cumbria e.g. range of distances travelled (6.9 to 208.8km) and travel times (4mins to 2 hours 51 mins) to reach nearest maternity services were much wider for the study population than would apply to women in Cumbria; Finland has lower absolute risk of neonatal and maternal mortality than England (neonatal mortality 1.2 per 1000 in Finland vs 2.6 per 1000 in England, 2016; maternal mortality: 3 per 100,000 births in Finland)

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73 For purposes of analysis (logistic regression), continuous variables home-to-hospital distance and travel time were re-categorised based on uppermost quartile (≥35km and ≥30mins)
### Evidence Summary Report

#### Study

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<tr>
<td>Paranjothy 2014</td>
<td>Singleton births (≥24 weeks) to women residents, 1995-2009</td>
<td>Shortest travel times(^74) from mother’s place of residence to (a) hospital where birth took place (50 hospitals), and (b) nearest hospital with maternity services open at time of birth (30 hospitals)</td>
<td>Intrapartum stillbirth (death during labour)</td>
<td>Maternal: Age, parity</td>
<td>Intrapartum stillbirth rate 0.3/1000 (n=135); early neonatal death rate 1.3/1000 (n=609); late neonatal death rate 0.5/1000 (n=251); composite outcome (intrapartum stillbirth and neonatal deaths combined) 2.1/1000 (n=995)</td>
<td>vs 9 per 100,000 births in England, 2016).</td>
</tr>
<tr>
<td>Cross-sectional study Wales</td>
<td>n=412,827 after exclusions (ante-partum stillbirths, lethal congenital anomalies, multiple pregnancies, records with invalid or missing data)</td>
<td>Mean age of women childbirth 27y (SD 5y)</td>
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<td></td>
<td></td>
<td></td>
<td>Early neonatal death (0-6 days)</td>
<td>Newborn: gestational age, gender</td>
<td>For actual hospital of birth, odds ratios (crude OR (cOR), adjusted OR (aOR), +/- 95%CI) for every 15min increase in travel time (p values not reported):</td>
<td>Strengths: Very large population-based study using dataset with high level of completeness and ascertainment. Adjustment for deprivation and urban/rural residence as possible confounding factors. Exclusion of congenital anomalies.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Late neonatal death (7-27 days)</td>
<td>Socio-economic/environmental: social deprivation(^75), urban/rural</td>
<td>Intrapartum stillbirth To birth hospital cOR 1.29 (1.14, 1.47) aOR 1.13 (0.98, 1.30) To nearest hospital aOR 1.11 (0.83, 1.48)</td>
<td>Limitations: No adjustment for whether baby had left hospital after birth (in case of neonatal deaths) or for level of maternity or neonatal care (only 8 of 50 hospitals had NICU) as possible confounding factors. The term ‘hospital with maternity services’ was not further defined. No information on reasons why women travelled to a hospital further away than their</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Intrapartum stillbirth and neonatal deaths combined</td>
<td>Analysis repeated separately on term singleton pregnancies and on nulliparous women</td>
<td>Early neonatal death To birth hospital cOR 1.37 (1.31, 1.45) aOR 1.13 (1.07, 1.20) To nearest hospital aOR 0.99 (0.86, 1.15)</td>
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<td></td>
<td>Late neonatal death To birth hospital cOR 1.33 (1.23, 1.44)</td>
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</tr>
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</table>

\(^{74}\) Calculated by assigning each birth to lower super output area (LSOA) using grid reference for postcode of mother’s residence, replacing mother’s address by ONS population-weighted centroid, and grid reference based on postcode for each hospital.

\(^{75}\) In quintiles, based on Townsend score derived from 2001 census.
## Evidence Summary Report

### Evidence Review:

**The association between distance/travel time and obstetric or birth outcomes**

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<tr>
<td></td>
<td>(n=198,849, 42.6%); 15-29min (n=182,060, 39.0%); 30-44min (n=66,447, 14.3%) and ≥45min (n=18,899, 4.1%)</td>
<td>Median travel time to actual hospital of birth: 17min (IQR 10, 27min); median distance: 11.7km (IQR 5.7, 20.8km)</td>
<td>Intrapartum stillbirth and neonatal death combined</td>
<td>aOR 1.15 (1.05, 1.26)</td>
<td>To nearest hospital aOR 1.00 (0.79, 1.25)</td>
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**Critical appraisal comments**

- Potential for confounding by women with higher risk pregnancies giving birth at hospital more distant to their home than nearest hospital; no adjustment for maternal risk factors, other than age and parity.
- Travel times based on road network in 2012, not 1995-2009 when births occurred. No p values reported for any results; lower limit of 95%CIs close to 1 for all outcomes where aOR +/- 95%CI >1.
- For composite outcome, no p value or 95%CI shown for aOR at 15, 30 or 45min which cast doubt on statistical significance of these aOR values. No subgroup analyses for preterm births or multiparous pregnancies.

**Applicability to Cumbria:** Similar population profile, geography and health care provision to Cumbria (although absolute risk of adverse outcomes may differ between populations in Wales and Cumbria.)
<table>
<thead>
<tr>
<th>Study</th>
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<td></td>
<td><strong>Nulliparous pregnancies only (n=185,419)</strong></td>
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<td>due to differences in prevalence of maternal risk factors such as smoking in pregnancy and obesity. In study population, median travel time to actual delivery hospital 17 mins (IQR 10 to 27), median distance travelled 11.7km (IQR 5.7 to 20.8). Most women (81.7%) travelled &lt;30mins to actual delivery hospital. Relatively few women (4.1%) travelled ≥45mins to delivery hospital.</td>
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<td>Travel to birth hospital (aOR +/- 95%CI):</td>
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<td></td>
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<td></td>
<td></td>
<td>Intrapartum stillbirth</td>
<td>1.21 (1.02, 1.44)</td>
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<td></td>
<td></td>
<td>Early neonatal death</td>
<td>1.15 (1.06, 1.25)</td>
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<td>Late neonatal death</td>
<td>1.11 (0.97, 1.28)</td>
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<td>Intrapartum stillbirth &amp; neonatal death</td>
<td>1.16 (1.08, 1.24)</td>
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<td>Travel to nearest hospital: aOR +/- 95%CI</td>
<td>NS difference for any outcome</td>
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<td>Cause of death reported for neonatal deaths (n=726 (84.4% of total 862)) by travel time (rate per 1000 live births):</td>
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<td><strong>Conditions consequent upon preterm birth (n=451):</strong></td>
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<td></td>
<td>0.7 at &lt;15mins to 3.7 at ≥45mins (p&lt;0.001)</td>
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<td><strong>Infection (n=107):</strong></td>
<td>0.2 at &lt;15mins to 0.4 at ≥45mins (p=0.024)</td>
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<td></td>
<td><strong>Intrapartum events (n=168):</strong></td>
<td>0.3 at &lt;15mins to 0.6 at ≥45mins (p=0.05)</td>
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<td>Preterm births (&lt;37 weeks) (n, % of total births in cohort) by travel time (derived from data published on pregnancy characteristics):</td>
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<td>&lt;15mins, n= 10,663 (5.4%)</td>
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<td>15-29mins, n= 11,188 (6.1%)</td>
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<td></td>
<td>30-44mins, n= 4,546 (6.8%)</td>
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<tr>
<td>Study</td>
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<td>Exposure</td>
<td>Outcomes</td>
<td>Variables adjusted for&lt;sup&gt;a&lt;/sup&gt; in analysis</td>
<td>Results</td>
<td>Critical appraisal comments</td>
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<tr>
<td>Pilkington 2014 Cross-sectional study France (all regions)</td>
<td>Total births (n=3,086,128) and stillbirths (n=26,860), 2002-05</td>
<td>Distance between centre of municipality of mother’s home and nearest maternity unit:&lt;br&gt;&lt;5km (n=1,404,665, 45.5%)&lt;sup&gt;76&lt;/sup&gt;, 5-14km (n=811,775, 26.3%), 15-29km (n=648,495, 21.0%), 30-44km (n=186,537, 6.0%), and &gt;45km (n=34,367, 1.1%) Urban/rural status&lt;sup&gt;76&lt;/sup&gt;</td>
<td>Stillbirth rate (fetal deaths &gt;22 weeks or &gt;500g birth weight per 1000 total births)&lt;sup&gt;78&lt;/sup&gt;</td>
<td>Neonatal mortality rate (all deaths 0-27 days per 1000 live births)&lt;sup&gt;79&lt;/sup&gt;</td>
<td>Neonatal deaths after OOH birth&lt;sup&gt;80&lt;/sup&gt; (per 100,000 live births) Maternal: age, pregnancy type (singleton/multiple) Socio-economic (municipality level): unemployement rate, % single-parent households, % foreign-born residents Stillbirths (2002-05): n=26,860, 8.7 per 1000 births; neonatal deaths (2001-08): n=14,860, 2.4 per 1000 live births; neonatal deaths after OOH birth (2001-08): n=282, 4.5 per 100,000 live births. CIs not reported</td>
<td>Crude relative risk (cRR) and adjusted relative risk (aRR) for each outcome by distance to nearest maternity unit (compared with reference level of &lt;5km):&lt;br&gt;Stillbirths cRR for which CI excludes 1:&lt;br&gt;5-14km 0.87&lt;br&gt;15-29km 0.85&lt;br&gt;30-44km 0.85&lt;br&gt;&gt;45km NS difference aRR: NS difference (p=0.51) for all distance cohorts Neonatal mortality cRR for which CI excludes 1, p&lt;0.01:&lt;br&gt;5-14km 0.79&lt;br&gt;15-29km 0.81&lt;br&gt;30-45km 0.77&lt;br&gt;&gt;45km 0.80</td>
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<td></td>
<td>Live births (n=6,202,918), 2001-08</td>
<td>No exclusions specified</td>
<td></td>
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<td>≥45mins, n=1,802 (9.5%)</td>
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</tbody>
</table>

<sup>76</sup> In 2010, there were 36,570 municipalities in France  
<sup>77</sup> Cohort size (number%) shown here for total births (2002-2005) only to illustrate relative size of each cohort; for live births (2001-2008), the % in each cohort was similar to that for total births data
## Evidence Summary

### Study

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<tr>
<th>Study</th>
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</tr>
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<tbody>
<tr>
<td></td>
<td>urban (n=1,975,555); peri-urban (n=639,600); rural (n=470,973)</td>
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<td></td>
<td>aRR for which CI excludes 1, p&lt;0.01: 5-14km 0.91; 30-44km 0.90; NS difference for 15-29, ≥45km</td>
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<td></td>
<td>Neonatal deaths after out-of-hospital birth</td>
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<td></td>
<td>cRR for which CI excludes 1, p&lt;0.01: ≥45km 2.45; NS difference for all other distances</td>
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<td></td>
<td>aRR for which CI excludes 1, p&lt;0.01: 15-29km 1.58; ≥45km 3.68; NS difference for 5-14, 30-44km</td>
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<td></td>
<td>Confidence interval figures not reported for any outcomes (other than indication of whether or not CI includes 1).</td>
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<td></td>
<td>*Outcome rates by urban/rural status (95%CI and p values not reported):</td>
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<td></td>
<td>Stillbirth rate (per 1000)</td>
<td>Urban 9.1; Rural 8.2</td>
<td>level of health care provided, CI level not stated (presumably 95%) and CI values not reported (only that 'CI does not include 1'). No distinction made between planned medical terminations of pregnancy (at ≥22 weeks) and spontaneous fetal deaths or between planned and unplanned OOH births (although home births are rare in France). No further information on cause of neonatal deaths following OOH birth.</td>
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</table>

**Critical appraisal comments**

- Population characteristics and maternity/neonatal outcomes in France similar to those in Cumbria.

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78 Using INSEE (the French National Institute for Statistics and Economic Studies) ZAUER classification (zonage en aires urbaines et aires d'emploi de l'espace rural), which divides municipalities by increasing urbanisation (urban, per-urban, rural).
79 Definition of stillbirths in this study differs from that in England where, since 1992, stillbirths include all foetal deaths after 24 weeks gestation.
80 Includes planned home births and unplanned out of hospital births; study authors stated that 'planned home deliveries are not offered as part of standard maternity care in France, and these are rare'.
81 Reported as 'confidence interval' but no indication of confidence level (eg 95% or 99%).
82 Distance categories reported incorrectly in study table as 5-15km, 15-30km, 30-45km.
83 Study reported that French maternity services 'do not include an option for home birth, although some midwives in the private sector offer this service. OOH births occurring far from a maternity unit are therefore highly unlikely to be planned home births (since) rapid transfer to a maternity unit in case of complications is a prerequisite for safe home birth.'
<table>
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</thead>
<tbody>
<tr>
<td>Combier 2013 Cross-sectional study*</td>
<td>Singleton births (≥22 weeks gestation), 2000-09 n=111,001 after exclusions</td>
<td>Travel time between mother’s home and nearest maternity ward (calculated at municipality,</td>
<td>Stillbirth (deaths in utero) Perinatal death (0 to 27 days)</td>
<td>Individual variables: maternal age, child’s sex and gestational age at birth, history of preterm</td>
<td>Neonatal mortality rate (per 1000) Urban 2.5; Rural 2.2 Neonatal deaths after OOH birth (per 100,000) Urban 4.1; Rural 7.3 Relative risks (cRR, aRR) for outcomes not reported by urban/rural status.</td>
<td>England (2016 data: neonatal mortality 2.4 per 1000 in France vs 2.6 per 1000 in England; maternal mortality 8 per 100,000 births in France, 9 per 100,000 births in England). Study measured distance not travel time, so results not readily transferrable to other locations where similar distances may be associated with very different travel times. Only small % of study population lived &gt;30km from nearest maternity unit (6.0% at 30-44km and 1.1% at ≥45km); most were categorised as urban/peri-urban (with only 15.3% rural).</td>
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</tbody>
</table>

* Using hospital discharge summary data

Evidence Review: the association between distance/travel time and obstetric or birth outcomes
Evidence Review: the association between distance/travel time and obstetric or birth outcomes

<table>
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<tbody>
<tr>
<td>(medically indicated termination of pregnancy, geographic residence codes where ≥6% births occurred outside Burgundy, births in two years when 3 rural maternity units closed)</td>
<td>not individual level. Four travel time categories (n/%)</td>
<td>acute fetal distress: fetal heart rate (FHR) abnormalities; meconium-stained amniotic fluid; Prenatal hospitalisation (consecutive to or separate from delivery); Hospitalisation ≥24h before delivery</td>
<td>delivery, adverse obstetric history</td>
<td>Perinatal deaths (n=710, 0.64%): cOR and aOR: NS difference for all travel cohorts</td>
<td>closure of some units). Limitations: No adjustment for level of maternity/neonatal care as potential confounder. No statistical adjustment described for multiple comparisons. Imprecise measure of travel times at municipality level to nearest, rather than actual, maternity ward so may not represent actual travel times. Travel times based on rapid travel via ambulance, so likely to underestimate time taken by non-emergency vehicles.</td>
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<td>87.8% of included births took place at nearest maternity</td>
<td>Meconium-stained amniotic fluid (n=8555, 7.71%)</td>
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<td>Hospitalisation occurring 24h or more before delivery</td>
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<td>Out-of-hospital deliveries</td>
<td>Prenatal hospitalisation</td>
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</table>

85 Population 1.631 million in 2008 representing 2.6% of population of France; population density 51/km²; 2064 municipalities
86 Hospitalisation occurring 24h or more before delivery
87 In France, maternity units are classified into three levels of care by their capacity to provide paediatric services to high risk newborns: level I units (20 in 2000, 15 in 2009 in Burgundy): community facilities providing care for women with low risk pregnancies with no special care unit for newborns; Level II (6 units in Burgundy): have neonatal nurseries but do not provide care for very preterm or VLBW infants; Level III (1 unit in Burgundy): maternity unit with NICU providing care for high risk neonates throughout the region.
### Study

<table>
<thead>
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<th>Results</th>
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<tbody>
<tr>
<td></td>
<td>ward to centre mother's municipality of residence</td>
<td>Medical induction of labour (data from 9 maternity units)</td>
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<td>(n=13,657, 13.40%): &lt;br&gt; cOR &lt;br&gt; 16-30: NS difference 31-45: 1.27 (1.19, 1.35), p&lt;0.05 46: 1.59 (1.21, 2.08), p&lt;0.05 aOR &lt;br&gt; 16-30: 1.11 (1.01, 1.22), p=0.04 31-45: 1.17 (1.04, 1.32), p=0.01 ≥46: NS difference</td>
<td>Hospitalisation ≥24h before delivery (n=7213, 6.50%): &lt;br&gt; cOR &lt;br&gt; 16-30: NS difference 31-45: 1.30 (1.19, 1.41), p&lt;0.05 46: 2.13 (1.54, 2.95), p&lt;0.05 aOR &lt;br&gt; 16-30, 31-45: NS difference ≥46: 1.78 (1.07, 2.97), p=0.03</td>
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Evidenc Review: the association between distance/travel time and obstetric or birth outcomes
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</tr>
</thead>
<tbody>
<tr>
<td>Renesme</td>
<td>Approx. 29,100 births (9,700/year) , 1 Jan 2007 - 31 Dec 2009</td>
<td>Home addresses used to calculate distance and travel times between home and nearest delivery unit (using a route planning package, selecting 'vehicle' as mode of transport and 'fastest' option)</td>
<td>OOH birth (unplanned)</td>
<td>Variables tested for association with unplanned OOH births. Maternal*: age, family status (single/couple), psychiatric history, smoking status, abortion history, gravidity, parity. Socio-economic: maternal and paternal employment status/level(s). Health care provision:</td>
<td>Distance between home and delivery unit (km), median (range): Cases: 21 (0.9 to 79) Controls: 15 (0.5 to 63) p=0.02 Estimated travel time (min), median (range): Cases: 23 (2 to 73) Controls: 19 (1 to 61) p=0.047 Adjusted odds ratio (OR, +/- 95%CI) for unplanned OOH by travel time (mins) (using &lt;15 min as reference level): 15-29: 1.92 (0.86, 4.96) 30-44: 1.10 (0.35, 3.48) &gt;45: 6.18 (1.33, 28.65) p=0.14 Compared with controls, multivariate analyses found unplanned OOH births to be associated with 4 independent risk factors: maternal unemployment multiparity lack of/poor antenatal care travel time &gt;45 min to delivery unit</td>
<td>Strengths: Descriptive analysis of OOH births in one district of France. Approach to selection of controls (via random selection of delivery units). Limitations: Small, incomplete study population (data available on only 76.5% (n=62) OOH births). Difference in exposure measurement between cases and controls (distance/travel times based on travel to nearest maternity unit for cases vs travel to actual unit for controls). Incomplete information to enable comparison of obstetric risk profile of cases and controls. Included live OOH births, not stillbirths. Limited analysis of birth outcomes associated with live OOH births. 81.5% (62 of 76) cases occurred at home; no further details provided</td>
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</table>

*4 Age and gravity excluded from model since too closely associated with parity
<table>
<thead>
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<tr>
<td>Blondel 2011</td>
<td>Singleton live births, 2005-06</td>
<td>Exclusions (missing records))</td>
<td>Distance between mother’s home and nearest maternity unit (distance by road from mother’s home to hospital calculated at municipality)</td>
<td>OOH births (n=5740), 4.3/1000 births</td>
<td>Association between distance (kms) to closest maternity unit and OOH birth showing adjusted OR (aOR +/-95%CI) compared with reference level (&lt;5km, parity ≤2):</td>
<td>Strengths: Large population-based study. Adjustment for potential confounders of occupation and closure of maternity unit within 5km radius. <strong>Limitations:</strong> No investigation of stillbirths. Measured distance rather than travel time and used imprecise distance calculation.</td>
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<td>Metropolitan France</td>
<td>Controls: 2 per case (n=152) selected at random from different delivery units, occurring at nearest date/hour, to each case</td>
<td>&lt;15, 15-29, 30-44, &gt;45min</td>
<td>whether mother was poor antenatal clinic attender (missed 2+ antenatal clinics)</td>
<td>Women with parity ≤2:</td>
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<td>&lt;5 km (reference level) 5-14km: 1.14 (1.03, 1.27) 15-29km: 1.39 (1.24, 1.57) 30-44km: 1.78 (1.55, 2.05) ≥45km: 2.47 (2.02, 3.02) p values not stated</td>
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*Not further defined
### Evidence Summary Report

**Evidence Review:** The association between distance/travel time and obstetric or birth outcomes

<table>
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<td></td>
<td>abnormally high OOH birth rates&lt;sup&gt;b&lt;/sup&gt;</td>
<td>level, with each hospital and mother's home placed at centre of municipality)</td>
<td>provision: maternity unit closure between 2003 and 2006 within 5km radius</td>
<td>Women with parity ≥3: &lt;5km: 1.73 (1.57, 1.90) 5-14km: 2.32 (2.04, 2.63) 15-29km: 3.25 (2.84, 3.71) 30-44km: 3.71 (3.13, 4.41) ≥45km: 6.46 (4.92, 8.48) p values not stated</td>
<td><strong>Association between rurality and OOH birth showing rate of OOH birth (per 1000 births) (no 95%CI or p value reported for differences between urban/rural cohorts):</strong> Urban 3.33; Peri-urban 4.61; Rural 7.44 Adjusted OR (aOR +/-95%CI) for association between rurality and OOH birth, with 'urban' as reference cohort: Peri-urban 1.09 (0.99, 1.19) Rural 1.43 (1.29, 1.58)</td>
<td>measure (at municipality, rather than individual level) to nearest rather than actual hospital of delivery. Excluded 11% births for reasons of data quality. No information on outcomes of OOH births or whether they were planned or unplanned (though home births are described as rare in France). <strong>Applicability to Cumbria:</strong> Population characteristics and maternity/neonatal outcomes in France similar to those in England. However, study measured distance not travel time, so results not readily transferrable to other locations where similar distances may be associated with very different travel times; study also measured association between rurality and OOH birth but rurality was not defined.</td>
</tr>
</tbody>
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<sup>a</sup> This followed revisions to the birth certificate in 1998 which included coding of the question on place of delivery. By 2006, the new coding rules had not yet been fully implemented in some municipalities so rules were developed to exclude births in these areas from the study.

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Evidence Review: the association between distance/travel time and obstetric or birth outcomes
## Evidence Summary

**Study** | **Population** | **Exposure** | **Outcomes** | **Variables adjusted for in analysis** | **Results** | **Critical appraisal comments**
--- | --- | --- | --- | --- | --- | ---
Grzybowski 2011 | All singleton births (>20 weeks gestation), 1 April 2000 to 31 March 2004 n=49,402 (94.8% of total) after exclusions (recognised congenital anomalies), Women were allocated to 1 of 6 obstetric service levels according to surface travel time between usual residence and nearest maternity service (with CS capability): Level 1 (n=506): No local services (>4hrs from maternity services); Level 2 (n=747): No local services (2-4 hrs from maternity services); Level 3 (n=1,359, 16.3%): No local services (1-2 hrs from maternity services with CS capability); Level 4 (n=8,031): Within 1hr of primary care services with or without CS provided by GP surgeon (intrapartum care provided by family physicians and midwives with no local specialist access); Level 5 (n=5,945): Within 1 hr of mixed model maternity care (CS provided by GP surgeon or specialist); Level 6 (reference level) (n=32,814): Within 1 hr of Obstetrics and Gynaecology and/or General Surgery services (CS provided by obstetricians or general surgeons). | Perinatal mortality, Prematurity (<37 weeks), Admissions to NICU (Level 2 or 3), Induction of labour, Primary Caesarean | Maternal: age, parity, history of previous stillbirth, previous neonatal death, previous premature birth, antepartum haemorrhage >20 weeks, pre-existing and/or | Adjusted odds ratio (aOR +/- 95%CI, p value) for Level 3 compared with reference level Level 6 for each outcome: PNM Level 3: 1.04 (0.48, 2.22) Prematurity Level 3: 1.12 (0.89, 1.41) NICU 2 admissions Level 3: 2.20 (1.59 to 3.05), p<0.001 Adjusted outcomes for NICU 2 bed days and NICU 3 admissions/bed days not reported (presumably due to small numbers). | Most births in study population were to women living within 30km of nearest maternity unit of any type; only 1.16% of births were to women living ≥45km and 6.57% living 30-44km from nearest unit. strengths: Adjustment for potential confounders of association between travel time/distance and outcomes, including social vulnerability, ethnicity and type of healthcare provision. Exclusion of congenital anomalies and late terminations. Limitations: No adjustment for neonatal risk factors. Imprecise measure of

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91 Level 1 (n=506): No local services (>4hrs from maternity services); Level 2 (n=747): No local services (2-4 hrs from maternity services); Level 3 (n=1,359, 16.3%): No local services (1-2 hrs from maternity services with CS capability); Level 4 (n=8,031): Within 1hr of primary care services with or without CS provided by GP surgeon (intrapartum care provided by family physicians and midwives with no local specialist access); Level 5 (n=5,945): Within 1 hr of mixed model maternity care (CS provided by GP surgeon or specialist); Level 6 (reference level) (n=32,814): Within 1 hr of Obstetrics and Gynaecology and/or General Surgery services (CS provided by obstetricians or general surgeons).

92 British Columbia has categorised Neonatal Intensive Care units (NICU) into either Level 2 (transitioning) or Level 3 (most severely compromised) dependent on the scope of problems (level of prematurity, respiratory status) of the newborns under care in the facility.

Evidence Review: the association between distance/travel time and obstetric or birth outcomes
<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Exposure</th>
<th>Outcomes</th>
<th>Variables adjusted for in analysis</th>
<th>Results</th>
<th>Critical appraisal comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>late</td>
<td>Level 1:</td>
<td>section</td>
<td>gestational diabetes. Socio-economic (catchment level): social vulnerability and % Aboriginal residents</td>
<td></td>
<td>socio-economic variables (at catchment rather than individual level). No apparent statistical adjustment for multiple comparisons, so some statistically significant results may arise due to chance. Criteria for admission to NICU 2 appear to vary between units, so significance of this finding is difficult to interpret.</td>
</tr>
<tr>
<td></td>
<td>termination</td>
<td>Level 2:</td>
<td></td>
<td>Unplanned OOH delivery</td>
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<tr>
<td></td>
<td>n=506</td>
<td>Level 3:</td>
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<td></td>
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<tr>
<td></td>
<td>n=747</td>
<td>Level 3:</td>
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<tr>
<td></td>
<td>n=1,359</td>
<td>Level 4:</td>
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<td></td>
<td>n=8,031</td>
<td>Level 5:</td>
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<td></td>
<td>n=5,945</td>
<td>Level 6:</td>
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<tr>
<td></td>
<td>n=32,814</td>
<td>Level 6 (reference level)</td>
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<tr>
<td></td>
<td>n=32,814</td>
<td>Reference</td>
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</tbody>
</table>

**Primary CS**
Level 3: 0.78 (0.65 to 0.94), p<0.01

**Induction of Labour**
Level 3: 1.01 (0.87, 1.17)

**Unplanned OOH deliveries**
Level 3: 6.41 (3.69 to 11.28), p<0.001

Applicability to Cumbria:
Population profile, geography, and health care provision likely to differ substantially between Canada and Cumbria eg population density of British Columbia (4.7 per km²) much lower than for Cumbria (73 per km²) and geographical area much larger (BC 950,000km², Cumbria 6,768km²). Level 4 and 5 obstetric service and travel time cohorts not within scope of this review since cohorts had same travel time (<1h) as reference.
<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Exposure</th>
<th>Outcomes</th>
<th>Variables adjusted for in analysis</th>
<th>Results</th>
<th>Critical appraisal comments</th>
</tr>
</thead>
</table>
| Lisonkova 2011 Cross-sectional study[^3] | All singleton births in BC (n=29,698) to women aged ≥35 years, 1 Apr 1999 to 31 Mar | Distance from maternal residence to nearest hospital with Caesarean section (CS) capacity. | Perinatal death (stillbirth or death 0-27 days after birth) | Maternal: parity, partner status (single or couple), smoking in pregnancy, alcohol/drugs in | After adjustment for confounding, adjusted OR (aOR +/- 95% CI) by outcome with increasing distance compared with reference level (<50km) (OR not reported separately for distances of 50-150km or >150km):  
  *Perinatal death*  
aOR 1.53 (1.10, 2.12), adjusted p<0.01 (for trend) | Strengths:  
Use of birth registry data with high level of completeness and ascertainment.  
Adjustment for potential confounders including ethnicity (Aboriginal status) and congenital |

[^3]: BC Perinatal Health Program (BCPHP) birth registry: includes data on all births in BC, extracted from hospital discharge charts by trained staff using standardised protocols. Includes information on mode of delivery, type of CS, prenatal care, prior obstetric history and behavioural factors eg smoking, alcohol and drug use. Vital statistics data, including neonatal deaths, are also linked to the registry.

[^4]: Straight line distances between postcodes (using central points of latitude and longitude) of residences and hospitals were measured manually using highway maps and, where relevant, distances were recalculated to represent longer actual road distances resulting from geographical barriers eg rivers, mountains.

Evidence Review: the association between distance/travel time and obstetric or birth outcomes
<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Exposure</th>
<th>Outcomes</th>
<th>Variables adjusted for in analysis</th>
<th>Results</th>
<th>Critical appraisal comments</th>
</tr>
</thead>
</table>
| Canada | 2003       | 3 distance categories<sup>95</sup>: <50km (n=27,836), 50-150km (n=1,534), >150km (n=328) Rural residence<sup>96</sup> | SGA<sup>97</sup> (<10<sup>th</sup> percentile), LGA (>90<sup>th</sup> percentile), NICU admission ≥1 day Labour induction (medical or surgical) CS (primary, repeat, and emergency) Pregnancy, low attendance at prenatal care (<4 vs 4+ visits), prior induced abortions, prior spontaneous abortions Neonatal: congenital anomaly, gender Socio-economic: Aboriginal status, low income neighbourhoood | aOR not reported. No significant trend in rate of stillbirth observed with increasing distance (no data published, adjusted p=0.10 for trend) CS (any) aOR not reported. No significant trend in rate of CS observed with increasing distance (no data published, adjusted p=0.06 for trend) Adjusted odds ratio (aOR +/-95% CI) (or unadjusted relative risk (RR) if aOR not reported) by outcome for rural vs urban cohort (p values not reported): Perinatal death aOR 1.47 (1.01, 2.14) Stillbirths aOR 1.51 (0.97, 2.35) Preterm birth RR (aOR not reported) 1.01 (0.90, 1.13) Labour induction RR (aOR not reported) 1.07 (0.99, 1.15) | Limitations: Only included women ≥35 years. No adjustment for level of maternity/neonatal care. Actual travel time not measured; instead travel time estimated according to road distance (50km approximating to 1h drive, mode of transport not specified). 93.7% of study population lived <50km from nearest hospital with CS capacity (used as reference level for analysis). Results for distance analyses described briefly in text with no tabulation of results (study focused instead on rurality vs urbanity). Applicability to Cumbria: Analysis of distance vs

<sup>95</sup> Categorisation informed by BC Ministries of Health Services and Planning which used 50km distance to approximate to 1h drive to nearest health facility in determining standards of accessibility and guidelines for provision of sustainable acute care services.

<sup>96</sup> Defined as residence in a community with fewer than 10,000 inhabitants, based on the 2001 Canadian Population Census (data published by Statistics Canada).

<sup>97</sup> Gestational age calculated from date of last menstrual period (LMP); where LMP estimate showed discrepancy of >2 weeks in comparison with first trimester ultrasound, the latter was used. Percentiles used to identify SGA and LGA infants were based on standard Canadian male and female birth weight distribution.
<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Exposure</th>
<th>Outcomes</th>
<th>Variables adjusted for* in analysis</th>
<th>Results</th>
<th>Critical appraisal comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CS (any)</td>
<td>aOR 0.84 (0.78, 0.91)</td>
<td>outcomes applicable only to women ≥35 years. Population profile, geography and health care provision in BC likely to differ substantially from Cumbria e.g. population density of British Columbia (4.7 per km&lt;sup&gt;2&lt;/sup&gt;) much lower than for Cumbria (73 per km&lt;sup&gt;2&lt;/sup&gt;) and geographical area much larger (BC 950,000 km&lt;sup&gt;2&lt;/sup&gt;, Cumbria 6,768km&lt;sup&gt;2&lt;/sup&gt;). Results for each outcome not reported separately for 50-150km vs &gt;150km distance cohorts, or for subgroups within 50-150km cohort, so not possible to identify results applicable to Cumbria where &gt;100km distances (equivalent to approx. 62 miles) do not apply. Outcomes by rurality difficult to interpret in Cumbria context.</td>
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<td>CS (primary only)</td>
<td>aOR 0.89 (0.80, 1.00)</td>
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<td>CS (repeat only)</td>
<td>aOR 0.75 (0.63, 0.88)</td>
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<td>CS (emergency only)</td>
<td>RR (aOR not reported) 0.90 (0.76, 1.02)</td>
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<td>NICU admission ≥1 day</td>
<td>RR (aOR not reported) 0.97 (0.78, 1.19)</td>
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<td>Adjusted OR (aOR +/-95% CI) by outcome for rural cohort of younger women aged 20-29 years who delivered singleton infant in BC between 1999 and 2003, compared with urban cohort (p values not reported):</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>Perinatal death</td>
<td>aOR 1.00 (0.74, 1.34)</td>
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<td></td>
<td></td>
<td>Stillbirths</td>
<td>aOR 0.94 (0.65, 1.37)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Preterm birth</td>
<td>aOR 1.00 (0.91, 1.11)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Labour induction</td>
<td>aOR 1.09 (1.03, 1.14)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CS (any)</td>
<td>aOR 0.98 (0.93, 1.04)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>NICU admission ≥1 day</td>
<td>aOR 0.68 (0.56, 0.82)</td>
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</tbody>
</table>
## Evidence Summary

### Study: Ravelli 2011

**Population:** All singleton births of 37-42 weeks gestation in the country during 2000-06 (n=751,926 (68.9%) after exclusions: home deliveries (n=291,676), antepartum mortality (n=1731), congenital disorders (n=23,560), invalid/missing postcodes for mother’s travel time by car from home to hospital or outpatient clinic, where delivery took place (estimated from distance between postcodes for home and place of delivery) for singleton births of 37-42 weeks gestation in the country during 2000-06.

**Exposure:** Travel time categories: 0-14mins (reference level), 15-19 (n=132,229; 17.6%), ≥20 mins (n=425,952; 56.6%).

**Outcomes:** Combined intrapartum mortality (death during labour) and neonatal mortality (0-27 days), Adverse outcome (combined endpoint of mortality and/or Apgar score <4, and/or transfer of newborn to NICU at birth).

**Variables adjusted for in analysis:** Maternal: age, parity, Newborn: gestational age, Socio-economic: ethnicity, socio-economic status (SES), urban/rural status, Hospital type (Tertiary perinatal intensive care vs other and hospital volume (annual birth rate for births of ≥22 weeks).

**Results:**

<table>
<thead>
<tr>
<th>Critical appraisal comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strengths:</strong> Well conducted large study. Adjusted for potential confounding by socio-economic factors and type of healthcare. Travel times estimated to actual place of delivery for individual women rather than at district level. Excluded congenital anomalies.</td>
</tr>
<tr>
<td><strong>Limitations:</strong> Home deliveries (27.6% of study population) involving lower risk pregnancies were excluded, so risk profile of those giving birth in hospital/OP clinic is likely to be higher than average. Travel times based on optimal travel conditions so may underestimate actual travel times. Time delays not considered for combined outcomes.</td>
</tr>
</tbody>
</table>

**Variables adjusted for in analysis:** Maternal: age, parity, Newborn: gestational age, Socio-economic: ethnicity, socio-economic status (SES), urban/rural status, Hospital type (Tertiary perinatal intensive care vs other and hospital volume (annual birth rate for births of ≥22 weeks).

<table>
<thead>
<tr>
<th>Variables adjusted for in analysis</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal: age, parity</td>
<td>Crude OR (cOR) and adjusted OR (aOR) (+/-95%CI) for each outcome by travel time (mins) (using &lt;15mins as reference level):</td>
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<tr>
<td>Newborn: gestational age</td>
<td>Overall p value for association between travel time and mortality was 0.037</td>
</tr>
<tr>
<td>Socio-economic: ethnicity, socio-economic status (SES), urban/rural status</td>
<td>Combined intrapartum and neonatal mortality</td>
</tr>
<tr>
<td></td>
<td>15-19mins: cOR, aOR NS difference</td>
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<tr>
<td></td>
<td>≥20mins: cOR, aOR NS difference</td>
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<td></td>
<td>For every 1min increase in travel time:</td>
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<tr>
<td></td>
<td>Composite adverse outcome</td>
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<td></td>
<td>15-19mins: cOR, aOR NS difference</td>
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<td></td>
<td>≥20mins: cOR, aOR NS difference</td>
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<td></td>
<td>Intrapartum mortality alone OR:</td>
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<td></td>
<td>1.03 (0.8, 1.3)</td>
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**Perinatal registry of the Netherlands (PRN):** A database containing linked and validated data from the three professional registries of midwives, obstetricians and neonatologists.

**The Netherlands has a two-stage maternity healthcare system (primary and secondary care).** At first prenatal visit, women are considered high risk if they have complicated obstetric or general medical history, otherwise they are considered low risk. Primary care for low-risk women (including care during delivery at home or in an outpatient clinic) is conducted by independent midwives. If low-risk status changes to high-risk during pregnancy or delivery, the woman is referred to secondary (obstetrician-led) care on the basis of a multidisciplinary guideline.

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**Evidence Review:** The association between distance/travel time and obstetric or birth outcomes
<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Exposure</th>
<th>Outcomes</th>
<th>Variables adjusted for in analysis</th>
<th>Results</th>
<th>Critical appraisal comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>residence or place of birth (n=11,771); unknown location of labour (n=7,689), women from ‘Wadden’ islands (not connected to mainland (n=741). Hospitals which only participated for 1 or 2 yrs during the 7 yr cohort were also excluded.</td>
<td>mins (n=193,745; 25.8%).</td>
<td>gestation)</td>
<td>travel cohort)</td>
<td>Neonatal mortality alone ≥20mins (vs reference level of &lt;20mins):</td>
<td>low-risk women assessed at home by midwife and who only began journey to delivery unit when (as authors report) ‘signs of labour are obvious to the midwife’. No information provided on unplanned OOH births. Authors report that ‘only a few women travelled &gt;30mins’ (number not stated); data not published separately for this cohort and likely to be unreliable.</td>
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<tr>
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<td></td>
<td>Within 24hrs of birth (n=255):</td>
<td>cOR 1.52 (1.17, 1.97)</td>
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<td></td>
<td></td>
<td></td>
<td>aOR 1.51 (1.13, 2.02)</td>
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<td>Within 7days of birth (n=523):</td>
<td>cOR 1.44 (1.20, 1.72)</td>
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<td>aOR 1.37 (1.12, 1.67)</td>
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<td></td>
<td>8-27days after birth (n=58):</td>
<td>cOR NS difference</td>
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<td></td>
<td></td>
<td>aOR NS difference</td>
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<td>Subgroup analysis by level of care at start of labour, place of birth, and level of care at birth; cOR and aOR (+/- 95%CI) for travel time of ≥20mins vs reference level of &lt;20mins by outcome:</td>
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<td></td>
<td>Combined intrapartum and neonatal mortality</td>
<td>Primary care at start of labour and at birth (in outpatient clinic) (n=120,896; 16%): cOR, aOR NS difference</td>
</tr>
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<td>Primary care at start of labour, secondary care at birth (in hospital) (n=142,824; 19%): cOR 1.34 (1.04, 1.75); aOR NS difference</td>
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<table>
<thead>
<tr>
<th>Study</th>
<th>Population</th>
<th>Exposure</th>
<th>Outcomes</th>
<th>Variables adjusted for in analysis</th>
<th>Results</th>
<th>Critical appraisal comments</th>
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<td>Netherland higher than Cumbria (506 vs 73 per km$^2$) and travel times to delivery locations (hospitals or outpatient clinics) are shorter in the Netherlands (74.2% of study population travelled &lt;20mins to delivery unit and ‘only few women’ travelled &gt;30mins; median travel time 13mins, median distance 7km).</td>
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- **Secondary care at start of labour and at birth (in hospital) (n=488,206; 65%):** cOR, aOR NS difference
  - Composite adverse outcome
  - Primary care at start of labour and at birth (in outpatient clinic): cOR, aOR NS difference
  - Primary care at start of labour, secondary care at birth (in hospital): cOR, aOR NS difference
  - Secondary care at start of labour and at birth (in hospital): cOR 1.11 (1.03, 1.19) aOR 1.19 (1.10, 1.30)

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101 WHO statistics 2016
Appendix 3: Research questions, PICO and search strategy

Primary research question:
Is there an association between distance/travel time to maternity delivery units (any type) and obstetric or birth outcomes?

Secondary research questions:
1(a) Is increasing distance from/travel time to place of residence to maternity delivery unit (any type e.g. birth centre or freestanding midwife led unit (MLU/FMU) or consultant-led unit (CLU)) associated with any adverse impact on obstetric or birth outcomes?
1(b) Does the picture differ for high versus low risk mothers/maternities?

2(a) Is increasing distance from/travel time between standalone midwife led units (MLUs)/freestanding midwife units (FMUs) or place of residence (for planned home births) and obstetric (consultant) led units (CLUs) associated with any adverse impact on obstetric or birth outcomes?
2(b) Does the picture differ for high versus low risk mothers/maternities?

Scope of literature search

<table>
<thead>
<tr>
<th>Population</th>
<th>Intervention</th>
<th>Comparator (exposure)</th>
<th>Outcomes</th>
<th>Study Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pregnant women in labour/about to</td>
<td>Maternity delivery unit/setting (any, including home for planned home births,</td>
<td>Differential travel times/distances between (a) place of residence and maternity delivery setting or (b) between different types of</td>
<td>Any including: maternal morbidity/mortality; perinatal mortality; neonatal mortality; intrapartum intrauterine death (stillbirth);</td>
<td>Any study type excluding single case series; limit to studies published in last 10 years conducted in locations with geography, travel factors (times/distances/transport) and maternity services applicable to Cumbria.</td>
</tr>
<tr>
<td>give birth</td>
<td>birth centre, FMU/MLU, CLU)</td>
<td>maternity delivery unit/setting</td>
<td>accidental/unplanned out of hospital (OOH) delivery; unplanned admission to neonatal intensive care (at different levels); meconium aspiration syndrome; Apgar score at 5 minutes; neo-natal encephalopathy; brachial plexus injury.</td>
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<td>Use distance as proxy for travel times if latter not reported</td>
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</tbody>
</table>

Factors to consider in selection and interpretation of evidence include:
- maternity service configuration, accessibility, funding (private versus publicly funded)
- whether studies have investigated and taken account of potential confounding factors e.g. population factors
- geography i.e. focus on rural areas, not urban
- patient selection/choice

Studies from developing countries will be excluded from the review because population characteristics and health care provision will differ significantly from Cumbria.

Evidence Review: the association between distance/travel time and obstetric or birth outcomes
**Medline search strategy**

1. Maternal Health Services/
2. Delivery Rooms/
3. Intensive Care Units, Neonatal/ and Intensive Care, Neonatal/
4. exp Hospital/ or Community Health Services/ or Rural health Services/
5. ((communit* or rural or district* or local*) adj3 (service? or hospital? or ward? or unit? or department? or centre? or center? or care)).ti,ab.
6. 4 or 5
7. exp Pregnancy/ or exp Delivery, Obstetric/ or Perinatal Care/ or Postnatal Care/
8. (fetal or fetal or foetus or fetus or newborn* or neonat* or infant* or baby or babies or maternal or maternity or pregnant or pregnancy* or perinatal or peri-natal or postnatal or post-natal or post-partum or postpartum or intrapartum or intra-partum).ti,ab.
9. 7 or 8
10. 6 and 9
11. ((maternity or maternal or obstetric* or birth) adj3 (service? or hospital? or ward? or unit? or department? or centre? or center? or care)).ti,ab.
12. ((midwifery or consultant or Obstetrician) adj3 (service? or unit? or ward? or centre? or center?)).ti,ab.
13. (delivery adj (ward? or unit? or department? or centre? or center?):ti,ab.
14. 1 or 2 or 3 or 10 or 11 or 12 or 13
15. "Transportation of Patients"/
16. Transportation/
17. Travel/
18. ((travel* or distance or time or transfer* or transport* or access*) adj3 (hospital? or service? or unit? or ward? or centre? or center?:)).ti,ab.
19. (access* or travel* or distance* or transport* or transfer*).ti.
20. 14 and 19
21. Developing Countries/
22. (Africa or Caribbean or West Indies or South America or Latin America or Central America).hw,ti,ab,cp.
Evidence Review: the association between distance/travel time and obstetric or birth outcomes

23 (Afghanistan or Albania or Algeria or American Samoa or Armenia or Armenian or Azerbaijan or Bangladesh or Benin or Byelarus or Byelorussian or Belarus or Belorussian or Belorussia or Belize or Bhutan or Bolivia or Bosnia or Herzegovina or Herzegovina or Botswana or Brazil or Brasil or Bulgaria or Burkina Faso or Burkina Fasso or Upper Volta or Burundi or Urundi or Cambodia or Khmer Republic or Kampuchea or Cameroon or Cameroons or Cameroon or Camerons or Cape Verde or Central African Republic or Chad or China or Colombia or Comoros or Comoro Islands or Comores or Mayotte or Congo or Zaïre or Costa Rica or Cote d'Ivoire or Ivory Coast or Cuba or Djibouti or French Somaliland or Dominica or Dominican Republic or East Timor or East Timur or Timor Leste or Ecuador or Egypt or United Arab Republic or El Salvador or Eritrea or Ethiopia or Fiji or Gabon or Gabonese Republic or Gambia or Gaza or Georgia Republic or Georgian Republic or Ghana or Gold Coast or Grenada or Guatemala or Guinea or Guinea-Bisau or Guam or Guiana or Guyana or Haiti or Honduras or India or Maldives or Indonesia or Iran or Iraq or Jamaica or Jordan or Kazakhstan or Kazakh or Kenya or Kiribati or Korea or Kosovo or Kyrgyzstan or Kirghizia or Kirghyz or Kirghizstan or Lao PDR or Laos or Lebanon or Lesotho or Basutoland or Liberia or Libya or Macedonie or Madagascar or Malagasy Republic or Malaysia or Malaya or Malay or Sabah or Sarawak or Malay or Nyasaland or Mali or Marshall Islands or Mauritania or Mauritius or Agalega Islands or Mexico or Micronesia or Middle East or Moldova or Moldova or Moldavian or Mongolia or Montenegro or Morocco or Infi or Mozambique or Myanmar or Burma or Namibia or Nepal or Netherlands Antilles or Nicaragua or Niger or Nigeria or Pakistan or Palau or Palestine or Panama or Papua New Guinea or Paraguay or Peru or Philippines or Philippines or Philippines or Philippines or Romania or Rumania or Roumania or Rwanda or Ruanda or Saint Lucia or Saint Vincent or St Vincent or Grenadines or Samoa or Samoan Islands or Navigator Island or Navigator Islands or Sao Tome or Senegal or Serbia or Sierra Leone or Sri Lanka or Ceylon or Solomon Islands or Somalia or Sudan or Suriname or Surinam or Swaziland or Syria or Principe or South Sudan or Tajikistan or Tadzhikistan or Tadjikistan or Tadzhik or Tanzania or Thailand or Timor-Leste or Togo or Togolese Republic or Tonga or Tunisia or Turkey or Turkmenistan or Turkmen or Tuvalu or Uganda or Ukraine or Uzbekistan or Uzbek or Vanuatu or New Hebrides or Vietnam or Viet Nam or West Bank or Yemen or Zambia or Zimbabwe or Rhodesia).hw,ti,ab,cp.

24 ((developing or less* developed or under developed or underdeveloped or middle income or low* income or underserved or under served or deprived or poor*) adj (countr* or nation? or state? or population? or world)).ti,ab.

25 ((developing or less* developed or under developed or underdeveloped or middle income or low* income) adj (economy or economies)).ti,ab.

26 (low* adj (gdp or gnp or gross domestic or gross national)).ti,ab.

27 (low adj3 middle adj3 countr*).ti,ab.

28 (lmic or lmics or third world or lami countr*).ti,ab.

29 transitional countr*.ti,ab.

30 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29

31 20 not 30

32 limit 31 to (english language and yr="2008 -Current")

Cochrane database search strategy

#1 MeSH descriptor: [Maternal Health Services] this term only
#2 MeSH descriptor: [Delivery Rooms] explode all trees
#3 MeSH descriptor: [Hospitals] this term only
#4 MeSH descriptor: [Hospitals, Community] explode all trees
#5 MeSH descriptor: [Hospitals, Rural] explode all trees
#6 MeSH descriptor: [Community Health Services] this term only
#7 MeSH descriptor: [Rural Health Services] explode all trees
#8 #3 or #4 or #5 or #6 or #7
#9 MeSH descriptor: [Pregnancy] this term only
Evidence Review: the association between distance/travel time and obstetric or birth outcomes

#10 MeSH descriptor: [Delivery, Obstetric] explode all trees
#11 MeSH descriptor: [Perinatal Care] explode all trees
#12 fetal or fetal or foetus or fetus or newborn* or neonat* or infant* or baby or babies or maternal or maternity or pregnant or pregnancy* or perinatal or peri-natal or postnatal or post-natal or post-partum or postpartum or intrapartum or intra-partum:ti,ab,kw (Word variations have been searched)
#13 #9 or #10 or #11 or #12
#14 #8 and #13
#15 ((maternity or maternal or obstetric* or birth) near (service? or hospital? or ward? or unit? or department? or centre? or center? or care))
#16 ((midwifery or consultant or Obstetrician) near (service? or unit? or ward? or centre? or center?))
#17 (delivery next (ward? or unit? or department? or centre? or center?))
#18 #1 or #2 or #14 or #15 or #16 or #17
#19 MeSH descriptor: [Transportation of Patients] this term only
#20 MeSH descriptor: [Transportation] this term only
#21 MeSH descriptor: [Travel] this term only
#22 ((travel* or distance or time or transfer* or transport* or access*) near (hospital? or service? or unit? or ward? or centre? or center?)):ti,ab,kw (Word variations have been searched)
#23 access* or travel* or distance* or transport* or transfer*:ti (Word variations have been searched)
#24 #19 or #20 or #21 or #22 or #23
#25 #14 and #24
Appendix 4: NICE Quality Appraisal Checklist for quantitative studies reporting correlations and associations

From Methods for the development of NICE public health guidance (third edition) (PMG4): process and methods (Appendix G), published 26 September 2012 (nice.org.uk/process/pmg4)

<table>
<thead>
<tr>
<th>Study identification: Include full citation details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study design: Refer to the glossary of study designs (appendix D) and the algorithm for classifying experimental and observational study designs (appendix E) to best describe the paper’s underpinning study design</td>
</tr>
</tbody>
</table>

Guidance topic:

**Assessed by:**

**Section 1: Population**

1.1 Is the source population or source area well described?
- Was the country (e.g. developed or non-developed, type of health care system), setting (primary schools, community centres etc), location (urban, rural), population demographics etc adequately described?

<table>
<thead>
<tr>
<th>++</th>
<th>+</th>
<th>−</th>
<th>NR</th>
<th>NA</th>
</tr>
</thead>
</table>

Comments:

1.2 Is the eligible population or area representative of the source population or area?
- Was the recruitment of individuals, clusters or areas well defined (e.g. advertisement, birth register)?
- Was the eligible population representative of the source? Were important groups underrepresented?

<table>
<thead>
<tr>
<th>++</th>
<th>+</th>
<th>−</th>
<th>NR</th>
<th>NA</th>
</tr>
</thead>
</table>

Comments:

1.3 Do the selected participants or areas represent the eligible population or area?
- Was the method of selection of participants from the eligible population well described?
- What % of selected individuals or clusters agreed to participate? Were there any sources of bias?
- Were the inclusion or exclusion criteria explicit and appropriate?

<table>
<thead>
<tr>
<th>++</th>
<th>+</th>
<th>−</th>
<th>NR</th>
<th>NA</th>
</tr>
</thead>
</table>

Comments:

**Section 2: Method of selection of exposure (or comparison) group**

2.1 Selection of exposure (and comparison) group. How was selection bias minimised?
- How was selection bias minimised?

<table>
<thead>
<tr>
<th>++</th>
<th>+</th>
<th>−</th>
<th>NR</th>
<th>NA</th>
</tr>
</thead>
</table>

Comments:

2.2 Was the selection of explanatory variables based on a sound theoretical basis?
- How sound was the theoretical basis for selecting the explanatory variables?

<table>
<thead>
<tr>
<th>++</th>
<th>+</th>
<th>−</th>
<th>NR</th>
<th>NA</th>
</tr>
</thead>
</table>

Comments:

2.3 Was the contamination acceptably low?

| ++ |

Comments:
### 2.4 How well were likely confounding factors identified and controlled?
- Were there likely to be other confounding factors not considered or appropriately adjusted for?
- Was this sufficient to cause important bias?

<table>
<thead>
<tr>
<th>Did any in the comparison group receive the exposure?</th>
<th>- NR NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>If so, was it sufficient to cause important bias?</td>
<td>- NR NA</td>
</tr>
</tbody>
</table>

### 2.5 Is the setting applicable to the UK?
- Did the setting differ significantly from the UK?

<table>
<thead>
<tr>
<th>Comments:</th>
</tr>
</thead>
</table>

### Section 3: Outcomes

#### 3.1 Were the outcome measures and procedures reliable?
- Were outcome measures subjective or objective (e.g. biochemically validated nicotine levels ++ vs self-reported smoking −)?
- How reliable were outcome measures (e.g. inter- or intra-rater reliability scores)?
- Was there any indication that measures had been validated (e.g. validated against a gold standard measure or assessed for content validity)?

<table>
<thead>
<tr>
<th>Comments:</th>
</tr>
</thead>
</table>

#### 3.2 Were the outcome measurements complete?
- Were all or most of the study participants who met the defined study outcome definitions likely to have been identified?

<table>
<thead>
<tr>
<th>Comments:</th>
</tr>
</thead>
</table>

#### 3.3 Were all the important outcomes assessed?
- Were all the important benefits and harms assessed?
- Was it possible to determine the overall balance of benefits and harms of the intervention versus comparison?

<table>
<thead>
<tr>
<th>Comments:</th>
</tr>
</thead>
</table>

#### 3.4 Was there a similar follow-up time in exposure and comparison groups?
- If groups are followed for different lengths of time, then more events are likely to occur in the group followed-up for longer distorting the comparison.
- Analyses can be adjusted to allow for differences in length of follow-up (e.g. using person-years).

<table>
<thead>
<tr>
<th>Comments:</th>
</tr>
</thead>
</table>

#### 3.5 Was follow-up time meaningful?
- Was follow-up long enough to assess long-term benefits and harms?
- Was it too long, e.g. participants lost to follow-up?

<table>
<thead>
<tr>
<th>Comments:</th>
</tr>
</thead>
</table>

### Section 4: Analyses

#### 4.1 Was the study sufficiently powered to detect an intervention effect (if one exists)?
- A power of 0.8 (i.e. it is likely to see an effect of a given size if one exists,
<table>
<thead>
<tr>
<th>Evidence Review</th>
<th>the association between distance/travel time of obstetric or birth outcomes</th>
<th>80% of the time) is the conventionally accepted standard.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2 Were multiple explanatory variables considered in the analyses?</td>
<td>Were there sufficient explanatory variables considered in the analysis?</td>
<td>++ + − NR NA</td>
</tr>
<tr>
<td>4.3 Were the analytical methods appropriate?</td>
<td>Were important differences in follow-up time and likely confounders adjusted for?</td>
<td>++ + − NR NA</td>
</tr>
<tr>
<td>4.6 Was the precision of association given or calculable? Is association meaningful?</td>
<td>Were confidence intervals or p values for effect estimates given or possible to calculate?</td>
<td>++ + − NR NA</td>
</tr>
<tr>
<td>Section 5: Summary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1 Are the study results internally valid (i.e. unbiased)?</td>
<td>How well did the study minimise sources of bias (i.e. adjusting for potential confounders)?</td>
<td>++ + − Comments:</td>
</tr>
<tr>
<td></td>
<td>Were there significant flaws in the study design?</td>
<td></td>
</tr>
<tr>
<td>5.2 Are the findings generalisable to the source population (i.e. externally valid)?</td>
<td>Are there sufficient details given about the study to determine if the findings are generalisable to the source population?</td>
<td>++ + − Comments:</td>
</tr>
<tr>
<td></td>
<td>Consider: participants, interventions and comparisons, outcomes, resource and policy implications.</td>
<td></td>
</tr>
</tbody>
</table>
## Appendix 5: Maternal mortality ratio\textsuperscript{102} (2015) and neonatal mortality rates (2016) by country/ies\textsuperscript{103}

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Maternal mortality ratio (per 100 000 live births) [95%CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>2015</td>
<td>7 [ 5 - 9]</td>
</tr>
<tr>
<td>Finland</td>
<td>2015</td>
<td>3 [ 2 - 3]</td>
</tr>
<tr>
<td>France</td>
<td>2015</td>
<td>8 [ 7 - 10]</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2015</td>
<td>7 [ 5 - 9]</td>
</tr>
<tr>
<td>Norway</td>
<td>2015</td>
<td>5 [ 4 - 6]</td>
</tr>
<tr>
<td>UK and Northern Ireland</td>
<td>2015</td>
<td>9 [ 8 - 11]</td>
</tr>
<tr>
<td>US</td>
<td>2015</td>
<td>14 [12 - 16]</td>
</tr>
</tbody>
</table>

Maternal mortality ratio is the number of maternal deaths per 100,000 live births (where maternal death is defined as the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes).

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Neonatal mortality rate (per 1000 live births) [95%CI]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>2016</td>
<td>3.2 [2.7-3.9]</td>
</tr>
<tr>
<td>Finland</td>
<td>2016</td>
<td>1.2 [0.9-1.4]</td>
</tr>
<tr>
<td>France</td>
<td>2016</td>
<td>2.4 [2.1-2.7]</td>
</tr>
<tr>
<td>Netherlands</td>
<td>2016</td>
<td>2.5 [2.3-2.7]</td>
</tr>
<tr>
<td>Norway</td>
<td>2016</td>
<td>1.5 [1.3-1.8]</td>
</tr>
<tr>
<td>UK and Northern Ireland</td>
<td>2016</td>
<td>2.6 [2.1-3.1]</td>
</tr>
<tr>
<td>US</td>
<td>2016</td>
<td>3.7 [3.4-4.0]</td>
</tr>
</tbody>
</table>

Neonatal mortality rate is the number of deaths during the first 28 completed days of life per 1000 live births in a given year or other period.

\textsuperscript{102} Described as ‘ratio’ on WHO website but is equivalent to a rate