

Evidence Review to Support the National Maternity Review 2015

Report 3:

**Systematic review and case studies to assess models
of consultant resident cover and the outcomes of
intrapartum care; and two international case studies
of the delivery of maternity care**

**Marian Knight, Jane Henderson,
Jennifer J Kurinczuk**

National Perinatal Epidemiology Unit
Nuffield Department of Population Health
University of Oxford
October 2015

Acknowledgements

We would like to thank Catherine Deneux-Tharaux, Gilles Kayem, Corinne Love, Sara Paterson-Brown, Joanne Topping, Sarah Vause and Ingela Wiklund who contributed to the case studies and Jessica K Knight who assisted with reference title screening.

Marian Knight is funded by an NIHR Research Professorship.

The views expressed are those of the authors and not necessarily those of the NHS, NHS England or the NIHR.

Funding

This evidence review was commissioned by the Healthcare Quality Improvement Partnership on behalf of NHS England.

This report should be cited as:

Marian Knight, Jane Henderson, Jennifer J Kurinczuk. Evidence Review to Support the National Maternity Review 2015; Report 3: Systematic review and case studies to assess models of consultant resident cover and the outcomes of intrapartum care; and two international case studies of the delivery of maternity care. Oxford: National Perinatal Epidemiology Unit, University of Oxford. 2015.

©2015 National Perinatal Epidemiology Unit, University of Oxford

Contents

1	Introduction	5
1.1	Aim	5
1.2	Objectives.....	5
2	Systematic literature review	6
2.1	Methods.....	6
2.1.1	Study inclusion criteria.....	6
2.1.2	Study exclusion criteria	6
2.1.3	Search methods for identification of studies.....	6
2.1.4	Data collection and analysis.....	6
2.1.5	Data extraction and management	7
2.1.6	Quality assessment of included studies	7
2.1.7	Data synthesis	7
2.2	Results	8
2.3	Discussion of systematic review results.....	16
3	Selected case studies from UK hospitals	17
3.1	Case Study from Saint Mary’s Hospital Manchester – 24 hour resident consultant presence introduced.....	17
3.1.1	Background	17
3.1.2	Planning.....	18
3.1.3	Assessment of Impact on Outcomes	19
3.2	Additional points from case studies of hospitals planning introduction of 24 hour resident consultant cover	20
3.2.1	Queen Charlotte’s and Chelsea Hospital	20
3.2.2	Simpson Centre for Reproductive Health, Royal Infirmary of Edinburgh.....	21
3.3	Case study from Liverpool Women’s Hospital – 24 hour resident consultant cover not introduced.....	22
3.3.1	Background	22
3.3.2	Planning and conclusions	22
3.3.3	Outcomes of care under the new working patterns.....	23
4	Models of care and outcomes in two selected European countries	24
4.1	Background	24
4.2	Delivery of care in France	25
4.2.1	The organisation of care	25
4.2.2	The funding of care	26

4.2.3	Women's choice.....	26
4.2.4	Outcomes of care.....	27
4.3	Delivery of care in Sweden.....	27
4.3.1	The organisation and funding of care	27
4.3.2	Women's choice.....	28
4.3.3	Outcomes of care.....	28
5	Conclusions and implications for policy and practice.....	29
6	References	31
7	Appendix – Medline search strategy	33
	MeSH terms	33

1 Introduction

A number of key policy documents and position statements have advocated 24 hour consultant presence on labour ward as a means of improving the safety of birth (Royal College of Obstetricians and Gynaecologists, et al. 2007). This was initially advocated on the basis of observed improvements in care at night in other consultant-led services (Mahon, et al. 2005), on the basis of observed differences in perinatal outcomes at different times of day and night (Heller, et al. 2000, Luo and Karlberg 2001, Pasupathy, et al. 2010, Ruffieux, et al. 1992, Stewart, et al. 1998), and on the basis of the changing demographic and other characteristics of women giving birth (Royal College of Obstetricians and Gynaecologists, et al. 2007). However, it is not clear what published evidence exists comparing the outcomes of intrapartum care with 24 hour consultant labour ward presence compared with other models of consultant presence. Additionally, it is unclear what factors influence the decision to introduce 24 hour consultant presence on the labour ward and what the experiences of individual hospitals which have recently changed to this model of consultant presence are. In order to address these uncertainties, a systematic review of the published literature was undertaken, supplemented with case studies from selected hospitals which have mixed obstetric-midwifery models of maternity service provision. We also conducted case studies in two European countries where 'risk tiering' is used and which was proposed in a report carried for Monitor (Monitor 2014) as potentially offering benefits if used more widely in the NHS.

1.1 Aim

The first aim of this review was to collate and critically appraise evidence for the effect of continuous resident consultant obstetrician cover on labour ward on outcomes of intrapartum care compared to other models of consultant cover. The second aim was to identify the benefits of risk tiering as used in two European countries.

1.2 Objectives

1. To conduct a systematic review and meta-analysis of the available published evidence.
2. To support the evaluation with a series of purposively chosen short case studies from hospitals in the UK.
3. To examine the models of care, risk tiering and outcomes in two selected European countries.

2 Systematic literature review

2.1 Methods

2.1.1 Study inclusion criteria

2.1.1.1 Population, intervention and comparator group

We included studies which quantitatively compared the outcomes for women and babies where continuous resident consultant obstetric cover was provided compared to other models of consultant cover, within health care systems with mixed obstetric-midwifery models of care. We included studies irrespective of women's individual risk status. Following the guidance from the Cochrane Effective Practice and Organisation of Care group (EPOC) randomised controlled trials (RCTs), non-randomised controlled trials (NRCTs), controlled before-after studies (CBAs) and interrupted time-series (ITS) studies were eligible for inclusion.

2.1.1.2 Outcome measures

Any measures of outcome of intrapartum care were included (see Appendix for relevant search terms).

2.1.2 Study exclusion criteria

Studies not meeting the inclusion criteria and studies from countries such as the USA that do not have a mixed obstetrician-midwifery model of care were excluded.

2.1.3 Search methods for identification of studies

Searches were conducted in English, but no language restrictions were set. No restrictions were set by date or publication type in the search for randomised controlled trials. For the less robust study types (NRCT, CBA, ITS) the search was limited to research published after 1st January 2000.

2.1.3.1 Electronic searches

The following databases were searched from inception to present:

- Cochrane Database of Systematic Reviews
- Cochrane Pregnancy and Childbirth Group Trial Register
- Cumulative Index to Nursing and Allied Health (CINAHL) plus
- EMBASE
- Medline

The search strategy for Medline is shown in the Appendix and was adapted for other databases where necessary.

2.1.3.2 Searching other resources

The reference lists of all studies meeting inclusion criteria were also searched, as well as key policy documents, and forward citations of studies meeting the inclusion criteria.

2.1.4 Data collection and analysis

2.1.4.1 Selection of studies

Titles and abstracts returned from searches were screened independently by two of three researchers (JH, JKK, MK) and appraised in light of inclusion criteria. Where both reviewers independently determined that studies did not meet inclusion criteria, they were excluded. Full

records were obtained for studies meeting the inclusion criteria and those with insufficient information to assess inclusion criteria from the title and abstract. Two reviewers independently screened full-text articles to assess consistency with the inclusion criteria (JH, MK). Where there was disagreement, reviewers met to reach consensus. The full process for study screening and inclusion were recorded in accordance with current guidelines (Moher, et al. 2009).

2.1.5 Data extraction and management

Data were extracted from papers using a piloted data extraction proforma developed for this review. Two reviewers (JH, MK) independently extracted data from each included study. Where disagreement occurred the reviewers met to reach consensus.

Data extracted included study details, methods, participants, intervention details (number of hours of consultant obstetrician presence provided), maternal and neonatal outcomes, funding, author contact details and quality assessment of the study.

2.1.6 Quality assessment of included studies

The quality of the included studies was assessed using the risk of bias criteria recommended for EPOC reviews (Canadian Agency for Drugs and Technologies in Health 2015).

The following items were appraised for each study:

- Was the allocation sequence adequately generated?
- Was the allocation adequately concealed?
- Were baseline outcome measurements similar?
- Were baseline characteristics similar?
- Were incomplete outcome data adequately addressed?
- Was knowledge of the allocated interventions adequately prevented during the study?
- Was the study adequately protected against contamination?
- Was the study free from selective outcome reporting?
- Was the study free from other risks of bias?

In addition, the comparability of exposed and non-exposed participants was assessed, as were the adequacy of statistical methods and adjustment for potential confounding factors. For each study, two reviewers (JH, MK) independently appraised quality.

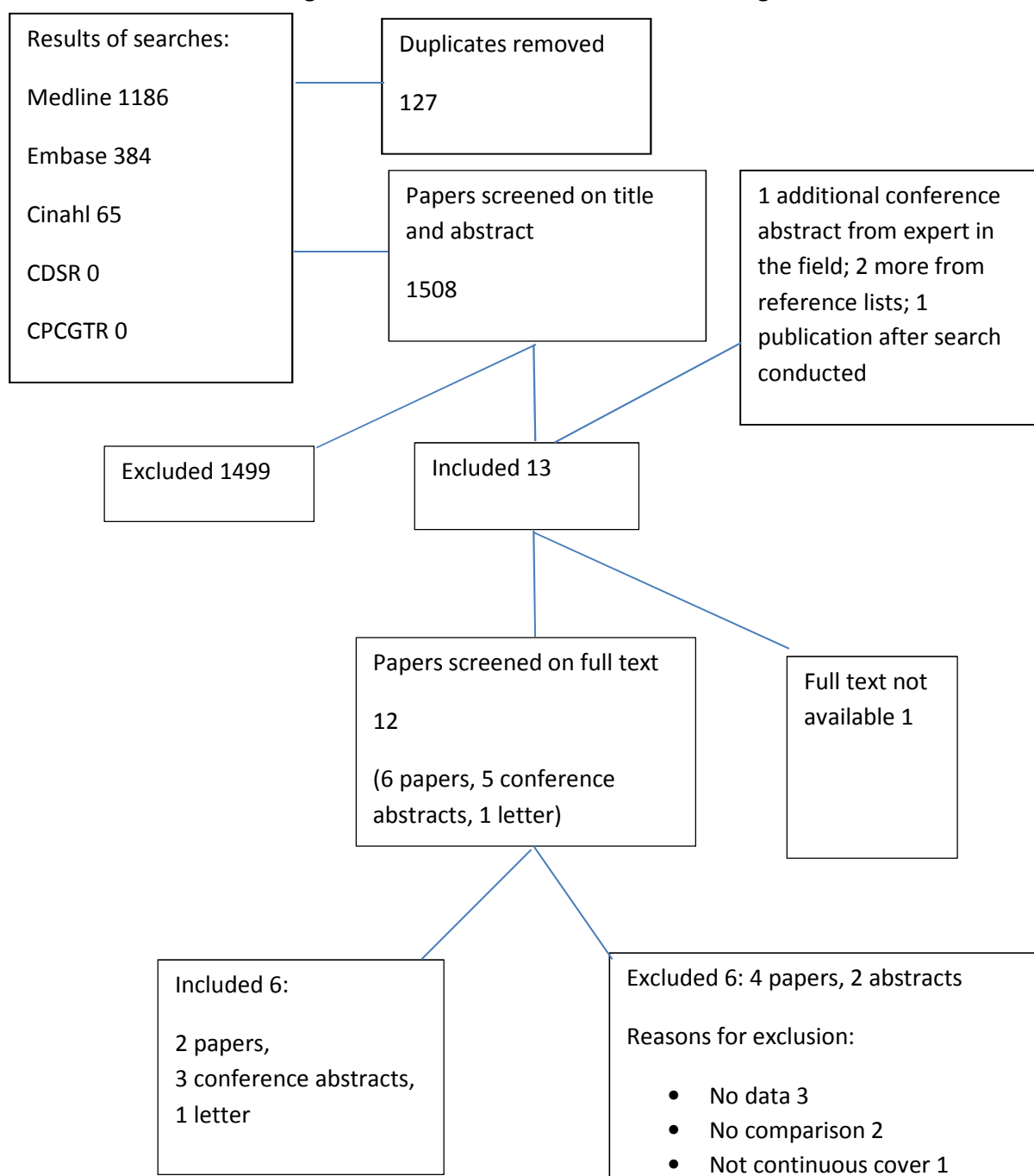
2.1.7 Data synthesis

As the publications all used similar methods and examined similar outcomes, quantitative synthesis was possible. This was performed using Review Manager 5.3 (Cochrane Collaboration 2011), fitting random effects models. Where quantitative synthesis was not possible, narrative synthesis of studies was carried out, consistent with current guidelines (Higgins and Green 2011, Moher, et al. 2009). Measures of effect for each study are presented.

2.2 Results

The results of the literature search and screening process are shown in Figure 1. After removal of duplicates, 1508 publications were screened on title and abstract (where available). Of these, nine publications were included. Discussion with experts in the field and checking bibliographies resulted in inclusion of three further publications; one letter was published as this analysis was being performed, resulting in 13 publications. One of these was not available; the other 12 were screened on full text. Only six were full papers, of the others, five were conference abstracts, and one was a letter. The final review included six publications which met the inclusion criteria, of which two were papers, three were conference abstracts and one was a letter. The reasons for exclusion are shown in Figure 1.

Figure 1 - Flowchart of searches and screening



The included publications are summarised in Table 1. All six studies were conducted in English hospitals between the years 2004 and 2015 and included between 486 and 5318 deliveries (although two (Ahmed, et al. 2015, Siddiqui, et al. 2008) did not state the study dates or number of deliveries). They were all based on audit of hospital records and compared resident obstetric consultant cover with on-call consultant cover (resident cover being provided by registrars). In five of the studies (Ballal, et al. 2012, Freitas, et al. 2012, Merrick and Rajesh 2013, Siddiqui, et al. 2008, Tang, et al. 2012) the focus of comparison was on night-time deliveries as resident consultant cover was standard on day shifts. The sixth study (Ahmed, et al. 2015) compared outcomes before and after the introduction of 24/7 consultant cover. In three of the studies, night-time resident consultant cover was provided twice a week (Merrick and Rajesh 2013, Siddiqui, et al. 2008, Tang, et al. 2012), in the others it was unspecified (Ballal, et al. 2012, Freitas, et al. 2012). Various maternal and neonatal outcomes were measured as indicated in Table 1.

The quality of studies overall was poor. The risk of bias of included studies was judged to be unclear, medium or high on most criteria for all six studies (Table 2). In particular none of the studies adjusted for potential confounding factors; there was clear potential for important differences between study groups which may have confounded the observed results.

Table 1 – Summary of studies included

Participants					Intervention	Comparisons	Outcomes	
Author, date	Year(s) and location study conducted	N	Exclusion criteria	Population representative-ness assessed			Maternal outcomes assessed	Neonatal outcomes assessed
Siddiqui et al, 2008 [conference abstract]	Jan 2004-Nov 2006 at Nottingham City Hospital	Not stated	None stated	Implied that all deliveries included	Resident consultant cover 2 nights per week	Senior specialist registrar cover on other nights (with consultant on-call)	Mode of delivery, fetal blood sampling, postpartum haemorrhage.	Apgar scores, neonatal unit admissions, cord pH
Ballal et al, 2012 [conference abstract]	Years not stated but duration 18 months at Liverpool Women's Hospital	5287 births during consultant sessions, 2810 outside hours.	Multiple births, elective caesareans and premature babies	No	90 hrs consultant resident cover, unclear how distributed, periods of continuous cover	Consultant on call	Mode of delivery, 3rd/4th degree tears, postpartum haemorrhage >1500 ml, duration of 2nd stage	Cord pH, Apgar scores
Freites et al, 2012	Aug 2004-Jul 2007 at Hull Royal Infirmary	5318 deliveries; 1226 resident consultant cover, 4092 on-call from home	Deliveries between 08.00 and 09.00 due to hand-over time	Not as such but maternal age, birthweight and gestational age all comparable.	2 consultant obstetricians and 1 associated specialist elected to be resident in hospital for period of responsibility	7 consultant obstetricians + 2 associate specialists providing cover from home	Mode of delivery, maternal death	Birthweight, gestation, stillbirth, neonatal death, resuscitation, referral/admission to neonatal unit, Apgar scores
Tang et al, 2012	Jul 2010-Apr 2011 at York Teaching Hospital NHS Trust	486 deliveries; 248 on consultant resident shifts, 238 on registrar shifts.	Excluded births between 09.00-20.00	No	Resident nights 20.00-09.00 Mon & Tues	Registrar cover	Mode of delivery, 3rd degree tears, maternal death, trial in theatre	Admission to special care baby unit, neonatal deaths
Merrick & Rajesh, 2013 [conference abstract]	Jan-June 2012 at York District Hospital	488 deliveries; 243 on consultant shifts, 245 on registrar shifts	Multiple births	No	Resident nights 20.00-09.00 Mon & Tues	Registrar cover	Mode of delivery, maternal death, trial in theatre	Neonatal deaths, cord gases
Ahmed et al, 2015	Unspecified; before and after introduction of 24/7 consultant cover in July 2014	Unspecified	Unspecified	No	Continuous resident consultant cover	Unspecified	Instrument deliveries, caesarean sections	Stillbirths

Table 2 – Risk of bias in studies included

Green indicates dimensions with a low risk of bias, orange indicates dimensions with a medium or unclear risk of bias, red indicates dimensions with a high risk of bias

	Risk of bias					
Author, date	Sample representativeness	Adequacy of exposure measurement	Attrition bias	Selective outcome reporting	Comparability of exposed/unexposed	Adjustment for confounders
Siddiqui et al, 2008 [conference abstract]	Risk of Bias Unclear: probably all births included but not stated	Risk of Bias Unclear: not stated	Risk of Bias Unclear: no information	Risk of Bias Unclear: no information	Risk of Bias Medium: possible that more planned high risk births occur during resident consultant sessions	Risk of Bias High: no adjustment
Ballal et al, 2012 [conference abstract]	Risk of Bias Unclear: implied that all births included but possible short-fall	Risk of Bias Unclear: not enough information	Risk of Bias Unclear: not enough information	Risk of Bias Unclear: not enough information	Risk of Bias Medium: possible that more planned high risk births occur during resident consultant sessions	Risk of Bias High: no adjustment
Freites et al, 2012	Risk of Bias Low: all night deliveries in time period	Risk of Bias Low: from hospital records	Risk of Bias Unclear: not stated	Risk of Bias Unclear: data from 2004-7 but submitted in 2012	Risk of Bias Medium: relative levels of experience of 2 groups not stated; possible that more planned high risk births occur during resident consultant sessions	Risk of Bias High: no adjustment
Tang et al, 2012	Risk of Bias Unclear: implied all night deliveries in time period included	Risk of Bias Low: from medical notes	Risk of Bias Unclear: only 60/70 consultant resident notes and 60/88 registrar notes retrieved. Possible loss of 'interesting' cases.	Risk of Bias Unclear: according to the Proforma in Appendix 1 there were data on a number of other outcomes which were not reported	Risk of Bias Medium: possible that more planned high risk births occur during resident consultant sessions	Risk of Bias High: no adjustment
Merrick & Rajesh, 2013 [conference abstract]	Risk of Bias Unclear: implied that all night deliveries in time period included	Risk of Bias Low: from medical notes	Risk of Bias Unclear	Risk of Bias Unclear	Risk of Bias Medium: possible that more planned high risk births occur during resident consultant sessions	Risk of Bias High: no adjustment
Ahmed et al, 2015	Risk of Bias Unclear: not assessed	Risk of Bias Unclear: not enough information	Risk of Bias Unclear: not stated	Risk of Bias Unclear: information on other outcomes may have been collected	Risk of Bias Medium: no information about relative levels of experience of staff prior to and after introduction of resident consultant cover	Risk of Bias High: no adjustment

The results of the individual studies are shown in Table 3. As all six studies used similar methods and included almost all deliveries, it was possible to conduct a meta-analysis, although two studies (Ahmed, et al. 2015, Siddiqui, et al. 2008) could not be included as no denominators were given. The risk ratios and Forest plots for each outcome reported in a comparable manner in two or more studies (spontaneous vaginal delivery, instrumental delivery, emergency caesarean section, and admission to neonatal unit) are shown in Figure 2. The results cluster around the line of no effect and none are statistically significantly different except for instrumental deliveries which occurred significantly more frequently when there was on-call consultant cover compared with resident consultant presence with an unadjusted risk ratio of 1.14. There was significant heterogeneity amongst the study results for caesarean delivery and neonatal unit admission. Two papers also reported results for postpartum haemorrhage (greater than 1500ml in one (Ballal, et al. 2012), undefined in the other (Siddiqui, et al. 2008)) with opposing findings. Two studies reported perineal damage (3rd degree tears in one (Tang, et al. 2012), 3rd or 4th degree tears in the other (Ballal, et al. 2012)); there was no statistically significant difference between resident consultant presence and on-call consultant cover (Table 3). Ballal et al (2012) reported that a prolonged second stage (>4 hours) was significantly more frequent in the resident consultant group.

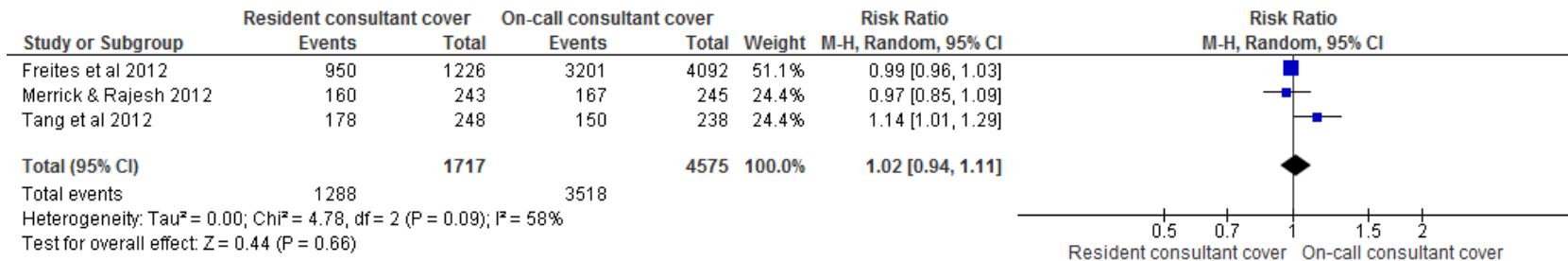
Table 3 – Results of studies included comparing resident consultant presence with other models of cover

	Continuous resident consultant cover		Other models of consultant cover		
Siddiqui et al 2008	n	%	n	%	
Spontaneous vaginal delivery	NK	65	NK	50.9	p<0.05
Forceps	NK	more	NK	less	
Category 2 caesarean delivery	NK	more	NK	Less	
Category 1 caesarean delivery	NK	Less	NK	More	
Any caesarean delivery	NK	more	NK	Less	
Fetal blood sampling undertaken	NK	Less	NK	More	p<0.05
Low Apgar (unspecified)	NK	7	NK	11	ns
Admission to neonatal unit	NK	3	NK	6	ns
Cord pH <7.1	NK	4	NK	6	ns
Postpartum haemorrhage	NK	10	NK	14	p<0.05
Ballal et al 2012	(N=5287)	(%)	(N=2810)	(%)	RR (95% CI)
Emergency caesarean delivery	696	13.2	321	11.4	1.15 (1.01, 1.30)
2nd stage caesarean delivery	54	1	56	2	0.44 (0.31, 0.63)
Instrumental delivery	927	17.5	435	15.5	1.10 (1.02, 1.25)
3rd/4th degree tears at instrumental delivery	29	5.5	14	4.9	1.10 (0.58, 2.08)
Postpartum haemorrhage >1500 ml	97	1.8	11	0.4	4.6 (2.5, 8.7)
2nd stage longer than 4 hrs	159	3	47	1.7	1.79 (1.30, 2.48)
Cord pH <7	20	0.4	7	0.2	1.51 (0.64, 3.5)
5 min Apgar <6	64	1.21	24	0.85	1.41 (0.88, 2.26)
Freites et al 2012	(N=1226)	(%)	(N=4092)	(%)	OR (95% CI)
Rotational forceps	3	0.2	7	0.2	0.70 (0.18, 2.71)
Non-rotational forceps	59	4.8	130	3.2	0.65 (0.47, 0.89)
Any forceps	62	5.1	137	3.3	0.65 (0.48, 0.88)
Rotational vacuum	4	0.3	7	0.2	0.52 (0.15, 1.79)
Non-rotational vacuum	25	2	114	2.8	1.38 (0.89, 2.13)
Total vacuum	29	2.3	121	3	1.26 (0.83, 1.90)
Assisted vaginal delivery	91	7.4	258	6.3	0.84 (0.66, 1.08)
Vaginal breech delivery	14	1.1	41	1	0.88 (0.48, 1.61)
Caesarean delivery	171	13.9	592	14.5	1.04 (0.48, 1.61)
Spontaneous vaginal delivery	950	77.5	3201	78.2	1.04 (0.90, 1.21)
Maternal death	1	0.1	0	0	
Stillbirth	0	0	1	0.03	
Neonatal death	0	0	6	0.2	
Neonatal resuscitation required	176	14.4	615	15	1.06 (0.88, 1.27)
Immediate referral to neonatal unit	71	5.9	241	6	1.02 (0.77, 1.34)
Admission to neonatal unit	48	3.9	180	4.4	1.13 (0.82, 1.56)
1 min Apgar <8	133	11.1	477	11.9	1.08 (0.88, 1.32)
5 min Apgar <8	15	1.3	56	1.4	1.12 (0.63, 1.98)
Tang et al 2012	(n) (N=248)	(%)	(n) (N=238)	(%)	
Spontaneous vaginal delivery	178	71.8	150	63	
Emergency caesarean delivery	30	12.5	48	20.6	
Assisted deliveries	40	16	40	16	
Assisted deliveries in labour room	19/31	61	16/29	55	
Unsuccessful trial of instrumental delivery	47	19	36	15	
3rd degree tears	8	3.3	4	1.7	
Special care baby unit admission	7	3	19	8	
Merrick & Rajesh 2012	(n) (N=243)	(%)	(n) (N=245)	(%)	
Spontaneous vaginal delivery	160	66	167	68	
Emergency caesarean delivery	37	15.2	47	19.2	
Assisted deliveries	40	16.5	31	12.8	
Assisted deliveries in labour room	30	73.2	12	35.3	
Unsuccessful trial of instrumental delivery	1	9.1	3	13.6	
Cord arterial pH <7.20	13	20	25	34.2	
Ahmed et al, 2015	(n)	(%)	(n)	(%)	
Instrumental delivery	NK	10.5	NK	10.6	
Caesarean delivery	NK	28.8	NK	28.6	
Stillbirth	NK	0.6	NK	0.5	

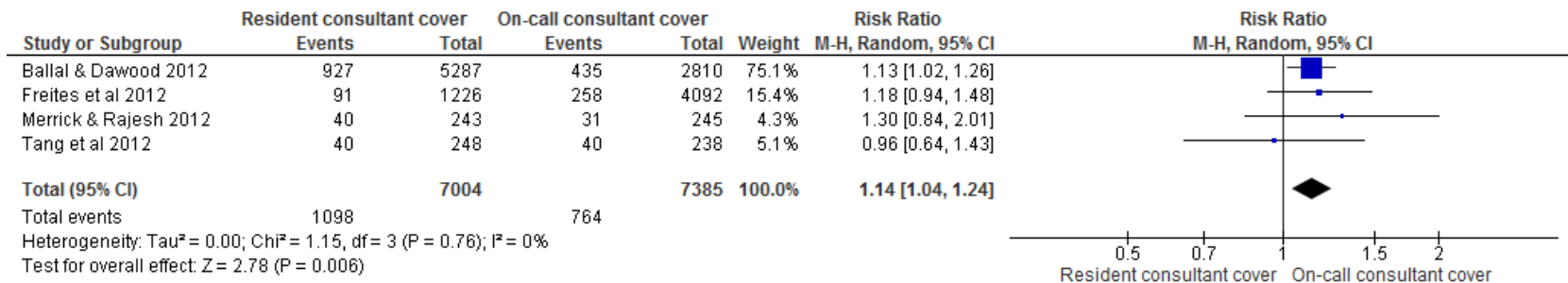
NK=Not Known

Figure 2 – Meta-analysis of main outcomes; unadjusted risk ratios comparing resident consultant presence with other models of consultant cover

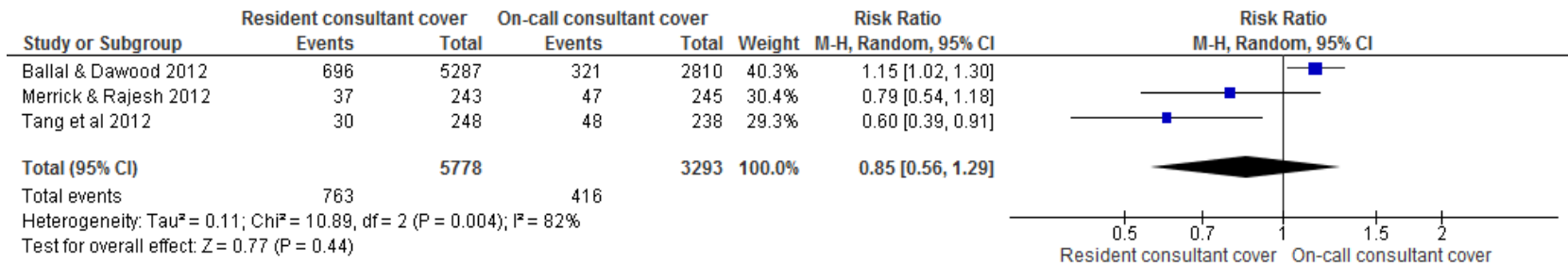
a) Spontaneous vaginal delivery



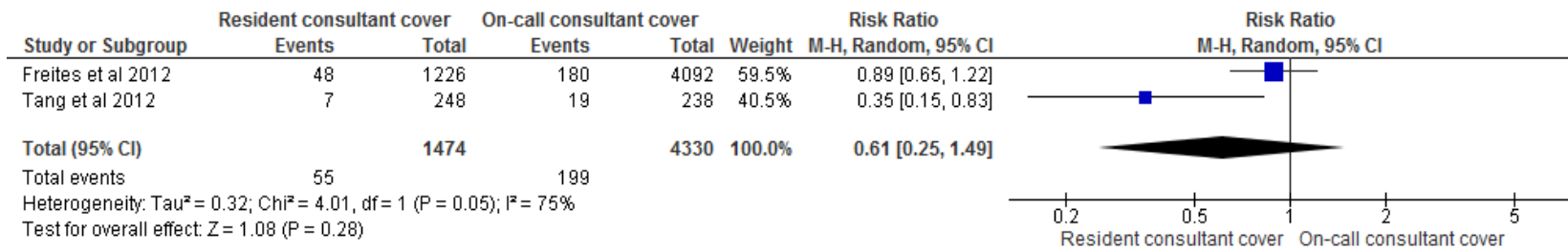
b) Instrumental delivery



c) Emergency caesarean section



d) Admission to neonatal unit



2.3 Discussion of systematic review results

This systematic review identified only six studies which compared outcomes between resident consultant presence on labour ward and on-call consultant cover. All studies were of low quality with a high risk of bias, principally because they were all observational studies and no attempt was made to adjust for differences in the characteristics of the women delivering on the labour ward during the two time periods which could confound the findings. Any results must therefore be treated with extreme caution. With this in mind, the only outcome which was reported in more than one study which was statistically significantly different was instrumental delivery. The risk of instrumental delivery was 14% higher in the on call consultant group compared with the resident consultant presence group. Only three other outcomes were reported a consistent manner in more than one study: emergency caesarean delivery, spontaneous vaginal delivery and neonatal unit admission. There was no statistically significant difference in any of these outcomes between groups.

Some of the study authors commented on possible differences in the characteristics of women delivering during the different care periods which may impact on the observed differences. None of these were accounted for in any study. For example, there are possible differences in experience between consultants who opted to be resident compared to those who opted to be on-call (Freites, et al. 2012), and the possibility that more problematic procedures and deliveries of higher risk women were scheduled for days when a consultant would be resident through the night. These were not accounted for in any analysis nor addressed by most of the authors. Tang et al note that they were unable to obtain some of the case notes required to confirm poor outcomes (Tang, et al. 2012); this may have resulted in a differential loss of cases with adverse outcomes. It is unclear in most studies whether there was any selective outcome reporting. The observed heterogeneity between study results may be explained by differences in some of these factors between studies.

This systematic review has thus not identified any reliable evidence from which robust conclusions can be drawn, based on intrapartum outcomes, to support a model of 24 hour resident consultant presence on the labour ward compared with other models of consultant cover.

3 Selected case studies from UK hospitals

In view of the very limited, low quality evidence identified in the literature review, additional evidence was sought concerning actual and perceived benefits of 24 hour resident consultant labour ward cover through case studies. Hospitals were recruited purposively to identify one unit in which 24 hour resident cover had been introduced and one in which it had been considered, but a decision taken not to introduce 24 hour resident consultant obstetrician cover on labour ward. Telephone or face-to-face interviews with key informants were carried out and the resulting key points summarised by the interviewer (MK) before amendment/correction by the interviewee. In the course of recruitment for these interviews, two hospitals were identified which are in the process of planning the introduction of 24 hour consultant resident cover. Additional points not identified from the two main case studies are therefore included from the experience of these two hospitals.

3.1 Case Study from Saint Mary's Hospital Manchester – 24 hour resident consultant presence introduced

3.1.1 Background

Saint Mary's Hospital is a tertiary referral unit in central Manchester. In 2010-11, maternity and paediatric services in Greater Manchester were reconfigured, with the closure of four small maternity units. This led to a significant increase in the number of women delivering at St. Mary's Hospital, from approximately 5,000 in 2009 to approximately 9,000 women per year in 2014-15. At the time of the reconfiguration, St. Mary's Hospital was staffed by 12 obstetricians and a further two obstetricians transferred from the closed units. Two more academic obstetricians joined the unit giving a total of 16 obstetricians.

The catchment area for St. Mary's Hospital has an approximately 15 mile radius and the hospitals that closed were all within this area. About half of the women delivering at St. Mary's Hospital are from within central Manchester and half from outside of the central Manchester area. Of the women coming in from other areas, some are clinically indicated referrals to the tertiary services, the others being women who choose to deliver at St. Mary's. Thirteen percent of all women delivering at St Mary's require tertiary care. A greater proportion of women attending Saint Mary's fall into the intensive and intermediate pathways under the National Tariff Payment System, compared with the average for the UK (see Table 4).

Table 4: Proportion of women in different National Tariff System pathways

National Tariff Payment System Pathway	UK	St Mary's Hospital
Intensive	5%	14%
Intermediate	35%	45%
Standard	60%	40%

Saint Mary's Hospital is co-located with the Royal Manchester Children's Hospital, the Royal Manchester Eye Hospital and the Manchester Royal Infirmary. In addition to maternity services, Saint Mary's Hospital has a large tertiary gynaecology unit, the Regional Genomics service, a Regional Fetal Medicine Unit and one of three 'level 3' Neonatal Intensive Care Units in Greater Manchester. Within the maternity unit there is a consultant-led obstetric unit (delivering approximately 80% of women) and an

alongside midwifery unit (AMU) providing midwifery-led care where 20% of women deliver. In the obstetric unit there is a four bed obstetric HDU with anaesthetic support and ITU nurse presence. In addition there is a freestanding midwifery unit (FMU) on the Salford Royal Hospital site providing midwifery-led care, which is run and managed by Saint Mary's Hospital where approximately 250 women per year deliver. If women from the FMU at Salford require medical intervention during labour they are transferred to the obstetric unit at Saint Mary's. The Caesarean section rate is 23%.

3.1.2 Planning

When the reconfiguration of maternity services in Greater Manchester took place there was an agreement that the midwifery and obstetric staffing levels recommended in 'Safer Childbirth' (Royal College of Obstetricians and Gynaecologists, et al. 2007) would be met in all the reconfigured units. In Saint Mary's there is a 1:28 midwife to birth ratio and one to one midwifery care is provided for all women in labour. The maternity network also provided pump priming / transitional funding to introduce 24/7 consultant presence on the labour ward.

In addition to the political drive for 24/7 consultant presence, the increased number of deliveries made the 'consultant on call from home' model unsustainable. Consultants were not only being called to make consultant level decisions about clinical management, or provide operative expertise for complex women, but were increasingly being called in from home due to excessive workload on the unit. Consultants were frequently required to be awake and working all night and working the next day became difficult; lists and routine clinics would have to be cancelled at very short notice. There were therefore clear political, clinical and organisational imperatives to deliver a 24 hour resident consultant obstetric service.

Planning for the delivery of a 24/7 resident consultant obstetric service was a gradual process and it took almost four years to achieve a model which was acceptable to staff and affordable for the Trust. A number of factors had to be balanced to achieve a sustainable model. This included balancing daytime work for Consultants to give them both experience and professional development opportunities, as well as enough time off. It was felt to be important that there should be equity across Consultants, with all Consultants participating in resident out of hours work. It was also felt that there must be equity in status and responsibility with none of the consultants being viewed as more senior than others, and all taking a fair share of management and governance roles. Introduction of the service also had to be undertaken within a nominal budget of transitional funding available from the commissioning organisation and Trust. In practice, the increased costs have been met by an increased income from a greater number of deliveries; the case-mix of the women attracting higher national tariff payments and the additional funding for provision of high dependency unit care. The costs are now being met from within the Obstetric Directorate meaning that the model should be sustainable in the long term.

The staffing model arrived at required the appointment of an additional 10 Consultants, 26 in total. Consultants are divided into two groups with a group of 16 consultants dividing the night shifts between them and a second group of 10 consultants dividing the evenings and weekend day shifts between them. Each of the 16 Consultants on the night rota works 13 week nights per year and three weekends per year (Fri, Sat, Sun nights). This represents a total of 23 resident nights per year and equates to 2.2 Programmes Activities (PAs) out of hours per week. The second group (10 Consultants) work weekend day time and evening shifts to make up their out of hours duties,

equating to 1.9 PAs out of hours per week. It is predominantly (but not exclusively) newer Consultants who work night shifts with the established Consultants, who had previously worked a traditional non-resident on call, now working the resident weekend daytime and weekday evening shifts on the labour ward. The advantage of this model is that all consultants can continue to contribute to the resident out-of-hours rota until retirement.

Recruitment of 10 new Consultants to a tertiary centre all at once was not straightforward and required two or three separate appointment processes, with locum consultant posts being used to enable the step change in the system to occur on 1st September 2014.

Whilst designing this system there was a gradual realisation that such a system would only be sustainable within a large conurbation with a high number of deliveries and a complex case-mix. Income has increased with births increasing from 5,200 in 2009/10 to 9,026 in 2014/15. Since a greater proportion of women attract the intermediate and intensive tariff payments, annual income is £1.92 million greater than if the case-mix conformed to the UK average. However, the cost of providing care for women requiring more complex care is also greater. Obstetric HDU care also generates £800k income, but again has its associated costs.

3.1.3 Assessment of Impact on Outcomes

The new system was introduced on 1st September 2014 thus formal evaluation is not yet possible. The management team have a number of planned evaluations to undertake, including both quantitative and qualitative outcomes. Some will require additional funding, and this has not yet been secured.

1. Quantitative clinical outcomes including:
 - Outcome of trials of instrumental delivery in theatre;
 - The blood loss for caesarean sections undertaken in the second stage of labour;
 - The number of babies born with Apgar scores of less than 7 at 5 minutes, or with low cord pH;
 - The number of term babies admitted to the neonatal intensive care unit;
 - The number of third and fourth degree tears at instrumental delivery;
 - The number of women with massive postpartum haemorrhage;
 - The mode of delivery of twins, where vaginal delivery is the intended mode;
 - Outcomes in women with BMI>40 who labour.
2. A qualitative study is planned of Serious Untoward Incidents to identify Consultant involvement and the impact of their decision making. Additional funding will be required for this evaluation.
3. The management team will be evaluating their staff and patient experiences including those of midwives, consultants and junior obstetric trainees.
4. Impacts on training will be examined. Whilst 24/7 consultant presence increases the number of hours when training and supervision are possible, there is the possibility that the presence of a consultant may hinder the development of decision making skills, leadership and prioritisation skills, particularly for the more senior trainees. This will be explored.

5. The management team also plan an economic and cost analysis. Additional funding will be required for this.

It should be noted that in the years prior to the change there had been a gradual increase in the number of hours of consultant presence on delivery suite, such that immediately prior to the 1st September 2014, there was 122 hours of consultant presence on the delivery suite. This then went up to 168 hours. On this basis it is possible that a significant difference in outcomes before and after the change may not be seen because of the high level of resident consultant presence prior to the final change.

Although no formal evaluation has been undertaken, the system has now been running for just over a year, and overall staff (consultants and midwives) are reported to be happy, clinical outcomes are perceived to be better and there is a feeling that training has improved. The Unit reports benefits to other aspects of the service such as improvements in the antenatal clinic and for inpatients, since with the greater number of consultants they have the flexibility to work in different ways which they feel have helped improve care.

3.2 Additional points from case studies of hospitals planning introduction of 24 hour resident consultant cover

3.2.1 Queen Charlotte's and Chelsea Hospital

The obstetricians at Queen Charlotte's and Chelsea Hospital are planning the introduction of 24 hour resident consultant labour ward cover for two reasons. Firstly, on review of their serious incidents they identified some instances where it was felt that consultant presence would have made a difference to the outcome. In these cases, workload for obstetric staff on the labour ward was identified as an issue alongside the fact that some of the junior obstetric staff did not recognise that they were getting into difficulties. The team felt that this assessment would not have been possible without good quality serious incident reviews, and noted also that some of the cases in the recent MBRRACE-UK Confidential Enquiry in relation to obstetric haemorrhage (Paterson-Brown and Bamber 2014) were illustrative of some of the problems of juniors with high workload and lack of appreciation of deteriorating patient condition. Secondly, the number of deliveries at the unit is about to increase by approximately 1,000 annually taking their delivery numbers up from 5,000+ to 6,000+. On the basis of this, they had already identified a need for consultant overnight presence although felt that this was not necessarily the optimum use of consultant expertise.

A particular concern was that using overnight consultants would compromise continuity of care which is already challenged during the day due to reduced junior doctor hours and the shift pattern of working. At the moment the Labour Ward is staffed in three shifts; 08.00-13.00, 13.00-17.00, 17.00-08.00, with the consultant going home to be on call from home overnight from approximately 23.00. Using this pattern, complex patients will often be cared for by multiple consultants and numerous handovers can be involved; another problem identified by the MBRRACE-UK Confidential Enquiries into Maternal Deaths. However, 24 hour consultant labour ward presence is thought to be essential to help with the workload and to maintain senior clinical expertise on hand. Therefore enhancing handovers will be necessary, in addition to highlighting the lead clinician for the complex women to try to mitigate the effects of decreasing continuity of care.

Two new consultants have been recruited starting in autumn 2015, with a plan for two more to supplement the current staffing which provides 98 hours labour ward consultant presence; each will undertake one night resident per week. Only new consultants will do resident overnight labour ward shifts; none of the incumbent consultants will undertake resident overnight shifts. The new consultants will also undertake alternating weekend nights. In addition, they will have an overnight buddy of a senior consultant on call from home. Note that there will be no prospective cover inbuilt into the system, hence it can be introduced with a smaller number of consultants. Thus when the resident consultants are on holiday, there will only be on call cover from home as currently practiced. There will thus not be 24 hour resident consultant presence 365 days per year.

This pattern of consultant presence has also been planned in order to help with junior training. At the moment, labour ward is so busy that consultants feel unable to teach in the same way they used to because of the workload. Peaks in the workload are thought to be what led to the serious incidents. The lengthened period of consultant presence will allow for teaching during periods when the workload is lighter as well as provision of immediate advice/assistance when the workload is high.

3.2.2 Simpson Centre for Reproductive Health, Royal Infirmary of Edinburgh

Plans for the introduction of resident consultant labour ward cover are being developed at the Simpson Centre for Reproductive Health, Royal Infirmary of Edinburgh. There were two drivers towards this change in Edinburgh. Firstly, concerns over patient safety with a generally perceived awareness that serious adverse events and major emergency situations such as postpartum haemorrhage often happen out of hours, such that women and junior medical staff in this large tertiary referral centre would benefit from more consultant presence out of hours. Secondly, they have experienced a shortage of trainees due to a reduction in National Training Numbers (NTN) across Scotland, which affected South East Scotland with a fall from 50 to 42 NTN in 2012/13. The lack of trainees was compounded by high numbers of trainees out of programme on grant funded PhD programmes, due to the academic environment of the University of Edinburgh, as well as maternity leave and less than full time training at a similar level to the rest of the UK.

The Simpson Centre for Reproductive Health first introduced overnight resident consultant posts three to four years ago and there are seven consultants currently providing some resident consultant cover in a unit delivering approximately 7,000 women per year. The remaining consultants work a traditional on call system resident until 21.00 and then on call from home, although the reality of this in a busy unit is that much of the 'on call' time is spent in the hospital. The resident consultants also currently have a senior consultant on call from home. The longer term aim is to recruit eight new consultants to give a total of 26, as per Manchester. There are currently four senior trainees (ST 6/7) on a second resident registrar rota, this will drop to two when the new consultants are appointed. All consultants will participate in resident cover (including overnight resident shifts) but there will be two groups of consultants with one group providing more, but not all, the overnight resident cover.

NHS Lothian are in agreement with the principle of 168 consultant labour ward resident cover but a final model and funding is still in negotiation and the aim will be to introduce this in a step-wise manner over the next 5 years. The trainees are keen on the proposed change because of benefits to training although concerns have been raised by some consultants about impacts on continuity of

care. Consultants undertaking overnight shifts will not be able to attend clinics the following day and it has therefore been proposed that, for example, all high risk antenatal clinics become two consultant clinics with a greater move towards team working and succession planning to maintain as much continuity as possible.

3.3 Case study from Liverpool Women's Hospital – 24 hour resident consultant cover not introduced

3.3.1 Background

Liverpool Women's Hospital is a stand-alone women's hospital which provides maternity, neonatal, fertility, genetics and gynaecology services. All consultants who work on labour ward are solely obstetricians; only one consultant works across both obstetrics and gynaecology. There are 12 consultant obstetricians covering labour ward; some of these consultants are clinical academics and therefore not undertaking NHS work full-time. Approximately 8,000 women deliver annually at Liverpool Women's Hospital; 5,500 women deliver on the high risk obstetric unit with the remaining 2,500 delivering in the alongside midwifery unit. Only high risk women (those not considered suitable for midwifery unit birth) deliver on the consultant-led labour ward.

Historically (prior to 2012), two consultants undertook resident night shifts on labour ward, one was because of the consultant's choice, one was a new appointment. Thus there were two periods of 24 hours when a consultant was resident throughout. Otherwise there was standard 12 hour cover. In view of this mixed model of overnight labour ward staffing, a comparison was undertaken between the outcomes during resident consultant and non-resident consultant overnight labour ward week-night shifts (reference Ballal et al 2012 included in the systematic review). The conclusion drawn by the authors of this comparison was that fewer second stage caesarean section deliveries were performed in resident consultant sessions, but there was a higher incidence of prolonged second stage (>4 hours) and post-partum haemorrhage, with no perceived improvement in neonatal outcomes (Ballal, et al. 2012). This analysis thus led to a review of the staffing pattern, on the basis that there may be other areas where increased consultant presence may have a more significant impact on outcomes than providing resident overnight labour ward cover.

3.3.2 Planning and conclusions

The review team studied their incident reports and felt that the reasons for the increased number of adverse events between the hours of 20.00 and 04.00 reported to the National Reporting and Learning System (NRLS) were multifactorial and would not necessarily all be addressed by 24 hour consultant labour ward presence. The review of consultant obstetrician staffing concluded that there were other areas more in need of consultant cover than the labour ward overnight. Overnight resident working was therefore stopped in order to expand the hours of weekend daytime consultant presence. In addition, a second consultant was introduced to the labour ward on weekdays to provide dedicated cover for the elective caesarean section list, because the workload on labour ward during the day could mean that a consultant was needed on delivery suite when he or she was in theatre. At the same time, the unit implemented one to one midwifery care, appointing 25 more midwives. The consultants work a 13 hour shift on delivery suite providing continuity of care and alongside the new shift pattern, the hospital highlighted the importance of

ensuring that every woman on the consultant labour ward had a consultant-led management plan with an appropriate handover of care.

The trust would like to increase consultant presence but this needs to be done step wise with prospective cover and over 7 days a week; a sudden increase in delivery rate or difficulty filling junior rotas would influence on-going review of consultant presence.

3.3.3 Outcomes of care under the new working patterns

A formal evaluation of outcomes under the current working patterns has not been undertaken. However, the current Care Quality Commission report on inpatient care is good although they did recommend that the trust reviewed its hours of consultant delivery suite presence and aimed to increase it (Care Quality Commission 2015). In the most recent MBRRACE-UK report on perinatal mortality for 2013, the stabilised and adjusted extended perinatal mortality rates for Liverpool Clinical Commissioning Group (CCG) and surrounding CCGs, all served by Liverpool Women's Hospital, all fell within the band of rates which were up to 10% lower than the UK national average (Manktelow BM, et al. 2015). Trust-specific perinatal mortality rates will be published in December 2015.

4 Models of care and outcomes in two selected European countries

4.1 Background

As part of the evidence review we were asked to include relevant information from two European countries to describe the organisation and outcomes of maternity care; one with similar maternal and perinatal outcome metrics and one with metrics which are amongst the best in Europe. In consultation with the National Maternity Review Secretariat at NHS England, France and Sweden were selected respectively on this basis and also because they were included in a review commissioned by Monitor and carried out by McKinsey and Company with Nigel Edwards from the Nuffield Trust (Monitor 2014). Of note the Monitor review covered a series of areas of care which included intrapartum maternity care.

A key finding from the Monitor review (2014) was that no single health system they studied offered a way of delivering consistently higher quality care at lower cost than the NHS. As a second key finding, they described three models of care which could “offer benefits if used more widely by the NHS” (Monitor 2014). In relation to intrapartum maternity care this was a greater emphasis on “risk tiering” facilitated through shared clinical governance and formal patient transfers and protocols.

To further explore the concept of risk tiering and how the models used in France and Sweden might be usefully applied in England we interviewed key informants to obtain more detailed information.

The Monitor report for France used case studies from the Hérault region (Languedoc Roussillon) which established a maternity network consisting of four maternity units in 2004 covering 8,915 deliveries per year, and Perpignan (Pyrénées Orientale) which has three maternity units delivering care for 3,800 births a year (Monitor 2014, Annex 13). For France we interviewed key informants who are familiar with the delivery of maternity care across France one of whom is a practicing obstetrician and researcher in Paris.

The Monitor review for Sweden reported a case study from Stockholm County which has about 29,000 births each year and care is delivered by seven maternity units (Monitor 2014, Annex 12). In this case we interviewed one of the key informants who also provided information for the Monitor report but who is also familiar with the delivery of maternity care across Sweden.

Table 5 provides comparative maternity statistics for France, Sweden and England as background to the following case studies. In comparing the perinatal mortality and maternal mortality statistics in Table 5 it is important to note that these were largely derived from the report of the Europeristat project (Europeristat 2013) which aimed to report comparable statistics based on the same definitions and routine sources of data. This ensures comparability across countries which use different definitions and data sources. For example, there is a wide variation across Europe in the gestation at which stillbirths are distinguished from late fetal deaths and for this reason Europeristat report stillbirths at ≥ 28 weeks' gestation. The Europeristat method of reporting also avoids the apparently higher maternal mortality ratios in countries which carry out enhanced surveillance, for example as part of a confidential enquiry process, where extensive efforts are made to identify all maternal deaths regardless of the cause of death and no deaths are excluded from the rates and

ratios reported, as happens in some countries. The effects of this enhanced surveillance are evident in the comparison between France and England of the maternal mortality rates, a result of enhanced surveillance, and the corresponding maternal mortality ratios which are estimated from routine sources of data.

Table 5. Maternity statistics for France, Sweden and England

	France	Sweden	England
Total births per year	~820,000	~115,000	~662,000
Number of maternity units:			
Obstetric units	535	44	160
Alongside midwifery units	0	1	97
Freestanding midwifery units	0	0	62
Number (%) of home births¹ per year	--	~100 (0.09%)	~16,000 (2.4%)
Perinatal mortality statistics 2010²:			
Stillbirth rate per 1,000 total birth ³	4.3	2.8	3.8
Early neonatal mortality rate ⁴ per 1,000 live births	1.6	1.1	1.9
Neonatal mortality rate ⁵ per 1,000 live births	2.4	1.5	2.5
Maternal mortality rate⁶	10.3	--	10.1
Maternal mortality ratio⁷	8.4 (95%CI 7.5-9.3)	3.1 (95%CI 1.8-5.0)	6.8 (95%CI 4.7-6.6)

1. These figures includes both planned and unplanned births at home
2. These figures come from Europeristat estimates for 2010 and for England are the combined rates for England and Wales as provided by the Office for National Statistics; 95%CI are not given and from the information provided it is not possible to estimate confidence intervals
3. For comparative purposes this is the stillbirth rate ≥ 28 weeks' gestation; this avoids the problem of the different gestational age limits used to define a stillbirth in the different countries
4. Neonatal deaths in the first seven days after birth
5. Neonatal deaths in the first 28 days after birth
6. Maternal mortality rate per 100,000 live births in France and per 100,000 maternities (women giving birth) in England derived from enhanced surveillance
7. The ratio of maternal deaths to live births was obtained from routine sources of data published by Europeristat for France and Sweden 2006-2010 and published by MBRRACE-UK for the UK 2006-2008; 95%CI's estimated for France and Sweden are based on the data reported by Europeristat

4.2 Delivery of care in France

4.2.1 The organisation of care

Maternity care in France is fully publicly funded but is divided into public care and private care. There were approximately 820,000 live births in France in 2014 (provisional figures from the National Institute of Statistics and Economic Studies) in 535 maternity units. There were 662,186 births in England in 2013, with care provided in 137 hospital Trusts (Manktelow, et al. 2015). There are thus almost four times the number of delivery units in France compared with Trusts in England; units in France thus deliver a correspondingly smaller number of women on average (Table 6). In the most recent French national perinatal survey (Blondel, et al. 2012), 64% of deliveries took place in public maternity units, 7% in private non-profit making units and 28% in private profit-making units.

All care in France is obstetrician-led, there are no midwife-led units or midwife-led deliveries. Although some low risk women will be cared for entirely by midwives in obstetric units, there is always an allocated lead obstetrician for their care. There is, however, increasing interest in midwife-led care in France such that a few midwife-led alongside midwifery units will be opening within the next year as a pilot with the first planned in Paris. There are no routine data on planned home deliveries, but numbers are believed to be very marginal (a few hundred each year), since the insurance required for midwives to supervise home delivery is very high. Less than 0.5% deliveries occur outside hospital (Blondel, et al. 2011); about half of them lead to secondary transfer to hospital. The majority of these are not planned, i.e. they are assumed to be women who deliver quickly and are unable to reach hospital in time to deliver there.

French maternity units are divided according to the type of neonatal care they offer on-site into Levels 1, 2 and 3, with the Level 3 units largely based in large cities and analogous to the tertiary units in the UK. These levels of neonatal care are analogous to the level 1, 2 and 3 neonatal units in the UK. Since 1998, all maternity units (public and private) must belong to a perinatal network. The perinatal networks are defined on a population basis, and specifically organised on a regional basis with rules for transfers of care.

Table 6: Comparative unit/trust sizes in France and the UK

Maternity unit/Trust size (annual deliveries)	France % ¹	England % ²
<500	2.5	2.2
500-999	14.9	0
1000-1499	20.6	2.2
1500-1599	14.0	4.4
2000-2999	29.2	13.9
3000 and more	18.8	77.4

1. Data based on a sample of 14,672 deliveries in the 2010 French National Perinatal Survey (Blondel, et al. 2012)
2. Data for Trusts from MBRRACE-UK

4.2.2 The funding of care

All maternity care is publicly funded, and the funding is similar in the public and private sector. However, in private hospitals, some additional procedure costs can be added. Hospitals are funded according to 33 different categories of delivery. Funding will then be allocated to hospitals on the basis of their coded hospital episode data i.e. they are entirely funded on the basis of activity.

4.2.3 Women's choice

Although women and couples in favour of midwife-led units are becoming more visible in the public debate, French obstetricians are not in general very comfortable with midwife-led care. When women are choosing where to have their babies, those women who are at low risk can choose to deliver anywhere including a Level 2 or 3 unit. However, women who have any complications will be referred to a Level 3 unit. Most regions, of which there are 22 in France (soon to be reorganised into 13), have one or two Level 3 units per region although there are more in the Paris region.

4.2.4 Outcomes of care

France has no routine collection of perinatal mortality statistics analogous to the data collection undertaken by MBRRACE-UK (Manktelow BM, et al. 2015). They rely on two sources: hospital discharge data for stillbirths, and vital event registration for neonatal deaths. Reporting of late (22 gestation or higher) miscarriages or late terminations of pregnancy is compulsory. Monitoring of medical practices, risk factors and preventive maternal behaviour rely mainly on a National Perinatal Survey which takes place once every five to six years (Blondel B and Kermarrec M 2011, Blondel, et al. 2012); this survey is based on a representative sample of births. In addition information on birthweight and gestational age is available for each birth from the hospital discharge data.

The most recent perinatal mortality data obtained from Europeristat reports a stillbirth rate of 9.2 per 1000 live births in 2010, the highest rate observed in Europe (Blondel B and Kermarrec M 2011). This ranking is mainly explained by the inclusion of terminations of pregnancy. Terminations of pregnancy are allowed without any gestational age limit and are frequently performed after 21 weeks of gestation. It is estimated that 40 to 50% of these stillbirths are terminations of pregnancy (Blondel B and Kermarrec M 2011). It is important to note that the rate given in Table 5 does not correspond to this rate as for comparative purposes the figures in Table 5 are based on stillbirths ≥ 28 weeks' gestation and will therefore exclude the majority of terminations of pregnancy. The neonatal mortality rate for 2010 is reported to be 2.4 per 1000 live births of which 1.6 deaths per 1000 live births within the first week after birth (early neonatal deaths) (Blondel B and Kermarrec M 2011).

The maternal mortality rates in France (from the French Confidential Enquiry into Maternal Deaths) are very comparable to those in the UK. For 2007-9, the reported rate in France was 10.3 maternal deaths per 100,000 live births compared with a rate in the UK for 2010-12 of 10.1 maternal deaths per 100,000 maternities (Bouvier-Colle, et al. 2013, Knight, et al. 2014). The key difference between maternal mortality in the UK and France is that in France there was a higher proportion of deaths from direct obstetric causes and in particular from post-partum haemorrhage.

4.3 Delivery of care in Sweden

4.3.1 The organisation and funding of care

Maternity care in Sweden is publically funded by local councils. There are about 115,000 births each year which deliver in 44 maternity units. This is compared with a total of 319 units in total in England (obstetric, alongside midwifery units and freestanding midwifery units).

There is one midwifery unit in Sweden which is located in Stockholm county. In this county there are about 29,000 births each year and care is provided in seven units of which the alongside midwifery unit is one; five of the units provide level 2 care, including the unit which is co-located with the alongside unit, and there is one level 3 unit. The midwifery unit delivers about 1,400 births per year and provides care solely for low risk women who meet similar criteria to define low risk as are used in England. Women who are booked for delivery care in the midwifery unit who develop pre-labour complications which change their risk status will have their booking transferred to either the co-located level 2 unit or the level 3 unit. Women who arrive at the midwifery unit in pre-term labour will be transferred to either the adjoining obstetric unit (≥ 28 weeks' gestation) or the level 3

unit (all gestations) depending upon the gestation. The midwifery unit has about a 30% transfer rate which is slightly higher than the 25% transfer rate from alongside midwifery units reported in the Birthplace in England study.

Level 2 care is defined based on the funded services available to care for preterm neonates with delivery ≥ 28 weeks as the cut-off; the level 3 units provide care for all preterm births. The choice of place of birth is made at 20 weeks gestation and women are free to choose an obstetric unit provided that they don't have any complications or a past history which increases their chance of delivery at < 28 weeks; although, as noted above only low risk women, likely to deliver at term, are booked for care in the alongside midwifery unit. If women booked in a level 2 unit go into labour prior to 28 weeks gestation they will, where possible, be transferred to the level 3 unit with the baby *in utero*, however, if labour is too far advanced then the level 2 units have full obstetric and anaesthetic services to provide assisted vaginal and caesarean deliveries and the baby will be transferred after delivery. When surveyed women reported mainly make their choice of unit for delivery based on the nearest to where they live or where they had their last baby.

Home births are very infrequent with at most 100 per year which represents 0.09% of all births. The local council will only provide funding for home births for women having their second or subsequent baby. Funding for home births for women having their first baby is not provided.

4.3.2 Women's choice

Whilst there is a single midwifery unit there appears to be little call for an expansion of this service and there are no plans at present to expand the current unit or open any new midwifery units. This is thought to be because the majority of care in the obstetric units is provided in units which have a 'homely' rather than a clinical atmosphere and clinical standards across all units is high. Care is thus provided in obstetric units which include many of the attributes of midwifery units which are valued by women.

Whilst some women wish to have a home birth, again there appears to be little call for an expansion of home births with a very small (< 100 per year) number of births at home each year which has remained relatively stable in recent times.

4.3.3 Outcomes of care

As noted in Table 5 Sweden has low rates/ratios of both perinatal and maternal mortality, although of note the maternal mortality ratio in Sweden is not statistically significantly different from the rate in the UK. On the basis of comparative statistics provided by the Europeristat project Sweden has amongst the lowest perinatal mortality rate across Europe and the rate is lower than in England.

Quality improvement activities in Sweden include the introduction of a professionally led patient safety project in about 2007. This was developed following a review which identified that there had been 20 "unnecessary" neonatal deaths in 100,000 deliveries. The project involves a peer review process with external visits by a group of professionals involved in all aspects of maternity and neonatal care. Detailed maternity and perinatal data collected by the Ministry of Health and Welfare since 1974 also allows extensive benchmarking; a new pregnancy register was established last year which will continue the tradition of extensive and detailed data collection on all births.

5 Conclusions and implications for policy and practice

The systematic review conducted has not identified sufficient research evidence comparing outcomes between a model of care in which consultant obstetricians are resident for 24 hours on labour ward and other models of consultant cover to reach robust conclusions. Thus a clear conclusion of this systematic review is that it is essential to obtain such evidence to assess whether patient safety is improved by 24 hour consultant presence on labour ward, alongside which a robust cost-benefit analysis can be undertaken.

Case studies from hospitals in the UK which have introduced, or are planning to introduce, or have considered continuous resident consultant labour ward presence have highlighted a number of key factors which need to be taken into consideration in relation to this model of intrapartum care:

- A model considered equitable by consultants and which includes prospective cover for holidays, thus truly providing continuous consultant labour ward presence, requires 26 consultants.
- Such a model can only be introduced within existing budgets in large urban hospitals with a high number of deliveries and a high load of 'high-risk' or higher tariff women.
- Consideration has to be made as to whether limited resources would be best used providing additional consultant or midwife cover at other times or in other areas in order to improve outcomes. This judgement is likely to be dependent upon the population each unit serves not only in terms of their risk status but other factors such as parity, ethnicity, deprivation status and geography. This review provides no evidence to guide that decision.
- There appears to be a tendency towards new consultants taking resident overnight shifts and established consultants being on call from home. This two tier system may lead effectively to a return to a system equivalent to the former senior registrar role and may lead to dissatisfaction and perceived inequity between recently appointed and established consultants.
- Allied to this, it is not clear whether consultants would be expected to continue a pattern of resident consultant labour ward overnight shifts throughout their entire working career.
- There is already some evidence that the number and grade of junior obstetric staff is reduced when consultants are resident overnight, which effectively may turn the consultant into a junior overnight, performing routine tasks rather than providing a more senior supervisory role. Some units are considering the model of 24 hour resident consultant presence in order to address problems with low junior staff levels which also raises the concern that consultants are deputising for juniors.
- A further linked issue is that with resident consultant presence the step-up from a trainee to a consultant will become effectively much greater, since trainees will never have had to act independently during their training without a consultant available to assist. This may further lead to a junior and senior consultant system without very serious consideration given to providing adequate training to obstetric trainees with resident consultants.

Case studies of maternity care in France and Sweden indicate that they use a 'risk tiering' system in networks of care very similar to the neonatal network system developed in England in the mid-2000s; some, but not all, of which have recently been expanded into perinatal networks with the closer involvement of maternity services. It is not possible to discern a clear relationship between

‘risk tiering’ and outcomes on the basis of the outcome data available. It is also not clear from the findings of our case studies how ‘risk tiering’ based on the parameters of gestational age at delivery, as used in France and Sweden, can be more usefully expanded in England other than to more clearly embed ‘risk tiering’ in commissioning contracts.

In conclusion, neither the systematic review nor the case studies provide clear evidence of different outcomes in terms of safety with a model of 24 hour resident consultant presence on labour ward. Different hospitals/trusts have taken different decisions about the model of consultant labour ward care used according to judgements based on their own local circumstances, including factors such as serious incident reviews, junior obstetrician staffing levels, midwifery staffing levels and the population served. Further evaluation of outcomes following the introduction of resident consultant presence, and associated economic evaluation, would need to be undertaken to determine whether this is the best use of current resources.

6 References

- Ahmed I, Wyldes MP, Chong HP, Barbar KJ, Tan BK. 24/7 consultant presence in a UK NHS tertiary maternity unit. *Lancet* 2015;386:951-52.
- Ballal S, Dawood F, Scholefield H. Resident consultant versus on call cover on delivery suite: are outcomes better? *Archives of Disease in Childhood Fetal and Neonatal Edition* 2012;97(s1):A78.
- Blondel B, Kermarrec M. French National Perinatal Survey 2010. Situation in 2010 and trends since 2003. . Secondary French National Perinatal Survey 2010. Situation in 2010 and trends since 2003. 2011.
<http://www.europeristat.com/images/French%20National%20Perinatal%20Surveys%202003-2010-2.pdf>.
- Blondel B, Drewniak N, Pilkington H, Zeitlin J. Out-of-hospital births and the supply of maternity units in France. *Health Place* 2011;17(5):1170-3.
- Blondel B, Lelong N, Kermarrec M, Goffinet F, National Coordination Group of the National Perinatal S. Trends in perinatal health in France from 1995 to 2010. Results from the French National Perinatal Surveys. *J Gynecol Obstet Biol Reprod (Paris)* 2012;41(4):e1-e15.
- Bouvier-Colle M-H, Deneux-Tharaux C, Saucedo MdC. Enquête nationale confidentielle sur les morts maternelles France, 2007-2009 Secondary Enquête nationale confidentielle sur les morts maternelles France, 2007-2009 2013.
<http://www.cngof.asso.fr/documents/Les%20morts%20maternelles%20en%20France%202007-2009%20-%20Rapport%20du%20CNEMM.pdf>.
- Canadian Agency for Drugs and Technologies in Health. EPOC Taxonomy. Secondary EPOC Taxonomy 2015. <https://www.cadth.ca/media/pdf/EPOC%20Taxonomy.pdf>.
- Care Quality Commission. Liverpool Women's Hospital Quality Report. London: Care Quality Commission, 2015.
- Cochrane Collaboration. Review Manager 5.3, 2011.
- Europeristat. European Perinatal Health Report. Health and Care of Pregnant Women and Babies in Europe in 2010. Europeristat, 2013. <http://www.europeristat.com/reports/european-perinatal-health-report-2010.html> (accessed September 2015)
- Freites J, Ruprai C, Paul H, Lindow SW. Resident consultant presence in labour ward after midnight - A retrospective cohort study of 5318 deliveries. *Journal of Perinatal Medicine* 2012;40(6):615-18.
- Heller G, Misselwitz B, Schmidt S. Early neonatal mortality, asphyxia related deaths, and timing of low risk births in Hesse, Germany, 1990-8: observational study. *BMJ* 2000;321(7256):274-5.
- Higgins JP, Green S. *Cochrane handbook for systematic reviews of interventions*: Wiley Online Library, 2011.
- Knight M, Kenyon S, Brocklehurst P, Neilson J, Shakespeare J, Kurinczuk JJ, (Eds.) on behalf of MBRRACE-UK. *Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009-12*. Oxford: National Perinatal Epidemiology Unit, University of Oxford, 2014.
- Luo ZC, Karlberg J. Timing of birth and infant and early neonatal mortality in Sweden 1973-95: longitudinal birth register study. *BMJ* 2001;323(7325):1327-30.
- Mahon A, Harris C, Tyrer J, Carr S, Lowson K, Carr L, Chaplin S, Wright D. The implementation and impact of Hospital at Night pilot projects. An evaluation report. Leeds: Department of Health, 2005.
- Manktelow BM, Smith LK, Evans TA, Hyman-Taylor P, Kurinczuk JJ, Field DJ, Smith PW, Draper ES, on behalf of the MBRRACE-UK collaboration. Perinatal Mortality Surveillance Report UK Perinatal Deaths for births from January to December 2013. . Leicester: The Infant Mortality and Morbidity Group, Department of Health Sciences, University of Leicester. , 2015.

- Merrick K, Rajesh U. Impact of resident consultant night on-call in York Teaching Hospital. *BJOG : an international journal of obstetrics and gynaecology* 2013;120(s1):474.
- Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *J Clin Epidemiol* 2009;62(10):1006-12.
- Monitor. Exploring international acute care models. London: Monitor, 2014. IRRES 06/14. <https://www.gov.uk/government/publications/exploring-international-acute-care-models> (accessed June 2015)
- Monitor. Exploring international acute care models. Annex 12 - case studies: maternity services in Stockholm County, Sweden. London: Monitor, 2014. IRRES 06/14. <https://www.gov.uk/government/publications/exploring-international-acute-care-models> (accessed June 2015)
- Monitor. Exploring international acute care models. Annex 13 - case studies: maternity services in France. London: Monitor, 2014. IRRES 06/14. <https://www.gov.uk/government/publications/exploring-international-acute-care-models> (accessed June 2015)
- Pasupathy D, Wood AM, Pell JP, Fleming M, Smith GC. Time of birth and risk of neonatal death at term: retrospective cohort study. *BMJ* 2010;341:c3498.
- Paterson-Brown S, Bamber J. Prevention and treatment of haemorrhage. In: Knight M, Kenyon S, Brocklehurst P, et al., eds. *Saving Lives, Improving Mothers' Care - Lessons learned to inform future maternity care from the UK and Ireland Confidential Enquiries into Maternal Deaths and Morbidity 2009-12*. Oxford: National Perinatal Epidemiology Unit, University of Oxford, 2014:45-55.
- Royal College of Obstetricians and Gynaecologists, Royal College of Midwives, Royal College of Anaesthetists, Royal College of Paediatrics and Child Health. *Safer Childbirth: Minimum Standards for the Organisation and Delivery of Care in Labour*. London: RCOG, 2007.
- Ruffieux C, Marazzi A, Paccaud F. The circadian rhythm of the perinatal mortality rate in Switzerland. *Am J Epidemiol* 1992;135(8):936-52.
- Siddiqui F, A. G, Moore J, Kean L. Resident obstetric consultant cover: does it make a difference to vaginal delivery rates or perinatal morbidity? *Archives of Disease in Childhood Fetal and Neonatal Edition* 2008;93(s1):Fa11.
- Stewart JH, Andrews J, Cartlidge PH. Numbers of deaths related to intrapartum asphyxia and timing of birth in all Wales perinatal survey, 1993-5. *BMJ* 1998;316(7132):657-60.
- Tang JW, Dwyer JP, Rajesh U. Impact of introducing consultant resident on-call in a district general hospital. *J Obstet Gynaecol* 2012;32(8):736-9.

7 Appendix – Medline search strategy

MeSH terms

1. Pregnancy in MeSH OR “Pregnan* OR intrapart* OR delivery OR birth” in Free text
AND

2.

Obstetrics and Gynecology Department, Hospital

OR

Personnel Staffing and Scheduling AND Obstetrics

OR

Delivery of Health Care AND Obstetrics

OR

Delivery room

OR

Obstetrics/ organisation and administration

OR

Personnel Management AND Obstetrics

OR

Manpower.fs (i.e. any MeSH term with manpower as subheading)

OR

“24-hour staff” OR “consultant obstetr*” in Free text

AND

3. Any of following MeSH terms relating to outcome

Maternal mortality

Stillbirth

Perinatal death

Perinatal mortality

Patient safety

Obstetric labor complications

Cesarean section

Delivery, obstetric/adverse effects

Pregnancy outcome

Labor, obstetric

Obstetric forceps

Birth injuries

Dystocia

Perineum

Postpartum hemorrhage

Intensive care unit

Length of stay

Urinary incontinence

Fecal incontinence

AND Human AND Female NOT United States

Without date restriction, this resulted in 1716 papers

