AN INVESTIGATION OF POSTNATAL LENGTH OF STAY IN HOSPITAL AND INFANT READMISSION TO HOSPITAL

By

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Abstract

More women in England now have a shorter stay in hospital following birth despite increased medical intervention during childbirth. Infant admissions have also increased over the last decade. Evidence on the association between postnatal length of stay and infant readmission to hospital is conflicting. This thesis investigated the possible relationship between postnatal length of stay in hospital and infant readmissions. The systematic review found that early postnatal discharge (< 48 hours following vaginal birth: < 96 hours following caesarean birth) increases infant readmissions to hospital. The cross sectional study found that most of the increase in infant admission rate in the first 0-6 days of life was attributable to potentially preventable conditions, physiological jaundice and feeding related difficulties. The qualitative interview study found that parents did not perceive their hospital postnatal care to be an important factor in their infant's readmission to hospital and were strongly motivated to go home following the birth hospitalisation. Given the enormous cost of infant readmissions to the NHS and potential trauma to both parents and infants, integrated care pathways and targeted community interventions should be developed to better support women and infants who are discharged under 48 hours, and infants at risk of being readmitted for jaundice and feeding difficulties.

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Introduction

This thesis examines the possible effects of postnatal length of stay (LoS) in hospital on infant readmissions to hospital. This body of work emerged from local clinicians identifying that more women were being discharged from hospital sooner after giving birth and more infants were being readmitted in the early postnatal period. Quantitative and qualitative research methods were chosen to explore: existing evidence on the effects of postnatal LoS in hospital; current trends in infant readmission to hospital in England; and parents' experiences of the time preceding infant readmission to hospital in the first four weeks after birth.

Thesis aims:

More women in England are now having a shorter stay in hospital following birth despite an increase in medical intervention during childbirth and more complex needs of women who become pregnant (1). Infant and paediatric emergency admissions have increased over the last decade placing considerable strain on secondary care (2). The evidence on whether there is an association between postnatal LoS and infant readmission to hospital is conflicting (3). The rationale for the thesis is described in more detail in chapter 1.

The following overarching aims were developed and planned:

- To use existing international evidence to explore the possible effects of postnatal LoS in hospital;

- To describe the current trends of infant readmissions to hospital in the first year of life in the period 2008-2014 in England using routinely collected data, with particular emphasis on admissions in the first 28 days which could be considered avoidable;
- To explore experiences and perspectives of parents whose infants are readmitted to hospital during the early postnatal period, focusing on the time preceding the readmission to hospital.

Structure of thesis

Chapter 1 provides the background to the thesis and gives an overview of the main issues that will be addressed. It describes the purpose and provision of postnatal care in England; current trends in postnatal LoS in hospital; international data on postnatal LoS; existing evidence on the effects of postnatal length of stay in hospital on maternal and infant outcomes and literature describing women's experiences of their postnatal care. It also details the evidence and trends on paediatric admission to hospital in England.

Chapter 2 describes the rationale and justification for the methods chosen. This is followed by a description of the ontological, epistemological and theoretical perspectives that underpin the studies presented in the thesis. An outline of how the findings of the qualitative and quantitative studies are brought together in the discussion is then described.

Chapter 3 addresses the first aim which is to explore the existing evidence on the effects of postnatal LoS in hospital for women and infants. This chapter describes the systematic review and meta-analysis which examines the effect of early postnatal discharge on maternal and infant outcomes with specific emphasis on the association between early

postnatal discharge and maternal and infant readmission to hospital. The systematic protocol has been published (4): **JONES, E., TAYLOR, B., MACARTHUR, C., PRITCHETT, R. & CUMMINS, C. 2016. The effect of early postnatal discharge from hospital for women and infants: a systematic review protocol. *Systematic Reviews,* 5, 24.**

Chapter 4 addresses the second aim which is to describe the current trends of infant readmissions to hospital in the first year of life in the period 2008-2014 in England using routinely collected data, with particular emphasis on admissions in the first 28 days which could be considered avoidable. This chapter presents the cross sectional study's methods. The study uses routinely collected national data to examine the trends in infant readmissions to hospital and rates and trends in potentially avoidable admissions for infants. It also describes the process by which a definition of potentially avoidable admission was developed. The study has been published (5): **Jones E, Taylor B, Rudge G, MacArthur C, Jyothish D, Simkiss D, Cummins C. Hospitalisation after birth of infants: cross sectional analysis of potentially avoidable admissions across England using hospital episode statistics. *BMC Pediatrics*. 2018; 18(1):390.**

Chapter 5 addresses the final aim which is to explore experiences and perspectives of parents whose infants are readmitted to hospital during the early postnatal period, focusing on the time preceding the readmission to hospital. This chapter presents the qualitative interview study that was conducted at a large urban children's hospital in England to explore parents' experiences of their infant being readmitted to hospital.

Chapter 6 presents the summary of the preceding chapters' findings and presents the overall discussion of the thesis. It also summarises the study's contributions to literature, implications for practice and future research opportunities.

Chapter 1 Postnatal care, postnatal length of stay in hospital and infant admissions to hospital

1.1 Purpose of the chapter

The purpose of this chapter is to outline the literature and data that is relevant to the thesis. It describes the purpose of postnatal care, the structure of postnatal care services in England and national and international temporal trends in postnatal length of stay (LoS) in hospital. It also describes the existing evidence on the effects of postnatal LoS in hospital on maternal and infant health outcomes, and women's experiences of postnatal care in England. Finally, it describes the trends and variation of emergency infant admissions to hospital in England.

1.2 The postnatal period and purpose of postnatal care

The postnatal period is defined by the World Health Organisation (WHO) as the period from childbirth to the 42nd day following delivery (6). The postnatal period represents a period of significant physical, emotional and psychological change, and is a time of increased vulnerability for families (7, 8).

The purpose of postnatal care is to provide a supportive environment in which a woman can recover physically and emotionally from childbirth, develop the necessary skills to care for her baby, establish infant feeding and begin bonding with her baby (7). An important component of postnatal care is the capacity to identify deviation from the expected recovery after birth including identifying potentially life threatening conditions such as deep vein thrombosis and haemorrhage in the mother and infection in the baby (7). The postnatal period has also been recognised as providing a key opportunity for health professionals to promote and support initiation of breastfeeding, deliver public health information, improve parenting confidence and promote long term healthy lifestyle choices (9).

1.3 Postnatal care in England

In England, the National Institute for Care Excellence (NICE) postnatal care guidance outlines the routine care that every woman and her baby should receive in the first six to eight weeks after birth (7). It also provides guidance on care pathways for women and infants who develop complications in the postnatal period (7). In the NHS in England, the majority of births take place in hospital and postnatal care usually starts in hospital following birth. Women and infants are cared for by a team of midwives and maternity support workers with additional care from obstetricians and paediatricians for high risk women and infants. Following discharge from hospital, postnatal care continues in the community with an average of three to four visits at home from a community midwife (10). Depending on clinical need, some women attend postnatal clinics instead of home visits (10). Discharge from midwifery services can occur any time after the tenth day when care is transferred to the health visitors (9). Postnatal care is usually concluded at the six to eight week postnatal examination by the general practitioner (GP) and is considered to be the end of a woman's maternity care (9).

Although the essential structure of postnatal care in England has remained the same since the 1970's, over the last 30 years, women and infants have less contact with health professionals as the length of stay in hospital has declined (11, 12). In 1989-90, only 44% women were discharged within two days of giving birth compared to 81% women in 2016-17 (1). There is some evidence to suggest that low risk women and babies are being discharged within four to six hours following birth (12). The frequency of midwifery visits however, has not increased in response to a decrease in postnatal LoS in hospital. In 1986, women

received an average of 9.2 postnatal contacts compared to three to four visits following discharge in 2017 (10, 13). In recent times many postnatal visits take place in postnatal clinics rather than at home (12). The frequency of visits following discharge from hospital is important in the context of postnatal care because as the length of stay reduces, the need to provide more support in the community is likely to increase.

In England, there is no professional guidance that specifies the length of time a mother and infant should stay in hospital following birth and instead NICE postnatal guidance recommends that the point of discharge be a joint decision between the mother and the health care team:

> *"Length of stay in a maternity unit should be discussed between the individual woman and her healthcare professional, taking into account the health and wellbeing of the woman and her baby and the level of support available following discharge." (7).*

The National Maternity Review, 'Better Births' (14) was introduced in 2016 to provide guidance on the transformation of maternity services in England and states that postnatal care should be *'resourced appropriately'* and that there should be a midwife available to women as they require. There is no detail however on specific postnatal length of stay or minimum number of postnatal visits (14). Published in 2019, the NHS 10 year Long Term Plan (15) provided no guidance on appropriate length of stay following birth. Instead, there is emphasis on continuity of care models which aim to reduce hospital admissions in addition to reducing preterm birth, the need for intervention in labour and women's experiences of care.

This shift towards a shorter postnatal stay in hospital has proved contentious; many have suggested that the decision to discharge women and infants from hospital is too often made on a resource-led rather than needs-led basis (12, 16). In recent years, a number of factors have had a substantial impact on the capacity of maternity services to deliver quality care including a rising birth rate and an increase in the proportion of women with complex medical and social factors (17). The increase in the number of 'complex births' has had an impact on all aspects of maternity care requiring: more intensive monitoring in the antenatal period; greater need for intervention during labour, and most notably, caesarean section and longer postnatal recovery time as a result (17).

Although the postnatal period provides a key opportunity to improve longer term maternal and family health and reduce health inequalities (18), many argue that it is perceived as less critical than antenatal or intrapartum care because it exists as a *'provision of a supportive environment'* rather than management of acute clinical situations (9). It has been suggested that this perception is further reflected in the National Health Service (NHS) Payments by Results scheme where hospitals in England receive £250.00 for the mother and infant for routine postnatal care even though the actual cost is around £1000.00 (16). Despite the increase in birth rate over the period 2006-2016 and the more complex needs of women who become pregnant, postnatal care has been a target for cost cutting and has frequently been referred to as the 'Cinderella' of maternity care (9, 16, 19).

1.4 Current evidence on trends and characteristics of postnatal LoS in England

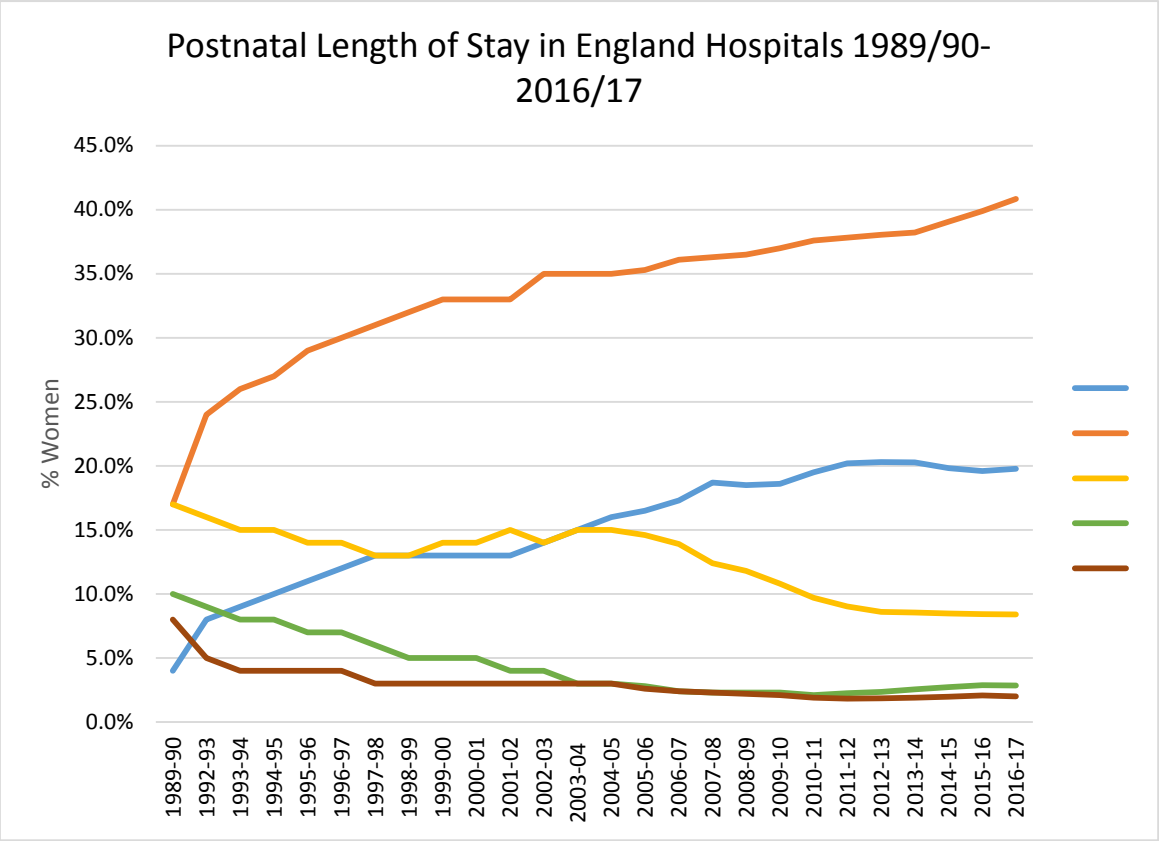
As part of the evaluation of postnatal services in England, it has been important to accurately monitor trends in antenatal and postnatal length of stay in hospital. The trends in postnatal LoS in England have been recorded in Hospital Episode Statistics (HES) data which is a routinely collected database of all inpatient, outpatient and accident and emergency attendances in NHS hospitals. The trends of postnatal LoS have been recorded since 1989 (11) although LoS is measured in calendar days rather than hours. Further evidence on the national trends in postnatal LoS is available from large scale national surveys conducted by the Care Quality Commission (CQC) (10, 20), the independent regulator for health and social care in England.

1.4.1 NHS digital data – Hospital Episode Statistics (HES)

Hospital Episode Statistics (HES) data is a data warehouse that processes over 125 million admitted patient, outpatient and accident and emergency records at NHS hospitals in England (21). Described in more detail in section 4.2, HES inpatient data collects routine demographic data, administrative information, geographical information and clinical information based on the World Health Organisation's International Classification of Diseases (ICD) and Classification of Operations and Procedures (22).

HES maternity statistics for 2016/17 show that over the last decade, the proportion of women and babies who are discharged within two days has increased (Figure 1.1). In 2005/06 nearly 73% of women were discharged within two days compared to 81.5% in 2016/17. The proportion of women who were discharged on the date of delivery has also increased from 16.5% in 2005/06 to 19.8% in 2016/17 (1).

Figure 1.1 Postnatal length of stay in hospital 1989/90-2016/17 adapted from Hospital Episode Statistics data



The proportion of women who have a length of stay more than seven days has remained stable (2.6% of women and infants being discharged more than seven days in 2005-06 compared to 2.0% in 2016/17) (1).

1.4.1.1 Birth and sociodemographic characteristics and postnatal LoS

1.4.1.1.1 Postnatal LoS and mode of delivery

HES data shows that postnatal LoS in hospital differs according to mode of birth. Women who have an operative birth or caesarean section have a longer postnatal stay compared to women who had a spontaneous vaginal birth. In 2016-17, 77% women who had a spontaneous vaginal birth were discharged from hospital within one day after birth

compared to 28% women who had a caesarean section. The majority of women (53%) who had a caesarean section were discharged either on the second or third day following birth (1).

1.4.1.1.2 Postnatal LoS and age of mother

Postnatal length of stay also varies by age of mother. HES data from 2014/15 shows that that 23.4% women aged 20-24 giving birth were discharged on the same day compared to 19% of women aged between 30-34 years (1).

1.4.1.1.3 Postnatal LoS and indices of multiple deprivation (IMD)

HES data shows that in 2016/17, duration of postnatal stay was consistent across IMD deciles, with a similar proportion of women going home on the same day or day after in both the most deprived and least deprived deciles (60.3% and 61.3% respectively). There was a slightly higher proportion of women in the least deprived decile discharged on the same day that they gave birth compared to women in the most deprived decile (20.5% and 19.7% respectively). However, 40.7% of women in the most deprived category were discharged from hospital the day after they gave birth and 40.7% in the least deprived decile (1).

1.4.1.2 Limitations of HES data on postnatal LoS

Although HES data provides the most comprehensive overview of trends in postnatal length of stay in England, there are a number of limitations which must be considered. Firstly, the data on length of stay in hospital is measured in days rather than hours. The potential postnatal LoS in hours for each 'day' category is illustrated in Table 1.1. In the same day discharge category, women may have been discharged anywhere between 0-23 hours 59 minutes after birth and this means that it is not possible to observe trends in discharges

under 24 hours. Secondly, current data is not strictly comparable to data collected before 2005/06 because the proportion of missing data was not reported prior to 2005-06. Finally, although characteristics of postnatal LoS have been described, with the absence of multivariate regression analysis, it is not possible to determine whether the observed characteristics are confounded by other variables (such as maternal age, parity and IMD score). These limitations mean that it is necessary to explore other sources of data on the trends and characteristics of postnatal LoS in England.

Table 1.1 Summary of length of stay in calendar days and hours

Length of stay (days)	**Possible length of stay (hours)**
Day 0	0-23
Day 1	24-47
Day 2	48-71
Day 3	72-95

1.4.2 Evidence on the incidence of postnatal LoS in hospital < 12 hours

There is a paucity of published data which describes postnatal LoS in hours and data are reliant on large scale national surveys such as the Care Quality Commission (CQC) surveys which uses a representative sample of women giving birth in NHS trusts rather than the whole population which HES data captures (10, 20, 23).

1.4.2.1 Care Quality Commission Survey

The CQC 2017 survey of 17,611 women (with a 37% response rate) found that 36% women stayed in hospital for one or two days. 21% of women stayed > 12 hours but less than 24 hours and 17% women stayed < 12 hours (10) (Table 1.2). Although the proportion of women who stayed in hospital up to 12 hours has remained stable, the proportion of women who go home within 12-24 hours after birth has increased slightly from 19% to 21% (10).

Table 1.2 Postnatal LoS 2013-2018 adapted from CQC Maternity Services Surveys 2013, 2015 and 2018 .

Length of postnatal stay	**Year of survey**		
	2013	**2015**	**2017**
Up to 12 hours	17%	17%	17%
> 12 hours < 24 hours	19%	20%	21%
1 to 2 days	37%	36%	36%
3 to 4 days	18%	17%	16%
5 or more days	9%	10%	10%
Number of respondents	22,158	19,289	18,036

In summary, in England women and infants stay in hospital for a shorter time than 30 years ago with an increasing an increasing number of women going home on the same day that they gave birth (1, 23). Although HES provides an overview of postnatal LoS in England, it is

of limited value for capturing the trends in postnatal LoS < 24 hours because it records LoS in days rather than hours and data on this is available only from the CQC surveys.

1.5 International data on postnatal length of stay in hospital

The decline in postnatal LoS in hospital in England is consistent with the other high income countries such as Australia, New Zealand, Sweden and Canada (3, 24, 25). A recent multi-country cross sectional study found considerable variation in the postnatal LoS in hospital after vaginal singleton birth across the world, ranging from 1.3 days (Egypt) to 6.6 days (Ukraine) (26). In an international comparison by Campbell *et al.* (26), women and infants in the United Kingdom (UK) have the eighth shortest stay in hospital post birth with an average (mean) stay of 1.5 days, and the shortest postnatal stay in Europe.

Campbell *et al.* (26) examined databases and health surveys including the Organisation for Economic Co-operation and Development, Multiple Indicator Cluster Surveys, Centres for Disease Control and Prevention Reproductive Health Surveys and Demographic and Healthy Surveys Data to examine postnatal LoS across the world. In addition to describing the difference in LoS by country, Campbell *et al.* (26) found that mean length of postnatal stay differed by mode of delivery. The mean postnatal LoS for singleton vaginal deliveries ranged from 0.5 (Egypt) to 6.2 (Ukraine) days and the mean postnatal LoS for caesarean section deliveries ranged from 2.5 to 9.3 days (26). This supports findings from the CQC survey that postnatal LoS differs by mode of birth, with women giving birth via caesarean section usually requiring a longer period in time to recover (8, 20).

According to the findings from Campbell *et al.* (26), when compared to other high income countries, the UK had the shortest postnatal LoS. Other high income countries all had longer postnatal stays in hospital. The United States had an average postnatal stay of 2 days, Sweden 2.3 days, Germany 3.0 and France 4.2 days (26). It is noted that although postnatal LoS in England may seem very short in comparison, it is recognised that comparison may not be appropriate because of the considerable variation in postnatal care service provision following hospital discharge. For example, in the Netherlands, women typically receive care from a maternity nurse for several hours a day up to ten days following the birth of their infant, compared to women in Canada who have just one postnatal visit in the postnatal period (27).

To summarise, the cross sectional study published by Campbell *et al.* (26) is the only known study to explore international trends in postnatal LoS and therefore provides an important overview into postnatal care service delivery across the world. Data for the study were nationally representative, comparable data where responses relied on women's self-reports of their most recent birth recalled for up to five years and therefore it is possible that women's recollection of their postnatal LoS may not be accurate. Data were also collected in days rather than hours and therefore limits it use to understand trends in postnatal LoS under 24 hours.

1.6 Evidence on the effects of 'early' postnatal discharge from hospital

There is controversy about what the optimal postnatal LoS is and although research on the effects on 'early' postnatal discharge for hospital has been conducted, the evidence is contradictory and inconclusive. International guidance produced by the World Health Organisation (WHO) recommends a minimum 24 hours stay after birth, but acknowledges that this is based on 'weak evidence' where additional evidence would likely alter the recommendations (18). On the one hand, it has suggested that 'early' discharge from hospital leaves insufficient time for women and babies to establish breastfeeding under direct supervision and as a result, leads to feeding related problems (28). It is also argued that 'early' discharge may increase the delay in identification and treatment of maternal and infant morbidity (29, 30). On the other hand, others have suggested that 'early' discharge from hospital creates opportunities for family centred care, creates greater opportunities for families to bond in their home environment and is a safe and cost effective way to provide postnatal care (31, 32).

The existing evidence on effects of 'early' postnatal discharge from hospital is inconclusive (3, 25). A Cochrane systematic review updated in 2010 and including 10 randomised controlled trials (RCTs) (involving 4489 women) compared early postnatal discharge with a standard length of stay (3). The pooled estimate of the included trials showed no statistically significant difference between 'early' discharge and standard length of stay for infant readmission to hospital (Relative risk (RR) 1.29 95% CI 0.60-2.79) or other important outcomes (3). One of the main limitations of this review is the methodological and clinical heterogeneity within included studies.

Firstly, the review authors used the definition of 'early' discharge given by each trial team. This is problematic because 'early' is a relative term and highly dependent on context and the definition of 'early' ranged from 12 hours to 3.5 days postpartum (33-35). As a result, 'early' discharge in one trial was the equivalent of standard length of stay in another trial. Secondly, the definition of 'healthy women and infants' differed among trials where some studies excluded women with comorbidities such as diabetes and others did not (34, 35). Finally, the trials had different co-interventions in the early discharge groups ranging from being monitored at home for the first 24 hours after birth (36) to only having two home visits once discharged from hospital (35). Statistical heterogeneity was found when data from the trials were pooled in meta-analysis and this is likely due to the varying definitions of early discharge, differing co-interventions and populations which were not clinically comparable. As a result, it is difficult to draw meaningful conclusions about the impact of shortened or 'early' postnatal stay in hospital.

To look more specifically at the RCTs included in the Cochrane review, one RCT which included 2324 women found that infants were twice as likely to be readmitted to hospital in the first month postnatally if they were discharged early (< 48 hours) compared to a standard length of stay in hospital (> 48 hours) (RR 2.14 95% CI 1.2-7.5)(35). Although this trial is the largest of its kind, its validity and reliability were compromised by non-compliance in the allocated intervention (50% women stayed longer than their allocated postnatal length of stay in the intervention group), poor recruitment (only 20% of women eligible chose to take part) and a sample size which was not large enough to detect significant differences between the intevention and comparison group. Other trials had

similar methodological constraints (37-40). Although an RCT is generally the best method to evaluate effects of an intervention, in the context of evaluating early postnatal discharge from hospital, an RCT design is likely to be both problematic and impractical. This has discouraged researchers from conducting further RCTs to assess the effect of early discharge from hospital on infant or maternal morbidity. Similar findings were also described in a more recent systematic review of RCTs examining effects of early discharge for women having a vaginal birth where authors concluded that the evidence neither supports nor discourages early postnatal discharge (25).

A recent population based study conducted in England using HES data from 2005-2014 used various models to explore the effect of length of stay and risk of readmission (41). Using an aggregate model, Harron *et al.* (41) found that as the postnatal LoS fell by an average 2% per year for vaginal births and 3.4% for caesarean births, the readmission rates increased by 4.4% and 5.1% per year respectively. However, using an individual level LoS model, Harron *et al.* (41) found no association between postnatal LoS and risk of readmission within 30 days for term infants born vaginally or via caesarean section. However, for late premature infants (born 34-36 weeks gestation), each additional day of postnatal stay in hospital was associated with an 8.6% (95% CI 6.1, 10.5) decreased risk of readmission. Although some confounding variables in the dataset were controlled for during analysis such as mode of birth, maternal age and measures of social deprivation, the authors did not have data for smoking and breastfeeding status which may have altered the findings and study's conclusions. Whilst the aggregate model might suggest that there is a relationship between postnatal LoS and risk of infant readmission, the latter findings from the individual level LoS

model suggests that risk of readmission may be further defined to identify specific groups of infants who are most at risk.

Several other large cohort studies have been conducted looking specifically at maternal and infant readmission rates to hospital within 28 days of birth (42). Many of these studies were conducted in the United States when state and federal laws were passed to ensure that health insurance companies covered a minimum postnatal stay in hospital, using large routinely collected hospital datasets and data from healthcare insurance claims data. Some studies found no association between postnatal LoS and infant readmissions (29, 41, 43-45) whereas others did find an association (46-49). Some of these observational studies also explored cause specific readmission rates in the context of postnatal care including: jaundice, gastroenteritis, dehydration and poor weight gain (29, 48, 50, 51). It has been suggested by some that these causes of readmission may reflect an inadequate assessment of readiness for discharge from hospital, and could possibly be avoided if sufficient support is available in the early postnatal period (3, 29, 35).

To summarise, despite the existing literature available on early postnatal discharge from hospital, there is insufficient evidence to inform policy. Although there is an existing Cochrane review with clearly specified outcome measures (3), it is limited by significant clinical and methodological heterogeneity where there is no consensus on what constitutes 'early' discharge. Agreement on the need for more high quality research on this topic is needed (3, 25), however, it is clear from previous research that RCTs are not methodologically feasible or appropriate in this area of study and other study designs using

readily available data should be considered (30). This topic is explored in more detail in chapter 3.

1.7 Women's experiences of postnatal care

It has been widely recognised that maternity services should provide care which is responsive to women's needs and preferences (16, 20, 52). Several surveys have been conducted in England over the last decade, including those conducted by Care Quality Commission (CQC) and National Perinatal Epidemiology Unit (NPEU) (8, 10, 20, 53). The two most recent surveys are representative of the population and are considered to provide a valid insight into how women are experiencing maternity care (8, 10). Further surveys have been conducted by the Royal College of Midwives (RCM) and National Childbirth Trust (NCT) (12, 52) although participants are not demographically representative (79% (n=1174) were > 30 years, 96% respondents described their ethnicity as white, 90% (n=1323) had reported completing higher education or postgraduate degree and 83% (n=1260) were first time mothers) and the findings would therefore need to be treated with caution. Although there are many findings from the surveys that are pertinent to how women experience postnatal care, focus will be maintained on those relevant to the thesis and include women's experiences of; postnatal LoS in hospital, support for infant feeding and frequency of postnatal visits once discharged from hospital.

1.7.1 Women's satisfaction with overall postnatal care

According the NPEU and CQC surveys, women's overall experiences of maternity care is improving, however, postnatal care is consistently reported least favourably when compared to antenatal and intrapartum care (77% women were satisfied with postnatal care compared

to 88% in pregnancy and 89% in labour and birth care) with more primiparous women dissatisfied with postnatal care than multiparous women (8, 20).

1.7.2 Women's perceptions of postnatal LoS

In the CQC survey (10), when women were asked about how they felt about their length of postnatal stay in hospital, 72% women felt that their length of stay in hospital was '*about right*' (10). From the NPEU survey it was found that 12% felt that their stay was too short and 15% too long (8). These findings contrast to further surveys conducted by the RCM which found that only 29% women felt that they stayed for long enough in hospital and a further 9% felt that they were 'rushed out before they were ready' (12). The Care Quality Commission report found that when asked about their care after leaving hospital, more than half of all women (56%) reported that they were not given a choice about where they would receive their postnatal care (10).

1.7.3 Infant feeding support

Women's experiences of infant feeding support is highly relevant to the issue of postnatal care and infant readmissions to hospital because difficulty in establishing feeding is associated with admissions for jaundice and neonatal weight loss (30, 54). The 2018 CQC survey found that that 62% of women felt that their midwives 'definitely' provided relevant information about feeding their babies. A third of women (29%) women thought they received relevant information to 'some extent' and a smaller group said they did not receive it at all (9%) (10). This corresponds with the NPEU survey which found that 27% would have liked more help with feeding. Although not a representative sample, it also supports findings

from a survey conducted by the NCT which found that only 45% women in the study felt that they got the breastfeeding help and support in the first 24 hours (52).

1.7.4 Frequency of visits once home

According to the CQC survey (10), there was a significant though small decrease in the number of women who saw a midwife three to four times (53% in 2013 and 52% in 2017, $p< 0.05$) (10). Whilst it is noted that a significant change does not necessarily indicate a trend (23), the survey also found that more women were likely to see a midwife once or twice when they got home (28%) in comparison with 2013 and 2015 (26%, $p< 0.05$) (10). Just over a fifth (21%) of women reported that they would have liked to have seen a midwife more often. In the NPEU report, 23% women would have preferred more home visits (8).

1.7.5 Strengths and limitations of CQC and NPEU survey data

Both the CQC and NPEU surveys used a large demographically diverse sample of women (20,631 and 4571 women respectively) (8, 20). Both surveys were conducted as postal surveys although the CQC sampled directly from NHS trusts and the NPEU from the Office for National Statistics (ONS) live birth data. The CQC and NPEU surveys achieved a response rate of 41% and 47% respectively and it is reassuring that there are similarities in the findings on women's experiences of their postnatal stay in hospital after birth, support with infant feeding and community visits. However, as with any study, non-response bias has the potential to affect study results (23, 55), with the possibility that women in particular demographic or clinical groups, or who had an extremely positive or negative experience possibly more likely to respond.

To summarise, there are established methods for recording women's experiences of their postnatal care which allow women's responses to be tracked over time. Data from the CQC survey (10) indicated that women in England were not always satisfied with their postnatal LoS in hospital although 72% women felt that their postnatal LoS was about right and women were particularly dissatisfied with breastfeeding support (8, 10). A quarter of women would have preferred more home visits following discharge from hospital (8). It is acknowledged that although postnatal length of stay may have been driven by dissatisfaction with their postnatal care, changes to parenting (including risk aversion), and greater awareness of services available may have also had an impact.

1.8 Potentially avoidable infant admission to hospital

Over the last decade, the rate of emergency admissions to hospital for infants under the age of one has increased in England (2). Across England, there has been considerable variation in the rate of readmission (an admission to either the same hospital or another hospital after the patient has been discharged home after birth) for full term infants in the first two weeks of life ranging from 9.0 to 240 admissions per 1000 births (56). Admissions that are not planned and happen at short notice because of perceived clinical need are expensive for the NHS, place additional pressure on elective healthcare and are distressing for patients and carers (57, 58). The association between inadequate health assessments due to the timing of discharge from hospital and subsequent readmissions to hospital has been well established in other areas of healthcare and many have suggested that a large proportion of readmissions within 30 days of discharge from hospital are avoidable (2, 59, 60). It has been

suggested that some neonatal readmissions to hospital are potentially avoidable in the context of postnatal care provision (30).

Looking broadly at the rate of emergency infant admissions to hospital in England, research has shown that the rate of emergency admissions for children, particularly for short stay (< 2 days) admissions for infants under the age of one year has increased over the last decade (2, 59). Gill *et al.* (2) found that the rate of emergency admissions for infants < 1 year increased by 52% from 263 to 349 per 1000 infants during the period 1999-2010. A time trend analysis conducted by Saxena *et al.* (59) in England using HES data also found that the rate of short stay admissions (< 2 days) in paediatrics has increased from 42.7/1000 to 60.2/1000 child years over the period 1996-2006. The authors from both studies conclude that many short term unplanned admissions (< 2 days) could be considered avoidable and hypothesise that such admissions could in part, occur as a result of poor assessment of children with acute illnesses in both primary and secondary care (2, 59).

A study published in 2016 by the Royal College of Obstetricians and Gynaecologists (RCOG) (61) has explored neonatal readmission rates to hospital in England. During the period 2013-2014, the mean rate of unplanned neonatal readmission (within 28 days) was 3% with individual NHS trust (unadjusted) rates ranging between 0%-11%. The study does not explore the specific types of illnesses and conditions that infants are admitted for and was conducted primarily as performance indicators for NHS trusts (61). Furthermore, the study findings only provide insight into neonatal readmissions over a period of one year and therefore, temporal trends in neonatal readmissions have not been explored.

As described in section 2.6, the evidence from observational studies on the association between postnatal LoS and potentially avoidable neonatal readmissions is conflicting (29, 43, 46, 48, 50, 51). Whilst some studies have found an increase infant readmission rate to hospital following a shorter postnatal stay (46, 48, 51, 62), other studies have found no association (29, 43, 45, 50). One of the main problems with these studies is the varying definitions of potentially avoidable infant admissions making it difficult to review the evidence. Furthermore, it is not possible to tell which ICD codes have been used to identify specific conditions within the data (Table 1.3).

Table 1.3 Existing definitions of potentially avoidable neonatal admission

Author	**Conditions**	**ICD 9/10 Codes described**	**Exclusion criteria**
Lain *et al.* (30)	Jaundice	X	X
Young *et al.* (51)	Feeding problems Jaundice	X	X
Lee and Perlman (46)	Jaundice Dehydration	✓	X
Liu *et al.* (48)	Jaundice Dehydration Inadequate weight gain Feeding problems Sepsis	✓	X
Madden *et al.* (32)	Jaundice Hyperbilirubinaemia Feeding problems	X	X
Edmonson *et al.* (43)	Feeding problems Dehydration	X	X

	Inadequate weight gain		

To summarise, there is a paucity of research exploring neonatal admissions in the context of postnatal care in England. The overall rate of admission to hospital in the first year of life is increasing and high rates of neonatal admissions could indicate poor quality postnatal care. The increased rate of neonatal admissions could also indicate changes to: thresholds for admission; experience of clinical staff in emergency department; the complexity of births; and parents' increased risk aversion to their infant's health conditions (2, 59). In order to generate hypotheses about the possible relationship between postnatal care, including postnatal LoS and women being discharged 'too early', resulting in infant readmission, it is necessary to explore the trends and characteristics of infant readmission to hospital. More specifically, there is a need to define conditions which could be considered potentially avoidable in the context of postnatal care. This topic is explored in more detail in chapter 4.

1.9 Conclusion of chapter and summary

This chapter has outlined the literature and evidence that is relevant to the thesis:

- Postnatal care is perceived as less critical than antenatal and intrapartum care and during a time of financial pressure for maternity care, postnatal care provision has reduced.

- There has been a trend towards shorter stay in hospital although there is very little data on length of stay in hospital under 24 hours.

- The observed trend towards shorter postnatal stay in hospital has occurred despite the increasingly complex needs of women who become pregnant (58).

- The existing evidence on the safety and effects of postnatal length of stay is inconclusive and there is a paucity of literature exploring the effects of postnatal stay under 12 hours for women and infants.

- There is no consistent definition of 'early' discharge which makes appraisal of existing literature challenging.

- There is ambiguity about what women think is the 'optimal' postnatal LoS with a considerable proportion of women who feel that the length of time spent in hospital was not right (8, 10).

- Despite the greatest increase in paediatric admissions to hospital was for infants < 1 year of age, there is very little research that has explored the trends and rates of age specific admissions for infants under one year of age in England.

Chapter 2 Methodological perspectives

2.1 Purpose of chapter

The purpose of this chapter is to describe the rationale and justification for using both quantitative and qualitative research methods to investigate postnatal length of stay and infant readmissions to hospital. This is followed by a description of the philosophical and theoretical positions underpinning the three studies presented in the thesis. An outline of how the quantitative and qualitative components of the thesis are brought together is then described.

2.2 Rationale for using qualitative and quantitative research methods

The thesis topic of postnatal length of stay (LoS) and infant readmissions to hospital emerged from local clinicians identifying an issue which needed exploration. Obstetricians highlighted uncertainty about the safety and effectiveness of the observed trend towards shorter stay in hospital whilst paediatricians observed a considerable increase in infants admitted in the early postpartum period which they attributed to a shorter postnatal stay in hospital. As a result of this, research evidence gaps and questions were identified and a project was designed to address them. This necessitated a range of different methods suited to the different questions. This thesis therefore comprises two quantitative studies and one qualitative study to generate hypotheses about a potential relationship between postnatal LoS and infant readmissions to hospital. The rationale for choosing these research methods is now described in more detail.

The first quantitative study is a systematic review of existing studies, combining primary studies' findings in meta-analysis to determine the effect of a policy of early postnatal

discharge on infant health outcomes. The second quantitative study is a cross sectional study that provides a detailed overview of the incidence, rate (per 1000 live births) and characteristics of infants that were admitted to English hospitals over the period 2008/09-2013/14. Particular emphasis was placed on describing the rate of admissions for conditions that may be considered potentially preventable in the context of postnatal care. This quantitative study is founded on a clinically driven assumption that some admissions may be potentially avoidable and amenable to earlier intervention in the care pathway. The qualitative study describes experiences and perspectives of parents whose infants are readmitted to hospital during the early postnatal period, focusing on the time preceding the readmission to hospital. The qualitative study also explores the assumption that postnatal care and postnatal LoS in hospital were perceived by parents to be a contributing factor in the infant readmission to hospital.

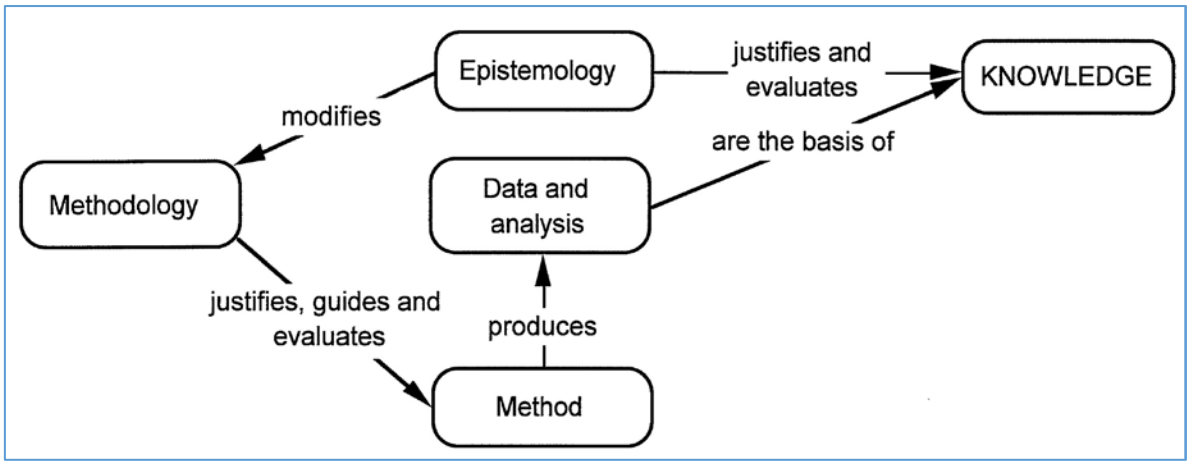
Conducting quantitative and qualitative studies would allow exploration of both the 'macro level', i.e. the data relating to infant readmissions to hospital, and the 'micro level' i.e. the individual parent's experience of infant readmission to hospital. It was anticipated that conducting quantitative and qualitative research would offer multiple viewpoints, perspectives, positions and standpoints (63) and therefore would offer a broader understanding of the issues than only using one type of method. Formal mixed methods methodology was considered; however it was decided that each research question aligned with quantitative or qualitative research methods. The studies therefore would not inform each other and would not be sufficiently integrated to define it as a mixed methods study. It

was planned however that the findings would be brought together and summarised in chapter 6, the overall discussion of the thesis.

2.3 Methodological perspectives

Epistemological and ontological stances play an integral part in the acquisition of knowledge and therefore will determine the research methodology used (64). This is because epistemology, 'how we make knowledge' (65) changes the methodology (the justification for the methods of a research project), which in turn defends, guides and evaluates the method (the practical aspects of the research) (64) . The generation of data and analysis become the basis of knowledge (64) (Figure 2.1). In order to use both quantitative and qualitative methods, it is necessary first to acknowledge that these research methods are based on opposing ontological and epistemological foundations and have different assumptions about how knowledge is best made and therefore, are not easily mixed (66-68). It is necessary therefore to state my philosophical position for discovering knowledge, truth and reality within this thesis (66). In this section, my epistemological position in relation to the studies are described and include a description of how these have been shaped by my midwifery practice, research training and experience as a 'service user'.

Figure 2.1 Relationship between epistemology, methodology and method (Carter and Little 2007)



2.3.1 Philosophical approach (ontological and epistemological perspectives)

Ontology is defined as the study of being, or the nature of existence and what constitutes reality (69). For this thesis, the reality under investigation is the length of stay in hospital following birth and infant readmissions to hospital in the context of postnatal care, and the ontological position which I adopt for the quantitative studies understands that reality constantly changes and is renegotiated. Moreover, reality has a dual aspect: some elements are accessible and independent of the mind, whereas other elements are constructed by the mind and therefore dependant on it (70). The world is independent of my knowledge of it, that it exists 'out there'; however, I also accept that ways of accessing this reality may be different. Therefore, I seek to understand infant readmissions to hospital in the context of postnatal length of stay but accept there is value gained by seeking multiple versions or perspectives of this reality in attempts to gain a better understanding of the subject. For example, synthesis of international studies on this topic (the systematic review), real-world clinical events (the cross sectional study) and different parents' experiences of infant readmission (the qualitative study).

Different paradigms, which for the purpose of this thesis is defined as '*a system of ideas or world views*' (71), can help to shape the approach to the research problem and offer solutions given certain beliefs about the world (72). Broadly, there are three epistemological paradigms: objectivism, subjectivism and constructivism (69) and from these paradigms, there are two predominant theoretical perspectives: positivism (founded in objectivism) and interpretivism (based on constructivism). For this thesis, in the making of knowledge, I adopt a 'pragmatic' approach which moves away the polarised views of positivist and constructivist ways of knowing with the view that a belief is true if it offers a contribution to improved purposeful living (73). However, in terms of the separate components of the thesis, I accept that the quantitative and qualitative studies will inevitably be approached from different perspectives or positions (74). The 'pragmatic' approach adopted is described in more detail following an exploration of the individual, apparently opposing paradigms.

Much of my midwifery practice within obstetric settings (such as labour ward) has been based on National Institute for Care Excellence (NICE) clinical guidelines which are predominantly informed by quantitative research (75). Such research is underpinned by objectivist epistemology where it is believed that reality can be measured and that it is possible to seek an external truth through scientific investigation. Objectivist epistemology states that our knowledge and values are objective; they are determined by one's mind rather than created by one's thoughts (76).

Positivism, a theoretical perspective closely aligned to objectivism, argues that there is a reality that exists independently of the researcher and should be investigated through a process of scientific inquiry that is logical, rigorous and precise (69, 77). Moving on from

positivism, the post-positivist movement has suggested that whilst reality exists externally to the researcher, knowledge and values of the researcher can influence what is observed (78). I recognise the benefit of conducting such research in a health research context with the aim of seeking the 'truth' in order to improve health care through findings that are generalisable, but recognise that the researcher cannot ever be completely separate from the research subject (78).

Whilst my overall philosophical approach to the thesis is 'pragmatic' because the research is driven by solving or better understanding the problem, I acknowledge that the systematic review and quantitative cross sectional study presented in chapter 3 and 4 are approached more from a post-positivist perspective: there is a reality and truth to be discovered, (early postnatal discharge and infant admissions to hospital) and that the methods adopted will follow objective scientific inquiry. I accept however that the generation of knowledge will be shaped by contextual influences and may only be an approximation of the truth (79) (78). Furthermore, I accept that it is not possible to completely separate my position as a researcher from the subject under observation (78).

By way of contrast, the midwifery led care settings in which I have worked (birth centre and community) have highlighted the value of instinct and intuitive midwifery practice which is vital to facilitating the birthing process (80). In addition to this, my experience as a service user has enabled me to see that there are several ways of experiencing the same phenomenon and that in a research context, there is value gained in understanding multiple perspectives, particularly in the context of giving birth and the early postnatal period. The knowledge gained during my applied health research training as part of the doctoral

programme led me to explore constructivist epistemology which closely aligns to this experiential philosophy and considers that truth and meaning do not exist in the same external world, but are created by the person's interactions with the world (70). Therefore, meaning is constructed not discovered, so people construct their own meaning in different ways, even in relation to the same phenomenon (69). The theoretical perspective interpretivism, is closely linked to constructivism and supports the view that there are multiple constructed realities and that social reality comes about through human interaction, and similarly, knowledge is highly relative to social context (81).

For the qualitative study described in chapter 4, I adopt an interpretivist perspective that challenges the idea that there is an objective truth or single knowledge and instead states that there a 'knowledges' and that these are related to specific social contexts. In a research context, this means that the knowledge gained from a study is one 'view of the scene, and that to make context-free generalisations is neither possible nor desirable (82). I recognise that the knowledge constructed with the parents would be context specific. In addition, I recognise that it is not possible to be disconnected from the research itself or their social, cultural, moral, ideological and political position and the research will be shaped by this (81, 83). I recognise subjectivity of research and accept that my own views as a midwife, mother and researcher will inevitably shape the research and generation of knowledge and reflect on this as part of my research practice. My epistemological position and theoretical perspective or 'lens' that I approach the qualitative study is described in more detail in section 5.3.1.

In terms of bringing together the qualitative and quantitative studies' findings, I approach this thesis with the view that it is possible to have a philosophical and methodological middle ground (82). I accept that philosophical debates on reality and how we understand reality should not end by simply adopting both qualitative and quantitative research methods (74). However, I reject the purist's view that differences in how we make knowledge from positivist and interpretivist paradigms make them incompatible (74, 84). As Onwuegbuzie and Leech (74) suggest, in the adoption of a 'pragmatic' perspective, I consider that it is possible to focus on the value gained by adopting both quantitative and qualitative research methods in order to better understand a problem: the relationship between postnatal length of stay and infant readmissions to hospital.

Pragmatism, also referred to as a '*third paradigm' (82)*, creates a bridge between different epistemologies and offers '*a philosophical and methodological middle ground*' (82). Pragmatism focuses not on whether a proposition fits a particular ontology and instead focuses on whether it suits a purpose and is therefore outcome orientated (85). Pragmatists ascribe to the philosophy that the research question should drive the methods rather than epistemological and ontological beliefs (74) and is referred to as the *'philosophical partner'* for researchers that use both qualitative and quantitative research methods (82).

Supporters of pragmatism in research also encourage consideration for the epistemological fundamental similarities of quantitative and qualitative research (82). For example, both qualitative and quantitative research collect data, describe it and discuss why the observed outcomes happened (86), and use empirical observations to formulate and address research questions. Secondly, both qualitative and quantitative research make efforts to minimise

confirmation bias (a systematic bias in which one's own pre-existing beliefs or hypotheses are reaffirmed through the research process) (87). In pragmatic ideology, if a belief opens up new ways to live in a purposeful, democratic way, then the belief is true (82). The studies described in this thesis aimed to better understand postnatal care and postnatal length of stay in relation to infant readmission to hospital and both quantitative and qualitative research methods were deemed important to fully understand this topic.

Pragmatists in a research context purport that using both qualitative and quantitative data in a study is appropriate and that both approaches are important and useful (82).For this body of work, it is recognised that there are several other factors which may have impacted on the readmission to hospital including: social support, access to infant feeding support, hospital, change in health seeking behaviour and thresholds for referral and admission (2, 59, 88). Therefore, although there is evidence from survey data to suggest that some women feel unsupported by health professionals in the postpartum period in comparison to antenatal and intrapartum care (8), it could not be assumed that parents of an infant who is admitted to hospital surmise the same relationship between lack of clinical support in the postnatal period and their infant's admission to hospital.

2.4 Summary

This chapter has outlined the rationale and justification for utilising both quantitative and qualitative research methods. I have described my ontological and epistemological position and how these have been shaped by my experiences as a midwife, researcher and service user. This is followed by a description of the 'pragmatic' methodological approach in which the methods for the studies are driven by the research questions, whilst accepting that the

qualitative and quantitative components will inevitably have different philosophical approaches.

Chapter 3 The effect of early postnatal discharge for women and infants – a systematic review and meta-analysis

JONES, E., TAYLOR, B., MACARTHUR, C., PRITCHETT, R. & CUMMINS, C. 2016. The effect of early postnatal discharge from hospital for women and infants: a systematic review protocol. *Systematic Reviews,* 5, 24) (Appendix 1).

Contributions

I designed the systematic review protocol for the review with support from CC, CM and BT. I designed the search strategy with support from Sue Bayliss, information specialist at University of Birmingham. The title and abstract screen was completed by me with Dr Ruth Blamey, Research Fellow at University of Birmingham, and Dr Lucy Hope, Senior Lecturer at University of Worcester. Data extraction was performed by me with Dr Lucy Hope, Mrs Sally Bradshaw, senior research fellow at University of Birmingham and CC. Meta-analyses of RCTs were conducted by me and reanalysis and meta-analyses of ITS studies were conducted by me with support from CC. The protocol manuscript was written by me and edited by CC, CM and BT.

3.1 Purpose of the chapter

In chapter 1, section 1.6 highlighted the methodological problems that researchers have encountered when examining the effects of postnatal length of stay in hospital. It was clear that an additional systematic review was needed that broadened the types of studies to be included and predefined 'early' was needed. This chapter presents the methods and findings of the systematic review and meta-analysis which were conducted to further explore the effects of early postnatal discharge for women and infants.

3.2 Background

As described in Chapter 1, there is considerable international variation in the postnatal LoS (26). Despite an increase in medical intervention during childbirth and more complex maternities, over the last 30 years, there has been a reduction in the postnatal LoS in hospital for women and babies in several developed countries including the United Kingdom (UK), Australia and Canada with an average stay of 1.5 days, 2.8 days and 1.7 days respectively (26). As described in section 1.6, the existing evidence on the effects of early postnatal discharge from hospital is inconclusive and there is some concern about whether earlier discharge from hospital is safe (3, 25). Although there is an existing Cochrane review (3), published in 2010 on this topic, as described in chapter 1, it is limited by significant clinical and methodological heterogeneity and there is insufficient evidence to inform policy.

The aim of this systematic review therefore was to determine the effects of a policy of early postnatal discharge for women and infants. Specifically, it considered whether there is an association between early postnatal discharge and infant readmission to hospital. It was

hypothesised that early postnatal discharge may increase infant utilisation of health services because there is inadequate time to provide support to women and babies to prevent problems from occurring, and inadequate time to detect medical problems and feeding difficulties before discharge from birth hospitalisation. This systematic review and meta-analysis addressed the same objectives and outcome measures as the Cochrane review (3) but broadened the study design to include both RCTs and quasi-experimental studies. It also predefined early postnatal discharge as < 48 hours following vaginal birth and < 96 hours following caesarean section.

3.3 Methods

The full systematic review protocol has been published (4) and the methods section that follows is a summary of the published version (Appendix 1). The review was registered with PROSPSERO (CRD42015020545) and the review conforms to the PRISMA Statement (Appendix 2).

3.3.1 Data sources and search strategy

Electronic databases (CENTRAL, MEDLINE, EMBASE, CINAHL, SCi) were searched for articles through 10/01/2018 with the following search terms: postnatal care, postpartum period, puerperium, postpartum, "length of stay", patient discharge, hospital stay*, patient readmission. Searches used free text and indexed terms combined using boolean operators, adjusted for each database (Figure 3.1). The search strategy was not limited by study design and time, language or geographical restrictions were not applied. Where applicable, authors of primary studies were contacted if further information.

3.3.2 Definition: 'Early' postnatal discharge

As described in section 1.6, 'early' is a relative term and highly dependent on context. One of the main problems of the Cochrane review (3) was defining 'early' using the trial authors' definitions (ranging from 6 hours to 3.5 days) which resulted in considerable cross over between the intervention and control group across studies. For better comparison of studies in this review, it was necessary to define 'early' postnatal discharge. The definition took into consideration current international trends in postnatal LoS as described in section 1.5 and availability of existing evidence. Whilst it would have been beneficial to explore the effects of postnatal discharge less than 24 hours following birth, trial data was not available and therefore, early discharge was defined as < 48 hours following vaginal birth and < 96 hours following caesarean section.

3.3.3 Eligibility criteria

Women and infants who were considered 'fit for discharge' by their healthcare practitioners were included. Women may have given birth in a consultant led unit, co-located midwife led unit or stand alone midwife led unit. Studies had to compare a policy of early discharge from hospital where 'early discharge' referred to a hospital discharge that was < 48 hours following vaginal birth (or < 96 hours following caesarean section) and earlier than the standard care in the setting in which the intervention is implemented to be included. As guided by the Cochrane Effective Practice and Orgnaisation of Care (EPOC) (89) all randomised controlled trials (RCTs), non randomised controlled trials (NRCTs), controlled before after studies (CBAs) and interuppted time series studies (ITS) were included in the review.

Figure 3.1 Example of search strategy for Medline

Example search strategy:

Database: Ovid MEDLINE:

1. exp postnatal care/
2. postnatal.ti,ab.
3. postpartum period/
4. puerperium.ti,ab.
5. puerperium/
6. postpartum.ti,ab.
7. "length of stay"/
8. patient discharge/
9. discharge.ti,ab.
10. hospital stay*.ti,ab.
11. (early adj3 discharge).ti,ab.
12. patient readmission/
13. readmission*.ti,ab.
14. admission*.ti,ab.
15. hospitalization/
16. outcome*.ti,ab.
17. hospitali*.ti,ab.
18. safety.ti,ab.
19. complication*.ti,ab.
20. patient admission/
21. 1 or 2 or 3 or 4 or 5 or 6
22. 7or 8 or 9or 10or 11
23. 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20
24. 21 and 22 and 23

3.3.4. Outcome measures

3.3.4.1 Primary infant outcomes

- Proportion of infants readmitted to hospital within 7 days and within 28 days after birth

3.3.4.2 Secondary infant outcomes

- Proportion of infants readmitted for conditions which may be considered avoidable (including jaundice, dehydration, poor weight gain, gastroenteritis) in the first 28 days after birth
- Duration of infant readmission for infants admitted within 7 and within 28 days after birth
- Total duration of infant hospitalisation over the first 28 days
- Proportion of infants attending accident and emergency department within 7 days and within 28 days after the birth
- Proportion of infants seen by a health professional in a primary care setting for a health related problem in the first 28 days after birth
- Number of contacts with health professionals regarding the infant within 28 days after birth

3.3.4.3 Primary maternal outcomes

- Proportion of women readmitted for complications related to childbirth (including postpartum haemorrhage, retained products of conception, infection, postpartum psychosis) in the first 6 weeks after birth

3.3.4.4 Secondary maternal outcomes

- Proportion of women breastfeeding (exclusively or partially) at 48 hours, 6 weeks and 6 months after birth
- Proportion of women scoring above the cut off score indicating probable depression on a validated standardized instrument for measuring depression
- Duration of readmission for women readmitted after birth
- Total duration of maternal readmission hospitalisation
- Proportion of women attending hospital accident and emergency department
- Number of contacts with health professionals regarding maternal health issues within 4 weeks after birth
- Proportion of women reporting infant feeding problems within 4 weeks after birth

3.3.5 Data collection

Citations were screened for inclusion by EJ and RB, full text articles were assessed independently and unblinded by EJ and LI. Any differences in opinion were resolved through discussion and where necessary, a third reviewer (CC) was consulted. Authors of primary studies were contacted if further information was required.

3.3.6 Data extraction

Data extraction was performed independently and in duplicate. The EPOC data extraction form (90) was adapted to answer the specific research questions for the review. Data extraction forms were piloted on a sample of included studies. Methodological quality of the included studies were assessed independantly and in duplicate using the Effective Practice

and Organisation of Care (EPOC) criteria for risk of bias tool (91) and Cochrane RCT tool as appropriate (91, 92).

3.3.7 Statistical Analysis

Meta-analyses of RCT studies were carried out in Revman version 5.3 (93) using a random effects model and where significant heterogeneity was present, data were combined in a narrative synthesis. Where data from ITS studies were presented graphically, data were extracted from graphs using plot digitizer software (94) and reanalysed using autoregressive integrated moving average (ARIMA) analysis using SPSS (version 22) as described in EPOC guidance (95). Data were reanalysed because the change in trend and change in slope was not always reported in the ITS analyses as recommended by Ramsay *et al.* (96). The ARIMA analysis estimated the effect of a policy change whilst taking into account the time trend and autocorrelation among the observations. Estimates for the regression coefficients correspond to three standardised effect sizes: change in slope, change in level at one year and two years post-policy change. The change in level was defined as the difference between the observed level at the intervention time point and that predicted by the pre-intervention time trend (95). The change in slope was defined as the change in trend from pre to post intervention reflecting the long term effect of the policy intervention (95). Data were then standardised by dividing the level/slope and standard error by the standard deviation of the pre intervention slope. The effect sizes for change in level at 1 year and 2 year and effect size for change in slope were entered into Revman (version 5) (93) and meta-analysed using the generic inverse variance method with random effects.

Statistical heterogeneity (variability in the intervention effects being evaluated in the different studies (92)) was examined by inspection of confidence intervals and through the I^2 statistic which calculates the percentage of variability in the effect estimates that is due to heterogeneity rather than chance (92). Heterogeneity was also explored through subgroup analysis. Sensitivity analyses were undertaken to assess the effect of incomplete outcome data and fixed effects versus random effects analysis. Subgroup analyses were undertaken to assess the effect of: antenatal versus postnatal recruitment, co-interventions versus no co-intervention, and studies including caesarean deliveries versus studies that only included vaginal birth. For the ITS studies, how the researchers used methods such as stratification and regression to adjust for potential confounders were also considered.

3.4 Results

In total, 9298 published studies were retrieved from electronic sources (Figure 3.2). A further five records were identified through hand searches. Following removal of duplicates, the title and abstracts of the remaining 5748 papers were screened and 150 papers were identified for full text screen. Following full text screen, 15 studies were identified for inclusion in the review and 135 excluded (Appendix 3).

3.4.1 Characteristics of included RCTs

Ten randomised controlled trials compared the effects of a policy of early postnatal discharge with a standard LoS post birth for women and infants. Four population based cohort studies with interrupted time series (ITS) assessed the effect of state and federal legislation introduced in the United States (US) prohibiting insurance plans from limiting coverage for postpartum hospital stay to < 48 hours for normal vaginal deliveries and < 96

hours for caesarean sections on various health related outcomes. Prior to the legislation introduced in 1996-1997, there was no minimum length of postnatal stay in the United States (US). The fifth ITS examined the effect of a same day discharge policy in five Danish counties introduced over the period 1990-2003 (Table 3.1)

Figure 3.2 PRISMA chart

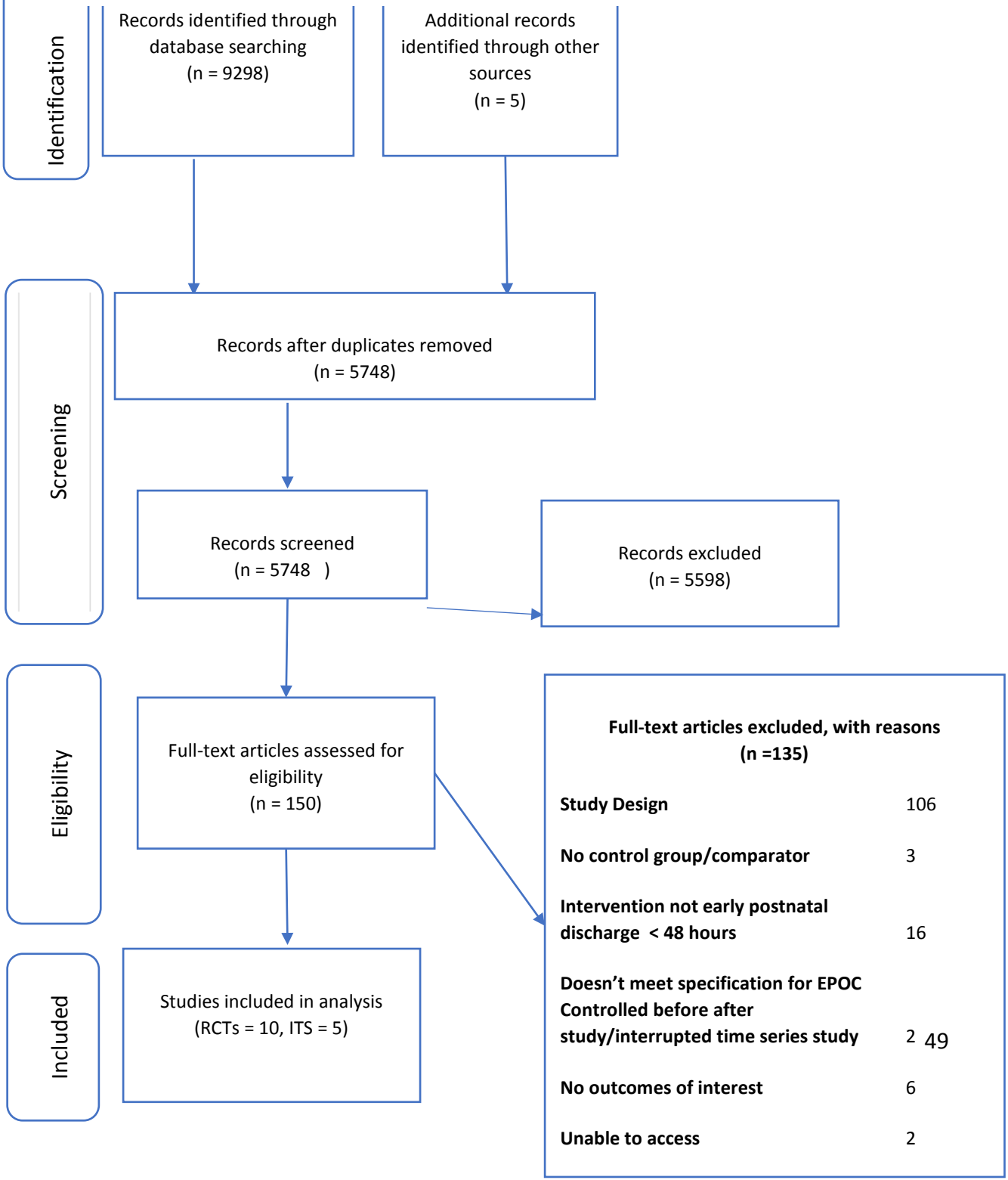


Table 3.1 Characteristics of included studies

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Bayoumi (2016)	**Design**: RCT **Randomisation method**: sealed envelopes with discharge protocol opened after 24 hours post birth **Recruited and randomised:** postnatal **Blinding**: caregiver, women and outcome assessor unblinded **Length of follow up**: 6 weeks **Type of analysis:** Per protocol **Total Incomplete outcome data:** 788 (21)% **Attrition:** I: 263/1890 (13.9%) C: 205/1896 (10.8%) Total: 468 (12.4% **Post randomisation exclusions:** I: 132/1890 (7%) C: 188/1896 (9.9%) Total: 320/3786 = (8.5%) **Duration of study:** Maternity hospital, Faculty of Medicine, Cairo University, Egypt **Setting:** June 2012-February 2014	**Number eligible:** 6340. Number recruited and randomised: I: 1890, C: 1896 **Inclusion criteria:** women had to be aged 20-40, no known medical condition, (e.g. diabetes, hypertension, renal, cardiac, chest problems or connective tissue disease, no obstetric complications e.g. placenta Previa, placenta accreta, accidental haemorrhage or pre-eclampsia; all term pregnancies, 37 weeks or more, no fetal problems, intrauterine growth restriction, or major congenital abnormality, and all patients discharged with their newborn. **Exclusion criteria**: < 20 years or > 40 yrs old, patients with a known medical problem, any fetal problem diagnosed after delivery, or patients and newborn who did not meet the criteria of discharge at the 24 or 72 hour interval chosen for their discharge. Fit for discharge criteria were: no postpartum complications, e.g. postpartum haemorrhage, urinary tract infection, chest complications, a febrile postoperative course defined as no temperature elevation above 38.3°C during the first 24 hours or above 38°C after 24 hours; bowel movement or passage of flatus, established urination, no neonatal problems e.g. respiratory complications, no jaundice or vomiting. **Characteristics of women:** I: Age 30.6 (SD 6.2) C: Age 30.9 (SD5.7) **Characteristics of infants**: Gestation at birth I: 39.44 (SD 1.47) C: 39.07 (SD1.28)	I: Discharge 24 hours after delivery C: Discharge 72 hours after delivery	Proportion of: infants and women readmitted to hospital < 6 weeks women reporting symptoms: wound infection, abdominal infection, secondary postpartum haemorrhage, successful breastfeeding, intestinal ileus, fever, breast engorgement, stress incontinence, chest infection, pulmonary embolism, deep vein thrombosis, mood swings.	Actual LoS: unknown Compliance to group allocation: 132/1890 from intervention did not stay 24 hours and were removed from analysis 188/1896 from control group who left earlier than 72 hours and were removed from analysis

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Boulvain *et al.* (35)	**Design**: RCT **Randomisation method**: telephone call, using sealed envelopes **Recruited and randomised**: Antenatal appointment at 37/40 **Blinding**: caregiver, women and outcome assessor unblinded **Length of follow up**: 6 months **Type of analysis**: ITT **Total Incomplete outcome data**: 22 (4.7%) **Attrition**: 21 (4.6%) **Post randomisation exclusions**: 1 (0.1%) **Duration of study**: November 1998-Oct 2000 **Setting**: Switzerland, tertiary level maternity unit	**Number eligible:** 2324. **Number recruited and randomised:** 460, I: 228, C: 231 **Inclusion criteria**: 'low risk women', at low risk of caesarean section or postnatal complications, nulliparous or multiparous **Exclusion criteria**: Placenta Previa, preeclampsia, diabetes treated with insulin, medical complication of pregnancy requiring postnatal hospital surveillance, past history of postnatal complication, difficult socioeconomic situation, multiple pregnancy, suspicion of IUGR, Estimated fetal weight > 95centile, fetal malformation or genetic disease, strong preference for length of postnatal stay **Characteristics of women:** I: mean age 29 (SD 4.8),137 (60%) nulliparous, 164 vaginal birth, 40 instrumental delivery, 24 caesarean delivery, 113 completed secondary education, mean birthweight: 3420 grams (SD 435) C: mean age 29 (SD 5.5), 131 (57%) nulliparous, 149 vaginal birth, 55 instrumental delivery, 27 caesarean delivery, 118 women completed secondary education, mean birthweight 3480 (SD 405)	**I:** Discharge 24-48 hours after delivery **C:** Discharge 4-5 days following vaginal birth (+ 2 days for caesarean delivery) **Co-intervention:** minimum 2 nurse home visits and 10 phone calls, number and timing dependant on needs of family	Infants and women readmitted to hospital < 28 days and 2-6 months breastfeeding at 7 days/28 days/6 months Depression at 7 days/28 days Infant feeding problems < 28 days SF12 physical and mental summary score Neonatal admissions for > 24 hours at 28 days post birth Neonatal jaundice Views about quality of postnatal care Missed metabolic or endocrine congenital disease Economic evaluation Maternal satisfaction	**Actual Length of postnatal stay (mean)**: I: 65 hours C: 106 hours **Compliance to group allocation:** 114/228 (50%) moved to control group from intervention 67/231 (29%) moved to intervention from control

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Sainz Bueno *et al.* (36)	**Design:** RCT **Method of randomisation:** opaque sealed envelopes, randomisation by blocks (opaque sealed envelopes) defined by parity in postnatal ward **Recruited and randomised:** Postnatal **Blinding:** women and health professional unblinded, blinding of outcome assessment unclear **Length of follow up**: 6 months **Type of analysis**: ITT **Total incomplete outcome data:** 5.1% **Attrition:** 22(5.1%) Post randomisation exclusions: None **Duration of study:** April 1999 - April 2001 **Setting:** Seville, Spain (urban maternity hospital)	**Number eligible:** unknown. **Number recruited and randomised:** 430 recruited. I: 213, C: 217. **Inclusion criteria:** Primiparous and multiparous women, term normal vaginal birth or vaginal assisted delivery, postnatal criteria: apyrexial, normotensive BP, postpartum estimated blood loss <500mls, and 'adequate' uterine involution. Neonate: term gestation with appropriate weight for gestational age, normal cardiorespiratory adaptation to extra uterine life, no evidence of sepsis or jaundice, normal temp (36.1-37oc). Physical examination by doctors, passed meconium and urine once, administration of Vitamin K and other vaccinations **Exclusion criteria:** third or fourth degree tear, maternal drug abuse, gestational diabetes, preeclampsia, rhesus isoimmunisation, postpartum blood loss > 500mls. > 20kms from hospital and or difficulty getting to hospital. **Characteristics of women:** I: mean birth weight 3348grams, 29 completed secondary education, 187 vaginal birth, 26 assisted vaginal birth, 78 primiparous, 135 multiparous, maternal age (categories): 11 <19yrs, 115 20-30yrs, 85 31-40 yrs, 4 > 40yrs. C: mean birth weight 3335grams (SD 372), 28 women completed secondary education, 82 primiparous, 135 multiparous, 192 normal vaginal birth, 25 assisted vaginal birth, maternal age (categories): 7 <19yrs, 117 20-30yrs, 88 31-40yrs, 1 > 40yrs.	**I:** Discharge <24 hours after delivery **C:** Minimum 48 hour stay in hospital and monitored at 7-10 days postpartum Intervention: home support for following 24-48 hours by a nurse qualified in postnatal and neonatal care	Proportion of: Infants readmitted to hospital < 28 days women readmitted <6 weeks of giving birth women breastfeeding at 1 week/1 and 6 months Depression at 1 week/1month Maternal exhaustion/fatigue <4 weeks postnatal women physical health problems in first 6 months Women and infants requiring health consultation health consultation Maternal satisfaction Duration of rehospitalisation Economic evaluation	**Actual Length of postnatal stay (mean):** I: 27.23 hours (SD 9.12) C: 51.25 hours (SD 7.29) **Compliance to group allocation:** not stated

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Carty and Bradley (37)	**Design:** RCT **Method of randomisation:** Sealed opaque envelopes opened by nurse at home visit **Recruited and randomised :** Antenatal, 37 weeks gestation **Blinding:** women and health professional and outcome assessor unblinded **Length of follow up:** 1 month **Type of analysis:** Not ITT **Total Incomplete outcomes data:** 30.7% **Attrition:** 13 (6.9%) **Post randomisation exclusions:** 45 (24%) **Duration of study:** not reported **Setting:** Vancouver, Canada, Tertiary care maternity unit	**Number eligible:** unknown. **Number recruited and randomised**: 189 recruited and randomised, Intervention 1: n=44, Intervention 2 n=49, control group n=38 **Inclusion criteria:** all women expecting a vaginal birth **Exclusion criteria:** caesarean or forceps delivery **Characteristics of women** (e.g. maternal age of intervention and control): Mean age 30.24 yrs. (SD 3.80), > 95% Caucasian, 93% married or cohabiting, 65% completed junior college or university, 50% combined household income > $40,000, mean paternal age 32.87 yrs. 53% primiparous, 47% multiparous (baseline characteristics table not reported to enable comparison of baseline characteristics by group allocation).	**I1**: 12-24 hour discharge after delivery **I2**: 25-48 hour discharge after delivery **C**: 3-4 day discharge **Co-intervention:** nurses had two week training course **Intervention 1:** home visits on day 1,2,3,5, and 10 **Intervention 2:** home visits on 3,5,10	Proportion of: infants readmitted to hospital in first 6 weeks women readmitted for complication related to childbirth in first 6 weeks women breastfeeding at one month women scoring above cut off for probable depression, and anxiety Maternal satisfaction Confidence in mothering role Frequency of maternal problems requiring physician referral <10 days	**Actual Length of stay (mean):** I1: 1.12 days(SD 0.4) 2I: 2.06 days (SD 0.6) Control: 4.03 days (SD 0.7) **Compliance to group allocation:** Not stated

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Gagnon *et al.* (38)	**Design**: RCT **Method of randomisation:** opaque sealed envelopes placed on medical file prior to antenatal home visit **Recruited and randomised:** Antenatal recruitment from attendance physician's office, hospital ultrasonography or family planning clinic (3 recruitment sites) between 32-38 weeks gestation **Blinding:** Women and health professionals and outcome assessor unblinded **Length of follow up:** One month **Type of analysis:** Not ITT **Total Incomplete outcome data:** 51.4% **Attrition:** 26 (7.2%) **Post randomisation exclusions:** 159 (44.1%) **Duration of study:** Jan-Dec 1990 Setting: Montreal, Canada	1354 women approached, 938 eligible, 360 **recruited and randomised.** I: 183 C: 177 Final number analysed: I: 78 C: 97 **Inclusion criteria:** parity 0-4, normal pregnancy (e.g. absence of medical conditions, cephalic presentation at 36 weeks, ability to speak English French or Spanish, telephone availability and residence within 30 minutes of hospital **Exclusion criteria:** Intrapartum exclusion: Prolonged rupture of membranes > 24 hours before birth, caesarean section, estimated blood loss > 500mls, and 3rd or 4th degree perineal tear. Postpartum exclusion: excessive bleeding, inability to void adequately, reduced mobility. no receipt of Anti D when indicated, medical conditions requiring close supervision Infant exclusion: multiple birth, birth weight <2500grams, preterm (<37 weeks), abnormal newborn physical exam, not established feeding **Characteristics of women** Mean age I: 29.6 (SD 4.7), C 29.1 (SD5.3), Parity: I: 38% primiparous, C: 34% primiparous, Mean birth weight I: 3389 (SD 419), C: 3496 (SD 364), Mean length time in education I: 13.8 9 (SD 3.8) C: 14.0 (SD 3.9), Recent migrant I 14.1%, C: 24.7%, Mean gestational age at recruitment I:34.5 C: 34.0, Antenatal depression: I 10.4% C: 13%, Smoking status I: 23.1% C: 9% Mode of birth I: 43.5% caesarean section, 56.3% vaginal birth C: : Caesarean section = 39.2%, vaginal = 60.8%, Mean gestation age at birth 39.3 (SD 1.3), C: 39.5 (SD 1.1), Intend to b/f I: 70.5%, C: 54.6%	**I:** 6-36 hour discharge after delivery **C:** 48-72 hours discharge **Co-intervention:** Nursing care by telephone < 48 hours and at 10 days postpartum home visits at 34-38 weeks and 3-5 days postnatal	Proportion of: women predominantly breastfeeding at one month infants requiring a 'health contact' at 10 days Maternal satisfaction Perceived maternal/parental competency	**Actual Length of stay:** I: 37.5 hours (SD 19.7) C: 54.3 hours (SD 18.0) **Non-Compliance to group allocation:** 26/78 (33%) in intervention group moved to control group .

Study	Methods	Participants	Intervention	Outcomes measures	Notes
McKeever *et al.* (97)	**Design:** RCT **Method of randomisation:** Unclear (using central randomisation methods) **Recruited and randomised:** Unknown method of recruitment, postnatal **Blinding:** women and health professionals unblinded, blinding of outcome assessor unclear **Length of follow up**: up to 12 days postnatal **Type of analysis:** ITT **Total incomplete outcome data:** 26% **Attrition:** 15 (14.9%) **Post randomisation exclusions:** 11 (11%) **Duration of study:** July 1999 - December 2000 **Setting:** Toronto, Canada	**Number eligible**: 156. **Number recruited and randomised:** recruited and randomised postnatally 156 recruited, 101 randomised (stratified by gestation) I: 53, C: 48. Number analysed: Term: I:34, C: 41 Near term: I: 15 C: 12. **Inclusion criteria**: live singleton within preceding 12 hours, were at least 21 yrs., resided in metropolitan area, had a telephone, intended to breastfeed, were breastfeeding at discharge, would receive satisfactory support at home Infant inclusion: ≥35 weeks gestation, breastfeeding at discharge, no congenital abnormalities or morbidities including hyperbilirubinemia, blood group incompatibility or sepsis **Exclusion criteria:** non English speaking, caesarean delivery, postpartum complications and morbidities such as fever, abnormal bleeding, chronic illness or disabilities **Characteristics of women:** I TERM: mean age 32 (SD 4.2), 51.3% primiparous, 48.7% multiparous, 100% vaginal birth, gestational age = 38-40/40 = 92%, 41/40 =8%, breastfeeding at discharge 87% I NEAR TERM: mean age 32.1 (SD 2.9), 57.1% primps, 42.9 multiparous, Breastfeeding at discharge 68%, gestational length: 35/40 - 10.5%, 36/40 42.1%, 37/40 47.4% C TERM: mean age 33.1 (SD 4.4), 45.5% primiparous, 54.5% multiparous, gestational age38-40/40 = 81%, 41/10 = 99%, breastfeeding at discharge 83% C NEAR TERM: mean age 32.1 (SD 4.4), 80% primiparous, 20% multiparous, gestational age, 35/40 = 5.6%, 36/40 = 33.3%, 37/40 = 61.1%, breastfeeding at discharge 72%.	I:24-36 hour discharge after delivery C: 48-60 hour discharge after delivery Co-intervention: breastfeeding clinic outpatient and encouraged to use the pre-existing 24 hour telephone helpline	Proportion of women breastfeeding at 5-12 days after birth	**Length of stay** **Term group:** I: 37 hours (range 23-61) C: 44.1 hours (range 15-107) **Near term group:** I: 45 hours (range 25-86) C: 48.2 hours (range 28-68) **Compliance to group allocation:** Not stated.

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Tan *et al.* (98)	**Design:** RCT **Method of randomisation**: Random number generator in random blocks of four or eight, numbered sealed envelopes. Attached to medical charts and opened on day one on postnatal ward by healthcare provider to reveal allocation. **Recruited and randomised:** Postnatally **Blinding:** women and health professional unblinded, outcome assessor, unclear Length of follow up: 6 weeks **Type of analysis:** ITT **Total incomplete outcome data:** 5% **Attrition:** 12 (3.3%) Post randomisation exclusions: 6 (1.6%) **Duration of study:** Nov 5th 2011 - Feb 15 2012 Setting: Kuala Lumpur, Malaysia University Hospital, Kuala Lumpur, Malaysia	**Number eligible:** 689 admitted for elective caesarean section, 329 either not eligible or not approach, unclear how many were ineligible. Number recruited and randomised: 360 women randomised postnatally, I: 179 C: 181. Number analysed I:170 C:172 **Inclusion criteria:** planned LSCS, aged > 18years, gestation > 37 or above, singleton pregnancy **Exclusion criteria:** Antenatal: known congenital abnormality, established medical problems or operative factors likely to preclude day 1 discharge (preeclampsia, cardiac disease, renal disease, connective tissue disease, two or more previous LSCS, major placenta Previa) Intrapartum: estimated blood loss > 800mls, haemoglobin < 80g/l, immobile, not established voiding, febrile > 38, abnormal blood pressure **Characteristics of women**: I: mean age 31.8 (SD 4.6), 179 had caesarean section, 67 completed higher education, mean birth weight = 3320 grams (SD 0.51), 134 in employment, planned duration of breastfeeding (months): no breastfeeding: 2 (1.1%) women, 1-2 months: 12 (6.7%), 3-6 months: 44 women (24.6%), 7-12 months 20 (11.2%), > 12 months: 101 women (56.4%) C: mean age 31.5 (SD 4.1) 181 LSCS, 76 completed secondary education, mean birth weight, 3160grams (SD 500), 137 women in employment, planned duration of breastfeeding: not planning to breastfeed: 0, 1-2 months: 9 women (5%), 3-6 months: 44 women (24.3%), 7-12 months: 26 women (14.4%), > 12 months: 102 women (56.4%)	I: day 1 discharge after delivery C: day 2 discharge after delivery Co-intervention: None	Proportion of: Infants readmitted < 7 days and < 6 weeks women readmitted to hospital <6 weeks women breastfeeding at 6 weeks Depression score at 6 weeks after birth Women attending medical consultation at 2 weeks and 6 weeks after birth Infant unscheduled medical consultation at 2 and 6 weeks after birth Maternal satisfaction	**Actual Length of postnatal stay:** **I:** same day 0: I: (0%) C: 1 (0.6%) Next day: I: 94 (55.3%) C: 58 (33.7%) Day 2: I: 66 (38.8%) C: 106 (61.6%) Day 4: I: 1 (0.6) C: 6 (3.5%) **Compliance to allocation:** 28/170 (16.5%) in intervention group not discharged on day 1 24/172 (14%) were not discharged on day 2 (12 stayed longer, 12 went home earlier).

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Waldenstrom (31)	**Design:** RCT **Method of randomisation:** Unclear **recruitment and randomisation:** recruitment method unknown Antenatal (30 weeks gestation) **Blinding:** Women and health professionals unblinded, outcome assessor unknown **Length of follow up**: 6 months **Type of analysis:** not ITT **Total incomplete outcome data:** 36.6% **Attrition:** 13 (7.9%) **Post randomisation exclusions:** 47 (28.7%) **Duration of study:** March 1984 -June 1985 **Setting:** Uppsala, Sweden	**Number eligible:** 1604. Number recruited and randomised: 1604 recruited, 164 randomised (10.2%), I: 85, C: 79, subsequently analysed I: 50 C: 54. **Inclusion criteria:** low risk normal delivery with no complications **Exclusion criteria:** caesarean section delivery, multiple birth, prematurity, birth weight <3000grams, significant morbidity in first 24 hours **Characteristics of women**: I: mean age 28, 20% primiparous, 44% completed education beyond secondary school, mean birth weight 3658grams, 60% in employment C: mean age 27, 30% primiparous, 44% completed education beyond secondary school, mean birth weight 3481 grams, 57% in employment	I: <48 hour discharge after delivery C: > 48 hour discharge after delivery Co-intervention: midwife home visits 3-4 times in the first week and antenatal visits, paediatric examination on day 5 after birth	Proportion of: Infants readmitted to hospital < 7 days after birth Mothers readmitted to hospital < 6 weeks after birth women breastfeeding at 2 months and 6 months Infant health problems at 5 days identified during routine paediatric assessment Maternal fatigue at 14 days Maternal satisfaction with care	**Actual length of postnatal stay** (average): I: 1.5 nights C: 4.1 nights **Non-compliance:** Not stated

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Winterburn and Fraser (40)	**Design:** RCT **Method of randomisation:** Sealed envelopes **Recruited and randomised:** Antenatal at parent education sessions **Blinding:** women and health professionals unblinded, unclear blinding of outcome assessor **Length of follow up:** 4 weeks **Type of analysis**: ITT and per protocol **Incomplete outcome data**: 2.7% **Attrition**: 7 (2.7%) **Post randomisation exclusions**: None **Duration of study**: February 1996-June 1998 **Setting:** North England, UK	**Number eligible:** 255. **Number recruited and randomised:** 255 recruited antenatal, 248 randomised, I:121, C: 127 **Inclusion criteria:** 'All women' **Exclusion criteria:** women that did not want to breastfeed or had strong preference for length of stay **Characteristics of women**: no data reported on baseline characteristics	**I:** 6-48 hour discharge after delivery **C:** > 48 hour discharge after delivery **Co - intervention:** home support with community midwife	Proportion of women breastfeeding at 4 weeks	**Actual length of postnatal stay** I: <48 hours = 31 women (25.6%) > 48 hours = 90 (74.4%) C: <48 hours = 20 women (15.7%) > 48 hours = 107 women (84.3%) **Compliance to group allocation:** 90/124 (74%) in intervention group moved to control group 20/127 (17%) control group moved to early discharge

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Yanover *et al.* (33)	**Design:** RCT **Method of randomisation:** Unclear **Recruited and randomised:** Antenatal **Blinding:** Women and health professionals unblinded, outcome assessor unknown **Length of follow up:** 6 weeks **Type of analysis:** ITT **Total incomplete outcome data:** 31.3% **Attrition:** none (all described as post randomisation exclusions) **Post randomisation exclusions:** 4.(31.3%) **Duration of study:** not reported **Setting:** San Francisco, United States	**Number eligible:** unclear. Number recruited and randomised: 271 approached, 143 not eligible, 128 recruited and randomised, 40 post randomisation exclusions, subsequently analysed: I: 44 C: 44 **Inclusion criteria:** 0 or 1 parity, mother aged between 19-35 yrs., low medical risk, completed secondary education, father willing to attend prenatal classes, prospective parents must be living together, converse in English, reside within 32km of the hospital **Exclusion criteria:** Intrapartum: caesarean delivery, prolonged rupture of membranes, precipitous labour (< 3 hours), blood pressure > 140/90mmhg, pyrexia Postnatal: maternal temp > 38oc, blood pressure <90/60mmhg or > 140/90mmhg, excessive blood loss, dysuria Infant: birth weight <2.5kg or > 4.5kg, gestation age > 38 weeks and <42 weeks, Apgar <7 at one minute, Abnormal vital signs, feeding difficulties, failure to void urine. **Characteristics of women:** 'no statistically significant differences between the intervention and control group in age, race, father's occupation, planned pregnancy, duration of marriage, length of time to conceive, mother's and father's education, presence of another child in the home, or mother's preference for antenatal classes, natural childbirth or breastfeeding', (but no data given by group allocation).	**I:** 12-48 hour discharge after delivery **C:** > 48 hours after delivery **Co-intervention**: family centred perinatal care program: collaborative multidisciplinary working from An to PN care, antenatal classes, daily visits for 4 days. Whilst on ward, infants went to nursery or 6 hours	Proportion of: infants readmitted in the first 6 weeks women readmitted in the first 6 weeks after giving birth Maternal views about length of postnatal stay	**Actual postnatal length of postnatal stay:** **I:** 12-24 hours (n=21), 25-48 hours (n= 11), 49-72 hours (n=10), 73-96 hours (n= 2), > 96 hours (n=0) **C:** 12-24 hours (n= 0), 25-48 hours (n=5), 49-72 hours (n=22), 73-96 hours (n= 12), > 96 hours (n=5) **Compliance:** 12/44 (27.2%) from I to C 5/44 (11.3%) from C to I

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Evans *et al.* (99)	**Design:** ITS **Data source:** linked administrative record data provided by the State of California Office of Statewide Health Planning and Development **Time points measured:** Monthly **Length of follow up:** 28 days **Type of analysis:** Two stage least squares model which combines first stage and reduced form estimates into a 2 stage least squares estimate **Missing Data**: not known **Duration of study:** July 1995-December 2000 **Setting**: California, US	**Number participants:** 3 million (grouped into six categories): 1. Medicaid Uncomplicated Vaginal birth, 2. Medicaid complicated vaginal birth, 3. Medicaid LSCS delivery, 4. Private uncomplicated vaginal birth, 5. Private complicated vaginal birth, 6. Private LSCS delivery **Inclusion criteria:** all mother infant pairs **Exclusion criteria:** **Characteristics of women:** **Age: < 20:** Group1: 0.295, Group 2: 0.232, Group 3: 0.286, Group 4: 0.089, Group 5: 0.075, Group 6: 0.043 **20-24yrs**: Group 1: 0.338, Group 2: 0.290, group 3: 0.286, group 4: 0.201, Group 5: 0.171, Group 6: 0.130 **24-30yrs:** Group 1: 0.215, group 2: 0.237, group 3: 0.253, group 4: 0.317, group 5: 0.299, group 6: 0.282. **Ethnicity**: Black: Group 1: 0.075, group 2: 0.086, group 3 :0.094, group 4: 0.052, group 5:0.065 , group 6: 0.067 other races: Group 1: 0.080, group 2:0.090 group 3: 0.066, group 4: 0.168, group 5: 0.159 , group 6: 0.160 hispanic: Group 1: 0.658, group 2: 0.607, group 3: 0.641, group 4: 0.281, group5: 0.278 , group 6: 0.258 **Maternal education**: < secondary school education: Group 1: 0.572, group 2: 0.563 group 3: 0.531, group 4: 0.140, group 5: 0.43 , group 6: 0.115 higher degree: Group 1: 0.403, group 2:0.411, group 3: 0.435, group 4: 0.534, group 5: 0.545 , group 6: 0.535 **Parity:** multiparous: Group 1:0.628, group 2:0.688 group 3:0.650, group 4:0.607 group 5:0.610 , group 6:0.574	**Federal law** (1996 Sept) mandated insurance providers to > 48h vaginal birth, > 96h caesarean delivery (Medicaid exempt from this coverage). **State law** (Aug 1997) Californian insurers cover for home visit if discharged early **State law** (August 1998) state legislature extending the Californian early discharge statute to all Medicaid patients in the state)	Proportion of infants discharged early in the pre legislative and post legislative period. Proportion of infants readmitted within 7 and within 28 days of birth.	

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Datar and Sood (100)	**Design:** ITS **Data source:** linked database (publicly available) of birth certificate, death certificate and hospital discharge data, available from California's office of State-wide Health Planning and Development. **Time point measured:** Yearly (prelaw and 1,2 and 3 years post law) **Length of follow up:** 28 days **Type of analysis:** Multivariate linear regression model and multivariate logistic regression **Missing Data:** not given **Duration of study:** 1991-2000 Setting: California, United States **Unit of allocation:** Population **Funding**: NICHHD grant	**Total population:** Not given **No participants eligible:** Not given **Number participants recruited:** 4, 662, 753 infants **Inclusion criteria:** singleton live born births in Californian civil hospitals **Exclusion criteria:** Infants who died before discharge, were transferred to another facility, implausibly short or missing LoS or missing birth hour (3%), medically unattended births and fetal deaths, multiple birth, premature and low birth weight infants **Characteristics of women (covariates):** Pre law (1991-1997) : Ethnicity: 40.6% white, 6.2% black, 41.6% Hispanic, 10.7% other, Mother's education 33.9%< high school, 66.1% > high school, maternal age: 4.6% <18yrs, 82.9% 18-35 rest, 12.6% > 35yrs. Insurance type: 44.5% Medicaid, 49.7% non Medicaid, 5.7% uninsured, Parity: 61.0% multiparous, mode of delivery: Caesarean 20.1% Post law (1998-2000): Ethnicity: 37.6% white, 5.6% black, 43.7% Hispanic, 11.8% other, Maternal education: 29.8% < high school, 70.2% > high school, maternal age at delivery: 3.9% <18 yrs,80.8% 18-35 yrs., 15.3% > 35 yrs., Insurance type: 40.1% Medicaid, 55.9% Non Medicaid, 4.0% uninsured, parity: 61.5% multiparous, mode of delivery: caesarean, 21.1%	**California's postpartum LoS legislation** introduced Dec 1996, adopted Aug 26 1997 insurance providers covered women for > 48 hours (> 96 for caesarean delivery) and follow up visits at home **Federal postpartum legislation** adopted Jan 1998 insurance providers covered at > 48 hour postnatal stay in hospital. (Neither federal or state law covered Medicaid recipients).	Change in length of postnatal stay in hours post law at 1,2 and 3 years compared with pre law Change in odds of infant readmission to hospital within 28 days (including cause specific conditions: jaundice, infection and respiratory problems Change in 1 year infant mortality (Mortality and cause specific mortality within one year of birth)	Yearly data available only: did not consider the impact of expanding the state law to all Medicaid patients in (September 1998) (LoS in hours imputed using hour of birth, nights hospitalised and assuming discharge at 5pm if on the day born and at 1pm if one or more night's stay).

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Meara *et al.* (101)	**Design:** ITS of a population based cohort study **Data source:** Medicaid claims data and birth certificate data **Time Points**: Quarterly prelegislation (1.7.1991 to 22.8.1995), legislative (1.10.1995 to 30.9.1996), postlegislative (17.10.1996 to 30.5.1998) **Length of follow up:** 21 days after birth **Type of analysis:** Interrupted time series segmented linear regression analysis. **Missing Data:** Not recorded **Duration of study:** June 1991 and June 1998 **Setting:** Ohio Medicaid services, USA **Unit of allocation:** Population **Funding:** Health Resources and Services Administration, Maternal and Child Health Bureau	**Number participants:**1,069,693 births in Ohio between July 1, 1991 and June 30, 1998. 288,808 infant Medicaid recipients with valid claims and still receiving Medicaid 31 days after birth. **Number recruited:** 155,352 infants (including 4.225 who were delivered vaginally and had short stays). **Inclusion criteria:** patients covered by Medicaid population Infants: 'normal infants who were born to Ohio Medicaid recipients. Normal= bw> 2000g gestation age > 37 weeks and those had a diagnosis related group 391 **Exclusion criteria:** Neonates who were born to mothers who were enrolled in health maintenance organisation plans , June births (inability to match births and claims across fiscal years) Births between 22.8.1995 and between 1.10.1996 and 16.10.1996 **Characteristics of women: Prelegislation** (1.7.91-22.8.95) n= 1.8494: Education <high school: 36%, high school degree: 48%, post high school: 17%, Age: 29% <20yrs, 2% > 35 yrs, Ethnicity: 23% non-white, 62% unmarried, Parity: 0 43%, 1-3: 53% > 4: 4%, 65% resided in metropolitan area, No of A/N visits: mean = 11 (SD= 4), Caesarean: 17%, rate of short stay: 17% **Legislative** (10/1/95-9/30/96) n= 19229: Education: < high school degree: 32%, High school degree: 47%, post-high school: 21%, Age: 2% <20 yrs, >35: 3%, Ethnicity: 18% non-white, 61% unmarried, 56% resided in the metropolitan area, Parity: 0: 46%, 1-3: 51%, >4: 4%, No or A/N visits: mean 11(SD 3.9), Caesarean 15%, rate of short stay: 55% **Post legislative** (10/16/96-6/30/98) n= 27629: Education: < high school degree: 33, High school degree: 47%, post-high school: 20%, Age: <20 yrs: 19%, >35yrs: 3%, Ethnicity: 15% non-white race, 61% unmarried, 52% resided in metropolitan area, Parity: 0: 45%, 1-3: 51%, >4: 3%, No. of A/N visits: mean 11(SD 4.0), Caesarean: 15%, rate of short stay 33%	**Ohio legislation** introduced August 22 1995, passed July 1996 implemented Oct 17, 1996 mandating insurance coverage of minimum postnatal hospital stay (> 48 hours following birth and 96 hours for caesarean delivery) and early follow-up visits by the age of four days .The Ohio legislation, was.	Change in length of postnatal stay (expressed as proportion (%) of infants having a short stay (defined as within 1 day of birth of vaginal birth and within 2 days for caesarean birth) Rate of follow-up visits within 6 days of birth Rehospitalisation within 10 days of birth: total, cause specific: jaundice, infection and dehydration and ED visits	To avoid including births from two different legislative periods in a single quarter, authors excluded births between August 22and Sept 30, 1995 and between Oct 1 and October 16, 1996. Excludes infants if mother had health maintenance organisation plan (HMO plan) because data deemed to be incomplete.

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Madden *et al.* (50)	**Design:** ITS of a population based cohort study **Data source:** Harvard Vanguard Medical Association Automated Medical Records System and claims for reimbursement **Time points**: Quarterly **Length of follow up:** 10 days **Type of analysis:** Interrupted time series regression **Missing Data:** Birthweight n=159, gestation n=3121, 5 minute Apgar score n=1283, maternal age n=9, parity n=4478 433 for ethnic group n=433 **Duration of study:** Oct 1990 to March 1998 Setting: Massachusetts, Harvard Vanguard Medical Associates, caring for 300,00 persons insured by Harvard Pilgrim Health Centre **Funding:** Agency for Healthcare Research and Quality, Harvard Pilgrim Child Health Foundation, Maternal and Child Health Bureau	**Number participants in population**:33,344 women and 30,228 infants detected, **Number eligible:** 20,366 mother and infant pairs **Inclusion criteria:** infant: infants were required to have Harvard Pilgrim Health Care (HPVC) insurance for at least 45 of the first 60 days and at least one medical encounter (95.5% of new-borns) **Exclusion criteria:** caesarean delivery (23.6%, LoS >4 days, unequal stays for mother and infant (3.2%), observations for the third quarter of 1994 and the first quarter of 1996 were omitted. **Characteristics of women:** Maternal age: 4.5% <22, 31.2% 22-29 yrs., 39.2% 30-34yrs, 25.1% >35 yrs., parity, 44.6% prim parous women, enrolled in Medicaid: 6.7%, census based Socioeconomic status indicators: living in low income: 6.7%, living in low education tract: 19.9%, Ethnicity: 69.2% white, 17% back, 6.6% Asian, 4.9% Hispanic, 22% other, **Infant characteristics:** Birth weight: <2.5kg 2.7%, 12.9% 2.5-2.99kg, 84.4% > 3.0kg, gestational age: 6.6% < 38 weeks, 27.1% 38-39 weeks, 66.3% 40+ weeks. 5 minute Apgar score: 1.7% <8, 6.7% 8, 91.6% 9-12. **Vulnerable group**: enrolled in Medicaid, living in neighbourhood with median household income<$25,000 or neighbourhood with one third more residents ≥25 less than high school education, or ages <22yrs. No data on pre/post law differences in characteristics of study population.	**I1: ROLOS reduced obstetrical length of stay program**, one night in hospital after a normal birth delivery and home visit by nurse within 48 hours and enhanced assistance with lactation **I2: Massachusetts law** mandating a > 48 hour minimum coverage for postnatal stay in hospital, or home visit if women were discharge home <48 hours.	Proportion of infants discharged early in the pre legislative, legislative and post legislative period Proportion of: mother infant pairs with LoS <2 days infants attending non urgent and urgent health centre infants readmitted in first 10 days infant admitted for avoidable conditions (in first 21 days) (jaundice, and feeding problems) infants treated for phototherapy women breastfeeding at 3 months	Excludes women who had a LSCS and those with no insurance. Teenage mothers and Medicaid recipients were underrepresented in study when compared to Massachusetts or the nation as a whole and women with HMO insurance are most likely to have higher levels of education and income compared to US overall.

Study	Methods	Participants	Intervention	Outcomes measures	Notes
Sievertsen and Wust (102)	**Design:** ITS of a population based cohort study **Data source:** Danish Inpatient Register (Hospital medical records) and survey data from the Danish National Birth Cohort (DNbC). **Time points**: Yearly **Length of follow up: 9 years** **Type of analysis:** Two stage least squares estimates **Missing Data:** **Duration of study:** 1985-2003 Setting: 5 Counties in Denmark: Aarhus, Ringkobing, Viborg, Veijle and Ribe **Funding:** Danish Council for Independent Research Grant 11-116669.	**Number participants in population**: 733,373 **Inclusion criteria: All** multiparous women were in the sample (mothers and infants were not excluded if they had health problems but rather estimates were compared with and without controls for health at birth. **Exclusion criteria:** Primiparous women, complicated birth **Characteristics of women:** Maternal age: 30.85 (SD 4.46), Maternal age <18yrs: 0 (SD 0.01), Caesarean Section: 0.13 (SD 033), married: 0.63 (SD 0.48), higher education 0.29 (SD 0.45), taxable income: 176.16 (85.07), mothers unemployed: 0.13 (SD 0.34), in education: 0.02 (SD 0.14), mother readmitted 0.02 (SD 0.14), mother readmitted <365 days 0.10 (SD 0.29) **Infant characteristics:** Male child: mean 0.51 (SD 0.50), birth weight: 3571.27 (SD 559.16), infant BW< 2.5kg: 0.03 (SD 0.17), preterm birth 0.04 (SD 0.19), APGAR <7: 0 (SD 0.07), child hospital nights at birth: 3.46 (SD 6.15), same day discharge 0.14 (SD 0.35), infant readmitted within 28 days: 0.04 (SD 0.20), infant readmitted within 365 days 0.21 (SD 0.40).	**Mandated discharge on the day of birth** – a same day discharge without formal maternity ward admission for all uncomplicated births by multiparous women in the period 1990-2003.	Proportion of: Infants readmitted < 28 days and 1 year Child's school achievement at aged 15yrs Mothers readmitted within 28 days Mothers readmitted one year Breastfeeding at 4 months GP contacts for infants and maternal health problems at 1 month	Same day discharge was defined as hospital discharge of the mother and child on the calendar day of birth – therefore this will underestimate the prevalence of same day discharge.

The RCTs took place between 1976 and 2015 in countries including: England, Switzerland, Spain, Sweden, US, Canada, Malaysia and Egypt. The policy of early postnatal discharge ranged from 0 to 48 hours although one study added an additional 2 days to both the intervention and control group for women who had delivered via caesarean section. For most trials, standard LoS for the control group was defined as anything greater than 48 hours (31, 33, 36, 38, 40, 97, 103, 104), although two trials specified a minimum LoS of 3-4 days or 4-5 days (5-7 days for caesarean delivery) respectively (35, 37). Several trials also specified a minimum LoS for the intervention group ranging from 6-24 hours post-delivery (33, 35, 37, 38, 40, 97, 98). In all trials, the LoS for the control group reflected the standard policy for the hospital at that time.

3.4.1.1 Co-interventions

Eight of the ten trials included in the review had a co-intervention of postnatal home visits, and two trials also provided additional staff training (33, 37). The largest trial was conducted by Bayoumi *et al.* (103) and included 3786 participants and the smallest trial was conducted by McKeever *et al.* (97) and included 101 women and infant pairs.

3.4.1.2 Types of women and infants recruited

All trials included in the review aimed to recruit women who were at low risk of intrapartum and postnatal complications, however, the characteristics of participants varied greatly across trials. Women defined as 'low risk' and suitable for an early postnatal discharge in some trials were defined as 'high risk' and not suitable for discharge in other trials. Six out of the ten trials recruited women in the antenatal period (31, 33, 35, 37, 38, 40) and four trials recruited women in the postnatal period (36, 97, 98). Where specified, antenatal

recruitment was either at parent education classes (40) or antenatal appointments with a midwife or obstetrician (35, 37, 38). The other four trials recruited and randomised women on the postnatal ward following delivery (36, 97, 98, 103). Follow up of participants ranged from 5-12 days (97) to 9 months post birth (36).

Some trials only included women who were expecting to, or already had a vaginal birth (31, 33, 36-38, 97) whilst other trials also included women who were planning to, or already had a caesarean section (35, 40, 98, 103). Some excluded women based on obstetric risk factors in the antenatal, intrapartum and immediate postnatal period (31, 37, 98) and other trials made further exclusions based on social risk factors, proximity to the local hospital and ability to speak the native language (33, 35, 36, 38, 97). McKeever *et al.* (97) and Winterburn and Fraser (40) focussed specifically on breastfeeding outcomes and only included women who were either interested in breastfeeding or breastfeeding on postnatal discharge from hospital. Nine of the ten trials in the review included term infants (> 37 weeks gestation) leaving only one trial that reported outcomes for premature infants born between 34-36 weeks gestation (97). Some studies specified 'fit for discharge criteria' following randomisation to ensure that women and infants discharged from hospital early were going home at the appropriate time (33, 36, 38, 97, 98, 103).

3.4.2 Characteristics of included ITS studies

Four of the population based cohort studies with ITS analyses examined the effect of postpartum legislation to enforce a minimum length of postnatal stay on various locations in the US including Ohio, California and Massachusetts over the period 1990-2000 (50, 99-101). None of the mandates covered Medicaid recipients however, in some studies, due to the

way in which their care was managed, a large proportion were covered by the mandate (99). One ITS study also assessed the effect of an early discharge programme to increase the proportion of women and infants discharged early which was introduced 18 months prior to the postpartum legislation (32, 50, 105). The ITS study conducted in Denmark examined the effect of a same day discharge policy for multiparous women who had an uncomplicated birth (102). The largest ITS study (100) included over four million mother infant pairs and the smallest ITS study (50) included 34,000 mother infant pairs. The population characteristics of the five ITS studies differed considerably. Madden *et al.* (50) used automated medical records from claims data within a large Massachusetts health maintenance organisation, and women in this study were more likely to have higher levels of education and higher incomes compared to the US overall. This population also had a lower prevalence of teenage mother and Medicaid recipients. Meara *et al.* (101) used Medicaid (health coverage that is administered by the state and jointly funded by the US state and federal government (106)) records from claims data in Ohio where the proportion of mothers under the age of 20 (29%) and mothers who had not completed secondary education (36%) was high. Evans *et al.* (99) and Datar and Sood (100) used linked administrative record data provided by the Californian state which provided data on both privately insured (49.7%) and Medicaid (44.5%) recipients. Sievertsen and Wust (102) used information on all registered live births in Denmark from 1985-2006.

3.4.2.1 Early discharge definition

There was considerable variation in how early postnatal discharge was defined in the ITS studies. Meara *et al.* (101) defined early postnatal discharge as less than 1 night for vaginal

birth and < 2 nights for caesarean section delivery. Madden *et al.* (50) described early discharge as the proportion of all mother infant dyads with a postnatal LoS < 2 days. Evans *et al.* (99) defined early discharge as < 2 nights in hospital following vaginal birth and < 4 nights following caesarean section, while Datar and Sood (100) did not define early discharge but estimated change in LoS by using hour of birth, number of nights in hospital and various assumptions about timing of discharge. Sievertsen and Wust (102) defined early discharge as the hospital discharge of the mother and infant on the calendar day of birth.

3.4.2.2 Types of women and infants included

There was considerable variation in the inclusion criteria for the ITS studies. Evans *et al.* (99) included all mother infant pairs regardless of medical complications and similarly, Madden *et al.* (50) did not consider medical status in inclusion criteria, but excluded those that had an initial hospital stay after birth > 4 days. Datar and Sood (100) only included term singleton infants and excluded infants that had an initial transfer to a neonatal unit, low birth weight, medically unattended birth or missing postnatal LoS or birth hour, or died before discharge. Meara *et al.* (101) only included 'normal infants' that were: greater than 2kg, term and those recorded as 'normal newborn' on medical records. Sievertsen and Wust (102) included all live births of multiparous women (although health at birth was adjusted for in analysis).

3.4.3 RCTs Risk of bias

Overall, the quality of individual studies was variable (Figure 3.3 and Figure 3.4). Risk of bias for the review was assessed using the EPOC risk of bias criteria (91) which considers four domains: selection bias, performance bias, attrition bias and reporting bias (Appendix 4 and 5).

Figure 3.3 Risk of bias summary: review authors' judgement about each risk of bias item for each included RCT

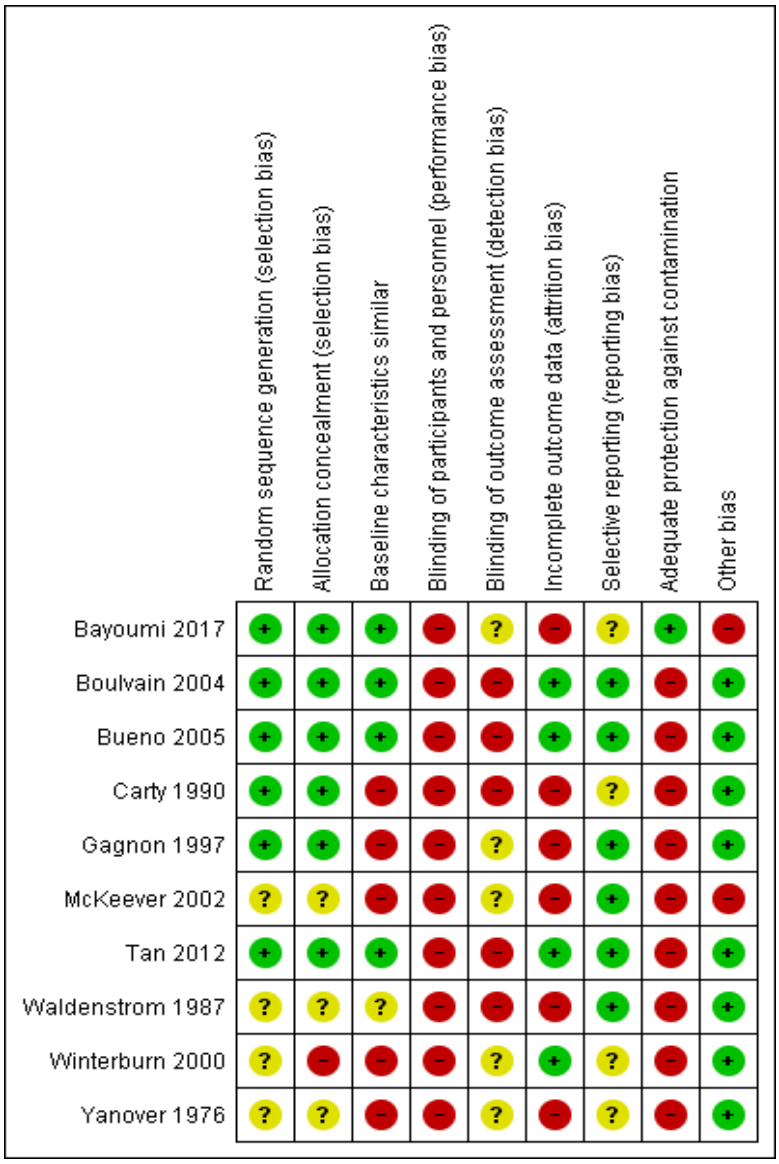
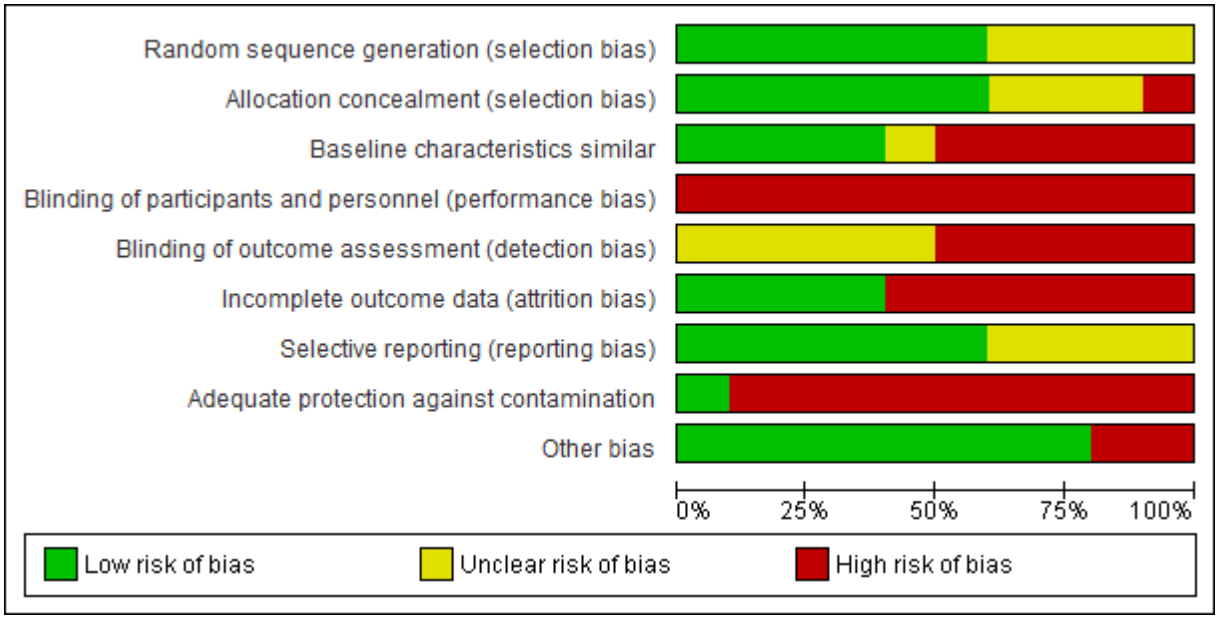


Figure 3.4 Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies



Eight trials reported on outcomes that had been described in the methods section (31, 35-38, 97, 98, 103) although none of the trials had published a protocol prior to the publication of the results. Only five of the trials specified a random method for the sequence generation process (35-38, 98). Adequate allocation concealment was described and achieved in six trials - all of which used opaque sealed envelopes (35-38, 98, 103). Six of the trials included a baseline characteristics table, although only four trials demonstrated a similar distribution of participant characteristics across the intervention and control group (35, 36, 98, 103). Only five trials clearly reported how many participants were eligible to participate in the study (31, 35, 38, 40, 97). Two of these trials reported an uptake above > 65% of eligible women/infants (40, 97). The other three trials described poor participation rates ranging from 10.4% to 38.4% and the reasons for not participating in the trials are not described (31, 35, 38). It is unclear in the other four trials how many women and infants met the inclusion criteria but chose not to take part in the trial (33, 36, 37, 98). Blinding of participants and

personnel was not possible in any of the trials due to the nature of the intervention. All outcome data was collected via patient self-reported questionnaires or medical records and it is not clear in any of the other trials whether the outcome assessor was blinded.

Incomplete outcome data due to attrition or post randomisation exclusions ranged from 2.7% to 51.4% across trials with only three studies reporting overall incomplete outcome data < 10% (35, 36, 98). In four of the trials, incomplete data could be attributed mainly to post randomisation exclusions rather than withdrawals or loss to follow up (31, 33, 37, 38, 103). Seven of the ten trials included in the review recruited women in the antenatal period and the proportion of post randomisation exclusions ranged from 0.1% to 44.1% (31, 33, 35, 37, 38, 40). Loss to follow up was low across all trials with only one trial reporting loss to follow up > 10% (97). Compliance to trial group allocation was inconsistently reported and treated across trials. In seven trials, the level of compliance was reported as an issue where a large proportion of women and infants did not have a postnatal LoS specified by the group allocation (33, 35, 38, 40, 98, 103). Non-compliance for these trials ranged between 16.5-74% non-compliance in the intervention group (staying in hospital longer than trial allocation) (40, 98) and 14-29% non-compliance in the control (staying a shorter time in hospital than allocated) (35, 98). Several of trials also reported that more women in the intervention group did not comply than those in the control group (33, 35, 40). For example, Winterburn and Fraser (40) found that 74% of women allocated to the intervention group moved to the control group, compared to only 17% of the control group that moved to the early discharge group. Level of compliance was not reported in four trials (31, 36, 37, 97).

Bayoumi *et al.* (103) excluded participants if they did not have a length of stay defined by the trial protocol.

Eight trials had a co-intervention of postnatal home visits (31, 33, 35, 37, 38, 40) (36). One study provided additional visits from a lactation specialist nurse (97) and two studies also provided telephone consultations (35, 97). A few of the older trials provided additional antenatal preparation (31, 33, 38) or additional staff training (33, 37).

3.4.4 ITS studies Risk of bias

Overall, the quality of the five ITS studies was good (Appendix 6). All studies reported outcomes that were described in the methods section, and had an intervention that did not affect data collection (Figure 3.5 and Figure 3.6). In all ITS analyses, the slope of the intervention was pre specified and authors acknowledged the potential effect other factors that may have coincided with the passage of the law (including changes to service mix, breastfeeding rates, physician awareness and flu outbreaks) (32, 50, 99-101, 105). Sievertsen and Wust (102) also compared the trends in readmissions of primiparous women and women who had a caesarean section (who were not eligible for same day discharge) to determine whether additional policies (such as new medical routines at birth) had an effect on the outcomes.

Figure 3.5 Risk of bias summary: review authors' judgements about each risk of bias item for each included ITS study.

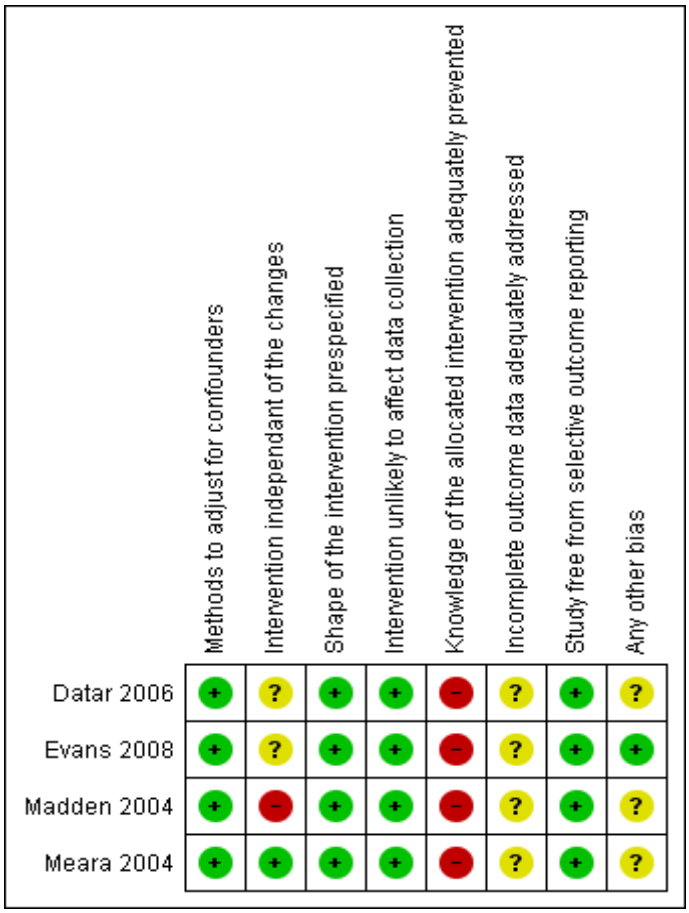
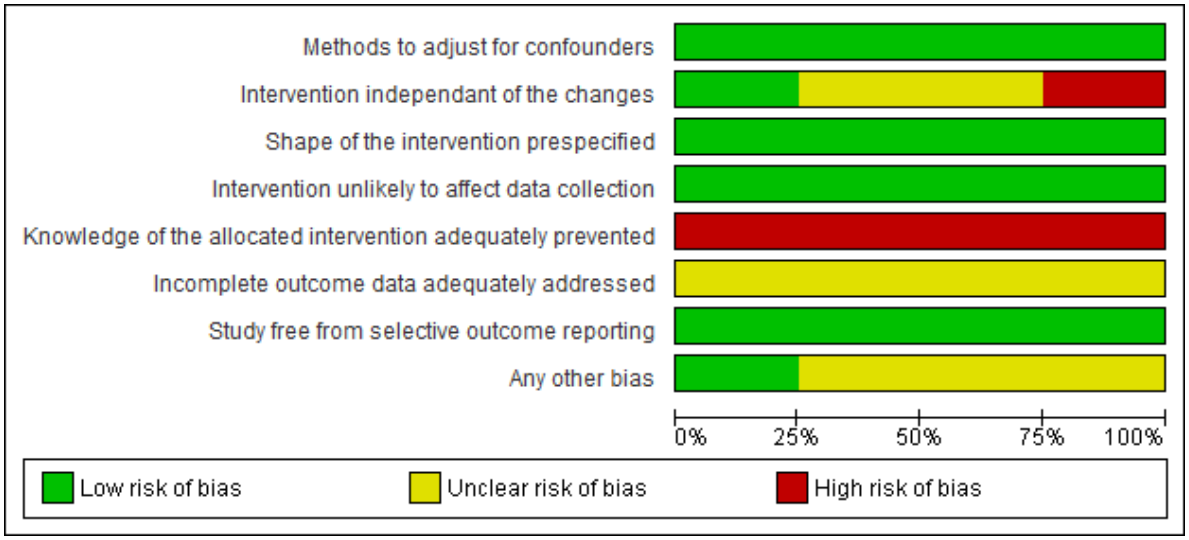


Figure 3.6 Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included ITS studies.



The five ITS studies had an appropriate statistical regression analysis where time was treated as a covariate. To control for potential confounding factors, authors considered the changes in baseline characteristics over the study period. Authors conducted either subgroup analyses based on mode of delivery, insurance type, maternal age, parity or other population characteristics (50, 99-102), and/or adjusted analyses to assess the effect of mode of delivery, infant risk factors, parity of mother and population characteristics. The change in trend and change in slope was not always reported in the ITS analyses as recommended by Ramsay *et al.* (107) and therefore the results for some of the outcomes should be treated with caution. In all of the ITS studies, the proportion of missing data were not described and therefore it is unclear how incomplete data were addressed.

Due to the heterogeneity of study designs of the studies included in the review, findings from the trials and ITS studies are reported separately. Where appropriate, meta-analysis has been performed for outcomes reported by the trials. To enable meaningful comparison for the ITS studies, and where meta-analysis was appropriate, reanalysis of digitised data was conducted for infant readmissions to hospital and a meta-analysis was performed. All other outcomes, including all other data from ITS studies are described in a narrative synthesis.

3.4.5 Outcomes

3.4.5.1 Postnatal length of stay ITS studies

In contrast to the RCTs which compared an intervention of early discharge with the standard longer stay in hospital, the ITS studies conducted in the United States reported on the effect

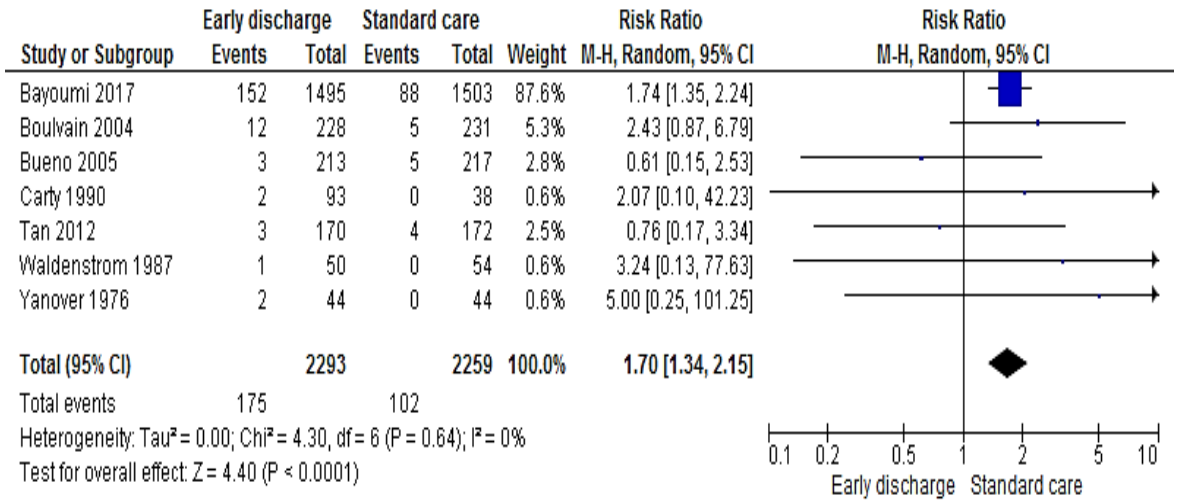
of a policy of a minimum 48 hour stay in hospital following vaginal birth and 96 hours following caesarean delivery (32, 50, 99-101). The studies conducted in the US found that the intervention of a minimum length of stay increased the postnatal LoS for mothers and infants. Datar and Sood (100) found that postnatal LoS one year after intervention increased by 9.5 hours ($p < 0.001$) and by 11.9 hours ($p < 0.001$) two years post law. Evans *et al.* (99) also studying the same California population, found that state and federal laws reduced the proportion on infants discharged early for both privately insured and Medicaid newborns with the greatest effect in privately insured women who had uncomplicated deliveries (86% discharged early in the pre legislative period compared to 46% in the post legislative period). Meara *et al.* (101) found the proportion of infants having a short stay decreased from 61% in the pre-legislative period to 53% by the end of the legislative period ($p < 0.001$ for trend). It decreased an additional 10.8% points when the legislation was passed ($p= 0.001$ for change in level) and continued to fall to 30% by the end of the post legislative period. Madden *et al.* (50) found that after the introduction of the legislation, the proportion of infants discharged decreased 42.2% points and the average proportion of infants discharged early over the following two years was 13.7% ($p < 0.001$ for change in trend). Sievertsen and Wust (102) found that following the introduction of the same day discharge policy there was a 25% point increase in the probability of same day discharge for multiparous women (Appendix 7.1).

3.4.5.2 Infant readmission to hospital within 28 days after birth

The pooled result of the seven trials that reported on infant readmission to hospital within 28 days after birth showed that infants were significantly more likely to be readmitted to

hospital within the first 28 days after birth if they were discharged from hospital < 48 hours compared to infants discharged > 48 hours (relative risk (RR) 1.70 95% CI 1.34-2.15) (Figure 3.7). For the specified sub-group analysis, removing the two studies (98, 103) which did not have a co-intervention and only included women who had a caesarean delivery, the pooled estimate was RR 1.74 (95% CI 0.82-3.68). There was insufficient data to provide a meta-analysis for readmissions within 7 days. Only one study reported on this outcome and reported a RR 3.24 (95% CI 0.13-77.63) in favour of the control group (31).

Figure 3.7 Forest plot of RCTs for proportion of infants readmitted within 28 days after birth



Results across primary ITS studies were inconsistent with both an increase and decrease in neonatal readmission rates following the passage of the minimum postnatal stay law found in studies (Appendix 7.2). Datar and Sood (100) found that pre law, the annual increased rate in odds of readmissions was 1.3 per 1000 births. Once the legislation was introduced, they described a significant reduction in the odds of neonatal readmission in California from (-9.3 per 1000 live births in the first year post legislation, -11.8 per 1000 live births in second year post legislation and -19.7 per 1000 live births in the third year post legislation (P< 0.01)). This

trend was observed across all subgroups which included mother's education, mother's age at birth, race, parity, delivery type and antenatal complications. Evans *et al.* (99) found that in California the legislation was associated with the best outcomes for infants of caesarean section, complicated vaginal birth or Medicaid recipient with complicated vaginal birth and there was little evidence that the readmission rates reduced for newborns from uncomplicated vaginal deliveries. Madden *et al.* (50) found no significant change over the pre legislative, legislative or post legislative period for neonatal readmission to hospital, where the readmission rate remained constant at 2.3%. Similarly, Meara *et al.* (101) found no significant trend in rates of readmission during the pre-legislative period (p=0.9 for trend) and the end of the study period (p=.2 and p=0.25 for changes in trend from period 1-2 and periods 2-3 respectively). Sievertsen and Wust (102) found that the same day discharge policy resulted in a 3% point increase in infant readmission rates within 28 days of birth (0.031, SE 0.11, $p < 0.01$).

The results of the meta-analysis of three of the reanalysed ITS studies showed that when the pre-slope trend was taken into account, there was a reduction in the proportion of infants readmitted to hospital within 28 days once the postnatal policy was introduced (change in slope -0.62 (95% CI -1.83, 0.60) although this was not statistically significant at the 5% level (Figure 3.8). The law appeared to be effective in reducing neonatal readmissions to hospital at one year post law -4.27 (95% CI -7.91, -0.63) (Figure 3.9) The pooled estimate for change in level at 2 years and corresponding confidence intervals suggests that the postnatal law was effective in reducing the proportion of infants to hospital (effect estimate -6.23 (95% CI -10.15, -2.32) (Figure 3.10). The I^2 statistic for assessment of heterogeneity was 19% for the

change in level at 28 days, and 0% for the change in level at one year and change in level at 2 years and therefore, further investigations for heterogeneity were deemed unnecessary. Evans *et al.* (99) was excluded from the meta-analysis because both Datar and Sood (100) and Evans *et al.* (99) used the same population and sensitivity analysis using Evans *et al.* (99) data instead of Datar and Sood (100) revealed similar findings (Change in slope: -0.07 (95% CI -0.26, 0.12), Change in level at 1 year: -0.63 (-3.95, 2.70), Change in level at 2 years -4.06 (-7.34,-0.77). It was not possible to include data from Sievertsen and Wust (102) in the meta-analysis because the same day discharge policy was introduced at different times in different counties and time series data on rates of readmission were not available by individual county.

Figure 3.8 Forest plots of reanalysed ITS studies for neonatal readmission to hospital within 28 days of birth: change in slope

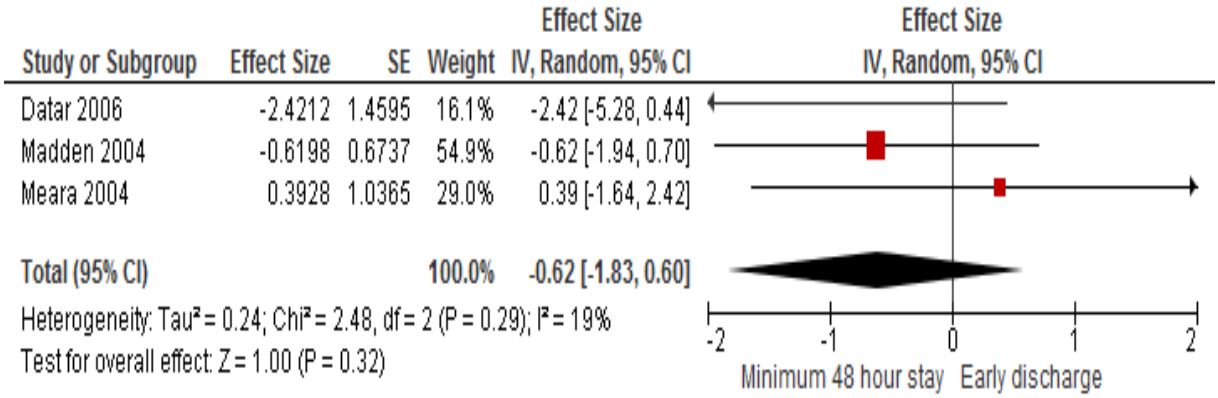


Figure 3.9 Forest plots of reanalysed ITS studies for neonatal readmission to hospital within 28 days of birth: change in level at 1 year post policy

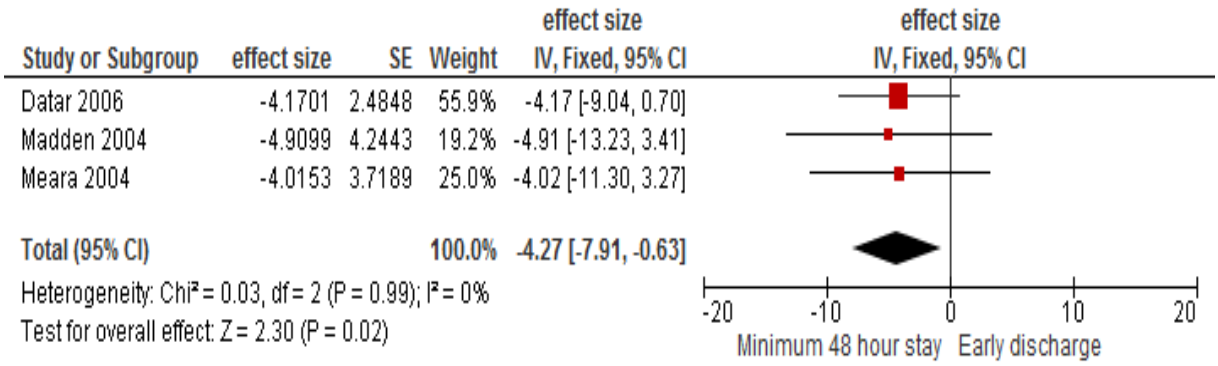
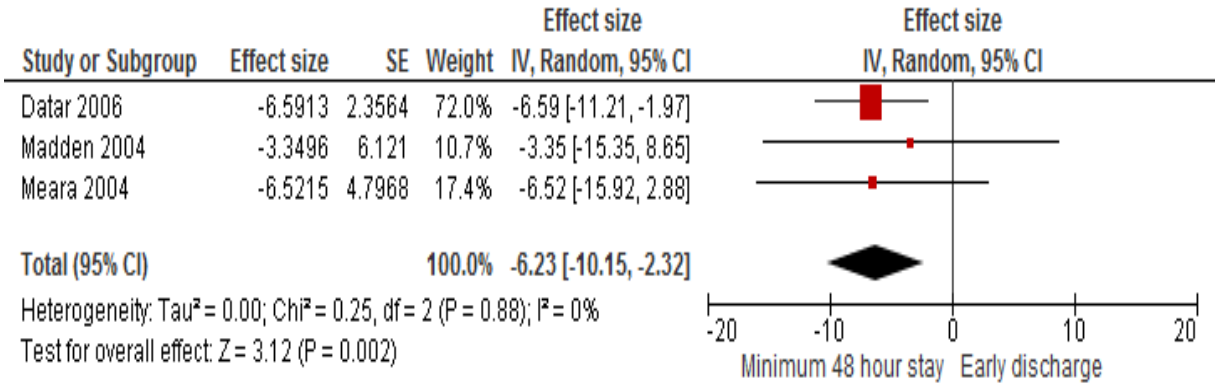


Figure 3.10 Forest plot of reanalysed ITS studies for neonatal readmission to hospital within 28 days of birth: change in level 2 years post policy



3.4.5.3 Cause specific infant readmissions to hospital within 28 days after birth

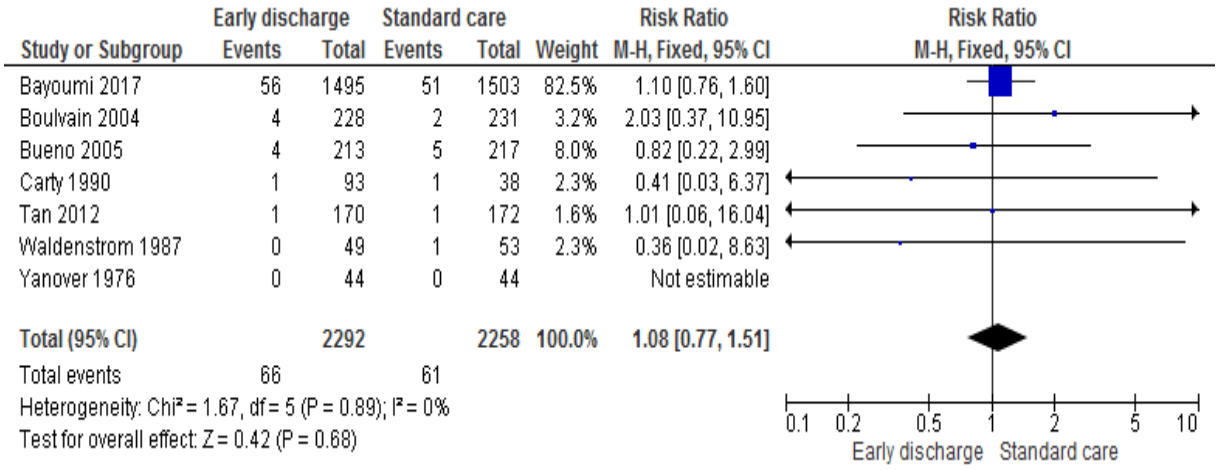
Three of the ITS studies reported on the effect of postpartum legislation on cause specific readmissions to hospital (Appendix 7.3). Datar and Sood (100) found a significant reduction in the odds of readmission for infection related readmissions within 28 days (from -8.7 per 1000 live births in the first year post law, -21.5 ($p < 0.05$) and -30.3 ($p < 0.05$) in the 3 years post law). Datar and Sood (100) also found reduction in odds of readmission (per 1000 live births) for jaundice and respiratory problems although these were not statistically significant at the 5% level. Madden *et al.* (50) found that the rate of readmission for jaundice remained

constant at 0.5% throughout the study period and found that readmission for feeding/dehydration problems were too rare and unevenly distributed to permit reliable statistical analysis. Meara *et al.* (101) found that jaundice admissions increased 0.1% points at start of legislative period (p=0.057 for level change) but fell 0.10% points per quarter from 0.78% to 0.47% by the end of the period (p=0.034 for change in trend).

3.4.5.4 Maternal readmission to hospital within 6 weeks

No statistically significant differences in maternal readmission to hospital within the first 6 weeks were found in the seven trials that reported on this outcome (Figure 3.11) (31, 33, 35-37, 98, 103). The pooled estimate was RR 1.08 (95% CI 0.77-1.51) for readmissions occurring within six weeks after birth (Figure 3.11). When Tan *et al.* (98) and Bayoumi *et al.* (103) were removed in subgroup analysis (due to the lack of co-intervention and only recruiting women who had a caesarean delivery), the conclusion remained unchanged (pooled estimate RR 1.08 (95% CI 0.39-2.77).

Figure 3.11 Forest plot of RCTs for proportion of women readmitted within 6 weeks after birth



The one ITS study that reports on maternal readmission to hospital found that the same day discharge policy for multiparous women who had an uncomplicated birth increased the maternal readmission rate to hospital within 28 days of giving birth by 2.2% points ($p < 0.10$) but this was not statistically significant at the 5% level (102) (Appendix 7.4).

3.4.5.5 Breastfeeding at 48 hours, 6 weeks and 6 months

No significant differences in the proportion of women who were breastfeeding at 48 hours following birth were found in the three trials that reported on this outcome (Figure 3.12). The pooled estimate was RR 1.05 (95% CI 0.99-1.11) for women breastfeeding at 7 days. Due to the presence of significant heterogeneity ($I^2 = 48\%$), data for premature infants was removed although the conclusion for this outcome remained unchanged (pooled estimate RR 1.05, CI 0.99-1.11).

No significant differences in the proportion of women who were breastfeeding between one-two months after birth were found in the eight trials that reported on this outcome (31, 35-38, 40, 98, 103) (pooled estimate RR 1.01 95% CI 0.94-1.09) (Figure 3.13). The conclusion remained unchanged when Tan *et al.* (98) and Bayoumi *et al.* (103) were removed in subgroup analysis (RR 1.05, 95% CI 0.98-1.12). No significant differences in the proportion of women who were breastfeeding at 6 months following birth were found in the three trials that reported on this outcome (31, 35, 36). The pooled estimate was RR 1.18 (95% CI 0.98-1.43) for women breastfeeding partially or exclusively at 6 months postpartum (Figure 3.14).

Figure 3.12 Forest plot of RCTs for proportion of women breastfeeding at 48 hours after birth

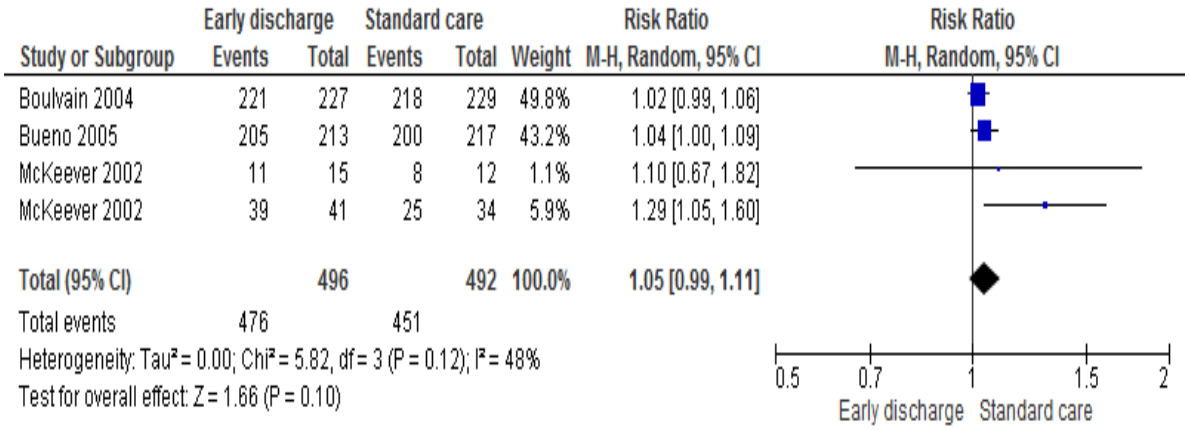


Figure 3.13 Forest plot of RCTs for proportion of women breastfeeding 6 weeks after birth

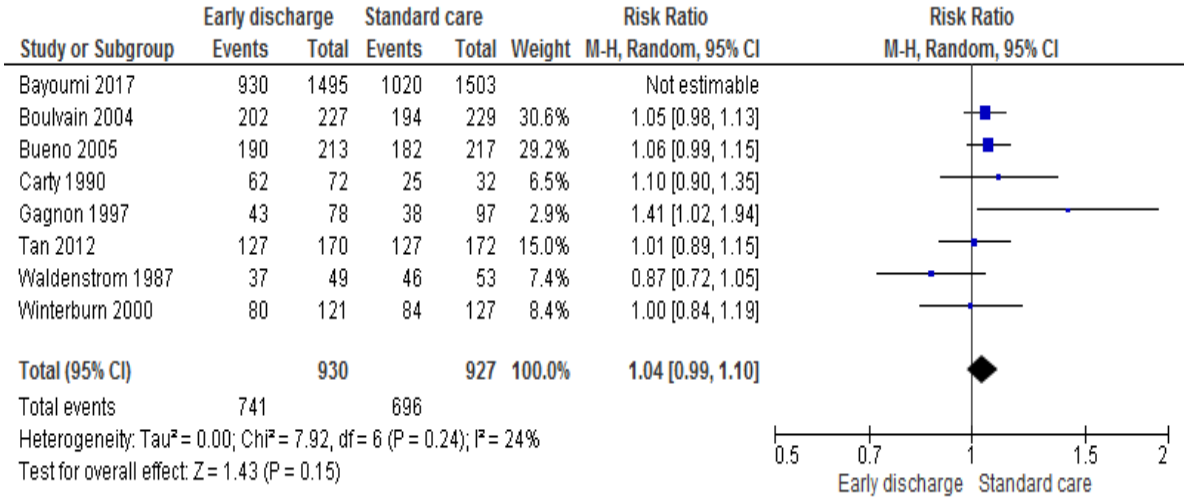
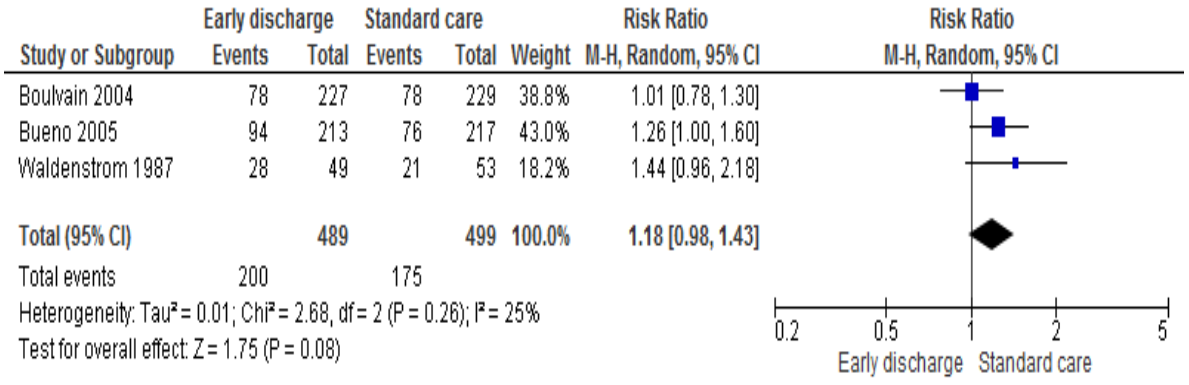


Figure 3.14 Forest plot of RCTs for proportion of women breastfeeding 6 months after birth



Two ITS studies reported on the proportion of infants who were breastfed before and after the implementation of the law (Appendix 7.5). Madden *et al.* (50) found that after adjusting for the long term increase in rate of breastfeeding initiation ($p < 0.0001$ for change in trend) throughout the study period, there was no evidence of an effect of the early discharge program. Nor was there evidence of an effect of the state postnatal law on breastfeeding rates at three months, where continuation amongst women who initiated breastfeeding remained constant at an estimated 76% throughout the study period. Sievertsen and Wust (102) assigned a propensity score (containing indicator variable for whether the other was married, unemployed, employed, in education, higher education degree and maternal age) and found that women in the lowest propensity score sample were less likely to breastfeed exclusively for at least four months if they were discharged on the day of birth (-0.311 $p < 0.05$) but the breastfeeding rates of women in the middle and highest propensity score groups were not affected (-0.213 (SE 0.146) and -0.015 (SE 0.244) respectively.

3.4.5.6 Infant feeding problems within 28 days after birth

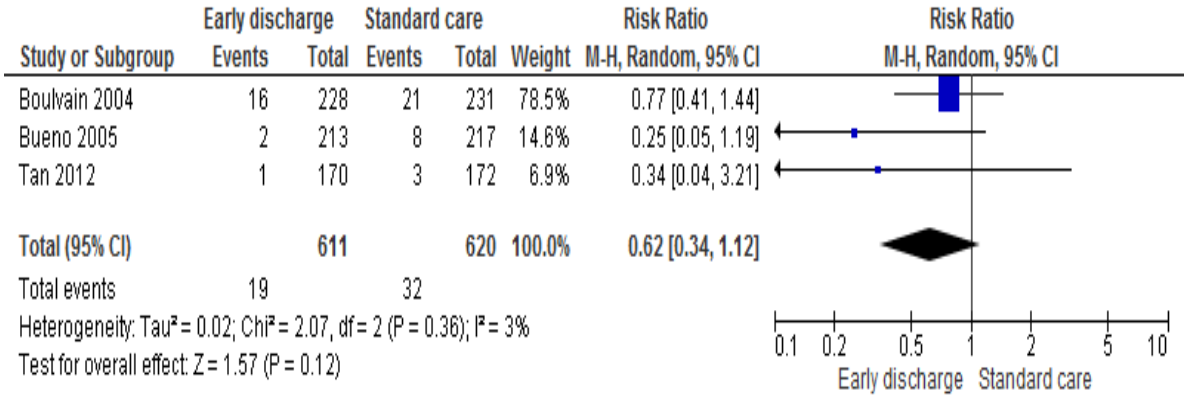
Only one trial assessed the proportion of women reporting infant feeding problems in the first four weeks after birth (35). This trial found a significant difference in the proportion of women reporting infant feeding problems (RR 0.65, 95% CI 0.48-0.89) in the first four weeks after birth in favour of the control group.

3.4.5.7 Maternal depression four weeks after birth

No significant differences in the proportion of women scored above the threshold for depression were found in the three trials that reported on this outcome (35, 36, 98) (Figure 3.15). The pooled estimate was 0.62 (95% CI 0.34-1.12) for women who had been assessed

within the first 6 weeks after birth. The conclusion remained unchanged when Tan *et al.* (98) was removed (pooled estimate RR.056 (95% CI 0.21-1.51).

Figure 3.15 Forest plot of RCTs for proportion of women depressed at 6 weeks



3.4.5.8 Primary care utilisation

Two ITS studies reported on this outcome and results from Madden *et al.* (50) suggest that after adjustment for baseline trend, the early discharge program and law mandate both had an effect on primary care service utilisation (Appendix 7.6). The rate of non-urgent visits to health centre increased by 10.2% points ($p < 0.001$) more than would have been expected had the baseline trend continued after the early discharge program was implemented. The rate of non-urgent visits to health centres slowly decreased by 1% point per quarter ($p < 0.001$) and this continued after the postnatal law mandate. Sievertsen and Wust (102) found that both women and infants attended a GP consultation in the first month after birth following a same day discharge from hospital.

3.4.5.9 Attendances at Emergency Department (ED)

Two ITS studies reported on this outcome and found that attendances at ED departments decreased following introduction of the postnatal minimum stay mandate (Appendix 7.7).

Meara *et al.* (101) found that rates of attendances at ED departments with 10 days of birth correlated with the proportion of infants who were discharged early. There was an increase in ED visits from 2.7% to 3.8% during the pre-legislative period ($p < 0.001$ for trend) and this reversed when the legislation was introduced. In the year after legislation was introduced, ED use within 10 days fell from 4.2% to 3.8% ($P=0.08$ for change in trend) during the legislative period and levelled off during the post legislative period. Madden *et al.* (50) found no sudden changes in the rate of urgent visits to ED departments in either the early discharge program or the state mandate although the rate of urgent visits was 5.2% and increased by 0.2% per quarter during the baseline and early discharge period ($p < 0.001$) and declined by 0.2% per quarter after the mandate ($p = 0.001$).

Two ITS studies reported subgroup analyses for vulnerable women. Madden *et al.* (50) found rates of short stay mirrored those in the overall population averaging 63.4% during the early discharge program and 15.1% after the mandate. Emergency visits within 21 days after birth in the subgroup were the same as those for the overall population during the early discharge program, federal legislative period and post legislative period. The rate of primary care visits within 21 days was 5.7% lower for the vulnerable subgroup before the early discharge program ($p < 0.001$) but was statistically identical to the rate in the overall population both during the early discharge program and after the mandate. Readmission rate to hospital within 21 days remained stable at 1.4% and 1.0% in this subgroup although the authors report that the number of infants admitted were too small to permit statistical analysis. Evans *et al.* (99) found that the federal postnatal law reduced the proportion of Medicaid recipient infants who were discharged early (uncomplicated vaginal birth, complicated

vaginal birth and caesarean section delivery), and this became more pronounced following the state-wide expansion law to include Medicaid recipients in the postpartum law. Evans *et al.* (99) also found a slight reduction in the readmission rate within 7 and 28 days after the law was extended to all Medicaid patients. In all three Medicaid groups, uncomplicated vaginal birth, complicated vaginal birth and caesarean section, readmission rates to hospital within 28 days were lower in post-federal law period by 0.24, 0.42 and 0.35% points respectively.

3.4.6 Sensitivity analyses

Sensitivity analyses allowing loss to follow up in the RCTs were deemed inappropriate given the large proportion of participants who were lost to follow up many trials and considerable variation in how protocol violations were managed. Given the small number of participants in most trials, it was not possible to undertake subgroup analyses to compare the outcomes for antenatal or postnatal recruitment, trials with co-interventions/no co- intervention.

3.5 Discussion

This is the first systematic review to include evidence from both RCTs and ITS studies with a predefined description of early discharge to assess the effect of a policy of early postnatal discharge on health related outcomes. The pooled results of the seven included trials on infant readmission to hospital showed that more infants who were discharged early were readmitted compared to infants in the control group though became non- significant when the largest and most recent trial was removed from meta-analysis. The meta-analysis of ITS studies showed that the United States minimum stay law was effective in producing a policy change for postnatal length of stay in hospital and data shows evidence of a long term

reduction in infant readmission rates within 28 days of birth. It is less clear whether the RCTs show that the policy of early discharge was successful in increasing early discharge due to the large numbers of women in the intervention group choosing to stay longer than assigned in the trail allocation.

This systematic review included two new RCTs which were not included in the existing Cochrane review which was updated in 2010 (3). It also utilised the evidence provided by study designs appropriate for policy intervention, both RCTs and ITS studies and therefore provides a better understanding of the effect of postnatal LoS in both an experimental trial and naturalistic setting. Use of EPOC criteria for selection of studies has enabled a wider range of evidence to be included in the review without compromising the quality of the findings. This review takes advantage of the evidence provided by good quality, well designed ITS studies which in contrast to the RCTs, clearly demonstrated that interventions introducing a policy of early discharge actually resulted in increased early discharge of women and infants. The ITS studies enabled assessment of outcomes of real policy changes and therefore has enhanced our knowledge of infant health outcomes in relation to early postnatal discharge policy in a 'real life' setting.

This is the first known study to carry out ITS meta-analysis on this topic and has provided an insight into the effect of federal and state law across several different state populations in the United States. Inclusion of these studies has also provided an understanding of the health related outcomes for all infants, regardless of medical status or gestation at birth. This review has also clearly defined early postnatal discharge allowing more meaningful comparison across trials.

The definition of early discharge differed slightly for ITS studies with different policies for minimum length of stay following caesarean section (< 96 hours compared to < 48 hours following vaginal birth). It was considered appropriate to include these because they provided valuable evidence on the effects of a policy change on postnatal length of stay.

The weaknesses of this review mirror those in other reviews and reflect poor trial quality and poor reporting. Despite the status of RCTs as the gold standard design for intervention studies, in this area they have already been described as problematic as they feature high rates of post randomisation exclusions, cross over and withdrawal. Many of the trials do not adhere to reporting standards trials in current research practice and therefore, the findings of the RCT data should be treated with caution. Many are of low quality, lacking intention to treat analysis with resultant systematic differences between participants in intervention and control group. Significant differences between the early discharge group and standard length of stay group were found in meta-analysis of trial data for the outcome neonatal readmission, although this significant finding was due to one large study which only included women who had delivered via caesarean section and therefore the application of these findings for infants born vaginally must be interpreted with caution. There were no significant differences in outcome related to maternal readmission, breastfeeding rates or maternal depression which might reflect insufficient power to detect differences given sample attrition.

It was not possible within this review to adequately report the effects of early postnatal discharge on primary care utilisation. Across the trials, it was difficult to ascertain the proportion of mothers and infants who accessed primary care services, outpatient services

and accident and emergency care and there were inconsistent definitions of primary care utilisation and a wide range of measurement methods. Neonatal readmissions are only a proxy for health status, and capture changes in clinical practice, such as threshold for readmissions and testing. The data from ITS studies were also inconsistent, reporting both an increase and decrease in utilisation following the postnatal mandate.

This systematic review has also highlighted direction for future research: there is no evidence to support discharge under 24 hours. In addition, the definition of early discharge for this review (< 48 hours for vaginal birth and < 96 hours for caesarean section) does not reflect the average length of postnatal stay for many high and middle income countries (26). In the UK, in 2014, the average postnatal LoS was 1.4 days and there is an increasing evidence to suggest that some low risk women and infants are being discharged within 6 hours of birth (12). Further research is needed to understand the pathways to readmission and to better understand the impact of postnatal LoS less than 24 hours.

3.6 Conclusion of chapter and summary

This chapter has described the methods and findings of a systematic review exploring the effects of 'early' postnatal discharge on infant and maternal health outcomes. The findings from the meta-analysis and review presented in this chapter show that in a trial setting, early postnatal discharge (< 48 hours following vaginal birth and < 96 hours following caesarean section) increased infant readmission rate to hospital within 28 days of birth. The ITS studies show that a minimum 48 hour stay in hospital policy reduced infant readmission to hospital within 28 days of birth. Furthermore, a law mandating a minimum stay in hospital was effective increasing the length of stay in hospital and was associated with a long term

reduction of neonatal readmission rates to hospital in the first 28 days after birth. The definition of early discharge (< 48 hours following vaginal birth and < 96 hours following caesarean section) is still considerably longer than the average postnatal stay in hospital in many high income countries. This review highlights that there is little or no research that has explored the effect of postnatal LoS < 24 hours. The generalisability and clinical implications of this systematic review in the UK context are described in the discussion (chapter 6).

Chapter 4 Neonatal hospitalisation in the first 28 days after birth: an exploratory cross sectional study of potentially avoidable admissions in England 2008-2014 using Hospital Episode Statistics

Jones E, Taylor B, Rudge G, MacArthur C, Jyothish D, Simkiss D, et al. Hospitalisation after birth of infants: cross sectional analysis of potentially avoidable admissions across England using hospital episode statistics. *BMC Pediatrics*. 2018; 18(1):390 (Appendix 8).

Contributions

The cross sectional study was conceived by EJ, CC, BT and CM. The definition of 'potentially avoidable neonatal admission' was developed by EJ in collaboration with CC, BT, CM and paediatricians, Dr Doug Simkiss (DS) and Dr Deepthi Jyothish (DY). The coding framework for 'potentially avoidable infant admissions' was developed by EJ with support from CC,BT, CM , DS and clinical coding manager at Birmingham Children's Hospital, Paul Allen. Gavin Rudge, Research Fellow at University of Birmingham extracted the data from the published Hospital Episode Statistics data warehouse and created the dataset for the study. EJ prepared the dataset and performed the data analysis. Results were discussed with CM, CC and BT. EJ drafted the paper which was edited by CM, CC, BT, DS, GR and DY.

4.1 Purpose of the Chapter

Chapter 1 described the paucity of literature exploring the age and cause specific reasons for admissions to hospital in children under one year despite the increase in paediatric admissions to hospital across England over the last decade. In order to generate hypotheses about a possible association between length of postnatal stay in hospital and infant readmission, it was necessary to explore the trends and characteristics of infant readmission to hospital. More specifically, there was a need to define conditions which could be considered potentially avoidable in the context of postnatal care. This chapter presents the evidence on the quality and uses of Hospital Episode Statistics (HES) in research. This is followed by the methods and findings from the cross sectional study which describes the incidence, temporal trends and characteristics of 'potentially avoidable neonatal admissions' in the first 28 days after birth in England over the period 2008/09-2014/15. This study was published (5) and this chapter presents the full methods and results of this study.

4.2 Background: Hospital Episode Statistics

Hospital Episodes Statistics (HES) is a database containing details of all inpatient admissions, outpatient and accident and emergency records at NHS hospitals in England (21). HES was originally developed in 1987 to record national coverage of hospital activity and since 2002, has been used to ensure that hospitals are paid for the care provided (108). Initially data are collected during a patient's time at hospital as part of the Commissioning Data Set (CDS). This is submitted to NHS Digital for processing and is returned to healthcare providers as the Secondary Uses Service (SUS) data set and includes information relating to payment for

activity undertaken. Payment by Results data for acute services are also sourced from the SUS database and enables hospitals to be remunerated for the number of patient treatments they perform (109). This database collects routine demographic data, administrative information, geographical information and clinical information based on the World Health Organisation's International Classification of Diseases (ICD) (currently ICD 10) and Classification of Operations and Procedures (OPCS) (22). The ICD and OPCS classification system enables health problems and medical procedures to be systematically recoded from clinicians' medical notes to alphanumeric code (World Health Organisation, WHO 2011).

HES is used for a variety of other purposes including: monitoring of NHS hospital activity trends, assessment of equality of access to healthcare, development and evaluation of government policy and local commission service planning (21). It is evident that a national database of primary and secondary healthcare use in the NHS is tremendously valuable for monitoring healthcare activity, clinical research, and service planning at national and international level. However, some of the limitations of HES, including concerns about its capacity to accurately reflect healthcare activity in the UK due to the accuracy and completeness of the HES record, must also be acknowledged. The quality of HES data in a research context is now described.

4.2.1 Quality of HES data

HES are increasingly used in epidemiological research and are considered to have several advantages (22, 110). Firstly, HES contains all inpatient, outpatient and emergency department medical records and therefore provides a comprehensive insight into secondary healthcare use across England. Secondly, HES are recognised as offering a 'real world setting'

where data are collected in a less intrusive, non-interventional manner and the population outcomes can be defined outside specialised units or university hospitals where the majority of research typically takes place (22). In practical terms, HES data has already been collected and are available electronically and therefore, study results are usually available more quickly than a prospective cohort study or randomised controlled trial. HES data are also easily accessible and relatively inexpensive compared to a prospective study or RCT (108).

Despite the well documented advantages of using HES data for health research, historically, there has been concern about its quality where both the accuracy of the primary diagnostic codes and the overall completeness of the data have been criticised (22, 110-112). To assess the accuracy of HES ICD clinical coding data, several accuracy studies and systematic reviews have been conducted (110, 113, 114). It is reassuring that the most recent systematic review assessing the accuracy of HES ICD codes and procedural codes found that of 32 accuracy studies, the overall mean accuracy of HES data compared to case notes or clinical registries was 83.2% (IQR 67.3-92.1%) (110). The mean diagnostic accuracy was 80.3% (IQR 63.3-94.1%) with a median procedure accuracy of 84.2% (IQR 68.7-88.7%) (110). These findings are consistent with a systematic review which found a median accuracy rate of 84% for the primary diagnosis code (113)and the Audit Commission's findings that the primary diagnosis code inaccuracy rate of 16.5% in 2007/08 and 11.3% in 2009/2010 (114). Burns *et al.* (110) conclude that current levels of reported accuracy suggest that HES is sufficiently robust to support its use in health research. However, researchers need to acknowledge and account for the degree of inaccuracy in routine hospital data research (110). This will be an important consideration when interpreting the findings of the cross sectional study.

Another concern raised about the use of HES in research is the completeness of HES data (22, 110). It has been suggested that variation in data completion over time, between different medical specialities and NHS trusts across the country may confound any study results and limit conclusions about the variation in healthcare outcomes (22, 110). It has been argued that the inaccurate clinical diagnosis codes compromise both the reliability and validity of study results because it is not known whether the any observed differences are attributable to poor data quality or actual changes in healthcare activity (110-112). For example, it is known that completion of data has improved temporally since HES was first introduced meaning that any observed trends in healthcare activity may be partly attributable to different coding practices rather than differences in healthcare activity (115). This variation must be acknowledged when interpreting the results of any study involving HES data (110).

To conclude, HES data are increasingly accepted as a database for health research and suitable for exploratory studies identifying trends in healthcare (108). Evidence from accuracy studies suggests that the accuracy and completeness of the data are improving temporally with the most recent data from NHS digital likely to accurately reflect inpatient healthcare activity in England (108, 110, 114). Despite the reassurance from accuracy studies, there is no consensus on what constitutes or defines an acceptable quality of data for health research (110). Therefore, any data quality issues would be considered when interpreting the results of the cross sectional study. To ensure rigour, the reporting of this study was guided by Sinha's et al's (22) recommendations for reporting parameters for

studies using HES data and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies (116).

4.3 Background: Infant admissions to hospital

As described in Chapter 1, hospital admissions, especially emergency ones place a huge cost on health services (57, 60) and there is evidence from studies using Hospital Episode Statistics (HES) data for England that emergency admissions of children have increased substantially. In England, between 1999 and 2010, all paediatric emergency admissions increased. The greatest increase observed was for infants (under the age of one) and in 2010, over a third of infants had an admission some time in their first year (2). While emergency admissions between 2006 and 2016 increased in all age categories 0-24 years, this was greatest in those under one (59). Short-stay (< 2 days) unplanned admissions among children up to age 10 increased between 1996 to 2006, again with the greatest increase in children less than one (59). A study of infant admission in England using HES data showed that between 2005 and 2014, 5.2% of infants were readmitted unexpectedly within 30 days of postnatal discharge and that the risk of readmission increased by 4.4% annually from 4.4% in 2005 to 6.3% in 2014 (117). Whilst similar trends have been observed in Scotland (118), in the United States and Canada the proportion of hospital stays for children has decreased or remained relatively unchanged over the period 2000-2012 (117, 119). As described in section 1.4, the postnatal length of stay has reduced and following discharge from hospital, women and babies also have fewer visits from community midwifery services before being discharged to the care of the community health visitor and GP (10, 13).

4.4 Aims and Objectives

This cross sectional study aimed to explore the rate and characteristics of infant admissions within the first year of life. It also aimed to investigate whether the increase in infant admissions was predominantly in the early neonatal period and whether it was confined to a sub-group of conditions more sensitive to the quantity and quality of postnatal care, and therefore amenable to intervention earlier in the care pathway.

4.4.1 Objectives

Specific objectives were to:

- Describe the incidence and rate of admissions within 0-6 days, 7-28 days, 1-3 months, 3-6 months, 6-9 months and 9-12 months after birth
- Develop a working definition of 'potentially avoidable admission' in the context of postnatal care provision
- Describe the rate of infants admitted for 'potentially avoidable' conditions
- Generate hypotheses about whether the causes of increase in admissions, including those defined as avoidable, could be linked to postnatal LoS.

As part of the cross sectional study, it was acknowledged that any change in infant admission rates are likely to be multifactorial and may be attributable to changes to: support and information available to parents, changes to parenting choices, thresholds for admission to hospital, community postnatal care provision, and sociodemographic characteristics of the population (2, 56, 59, 88).

4.5 Methods

4.5.1 Study Design

This was an observational cross sectional study design to investigate the incidence of 'preventable neonatal admissions' in England from 2008-2014.

Cross sectional studies are a type of observational study and involve the collection of data from a specific point in time (120). Cross sectional studies are most commonly used for prevalence or incidence studies in health research and although attempts to make causal inferences are not appropriate, cross sectional studies are considered particularly useful for exploring trends in healthcare (108). Cross sectional studies using routinely collected data are also relatively quick and inexpensive to conduct. A cross sectional design was appropriate for this study because the incidence of 'potentially avoidable neonatal admissions' was not known. In order to develop hypotheses about the possible relationship between postnatal length of stay and infant readmissions, as a preliminary step, it was necessary to explore and describe the temporal trends and characteristics of potentially avoidable neonatal admissions to hospital.

4.5.2 Setting

The study setting was England, UK.

4.5.3 Population

All infants under the age of one year admitted to an English NHS hospital as an inpatient in the period 2008-2014.

4.5.4 Data source

- Anonymised Hospital Episode Statistics Admitted Patient Care records 2008/09-2013/14.
- Office for National Statistics (ONS) live birth data 2008-2014

4.5.5 Data definition

An inpatient admission in the HES dataset was defined as a 'continuous inpatient spell' (CIP) . This is the *'continuous time spent in hospital from admission to discharge regardless of any within-hospital transfers'* (121). This may include several 'episodes of care' under the care of several different consultants, nurses or midwives and at various NHS care providers.

4.5.6 Data extraction

All inpatient admissions for infants under the age of 1 year were extracted for the period 2008-2014. This time period was decided a priori and chosen due to data quality issues and the comparability of HES data prior to 2008. The variables extracted to describe each case are described in Table 4.1. To ensure that the dataset did not include admissions occurring straight from birth or within a spell of care that included a birth episode, a unique data extraction inclusion and exclusion criteria were applied.

Table 4.1 Variables included in the dataset

Sex
Admission date
Admission source*
Age on admission
Neonatal age on admission
Admission method **

Hospital trust name
Lower super output area (LSOA)
Spell end date
SUS HRG code
SUS spell identification
Spell duration
Episode order
Episode type ***
ICD 10 diagnoses codes (x20)****
OPCS 4 procedure codes (x24) ****
Ethnicity *****

**Admisource '79' 'babies born on way to hospital were excluded*
*** Only cases with method of admission codes 8,31,32,82,83 were excluded*
**** Cases with a delivery episode were excluded.*
*****Cases with 'Z380' (Singleton, born in hospital) were excluded.*
****** Self-reported in HES*

4.5.6.1 Creating inpatient spells from episodes of care

To create continuous spells from episodes of care, the 'spell identifier' variable was used which is provided from NHS digital and indicates episodes of care that are likely to be linked part of the same spell of care. Clinical diagnosis data were obtained from the final discharge episode of the spell. This method was chosen because using the diagnosis from the admission episode might underestimate the case-mix severity in multi-episode spells. The majority of inpatient spells only have one episode which is both the admission and discharge episode.

4.5.6.2 Additional variables – English Indices of Multiple Deprivation (IMD) and Region in England

Each infant admitted was assigned a Local Authority District and Government Office Region (GOR) of residence based on their Lower Super Output Area (LSOA) of residence. A LSOA is a small unit of United Kingdom census geography (122) and contains a mean resident population of approximately 1600 individuals (122). Currently, there are 32,844 LSOAs in England (122). An index of multiple deprivation 2010 score was assigned to each individual based on the LSOA (123). The index of multiple deprivation (IMD) is an area based score that combines housing, social and economic indicators to indicate the level of deprivation in each area. The income domain score is the one that most accurately reflects material deprivation as it is based on the Government definition of poverty (123). These were converted into quintiles by subdividing the ranks of the 32,480 areas in England, quintile 1 being most deprived and quintile 5 least deprived.

4.5.6.3 Data cleaning and coding errors

Data cleaning processes were conducted by the NHS digital (formally the Health and Social Care Information Centre (HSCIC)) prior to being made available in the published HES data warehouse (124). HES Data cleaning processes included:

- Organisation code mapping to ensure that NHS organisations had the correct code
- Removal of obvious errors (for example, a maternity record in the admitted patient care dataset rather than maternity dataset)
- Validation of codes where codes were reset to the standard invalid codes

Further data cleaning was necessary to identify missing data, duplicate cases and invalid data *(*Table 4.2 and

Table 4.3*).* This was done by formulating frequency tables of all categorical variables and creating histograms for continuous variables to look for any inconsistencies. Duplicate cases were identified by the unique HES patient identifier (HESid), episode reference (epikey) and date of admission (admidate). The HSCIC clinical classification standards were also used to help identify potential coding errors (125). Overall incidence of admission to hospital in the first year of life was checked with existing research and from an earlier version of the dataset which did not link episodes of care to create spells of care.

Ethnicity within HES is self-reported and the 16 Census ethnic groups [10] were merged into five groups to avoid risk of de-anonymisation for any very small groups when merged with the ONS data: white (british, irish, any other white background), asian (indian, pakistani, bangladeshi, any other asian background), black (caribbean, african, any other black background), other (white and black caribbean, white and black african, white and asian, Any other mixed background, chinese, any other ethnic group), not stated (not stated, missing/null).

Table 4.2 Coding errors in the dataset

Coding error	Number of errors	Action
Neodur (continuous data) age of infant if admitted within 28 days of birth	12% cases with a neodur of '0' didn't have a startage that reflected the same age category	Caution on interpretation as 'neodur' is a derived variable and not as accurate as the 'startage' variable

Table 4.3 Missing data

Variable	Number of cases with information missing	% missing in overall dataset
Discharge date	21	< 0.001%
Ethnicity	112727	7%
IMD quintile	18034	1%

4.5.7 Definition - Potentially preventable neonatal admission

This was defined as an admission to hospital within 28 days of birth for a condition or illness which should have been identified before postnatal discharge from hospital, or in the community and adequately treated during birth hospitalisation or through primary care services. Although the neonate may require admission to hospital at the point of contact with secondary care services, the risk of developing the illness may have been reduced or the severity of the illness may have been reduced had the problem been identified and an intervention taken place earlier. This definition was determined in collaboration with clinicians and is described in more detail in the following section (4.5.8).

4.5.8 Selection of conditions/illness for 'potentially avoidable admission'

The process for identifying conditions/illnesses that could be considered potentially avoidable was completed in collaboration with an advisory panel consisting: a consultant paediatrician at a large urban referral paediatric hospital, an associate professor in child health, consultant paediatrician and the clinical coding manager at BCH. Due to the exploratory nature of this study, consensus methods, such as Delphi (126), were not used to develop the definition of an avoidable admission due to time restrictions and availability of

the paediatricians, although it was recognised that further research in this area may benefit from using such methods to enhance this process.

The selection of conditions/illnesses and corresponding coding framework developed iteratively (Figure 4.1). In order to prompt discussion with the paediatricians about which conditions might be considered avoidable in the context of postnatal care, firstly, frequencies of common illnesses/conditions with the relevant ICD-10 codes by age on admission were produced from the dataset. The paediatricians were able to consider the clinical care pathways, in addition to the physiological and aetiological factors of the conditions. Secondly, following the first two meetings, the list of potentially avoidable conditions and corresponding coding framework was refined. Thirdly, meeting with a clinical coder at BCH encouraged discussion about specific HES diagnosis coding rules and standards which were relevant to the dataset (Table 4.4). At the final meeting with the paediatricians, a formal list of conditions and corresponding ICD-10 codes which could be used to identify admissions for within the dataset was agreed.

Figure 4.1 Process for identifying potentially avoidable admissions and development of the coding framework

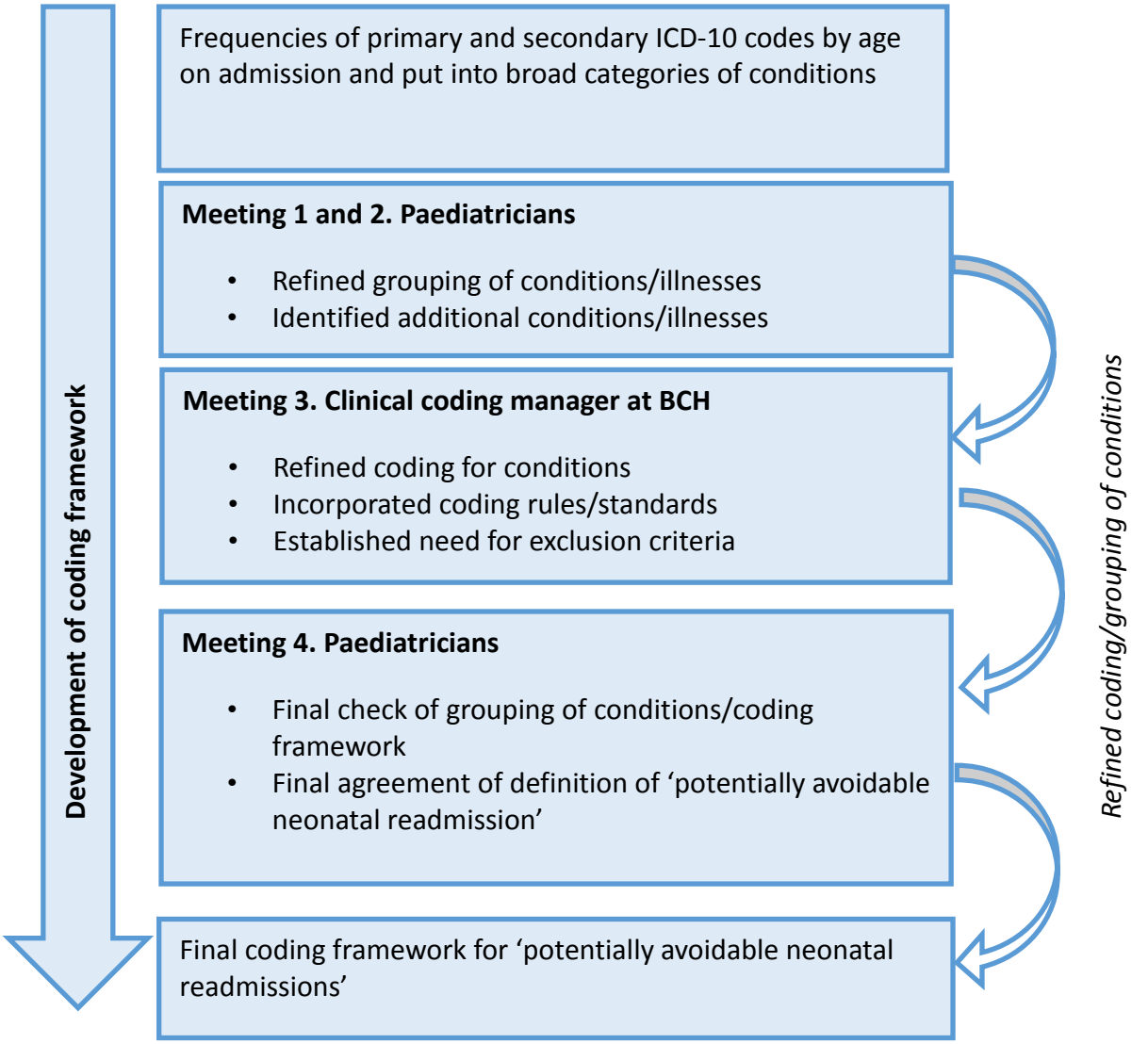


Table 4.4 General HES coding standards relevant to the coding framework

Coding rule	Description	Application
Primary diagnosis field -The first diagnosis field of the coded clinical record**.**	Should contain the main condition treated or investigated during the episode of healthcare.	Primary diagnosis code should be considered the most reliable code for describing the condition because it is used for the PbR system.
Signs and Symptoms- symptoms, signs, abnormal results of clinical or other investigative procedures, and ill-defined conditions regarding which no diagnosis classifiable elsewhere is recorded.	Where a definitive diagnosis has not been made by the responsible clinician, the main symptoms, abnormal findings or problem should be recorded in the first diagnosis field. Coders should also code any other relevant information.	Where the primary diagnosis code is a symptom or sign of illness from ICD 10 classification (chapter 18), primary and secondary codes will be explored as 'combined codes'. E.g. an admission for gastroenteritis could be identified if both 'R11X' Nausea and vomiting and 'R509' Fever unspecified are present.
Comorbidities - Any condition which coexists in conjunction with another disease that is currently	Any comorbidities defined in the HSCIC clinical coding standards should be recorded alongside the primary diagnosis	Relevant comorbidities: Jaundice 'R17X' Dehydration 'P741'

Coding rule	Description	Application
being treated at the time of admission or developed subsequently and that affects the management of the patient's current episode.	as these comorbidities will always affect the management of the patient's current consultant episode	Caution on interpretation as incidence for these conditions may be higher when all diagnosis codes are used to select cases.
ICD 10 – Dual Coding Where two codes are used to describe the reasons for the current episode of care	When a code from injury, poisoning or other adverse event (ICD 10 Chapter 19) is coded in the primary diagnosis field, a code from chapter 20, (external causes of morbidity) must be added after the code to describe the injury, poisoning or other adverse event.	To identify admissions for home accidents, all diagnosis fields as several injuries may have taken place. To select these admissions, a primary code beginning with 'S00-T98' should be searched for an additional diagnosis code beginning with 'W00-Y34' and ending in '0' to indicate that the accident took place at home.
P coding – coding system for infants	Must be used for infant admitted before 28	Include P codes in the coding framework in addition to

Coding rule	Description	Application
< 28 days	days old	other ICD 10 codes describing the same condition for infants > 28 days. E.g. ‘R17X’ would be coded for infants aged > 28 days but will be coded as ‘P599’ if infant is < 28 days.

4.5.9 Development of the coding framework

The coding framework comprised the primary and secondary ICD-10 diagnosis codes (4th edition, version 2008, 2010 and 2014), primary and secondary OPCS4 codes (version 4) and method of admission codes with consideration to NHS Digital coding rules and standards (Table 4.4). Table 4.5 describes the rationale for choosing these variables. It was decided that age on admission would not be used in the coding framework because it enabled exploration of the validity of the coding framework to identify relevant cases. If codes within the framework had extracted many admissions for infants > 28 days, it indicated that the coding framework was incorrect.

Table 4.5 Variables used in coding framework to select potentially avoidable admissions

Variables	Rationale	Example
ICD10 diagnosis codes	This will describe the reason/cause of admission. The primary and secondary diagnosis codes will be used in the coding framework. Although the primary diagnosis in HES is considered the most reliable and accurate record of the reason for admission to hospital (110, 114), the secondary diagnosis code may describe an underlying chronic condition and may help to indicate whether the primary cause for admission was manageable in primary care and potentially avoidable or not. The exclusion criteria were unique for each condition, although all preterm infants were excluded from the case definitions because the focus of the study was on infants who were born at term. Exclusions were identified either at the three or four digit character level of the	An infant admission for 'underfeeding of the newborn' may be considered potentially avoidable in the context of postnatal care, however, if the secondary diagnosis indicated that the infant also had a cleft lip and palate, it is reasonable to assume that there was a was real clinical need for additional support for the infant and was therefore an unavoidable admission.

Variables	Rationale	Example
	ICD-10 or OPCS classification.	
OPCS4 codes	The OPCS (4th revision, OPCS4) classification is used to record details of any procedures or interventions performed (for example, phototherapy). For some conditions, an OPCS4 code could be used in the coding framework to identify cases of the condition. Cases may also be excluded using an OPCS4 code which indicated an underlying medical condition or differential diagnosis.	Excision of bile duct (OPCS4 code 'J279') would only be used to correct the congenital abnormality 'biliary atresia' and therefore could be used to identify pathological jaundice. An admission with a primary diagnosis of 'jaundice, unspecified' and an OPCS4 code 'excision of the bile duct' indicates that the infant has a biliary atresia , and therefore a pathological cause of jaundice.
Method of admission codes	This will differentiate elective admissions from emergency admissions. The aim of the study was to identify unplanned admissions, however, some elective admissions for certain conditions were also relevant. The inclusion and exclusion of cases based on method of admission codes	Admissions for frenulotomy ('F2620') to correct a tongue tie may have be planned prior to admission and therefore coded as an elective admission. This sort of admission should not be excluded from the coding

Variables	Rationale	Example
	were considered separately for each condition.	framework for feeding difficulties.

4.5.10 Data storage, governance and ethics

An application to NHS Digital (formally Health and Social Care Information Centre, HSCIC) to hold a national extract of admitted patient care data was approved by the Data Access Advisory Group at the HSCIC. A self-assessment form was submitted to University of Birmingham Ethics Committee indicating that access to the data had been granted. The research team were compliant with the Department of Health Information Governance Toolkit and the HES data was held on a system with an approved system level security protocol. The data were anonymised and no information that could potentially allow a patient to be identified was included in any report or publication.

4.5.11 Analyses

Statistical Package for the Social Sciences (SPSS) version 22 (127) was used to analyse all infant admissions. Summary statistics were used to describe the proportion of avoidable infant admissions in 0-6 days and 7-28 days, 1 to under 3 months, 3 to under 6 months, 6 to under 9 months and 9 to 12 months after birth by condition/illness, ethnicity, deprivation indices, region in England and year of admission. Frequency of admissions by hospital trust was also explored in addition to exploring readmission rates. Unadjusted annual infant admission rates and annual rates for specific conditions and 95% confidence intervals were calculated by (number admissions for each year /number live births 2008-09) x 100. Change in admission rates were calculated as follows: (rate in 2013-14/rate in 2008-09) x 100. Where appropriate, Cochrane Armitage tests for trend were conducted to assess significance of the year on year trend over the 6 year period. A sample size calculation was not necessary due to the exploratory and descriptive nature of the study. The following sensitivity analyses

were conducted: comparison of the rates of admissions by episodes of care versus spells of care and selecting the primary diagnosis code versus all diagnostic codes. The following sensitivity analyses were conducted: comparison of the rates of admissions by episodes of care versus spells of care and selecting the primary diagnosis code versus all diagnostic codes.

4.6 Results

There were 1,387,677 admissions in the first year of life and 4,063,050 live births from 1st April 2008 to 31st March 2014. The overall rate of admission increased significantly over the period from 335.0 (95% CI 333.8, 336.1) to 354.6 (95% CI 353.6-355.9) per 1000 live births (Table 4.6). Infants born in 2013/14 had 1.06 times the risk of being admitted to hospital within the first year of life compared to infants born in 2008/09 (Relative risk 1.06, 95% CI 1.05-1.06). Infants who had one admission were 47% more likely to be readmitted at least once more within the first year of life. The increase in admissions was most marked for the 0-6 day age category where admission rate increased from 26.39 per 1000 live births (95% CI 26.01-26.78) in 2008/09 to 33.31 per 1000 live births in 2013/14 (95% CI 32.88-33.74) ($p < 0.0001$). Infants born in 2013/14 had 1.26 times the risk of being admitted within the first 6 days of life compared with infants born in 2008/09 (Relative risk 1.26, 95% CI 1.24-1.29) (Figure 4.2).

Admission rates also varied considerably by ethnicity where the highest rate of admission was in the 'not stated' ethnicity category (528.22 per 1000 live births (95% CI 525.93-530.52) compared to 216.85 per 1000 live births (95% CI 215.11-218.60) in the black ethnicity category.

The rate of admission for the potentially avoidable conditions increased by 39% from 39.79 to 55.33 per 1000 live births. In the 0-6 day age category the increase in admissions to hospital for these three conditions from 12.36 to 18.23 per 1000 live births contributed 85% of the increase in admission rate (Table 4.7). The rate of admission for infants under 7 days increased by 6.92 per 1000 live births (RR 1.26, 95% CI 1.24-1.29) however, once the potentially avoidable admissions were removed the rate only increased by 1.05 per 1000 live births (RR 1.07 95% CI 1.04-1.10) (Table 4.7).

Figure 4.2 Age specific infant admission rate per 1000 live births to hospitals in England by year of birth 2008/09-2013/14

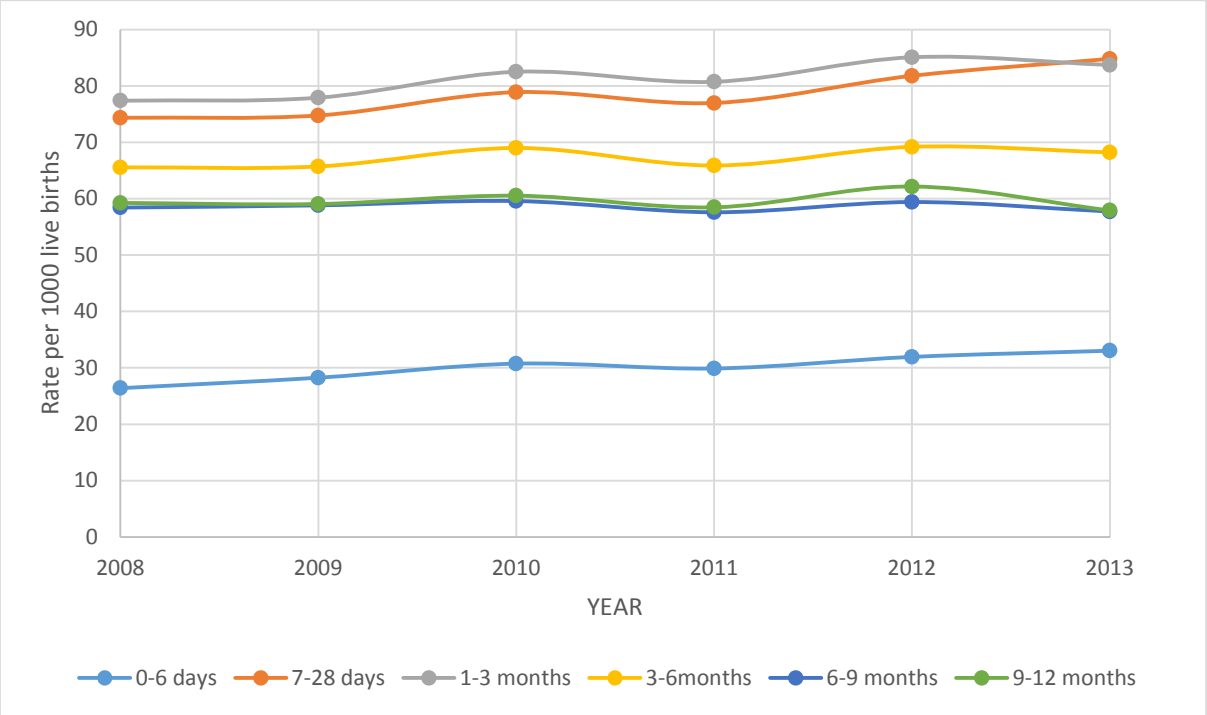


Table 4.6 Number and incidence (per 1000 live births) of infants admitted by year of birth and age group in England 2008/09-2013/14

Year	Total No. admissions	No. Live births	Rate* (95% CI)	Age specific rates of admissions per 1000 population (95% CI)					
				0-6 days	7-28 days	1-3 months	3-6 months	6-9 months	9-12 months
2008/09	223735	667932	334.97 (333.83-336.10)	26.39 (26.01-26.78)	47.96 (47.44-48.47)	77.38 (76.74-78.02)	65.56 (64.97-66.15)	58.43 (57.86-58.99)	59.25 (58.69-59.82)
2009/10	225130	674949	333.55 (332.43-334.68)	27.96 (27.56-28.35)	46.81 (46.30-47.31)	77.11 (76.47-77.74)	65.04 (64.45-65.63)	58.20 (57.65-58.76)	58.44 (57.88-59.00)
2010/11	235288	682892	344.55 (343.42-345.67)	30.07 (29.66-30.47)	48.82 (48.31-49.33)	80.69 (80.05-81.34)	67.49 (66.89-68.08)	58.27 (57.72-58.83)	59.20 (58.64-59.76)
2011/12	228534	689582	331.41 (330.30-332.52)	28.95 (28.55-29.34)	48.03 (47.52-48.53)	78.20 (77.56-78.83)	63.81 (63.24-64.39)	55.78 (55.24-56.32)	56.64 (56.09-57.18)
2012/13	240090	685174	350.41 (349.28-351.54)	31.14 (30.73-31.55)	50.66 (50.14-51.18)	82.94 (82.29-83.59)	67.46 (66.86-68.05)	57.91 (57.36-58.47)	60.59 (60.03-61.16)
2013/14	234900	662521	354.55 (353.59-355.89)	33.31 (32.88-33.74)	51.49 (50.96-52.02)	84.40 (83.73-85.07)	68.77 (68.16-69.38)	58.19 (57.63-58.76)	58.39 (57.82-58.93)
Cochran Armitage test for trend			775.7362 (p < 0.0001)	611.4452 (p < 0.0001)	166.0960 (p < 0.0001)	959.3922 (p < 0.0001)	58.8150 (p < 0.0001)	3.7260 (p=0.0536)	0.0190 (p=0.8904)

Table 4.7 Frequency and rate (per 1000 live births) of admission for infants aged 0-6 days in England 2008/09-2013/14 (overall and

YEAR	overall No. admissions	No. avoidable conditions	No. live births	rate* overall admission	admission rate* for potentially avoidable conditions
2008/09	17629	8257	667932	26.39	12.36
2009/10	18869	8798	674949	27.96	13.04
2010/11	20534	9932	682892	30.07	14.54
2011/12	19962	10313	689582	28.95	14.96
2012/13	21334	11373	685174	31.14	16.60
2013/14	22067	12079	662521	33.31	18.23

potentially preventable conditions (physiological jaundice, feeding difficulties and gastroenteritis).

per 1000 live births

For physiological jaundice there were a total of 73,403 admissions over the study period, the rate of admission increasing from 16.30 (95% CI 16.00-16.61) to 22.35 (95% CI 21.99-22.70) admissions per 1000 live births ($p < 0.0001$) (Table 4.8). The admission rate in 2013/14 was 1.37 times the risk of being admitted in 2008/09 (RR 1.37 95% CI 1.34-1.40), an absolute risk increase of 6 per 1000 live births. The increase was concentrated in the 0-6 day category where the admission rate rose from 8.40 to 12.45 per 1000 with statistically significant increases confined to the first 28 days (Table 4.8). The duration of hospital admission for physiological jaundice was short with a median length of stay of 1.6 days. The vast majority of infants (94%) admitted for physiological jaundice had a hospital stay ≤ 3 days.

The admission rate for physiological jaundice differed significantly by gender: 44,153 male infants (21.20 per 1000 live births (95% CI 21.03-21.37) were admitted over the period compared to 29,251 female infants (14.77 per 1000 live births (95% CI 14.63-14.92). The infant admission rate for physiological jaundice varied by IMD quintile (Table 4.9), the lowest in the most deprived quintile (16.97 per 1000 live births, 95% CI 16.73-17.21). The rate of admission for physiological jaundice differed by ethnicity (Table 4.9).The lowest rate was for black infants where the rate was 6.97 per 1000 live births (95% CI 6.62-7.33) and the rate of admission was four times higher for infants with an ethnicity code 'not stated' (26.14 per 1000 live births, 95% CI 25.41-26.87) (Table 4.9).

The admission rate for feeding difficulties rose from 11.35 (95% CI 11.10-11.60) per 1000 live births in 2008/09 to 13.12 (12.85-13.40) in 2013/14 ($p < 0.0001$) (Table 4.8). The age specific admission rate for feeding difficulties varied considerably over the period. The largest increase in risk of admission over the period was in the 0-6 day age category where there

was a 46% increase in 2013/14 compared with 2008/09 (RR 1.46, 95% CI 1.39-1.54) ($p < 0.0001$). Admissions to hospital for feeding difficulties after one month of age were much less common and the rate consistently decreased with age up to one year (Table 4.8). The median length of admission for feeding difficulties was 1 day and the majority of infants (91.7%) had an admission of 3 days or under. There was no significant difference in the rate of admission by gender: the rate for male infants was 12.57 per 1000 live births (95% CI 12.42-12.72) compared to 12.37 per 1000 live births (95% CI 12.22-12.53) for females (Table 4.9). There was a small but significant difference in the admission rate for feeding difficulties by IMD quintile with the lowest rate in the most deprived quintile 11.31 per 1000 live births, (95% CI 11.11-11.50). The lowest rate of admission was observed for black infants (6.59 per 1000 live births, 95% CI 6.26-6.94) compared to 16.69 in the 'not stated' ethnicity category (95% CI 16.10-17.28) (Table 4.9).

For gastroenteritis the rate of infant admission per 1000 live births rose from 12.14 in 2008/09 (95% CI 11.88-12.40) to 19.86 (95% CI 19.52-20.19) ($p < 0.0001$). The rate of admission for gastroenteritis significantly increased across all age categories but admission was least frequent in infants in the first 28 days. It was greatest in the 9-12 month age category, although infants aged 1-3 months had the largest relative increase in risk of admission (RR 2.04, 95% CI 1.90-2.19) from 2008/09-2013/14 (Table 4.8). The median length of stay was less than one day and 96.8% infants were discharged within 3 days. There was a small but significant difference in rate of admission for gastroenteritis by gender; the rate for male infants was 15.73 per 1000 live births (95% CI 15.56-15.90) and 14.07 (95% CI 13.90-14.23) for female infants. The highest rate was noted in the most deprived IMD quintile

(17.01 per 1000 live births, 95% CI 16.77-17.25) (Table 4.9). There was also considerable variation by ethnicity, where the rate of admission per 1000 live births was more than double for infants with 'not stated' ethnicity, 18.04 per 1000 live births, (95% CI 17.43-18.65) compared to 8.31 per 1000 live births (95% CI 7.92-8.69) (Table 4.9)

The number of admissions for the conditions identified as potentially avoidable varied considerably with high numbers of admissions to larger specialist paediatric hospitals.

Table 4.8 Number and incidence (per 1000 live births) of infant admissions for potentially preventable conditions for infants by year and age group on admission in England 2008/09-2013/14

Year	No. admissions	Rate per 1000 live births (95% CI)	Age specific rates of admissions per 1000 live births (95% CI)					
			0-6 days	7-28 days	1-3 months	3-6 months	6-9 months	9-12 months
Gastroenteritis								
2008/09	8108	12.14 (11.88-12.40)	0.02 (0.01-0.03)	0.38 (0.33-0.43)	1.77 (1.67-1.87)	2.48 (2.36-2.60)	3.37 (3.23-3.51)	4.11 (3.96-4.26)
2009/10	8257	12.23 (11.97-12.50)	0.01 (0.00-0.02)	0.35 (0.31-0.40)	1.80 (1.70-1.90)	2.43 (2.31-2.54)	3.53 (3.39-3.68)	4.11 (3.95-4.26)
2010/11	7785	11.40 (11.15-11.65)	0.01 (00.00-0.010	0.28 (0.24-0.32)	1.56 (1.46-1.65)	2.46 (2.34-2.58)	3.20 (3.07-3.34)	3.89 (3.75-4.04)
2011/12	7859	11.40 (11.15-11.65)	0.01 (0.00-0.01)	0.26 (0.22-0.30)	1.55 (1.46-1.64)	2.34 (2.23-2.45)	3.27 (3.14-3.41)	3.96 (3.81-4.11)
2012/13	15451	22.55 (22.20-22.90)	0.04 (0.03-0.06)	0.58 (0.53-0.64)	3.61 (3.47-3.76)	4.58 (4.42-4.74)	6.24 (6.06-6.43)	7.49 (7.29-7.69)
2013/14	13155	19.86 (19.52-20.19)	0.03 (0.02-0.05)	0.56 (0.50-0.61)	3.61 (3.47-3.75)	4.32 (4.16-4.47)	5.30 (5.12-5.47)	6.04 (5.86-6.23)
Cochran Armitage test for trend:		3170.9178 (p=0.000)	10.2750 (p= 0.013)	57.4530 (p=0.0000)	805.7172 (p=0.0000)	748.2772 (p=0.0000)	742.1982 (p=0.0000)	779.7762 (p=0.0000)
Physiological jaundice								
2008/09	10890	16.30 (16.00-16.61)	8.40 (8.18-8.62)	6.14 (5.95-6.32)	1.66 (1.56-1.76)	0.02(0.01-0.04)	0.05 (0.03-0.07)	0.03 (0.02-0.05)
2009/10	10637	15.76 (15.46-16.06)	8.22(8.01-8.44)	5.93 (5.74-6.11)	1.54 (1.45-1.64)	0.02 (0.01-0.03)	0.03 (0.02-0.02)	0.01 (0.01-0.02)
2010/11	11305	16.56 (16.25-16.86)	8.96 (8.73-9.18)	6.16 (5.98-6.35)	1.37 (1.28-1.46)	0.02(0.01-0.03	0.02 (0.01-0.04)	0.01 (0.02-0.02)

Year	No. admissions	Rate per 1000 live births (95% CI)	Age specific rates of admissions per 1000 live births (95% CI)					
			0-6 days	7-28 days	1-3 months	3-6 months	6-9 months	9-12 months
2011/12	11947	17.33 (17.02-17.63)	9.35 (9.12-9.58)	6.76 (6.57-6.95)	1.42 (1.36-1.51)	0.02 (0.01-0.04)	0.04 (0.02-0.05)	0.02 (0.01-0.04)
2012/13	13823	20.17 (19.84-20.51)	10.80 (10.59-11.05)	7.65 (7.44-7.85)	1.63 (1.53-1.72)	0.04 (0.03-0.05)	0.04 (0.03-0.06)	0.02 (0.01-0.03)
2013/14	14806	22.35 (21.99-22.70)	12.45 (12.19-12.27)	8.22 (8.00-8.36)	1.61 (1.51-1.71)	0.02 (0.01-0.03)	0.03 (0.02-0.04)	0.02 (0.01-0.03)
Cochran Armitage test for trend:		1053.1403 (p < 0.000)	800.999 (p=0.0000)	430.788 (p=0.0000)	0.0260 (p=0.8719)	0.4890 (p=0.4844)	1.4770 (p=0.2242)	1.3500 (p=0.2453)
Feeding difficulties								
2008/09	7581	11.35 (11.10-11.60)	3.94 (3.79-4.09)	4.14 (3.99-4.29)	2.06 (1.95-2.16)	0.77 (0.70-0.83)	0.28 (0.24-0.33)	0.16 (0.13-0.19)
2009/10	8046	11.92 (11.66-12.18)	4.80 (4.63-4.96)	4.12 (3.96-4.27)	1.93 (1.82-2.03	0.68(0.62-0.74)	0.24 (0.21-0.28)	0.15 (0.12-0.18)
2010/11	8784	12.86 (12.60-13.13)	5.58 (5.40-5.75)	4.27 (4.15-4.43)	1.97 (1.87-2.08)	0.70 (0.64-0.77)	0.22 (0.18-0.25)	0.12 (0.10-0.15)
2011/12	8879	12.88 (12.61-13.14)	5.60 (5.43-5.78)	4.23 (4.08-4.39)	1.95 (1.8-2.05)	0.74 (0.68-0.81)	0.23 (0.19-0.26)	0.13 (0.10-0.15)
2012/13	8706	12.71 (12.44-12.97)	5.75 (5.74-5.93)	4.10 (3.95-4.25)	1.80 (1.70-1.90)	0.70 (0.64-0.77)	0.21 (0.18-0.24)	0.14 (0.11-0.17)
2013/14	8694	13.12 (12.85-13.40)	5.75(5.56-5.93)	4.29 (4.14-4.45)	1.91 (0.81-2.02)	0.79 (0.73-0.86)	0.25 (0.21-0.29)	0.12 (0.10-0.15)
Cochran Armitage test for trend:		97.70 (p< 0.0001)	260.5501 (p=0.0001)	54.0300 (p=0.0000)	6.1920 (p=0.0128)	0.6870 (p=0.4072)	2.7600 (p=0.0966)	3.3200 (p=0.0684)

Table 4.9 Number and incidence (per 1000 live births) of infant admissions for potentially preventable conditions by ethnicity, gender and IMD quintile 2008/09-2013/14

	Feeding difficulties		Gastroenteritis		Physiological Jaundice	
	No admissions	**Rate (95% CI)**	**No admissions**	**Rate (95% CI)**	**No admissions**	**Rate (95% CI)**
Ethnicity*						
White	37746	12.81 (12.68-12.94)	47616	16.16 (16.01-16.30)	51082	17.34 (17.19-17.48)
Asian	5102	12.19 (11.86-12.52)	4570	10.92 (10.60-11.23)	9517	22.74 (22.28-23.19)
Black	1415	6.59 (6.25-6.94)	1783	8.31 (7.92-8.69)	1497	6.97 (6.62-7.33)
Other	3391	11.26 (10.89-11.64)	3365	11.18 (10.80-11.55)	6556	21.78 (21.26-22.30)
Not stated	3036	16.69 (16.10-17.28)	3282	18.04 (17.43-18.65)	4756	26.14 (25.41-26.87)
Gender						
Male	26183	12.57 (12.42-12.72)	32761	15.73 (15.56-15.90)	44153	21.20 (21.03-21.37)
Female	24502	12.37 (12.22-12.53)	27854	14.07 (13.90-14.23)	29251	14.77 (14.63-14.92)
IMD Index*						
1	12708	11.31 (11.11-11.50)	19122	17.01 (16.77-17.25)	19077	16.97 (16.73-17.21)
2	10860	11.89 (11.67-12.11)	13967	15.29 (15.04-15.55)	16111	17.64 (17.37-17.91)
3	9899	13.14 (12.82-13.40)	10903	14.47 (14.20-14.74)	14084	18.69 (18.39-19.00)
4	8952	13.63 (13.35-13.91)	8953	13.63 (13.35-13.91)	12367	18.83 (18.50-19.16)
5	7995	12.99 (12.71-13.27)	7254	11.78 (11.51-12.05)	11245	18.27 (17.93-18.60)

**** Missing data:***
Gastroenteritis: 0.7% IMD index, 0.6% Ethnicity
Physiological Jaundice: 0.9% IMD index, 0.6% Ethnicity
Feeding difficulties: 0.8% IMD index, 0.4% ethnicity

4.7 Discussion

The rate of hospital admission in the first year of life for the three conditions identified as potentially preventable increased by 39% relative to an overall increase of 6%. Over the first year, the biggest increase in admissions occurred in the first 0-6 days and 85% of the increase in this period was for the identified potentially preventable conditions of jaundice, feeding difficulties and gastroenteritis for which admissions rose from 12.36 to 18.23 per 1000 live births.

This study used a large routinely collected national dataset and a robust method to develop a working definition of 'potentially avoidable' infant admissions in the context of postnatal care provision, drawing on the expertise of paediatricians, research data analysts and clinical coders. The potentially avoidable conditions were pre specified prior to calculation of admission rates. The coding framework used to identify such admissions incorporated inclusion and exclusion criteria to ensure that infants with underlying conditions were excluded from the sample population (for example, infants born with cleft lip and palate, and subsequent feeding difficulties). It is reassuring that the incidence of admissions for physiological jaundice and feeding difficulties over the age of 3 months was very small, suggesting that the selection of codes for these conditions was accurate. Although a systematic review of coding accuracy studies suggested that HES data has improved significantly over time (110), it is unlikely that this would have affected our study findings because the NHS Payment by Results system, a key driver for improving HES data accuracy, had been fully implemented by 2007 (109, 128).

HES is widely accepted as a database for health research and suitable for studies identifying trends in healthcare (108), although there are a number of limitations. The ethnicity variable was not as complete as other data fields with 7% of infant admissions having a 'missing' or 'not known' code. Previous research has indicated that missing ethnicity data may not be random and instead relates to service pressures, a lack of opportunity for health professionals enquiry or the circumstances of hospital admission (129, 130). Additionally, the broad denominator ethnicity categories necessary to maintain confidentiality prohibited a thorough assessment of admission rates by ethnicity. It was not possible to explore hospital level admission rates because denominator data were not available at hospital level but it was anticipated that variation would be affected by patient and hospital level factors. Finally, we did not have data on smoking status and breastfeeding status.

Use of age specific admission rates for infants under one year showed that the increase in admission over the period 2008 to 2014 only existed within the first 6 months of life, and had increased most in the 0-6 day category. The admission rate for infants from 6-12 months remained stable over the period. Our findings are consistent with those of other studies that explore unplanned infant admissions to hospital (59). It is also consistent with the literature in finding that the rate of admissions varied by IMD (131). The overall admission rate to hospital by IMD quintiles supports existing evidence that admission rates are strongly correlated with measures of social deprivation (131). For admission rates for jaundice and feeding difficulties however the admission rate was highest in the least deprived quintiles and may reflect variation in infant feeding practices with women in the least deprived quintiles more likely to breastfeed. Inability to initiate and establish

breastfeeding resulting in an insufficient milk supply is a known risk factor for physiological jaundice (30). Exclusive initial breastfeeding initially rose from 65% in 2005 to 69% in 2010 when 46% of babies were still exclusively breastfed at one week (132). While breastfeeding may be a factor influencing the trends seen, it does not provide a sufficient explanation of them. Increases in admission rates for gastroenteritis showed a different pattern from jaundice and feeding difficulties as the increase for this was greatest in infants after the first month and may possibly be related to feeding practices and insufficient support for infant feeding.

The change in infant admission rates we observed over the period was concentrated in those under 7 days of age and for the potentially avoidable conditions, particularly jaundice and feeding difficulties. In England over a similar period of time women and infants have had less routine contact with health professionals as the length of stay in hospital after birth and the median community visits following discharge from birth has reduced (13, 23). Over the period of this study, the average postnatal length of stay hospital reduced slightly from 1.7 days in 2008/09 to 1.5 days in 2013/14) (1) . Several large surveys of women's experiences of postnatal care have shown that a large proportion felt that they needed more support, particularly establishing breastfeeding (8, 10, 52, 53). Although temporal association does not prove causation, the increase in admissions may in part prove to be attributed to changes in the postnatal care provision and management of neonates in the community. Other possible causes to the increase observed in this study include an increase in parents being advised by NHS 111 system to take their child to be assessed at hospital, and a decrease in training and experience for doctors to assess young infants in community health

settings (2). If the reduction in postnatal care provision does have a part to play in the increase in infant admission rate, the current National Maternity Review in England (133) aimed at transforming maternity services has the opportunity to ensure that women's needs are being met prior to discharge from hospital. It could also ensure that women are able to have more effective community provision including more frequent home visits where needed and easy access to midwifery advice in order to identify potential infant health problems to improve this situation. The clinical implications and research opportunities of this study are described in section 6.5 and 6.7 respectively.

4.8 Summary and conclusion of chapter

This chapter has presented the cross sectional study which explored the age and condition specific rates of infant admissions over the period 2008/09-2013/14 and investigated whether there was an ecological association between postnatal LoS and infant readmissions to hospital. It was based on a clinical view that some admissions may be related to the trend in shorter postnatal LoS, potentially avoidable and amenable to interventions earlier in the postnatal care pathway. The findings from the cross sectional study presented in this chapter show that most of the increase in the rate of admission to hospital for infants up to age one over the period 2008-2014 was in the early neonatal period; and the great majority of this increase is explained by the three conditions, physiological jaundice, feeding difficulties and to a lesser extent, gastroenteritis. Findings from this study indicated that there may be potential missed opportunities within the postnatal care pathway that would be amenable to integrated care pathways between postnatal hospital care and community and community based midwifery interventions.

Chapter 5 Parents' experiences of the time preceding infant readmission to hospital within 4 weeks of birth: a qualitative interview study

Contributions

I conceived the study and wrote the protocol supported by CC, CM and BT. I created the study documents and interview topic guides. Potential participants were recruited by Dr Deepthi Jyothish (DY), Paediatrian at Birmingham Children's Hospital and all interviews were conducted by me. One audio file was transcribed by me and the rest were transcribed by a professional transcription service. Dual coding of nine transcripts was conducted with BT, CC and CM to ensure that the coding framework was appropriate. I devised the themes and these were discussed with BT, CC and CM.

5.1 Purpose of the Chapter

Chapter 4 describes the considerable increase in infant readmissions, and particularly potentially avoidable admissions within the first 28 days of life over the period 2008/09-2013/14. It is recognised that understanding parents' perspectives in the context of paediatric health service use is crucial. As primary care providers of the infant during the time preceding postnatal readmission to hospital, it was anticipated that exploring parents' experiences would offer a perspective of the circumstances leading up to and reasons why their baby was admitted to hospital. It would also enable exploration of whether they gave any accounts of postnatal LoS or postnatal care more widely as a factor. This chapter describes the existing qualitative literature exploring parents' experiences of navigating care pathways when their child is unwell. It is followed by the method and findings of the qualitative interview study which explored experiences and perspectives of parents whose infants were readmitted to hospital during the early postnatal period, focusing on the time preceding the readmission to hospital.

5.2 Background

It has been recognised that parents' perspectives are crucial in understanding health service use in paediatrics (134-138). Parents are most often the ones to detect that their child is unwell, are the primary decision makers regarding when to seek help and the means by which the child gets to hospital (134-136). Some have suggested that gaining parents' perspectives may also provide an insight into potential barriers to accessing care, highlight

missed opportunities for earlier intervention and initiate ideas for how health services could be improved (134, 135).

Existing qualitative literature exploring parents' experiences of the time preceding paediatric admissions or contact with health services has not focussed on the immediate postnatal period. Instead research has focussed on children with respiratory tract infections (RTIs) (135, 136), children with complex medical needs (134) or children consulting primary care for acute medical illness (137-139). In a similar approach to the proposed study, Francis *et al.* (135) sought to better understand the circumstances in which children (aged 6 months to 16 years) were admitted to a large hospital in Wales, United Kingdom for a RTI. Francis *et al.* (135) interviewed parents of 22 children to explore their accounts of the time preceding their child's admission to hospital and data from the interviews were analysed using the framework method framework (140). Parents' accounts revealed missed opportunites for timely treatment and health service associated factors (including perceived problems accessing healthcare services, inadequate primary care triage, barriers to accessing timely consultations and past experiences of problems accessing health professionals and poor previous experiences accessing health advice (135). Despite only recruiting parents who were from low socioeconomic groups, this study is of value because it highlights the value of placing parents as 'key informants' in the time leading up to a child's admission to hospital. It also demsontrates the opportunity to identify missed opportunities for earlier intervention from parents' perspectives.

Ingram *et al.* (136) explored parents' views on support and information-needs prior to consulting health professional in the community when their child has a repiratory tract

infection. Conducted in England, the study was used to inform the development of an intevention to support parental-decision making. Using a combination of 30 semi structured interviews and seven focus groups and using thematic analysis using the constant comparison method, the authors found that parents from all socio-economic backgrounds sought information from a wide range of sources about paediatric RTIs to identify which of their child's symptoms they should worry about. Ingram *et al.* (136) identified that parents' experiences, confidence and efficacy influenced whether parents consulted primary care for the child's illness. The authors conclude that parents would benefit from consisitent advice to address common concerns in order to support parents' decision making at home about when to seek medical advice for their child (136) . Fathers were underpresented in the study and therefore it was not possible to make meaningful comparisons between data from mothers and fathers. However, the study highlights how seeking parents' perspectives enabled opportunities to identify an intervention to support parents' decision making processes.

Other qualitative literature has focussed on better understanding admissions for children with medical complexity (CMC). Nelson *et al.* (134) conducted semi-structured interviews with parents to identify opportunities to reduce hospital use for CMC through the development of interventions. The study was conducted in a complex medical care facility in Los Angeles, California which delivers accessible family centred care to children with medical complexity from low income communities. Nelson *et al.* (134) found that parents tended to describe their experiences leading up to their child's hosptilisation in terms of perceived risk and reaching a threshold in which they were no longer comfortable taking care of their

children ar home and sought help. Families sought help when they exceeded a comfort threshold for caring for their child at home. Although most parents perceived their child's admission to be unavoidable, the authors highlight that understanding parents' perceptions of risk, and that more actively supporting parents in caring for their child at home could potentially reduce the need for hosptilisation by adapting parenting decisions regarding the need for urgent care (134).

In summary, gaining parents' perspectives can offer a valuable insight into: potential barriers and missed opportunities for intervention to prevent admission to hospital; parents' support seeking behaviour prior to getting medical advice from a health professional; and how parents access healthcare for their child (134-137, 139). There are no known studies that have focused on parents' experiences of the time preceding readmission to hospital in the postnatal period. Parents' narratives of the time preceding postnatal infant readmission to hospital may offer a valuable insight into their infant's illness course, parents' experiences of seeking contact with health services, and their experiences of the admission. This qualitative study explores why and how infants came to be readmitted to hospital from parents' perspectives and is reported using the consolidated criteria for reporting qualitative research (COREQ) (141) (Appendix 9).

5.3 Aims and objectives

This study aimed to explore experiences and perspectives of parents whose infants were readmitted to hospital during the early postnatal period, focusing on the time preceding the readmission to hospital. As primary care providers of the infant during the time preceding postnatal readmission to hospital, it was anticipated that exploring parents' experiences

would offer a perspective of the circumstances leading up to and reasons why their infant was admitted to hospital.

5.3.1 Objectives

Specific were to:

- explore parents' experiences of the time leading up to infant postnatal readmission to hospital
- elicit accounts of how parents responded to their infant's admission and explore the process by which the infant was admitted to hospital.
- explore the factors contributing to their infant's readmission to hospital from parents' perspectives.

5.4 Methodology

5.4.1 Theoretical perspective

Theoretical perspectives in research provide a framework or 'lens' in which researchers conduct research and analyses (142). Therefore, to ensure coherence and consistency, it is therefore important to state the theoretical frameworks underpinning the study to understand how the research questions and aims were explored (141).

The epistemological and theoretical foundations of this thesis have been described in detail in chapter 2.3.1. In summary, this qualitative study was approached from an interpretivist perspective. It is based on relativist ontology which challenges the idea that there is an objective truth or single knowledge and instead states that there are *'knowledges'* and that these are related to specific social, cultural contexts (81). Interpretivism purports that social

reality is dependent on how we interpret it, and knowledge is closely connected to the social world in which we live (81). In a research context, I understand that the knowledge gained from the study is only one perspective or one 'view of the scene' and it is not possible or worthwhile to determine if the knowledge gained is the 'right' one (81).

As part of an interpretivist approach, I accept that the knowledge constructed through the research will be a creation of the specific interactions and relationship between me, the researcher and the participants within the specific context of the study. Furthermore, I acknowledge that it is not possible to be disconnected from the research itself or my world view and the research will be shaped by this to a certain extent (81, 83). In order to be transparent about how qualitative themes are developed, I am aware that my roles as parent, researcher and midwife, combined with my own societal positions and values, may affect the research and this was discussed in more depth in section 2.3.1.

5.4.2 Thematic analysis

Thematic analysis is a method used in qualitative research and is used for identifying, analysing and reporting patterns within the data (143). Braun and Clarke (83) suggest that thematic analysis is a method that provides opportunities for rich overall description and interpretation of data (83, 144). Thematic analysis is often assumed to be either an objectivists research method (with a belief that entities exist independently of being perceived, or independently of a researcher's theories about them) or atheoretical (without theoretical basis). However, thematic analysis is flexible because it is not aligned to underlying epistemology, ontology or theoretical framework and therefore can be used with several theoretical perspectives (143). The principal reason for choosing thematic analysis

for this study is that it would enable the aims and objectives to be met whilst also considering the study findings' relevance and context within a thesis that uses both quantitative and qualitative methods(144).

To explore further, thematic analysis is considered a method for: '*examining perspectives of different research participants; highlighting the similarities and differences in the data and generating unexpected insights*' (145). Critics have argued that thematic analysis is simply a process rather than a method in its own right, and that its flexibility can lead to lack of coherence in the development of themes (143, 144, 146). However, others have argued that consistency and coherence can be ensured through consideration of the ontological and epistemological perspectives underpinning the study. It was felt that thematic analysis would be a sufficiently rigorous method for analysing the data because it would be possible to better understand: parents' experiences and perspectives of the time preceding infant readmission to hospital; how parents negotiated the clinical care pathway; and the process by which infants were readmitted. It would also enable exploration of factors which parents felt may have contributed to their infant being readmitted to hospital.

Other qualitative approaches were considered including Interpretive Phenomenological Analysis (IPA) and Grounded Theory (GT) although neither were considered as appropriate as thematic analysis for this study. Both IPA and GT approaches are structured methodologies that have a theoretically informed framework for conducting research rather than thematic analysis which is considered a method. GT is suitable for research questions that focus on social processes or the factors that influence particular phenomenon. This study was not interested solely on how individuals gave meanings to social phenomena in

their daily lives and how individuals made sense of the world in terms of the meanings and classifications they employ (142). It was also interested in parents' perspectives on care received and the descriptions about how parents navigated the health system in order to seek help for their child. In addition, although it was hoped that it would be possible to create conceptually-informed interpretations of data, the study's aims were not to develop a theory about this particular topic as would be expected in GT.

IPA aims to *"understand what it is like to stand in the shoes of the participants and identify the essential components of phenomena or experiences which make them unique or distinguishable from others"* (147). IPA is idiographic in nature and involves an in-depth analysis of each case before moving onto the next case. Although the research questions aimed to elicit parents' experiences of the time preceding infant readmission to hospital, it was important to also describe and highlight potential missed opportunities for earlier intervention in the care pathway. If IPA had been used, it would not have been explored because the single aim of IPA is to allow the phenomena or participant to speak for themselves (147).

The flexibility and theoretical freedom provided through thematic analysis is considered a strength by many qualitative researchers (83), although it has also been criticised for providing research that lacks coherence and consistency when the developing themes are derived from the data (146). In order to maintain coherence and consistency, it has been suggested that the epistemological positions underpinning the data are made clear (146) and these have already been described in section 1.3.1 and summarised in section 5.4.1.

5.4.3 Definition: Neonatal readmission

For the purpose of this study, a 'postnatal infant readmission' was defined as an infant admission to hospital within four weeks following discharge home from birth. This is because the majority of infants are born in hospital (148) and therefore, an admission to hospital within four weeks was considered a readmission in the postnatal period.

5.4.4 Sampling, Access and Data Collection

Parents of infants who were admitted to Birmingham Children's Hospital (BCH) and aged < 4 weeks.

5.4.4.1 Inclusion criteria:

Parents of a term (> 37 weeks) infant aged under four weeks who was unexpectedly admitted to hospital. This inclusion criteria were created because the aim of the study was to explore postnatal readmissions to hospital, and specifically, infants who had been healthy at the point of discharge from postnatal care services rather than infants who had an underlying health condition and had been readmitted for a routine procedure.

5.4.4.2 Exclusion criteria

- Parents of an infant with a complex medical history including prematurity (< 34 weeks), congenital abnormality, birth asphyxia or trauma, or initial admission to a neonatal intensive care unit or special care baby unit.
- Parents of an infant who has a planned admission to hospital (for example, surgery to correct a congenital defect)
- Parents under the age of 16 (due to ethical issues of gaining informed consent)

This study relied on maximum variation sampling where diverse individuals were chosen as they were expected to hold different perspectives on the research topic (range of: infant conditions, length of time at home before readmission, length of readmission, family composition and sociodemographic characteristics) (149). Only one interview per family was conducted (interviews took place with one or both parents present depending on parental choice and or availability) as a comparison of each parental account was not the focus of the study. Maximum variation sampling was deemed appropriate for this research project because it enabled a variety of postnatal infant readmissions, which ranged in cause and severity, to be explored. It was anticipated that some of the infants would have been admitted for conditions that had been defined as potentially avoidable in chapter 4 (jaundice, feeding difficulties or gastroenteritis) although it was important to recruit families where infants were diagnosed with a wide range of conditions in order to compare and contrast parents' responses. In addition, the recruiting hospital has a high turnover of patients and although it would have been practical and informative to have the clinical diagnosis information prior to the interview, this was not always possible. Utilising a maximum variation sampling also enabled exploration of a demographically diverse sample of parents (including a range of age, parity and ethnic group). Confirmation of the infant's diagnosis or suspected diagnosis from the clinical team was sought with parent's consent.

The sample size was determined by saturation, which means that no new data was being uncovered from additional interviews, and data collection subsequently ceased (150). Data saturation was identified through reflection on interview notes made following each

interview in addition to data analysis memos that had been completed at the same time as data collection.

5.4.5 Participant selection and recruitment

Permission was sought from Birmingham Children's Hospital (BCH) NHS Foundation Trust (now Birmingham Women's and Children's NHS Foundation Trust) to conduct interviews in November 2016. Recruitment took place from December 2016 to June 2018 although between January 2017 and January 2018, no participants were recruited due to my maternity leave. Research nurses and clinical staff on any appropriate ward at Birmingham Children's Hospital checked the inpatient ward admissions to identify potential participants and assess whether they met the inclusion criteria for the study by checking the medical records of the infant. Clinical staff also ensured that there were no clinical or safeguarding reasons why parents should not be contacted. Clinical staff informed potential participants about the study and provided them with a participant information sheet. Parents who were interested in receiving more information about the study were asked to provide contact details so that a researcher could contact them. Clinical staff obtained contact details of parents who gave consent to be contacted about the study. Parents who were interested in participating received relevant information about the study (Appendix 10) and a consent form (Appendix 11) was given for their consideration. It was emphasised that their decision to take part was both voluntary and anonymous.

It was emphasised to parents that their infant's care would not be affected if they chose not to participate. It was also emphasised that participants would have the opportunity to withdraw from the research at any point. Written informed consent was gained from

parents who were happy to take part. This process for recruitment helped to ensure that participants had freely consented to participation, without being pressurised or coerced.

5.4.5 Data collection

Data were collected via face to face interviews with one or both parents. Interviews that took place in the hospital tended to be more flexible in order to fit in around infant's medical needs and also tended to be shorter in length. Although it was anticipated that many interviews would take place during the readmission or shortly after, interviews could take place up to three months after the readmission. Consideration of the length of time between readmission and interview was explored in data analysis.

In depth interviews with parents were conducted to elicit parents' views and experiences of the time preceding the infant readmission to hospital. In depth interviews were considered to be an appropriate method to meet the aims and objectives of the study because they are a flexible and dynamic method of data collection and provide the opportunity for the participants to be informants of the phenomenon (151). In depth interviews are also considered particularly helpful for exploring the participants' point of view and can offer an insight into the cultural frames people use to make sense of their experiences. These are considered important in the interpretation process during data analysis (152). Interviews are the most common form of generating data in qualitative research (152) and invites individuals to think and talk about their needs, wants, expectations, experiences and understanding at both a conscious and subconscious level (153). During the interview, the participants were encouraged to reveal their own views and to describe what happened in the time period (151).

Parents were given the opportunity to be interviewed together. It was recognised that individual interviews and joint interviews are two different methods of data collection and may create different sorts of data (154); however it was felt that the advantages outweighed the disadvantages for this study. Firstly, offering a choice about how parents would like to be interviewed enabled parents to feel more comfortable during the interview and offering this choice was considered empowering (154). Secondly, offering joint interviews also avoided potentially difficult scenarios in which one parent was asked to leave the space in order for the individual interview to take place which may have been in itself damaging to the data collection process (154). Finally, it has been argued that joint interviews enable the interview to fill the gaps in the narrative more easily because of the dialogue and corroboration of sequence of events during the interview (154). This was particularly important in ascertaining the sequence of events from hospital discharge to readmission in this study.

Prior to commencing interviews, a pilot interview was conducted to practise interviewing skills and to test the topic guide. The practice interview was conducted with a parent of an infant who had been readmitted to hospital and was not involved in the study. This enabled a critical appraisal of the interview technique including whether the questions were too directive and whether the participant was given enough time to explain their responses. This was particularly important as I moved from a health professional role in which closed questions are asked to gain a specific response to become research interviewer, where participants are encouraged to talk freely and without being led (155).

Following the pilot interview, the topic guide was also refined. A flexible topic guide was used and was revised following several discussions with the supervisory team and as new

potential themes in the data were identified (Appendix 12). This ensured that unexpected and emerging themes could be explored with new participants. In order for this to be possible, data collection and data analysis were conducted at the same time. During the interview, the order of questions and language used was flexible to enable exploration of participants' views rather than adhering to a fixed topic guide. If participants described any ongoing concerns about healthcare organisations, they were signposted to the relevant Patient Advisory Liaison Service or complaints system.

In depth interviews were conducted by me, a postgraduate student not involved in the care of families participating in the study. I aimed to establish a rapport with parents at the beginning of the interview in order to create an atmosphere in which they were likely to talk freely. Most parents were made aware of my professional role as a midwife and were made aware that I was a mother of three young children. A detailed reflexive diary was maintained during the interviewing period to ensure reflexivity and contained an outline of topics discussed in each interview, notes of emerging themes, interpretation, gestures and non-verbal expressions. On occasions, some parents described something interesting whilst not being recorded and these discussions were described in field notes shortly after the interview. This encouraged conceptual development during data analysis and understanding of the meaning of the participant's words which is important within the interpretive paradigm (151, 152).

The interviews were digitally audio recorded with consent and conducted in the hospital ward or in the parent's home if the infant has already been discharged from hospital.

As described in section 5.3.4, when saturation was reached, meaning that no knew data were being uncovered from additional interviewed (150), data collection subsequently ceased.

5.4.5.1 Participant and researcher safety

If parents became distressed during or after the interview and felt that they need further support following the interview, I signposted them to relevant health professionals and support organisations. Participants were informed both that they were free to withdraw at any point during the research and that if they disclosed risk of harm to themselves or another person, breach of confidentiality would be necessary and procedures would be followed in accordance with BCH safeguarding policy.

The University of Birmingham 'lone working' guidance was followed where interviews were conducted in participant's homes. This involved informing a colleague based at the research office to notify them of the arrival and departure at a participant's home (156).

Supervision meetings provided an opportunity to debrief and discuss any difficult or distressing situations during the interviewing process.

5.4.5.2 Management of data

Digital audio recordings were transcribed into a Microsoft Word document (Appendix 13). I transcribed the first interview and the remaining interviews were transcribed by a professional transcription service. All names were removed following transcription to protect participants' rights to confidentiality and anonymity. Digital recordings were downloaded onto a secure, password protected University of Birmingham server with access

restricted to researchers. Recordings were deleted from the digital recorder once transcribed and checked for accuracy. All typed records were kept in a password protected computer hard drive and in a password-protected back-up drive. Only the named authors had access to the data files. Hard copy files were to be stored in a lockable filing cabinet at the University of Birmingham for 10 years.

A standardised layout was applied to all transcripts and included a summary of quantitative data to describe the participant's demographic characteristics, the location and other key information to situate the interview. To ensure rigour, transcripts were reviewed alongside recordings for accuracy.

In accordance with the University of Birmingham code of practice for research, electronic data would be deleted and plans were made for hard copy data to be shredded after ten years (156).

5.4.6 Data analysis

Data collection and data analysis occurred at the same time to enable the interview topic guide to be refined and the opportunity to explore new areas of enquiry. This was appropriate in this context because little was known about parents' experiences during this period of time (157). Data was thematically analysed and guided by Braun and Clarke's six step approach to thematic analysis (83).

Familiarisation of data was fairly straightforward because I had conducted all interviews with participants. Initially, data were organised into preliminary codes; dual coding was conducted on nine transcripts with BT, my PhD supervisors and researcher who are

experienced in qualitative data analysis to ensure rigour (144). Once the coding framework had been finalised, it was checked by PhD supervisors BT, CC and CM with each supervisors independently coding three transcripts. In order to code the data inductively, data were coded without trying to fit into a pre-existing coding frame (158). This inductive process of coding data was appropriate in this context because it was not known how parents conceptualised this period of time. An inductive approach to data analysis is considered appropriate when investigating an under researched area or with participants whose views on the topic are not known (83, 144).

As more data were collected and analysed, the description of the codes became more definite (Appendix 14.1 and Appendix 14.2). Tables, maps and schematic diagrams were used to consider how different codes may be refined or combined and where links between codes may exist (Appendix 14.3). Patterns in the data were explored to consider parity, birth experiences, demographic characteristics of participants and severity of infant's condition.

All phases of data collection and analysis described were discussed at supervisory meetings with BT, CC and CM to ensure that coding, mapping and interpretation was accurate. Qualitative data software package NVivo 10 (159) was used to store, code and search data.

5.4.7 Ethics

Participants were assured that their choice to take part would not be disclosed to anyone outside the research team (participation was kept confidential). All personal information would be kept within the research team and not disclosed to anyone unless there was reasonable justification to do so, for example, risk of harm to another person. (Personal information was kept confidential). Any data that was presented in public was not

attributable to any individual participants (data was anonymised). Following the interview, participants were signposted for further support if necessary.

A University of Birmingham research passport and Research Governance permission from BCH was obtained prior to starting the research and NHS ethical approval and approval from the University of Birmingham Ethics Review System was be sought prior to data collection and analysis (NHS Ethics reference: 16/EE/0268) (Appendix 15).

5.5 Findings

5.5.1 Participants

Overall, 31 parents were asked if they would like to participate and three declined participation. Of the 28 parents interviewed, eight interviews were conducted with the mother, and ten interviews were conducted with both the mother and father (Table 5.1). The median age of the mothers was 33 years (IQR 29.8-37) and median age of fathers was 31.5 years (IQR 29.75-35.25). All parents were living with their partner. There was a broad ethnic diversity: 14 participants were white british, 5 asian pakistani, 3 asian bangladeshi, 3 arabic, 1 indian, 2 other. There was also a broad variety of family compositions: 12 participants were first time parents, although this didn't reflect the number of first time couple parents because some relationships were new and one participant had existing child/children from a previous relationship. Postnatal LoS in hospital ranged from 6 hours to 4 nights. Length of time at home before readmission ranged from 12 hours to 4 weeks. The median age of infants on admission was seven days (IQR 5-23.5). Reason for infant readmission to hospital ranged in severity; some babies were admitted to the paediatric or neonatal intensive care unit and others were admitted to the paediatric admissions unit

(Table 5.1). Reasons for admission included: jaundice, haematosis, hypoglycaemia, bronchitis, weight loss, meningitis, apnoeic episodes and varicella-zoster virus. Length of stay on readmission to hospital varied between 12 hours and 3 weeks. Interviews had a median duration of 27 minutes. Led by parental preference, six interviews took place at the participants' homes following discharge home from the readmission and 12 interviews took place in the hospital during the readmission.

Parent characteristics	**n (28)**	**Infant characteristics**	**n (18)**
Male	10	**Gender (m)**	11 (61%)
Female	18	**Age on admission (days), median (IQR)**	7 (5-23.5)
Mothers age (yrs), median (IQR)	33 (29.8-37)	**Breastfeeding on admission**	11 (61%)
Fathers age (yrs), median (IQR)	31.5 (29.75-35.75)	**Diagnosis:**	
Ethnicity:		Jaundice	2
White British	14	Haematosis	1
Asian		Hypoglycaemia	3
Indian	1	Bronchitis	3
Pakistani	5	Excessive weight loss	4
Bangledeshi	3	Meningitis	2
Other	2	Apneoic episode	1
Any other (Arab)	3	Varicella Zoster virus	1
Family composition*:		Infection	1
One child	12	**Length of postnatal stay (days)**	2.4 (SD 1.6)
Two children	6		
Three children	5		
Four children	2		
> Four children	3		

Table 5.1 Parent and Infant demographics and characteristics

**Differential family composition for some due to previous relationships with existing children*

5.5.2 How infants ended up back at hospital

All babies except one were born in hospital (one was born unplanned at home) and were readmitted to Birmingham Children's Hospital (Figure 5.1). All parents reported receiving some postnatal care in across three different hospitals in Birmingham and Dudley area prior to being discharged home. This was provided on the postnatal ward or in a birth centre. Following discharge home, the majority of parents reported detecting and raising concerns about the health of their baby with either a health professional, friend or family member. Once the community health professional was consulted (community midwife, health visitor or GP), parental concerns were either confirmed and an appropriate care pathway to seek further medical advice was initiated, or parents were reassured that further medical assistance was not required. In three cases, parents who were not satisfied by advice provided by the health professional described seeking alternative advice from a different health professional and the admission to hospital was instigated from there. In another three cases, the parents described being unaware of any health problem and the admission was instigated following detection of a problem during the routine check with the community midwife. Once discharged from the readmission, three babies were subsequently readmitted again via community health services and these parents were interviewed at the second readmission episode.

5.5.3 Thematic analysis findings

Two overarching themes were identified, one with three subthemes and one with four. A further cross cutting theme was also identified (Table 5.2). The themes identified during data analysis reflect parents' descriptions their experience of time preceding, and

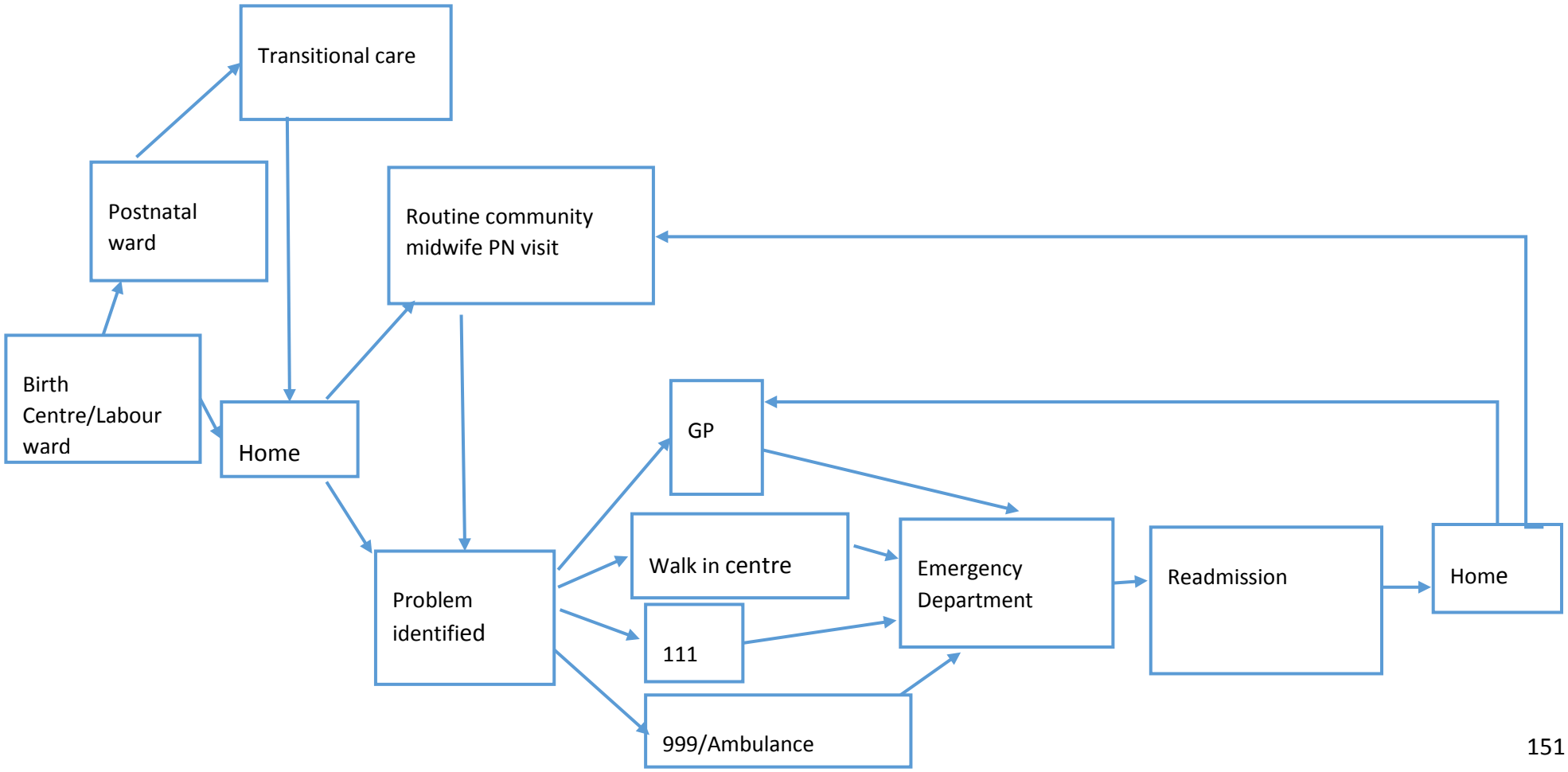
experience of, readmission to hospital. As outlined in section 5.3, the themes were inductively derived and therefore it was anticipated that the themes identified from parents' descriptions may not map directly to the research aims and objectives. Theme one 'Parent as protector' summarises parents' perceptions about their role and responsibilities of being a parent and people who enabled them to achieve this. The second theme 'Baby's deterioration' refers to parents' accounts of witnessing their baby becoming unwell, their capacity to trust their intuition in order to seek advice and how they got to hospital. The two main themes are interrelated; all parents sought to protect their baby but for many parents, this role became problematic when their baby's health was deteriorating because they described not always knowing from whom, or where to seek advice. They described their confidence as 'parents as protector' was damaged, feeling unable to fulfil their role adequately. The cross cutting theme, 'sharing responsibility' describes the relationships that parents had with health professionals. Parents reported a great diversity in how they desired their relationship to be with health professionals; some parents described wanting health professionals to take responsibility for caring for the baby due to physical ill health following birth, whereas others desired a more equal relationship.

Table 5.2 Themes

Theme	Subtheme
1. 'Parent as protector'	Parenting together Being responsible Family support
2. Baby's deterioration	Seeking advice Who knows best? Getting to hospital Having a diagnosis
3. Sharing responsibility (Cross cutting theme)	

For most interviews, a proportion of the interview time was occupied by parents describing their antenatal and birth experiences and these were subsequently coded in the data analysis process. The following principles are used in the quotations, all of which are verbatim. Where needed for clarity and brevity, words have been inserted into quotes (denoted by [square brackets]) or omitted (denoted by …). Reported speech is in inverted commas. Health professional refers to nurses, midwives, health visitors, general practitioners and paediatricians. The order of themes described was considered the most logical in terms of topics, rather than prominence in the data. The themes are presented separately and begin with an overall description of how the subthemes link together to form the overarching theme.

Figure 5.1 Process map of how babies ended up in hospital



5.5.3.1 Theme 1: Parent as protector

This theme describes the parent's role of providing and caring for a newborn baby and encapsulates the subthemes of 'parenting together', 'being responsible' and 'family support'. Overwhelmingly, parents gave accounts of how they sought to protect their baby and described this as a basic instinct.

> *"I just knew straight away by looking at her something was more than what I thought was wrong with her. She wasn't responding to anything, she wasn't even opening her eyes and looking at me, nothing." (Mother ID 16)*

> *"And I straightaway said to my husband, no, I am not going to let my child cry like he is in agony for 10 minutes just because the midwife is saying you're holding him too much. No, he's young, it's fine, he needs to be held. Like now, I'm making sure I'm holding him because they need the cuddles and the warmth" (Mother ID 20)*

The role of protector was shared by the parenting couple and where possible, parents were supported in fulfilling this role by wider family networks. Although participants who had existing children were familiar with the role of protector, they described how their role of protector changed as their new baby was born. These parents describe 'getting to grips' with their changing role of protector as the new baby was born.

> *"I went home and I relaxed but the first night is really hard because she (older sibling) had a temperature and was crying, so I don't manage myself. Do I look after her or her? My husband tried his best but he can't look after (baby)…My husband said, 'I can't feed her, so what do I do now?' It was a little bit hard, at the time, and the next day, my husband took my daughter to school because it was Monday" (Mother ID 7)*

Some parents described finding it difficult to fulfil their role as protector resulting in feeling a burden of responsibility, especially as their baby's health deteriorated.

"It was just a bit overwhelming really. I've never had a baby before and they were just saying, 'Try and latch on'. It wasn't that they weren't giving support but it was just a different type. I just felt a bit overwhelmed really, yeah" (Mother ID 11)

5.5.3.1.2 Parenting together

All parents in the study had a partner at the time of interview and for most, they described that the capacity to parent together was deemed by them to be crucial to effectively fulfil their role as protectors. Parents describe that their partner's support provided emotional stability, help with decision making and caring for the baby.

"My husband's supports me all the time and while he's the only family I've got round here, he was quite supportive really. (Mother ID 1)

Several mothers perceived that they wouldn't cope if they were not able to have the support of their partner.

When I was brought up here, they said, 'Partners can't stay' and so that panicked me incredibly because I thought, 'I know that I don't do well. I need my husband here' (Mother ID 11)

Many described that the postnatal ward experience prevented them from being together as parents and this motivated them to seek discharge from hospital. Many parents described feeling that their journey as parents had not yet started in the postnatal ward. The desire to parent together was described as a strong motivator for going home and shortening their postnatal length of stay in hospital.

"By the time that we were discharged, we were just really anxious to get home and thinking, 'it will be different once we're in our home environment'" (Mother ID 11)

Parents perceived themselves to be a team and mutually supportive. At home, parents described 'tag teaming' the care of the baby to enable time to catch up on sleep, caring for

older siblings, and care for the baby once readmitted to hospital. Many mothers described that their partner provided both practical support and emotional stability throughout the postnatal period, the time in which they were particularly vulnerable as they recovered from the birth experience.

> *"He took a week off for that and then obviously because I had to go back in, we didn't expect that, he took another week off so he's literally only gone back to work today but he's been up here at night as well trying to help looking after him so I can get a bit of sleep" (Mother ID 28)*

Many parents described the difficulty of being able to parent together whilst being in hospital during the birth admission and the infant readmission; in nearly all cases, fathers were not able to stay in hospital overnight and many mothers describe this as making the situation more challenging because they were not able to share the care of the baby or support each other at times when they were emotionally drained or feeling tired.

> *"When I was brought up here (ward), they said, 'Partners can't stay' and so that panicked me incredibly because I thought, 'I know that I don't do well. I need my husband here'…the thought that I couldn't be with him last night was just too unimaginable".' (Mother ID 11)*

For a few parents, when exceptions were made to the visiting rule, they described the intense relief at not being alone in hospital overnight.

> *"We were downstairs in a nice room with lovely staff and before we got moved up here, they said, 'Yeah, your husband can stay tonight' and I was instantly put at ease" (Mother ID 11)*

> *"I did ask whether he could stay or not because after the C-section it was too hard for me to care about her because she is a little bit heavier so if she cries he has to take her and they say 'yes, anyway he can stay'." (Mother ID 12)*

Many mothers described that their partner would be able to provide the practical and emotional support that was not provided by health care staff in hospital, and the separation sometimes resulted in mothers feeling an enhanced burden of responsibility.

> *"I just would keep pressing the buzzer and saying, 'He's not latching on' and they'd say, 'It will come'. They couldn't say anything that was really helping me and they weren't doing anything that was really helping me" (Mother ID 11)*

This was particularly the case for women who had a caesarean section, women who were physically affected by birth, or first time mothers who felt lacking in confidence in caring for the baby independently. One woman reported such difficulty in caring for her baby on the postnatal ward due to severe anaemia, saying that she needed to go home so that she could have more support from her partner in caring for her baby.

> *"After one night, I thought, 'I can't be here another night without my husband'". (Mother ID 11)*

For a few mothers, being at home meant that they were able to get more support from their partner and help with caring for the baby and they felt that their baby's health would improve if they could get home. These mothers described that their baby was not thriving in hospital because they were not able to parent together.

> *"So when I was leaving hospital the baby was over 11% weight loss and the doctor came and said they should keep me but I wanted to go home because at night [because] I didn't have any help, I was very weak so I said 'It may be easier at home with my husband'. So they said, 'Okay, go home'" (Mother ID 5)*

The desire to parent together and to be together as a family appeared to be a significant motivator for being discharged from hospital relatively soon following birth, and during the subsequent infant readmission, it was described as something that they were working

towards. Sometimes parents described that risks were being taken in taking their baby home but they felt that it was important to get home.

> *"We were a little bit nervous and then seeing him a little jaundiced on the Saturday morning caused us some concern. But we came home with him because, we'd sort of reached, you know, we rather be home now. But we did make it absolutely clear to the staff we'd only go home if our baby is safe to come home. You know, in terms of his health and we were assured he was absolutely fine to go home". (Mother ID 1).*

Several parents gave accounts of how the risks of being discharged after birth were discussed with health professionals in order to share the responsibility of making a decision. Whilst parents were able to express preference in going home, ultimately, they sought reassurance from health professionals about the health and wellbeing of their baby before they went home.

> *"They kind of said that once he was at a certain weight, we could go and he was just under that weight and so they said it was up to me whether I wanted to stay an extra few days or go because from their perspective, he was fine. In hindsight, we probably could have stayed those two extra days but I wanted to get home to see my other son" (Mother ID 9)*

5.5.3.1.3 Being responsible

Parents recognised and described the basic instinct to protect and be responsible for their baby. Whilst this state of being accountable for their baby was something that they anticipated, many parents described the overwhelming pressure or burden of responsibility that accompanied being a parent.

> *"Obviously at the same time, I was kind of overwhelmed and so worried, like, oh my god, how are we're going to bring up, like, you know, how are we going to take care of the baby, you know?" (Mother ID 20)*

The burden of responsibility was amplified when parents were still recovering emotionally and physically from the birth experience, felt unprepared or lacking in knowledge and skills in caring for their baby (for example, breastfeeding) and were unable to parent together due to hospital visiting restrictions. For some parents, the burden of responsibility led to feelings of guilt as they describe failing to meet their duty in caring for their baby.

"Prior to that [the readmission], you'd kind of been made to feel that it was your fault that he was kind of in this way and that you'd been kind of re-admitted because there was something lacking?" (Mother ID 14)

Parents' self-confidence was damaged because the deterioration of their baby's health meant that they were not fulfilling their role as protector.

"It's like I can't provide for my child" (Mother ID 14)

Parents who were struggling with the burden of responsibility described how it was exacerbated by extreme tiredness and or maternal physical ill health following the birth experience. Mothers who had more intervention during the birth process than they had anticipated, and mothers who felt that their labour was much longer than they had anticipated, described the burden of responsibility as particularly problematic.

"I've not caught up on my sleep. That's why I'm very emotional. I'm having to have people repeat things multiple times. I suppose I'm quite anxious but I'm aware as well that it is hard at the start. I've lost a bit of my logic because I'm so tired, if that makes sense". (Mother ID 11)

In some cases, physical ill health prevented mothers from being able to fulfil their role as protector and these mothers describe the necessity of having their partner there to support them.

"I felt so, like, I felt unwell, I didn't feel like I'm eating properly and at night because the little one he was up all night I just, I felt it's just too much for me to take care of him. And that's why I said to the doctor and it was maybe not my idea but I was saying, 'I prefer going home to get help from my husband during the night. Even, you know to hold him or just to give him for feed" (Mother ID 5)

This differed from parents who felt that that their birth experience had gone better or more quickly than expected. These parents described being more comfortable with the responsibility of being a parent.

" You're happy with the crying at night, you're happy with changing the nappy and the constant vomiting or puking, whatever he's going to do as a baby is fine" (Father ID 21)

For mothers who were having difficulty establishing breastfeeding, the role of sole provider of nutrition for the baby amplified the burden of responsibility. Several of the mothers describe feelings of guilt for choosing to breastfeed because they believed it caused the need for readmission. This seemed to highlight an important contradiction that breastfeeding was perceived by these mothers as the 'right' thing to do, but if not done well, it was considered the wrong thing to do. They also describe feelings of inadequacy at not being able to successfully feed their baby.

"It's like I can't provide for my child and it's like everyone's telling me I'm doing it wrong …Yeah so you feel like all the pressure, like obviously it's going to be me staying with him so I feel a lot of pressure thinking ok I've got to get this right" (Mother ID 14)

"When we were seen by the consultant and again, he had lost weight. And I was feeding him overnight. So, as a mum who is breastfeeding, it was a very hard thing to hear. So, during the day I was very down because you feel as a failure as a mum and the fact that he's not gaining weight is really hard….And it's very easy to give up because you think my child needs to gain weight, why am I putting him through this?" (Mother ID 20)

This often led to mothers feeling that they had to justify their position and reasons to breastfeed. Several mothers described a sense of relief when health professionals advised that they should top up feeds with formula milk because it gave mothers the opportunity to share responsibility with somebody else. These women describe feeling relieved that somebody was making the decision to stop exclusively breastfeeding on their behalf.

"They decided to put a tube in, just in case I couldn't breastfeed for whatever reason or I couldn't express enough, then we can fill him up with Aptamil and then go from there and the pressure is off me a little bit more" (Mother ID 11)

This shift of responsibility tended to come at the expense of mothers' self-confidence because it confirmed that their supply of milk was 'insufficient' and several mothers describe feelings of inadequacy as a result of this formula 'prescription'.

"It's like I can't provide for my child" (Mother ID 14)

"I was very down because you feel as a failure as a mum and the fact that he's not gaining weight is really hard" (Mother ID 20)

5.5.3.1.1 Family Support

Wider family networks provided a range of support in order for parents to fulfil their role as protector and included practical and emotional support and advice. Parents who received considerable support from family were aware of the need to maintain their own wellbeing in order to care for their baby.

"The most important thing before I gave birth was to say to my home we need home cooked food, we can't be eating from out, you know? And my mum was cooking for us. And my mother-in-law would has been wonderful, she'll come and, I've not had to worry about housework, I'm not one of those people who's priority is cleaning, my priority was my child and my

family…him [baby] is first and we need to be resting. Everything else will sort of pick up" (Mother 19)

Parents who had family close by utilised and appreciated the practical support provided and it helped them to prioritise their efforts on caring for their new baby. Having a strong family relationship in which everybody was playing a part was considered to be an important group effort in the survival of the baby.

"Obviously at the same time, I was kind of overwhelmed and so worried, like, oh my god, how are we going to bring up…how are we going to take care of the baby…? I've not taken care of a baby like this before so we were lucky that we had the family support and our mothers were there and just literally helping us out which was very helpful" (Mother ID 20)

These parents were able to fulfil their role as protector without the extra pressure of daily tasks such as caring for older siblings, cooking and cleaning. These parents described being aware of the need to stay well in order to care for their baby. Having family also provided comfort that they too were being cared for. Some parents reported that family also provided a 'sounding board' where parents could raise their concerns or where they could ask advice about what to do. Whilst some family members were described and considered experts, others were simply people that they trusted.

"I phoned up my sister and I asked her, I said 'is it normal?' and she said 'you are just worrying for no reason, it's absolutely normal" (Mother ID 16)

"We've got a great family , mum's around, sister's around, brother's around, we've got a really large extended family, So like mum's always giving us her advice and she's telling us to come and do this, come and do that, but at the end of the day we follow what we need to follow as a parent" (Father ID 19).

Parents that had family support described recognising its value and sympathised with those that did not. Several parents describe that parents 'in a worse off' situation were those with

little or no family support. Consideration for those in a worse situation also provided them with a positive attitude about their infant's readmission to hospital — a feeling that their situation could be worse.

> *"We are a big family, we are okay, she has been well-supported food in and out, shifts, I can stay here, her mother in law can stay here, are you with me, but we have got our own business, we are okay like that. But there are people here on their own and they can't speak the language and they are lost. I have spoken to them." (Father ID 17)*

Two parents who described having little wider family support felt that their partner compensated for this by being a supportive person for the mother. For these parents, there was a sense that they were more reliant on each other than other parents who had more support.

> *"My husband supports me all the time and while he's the only family I've got round here, he was quite supportive really." (Mother ID 1)*

No parents described being totally isolated from any family or partner support.

5.5.3.2 Theme 2: Baby's deterioration

Nearly all parents described witnessing signs of deterioration in their baby's health in the time preceding the readmission to hospital. Many parents described a feeling of intuition or instinct that something wasn't right and used their knowledge of their baby's behaviour prior to them becoming unwell to make this judgement.

> *"They've got this routine of waking up every three hours but this one would wake up but then that one wouldn't. I thought, 'Something isn't quite right'. He just didn't seem right but when the health visitor came in, she said, 'Oh, it's just because he's smaller' and not to worry. They said, 'If he doesn't wake up after five hours, then raise it'. That's what happened on the Friday evening, so we came up there". (Mother ID 9)*

Some parents were confident to take action based on their instinct whereas others sought reassurance from a trusted family member before consulting health professionals.

> *"I was really scared and told my husband who said, 'You're a stress head'. I said, 'You always tell me I'm a stress head. I'm not a stress head'. My mother-in-law said to me, 'Yeah, she's a newborn baby. She'll be tired. She needs her sleep. Don't worry. Is she drinking?' "(Mother ID 7)*

Whilst some parents reported to be accepting of health professional's advice, others were not. Consulting health professionals became a challenging period of time for some parents when their concerns were not validated by health professionals. Some parents reported accepting the health professionals' judgment as superior to their own, whilst others sought a second opinion from an alternative health professional. The route by which parents got to the hospital reflected parents' perceptions about the severity of the illness and also frustrations in the system.

> *"Well we did try calling 111 first but it was just so much automated stuff and I didn't think I was getting anywhere so then I just called 999" (Father ID 25)*

Once the baby was readmitted to hospital, many parents described attempting to protect their baby's vulnerability and reported this as extremely challenging.

> *"We was very shocked that, ok, he's dehydrated and then they had to do like a lumber puncture on him. He's really young and, you know, it was the first experience as parents and we just felt really bad". (Mother ID 20)*

Parents who identified that their baby was unwell describe feeling relieved when their baby was given a diagnosis because it confirmed that their parental judgment was correct.

> *"Yes he has suspected sepsis so they are treating him for that as a precaution but obviously we won't know exactly what it is until his results come back from his lumber puncture. [OK and how do you feel about*

that?]. To be honest there's been a few different things over the last few days that we've both kind of picked up on but we've been told, no, no that's fine, that's fine, [right] but then when the doctor came to see him this morning and she checked him over she was like well actually no, because she connected all the dots basically…so we both now feel better now knowing that he's being treated for something" (Mother ID14)

5.5.3.2.1 Seeking advice

Many parents describe noticing signs or symptoms that their baby was unwell.

"At first, I thought he was fine but this one was just getting less and less responsive, so he wouldn't wake up as often for a feed. They've got this routine of waking up every three hours but this one would wake up but then that one wouldn't. I thought, 'Something isn't quite right'" (Mother ID 9)

"At 4 or 5 o'clock, I tried to feed her but she didn't respond to me. She was really cold and straight. I touched her and tickled her but she wasn't moving" (Mother ID 7)

Some parents described being confident in taking action once they were concerned about their baby's ill health. These parents tended to be parents who had existing children and who had previous experience of seeking medical advice from health professionals.

"we've got a sixth sense and we say 'you know what, we need some help' and then we just take them in'" (Father ID 19)

Other parents were not so confident and described an inability to trust their own judgement and needing to seek advice or check their concerns with a family member before seeking medical advice from a health professional. Once the family member had been consulted, parents took action to seek advice from professionals. If somebody they trusted had validated their concerns, it justified their seeking advice.

"My mother-in-law said to me, 'Yeah, she's a newborn baby. She'll be tired. She needs her sleep. Don't worry. Is she drinking?' I said, 'No, it's 5 o'clock and she said I should try to feed her every two hours because she'd lost the

weight. 'If you're not happy, take her to the hospital'. I thought she wasn't well". (Mother ID 7)

"I spoke to my mum just before we decided to come up to A&E and I said, 'It's been a while since he's had a wet nappy'. Hearing it, it's obvious but I think because I've just been so sleep deprived and maybe possibly doubting my own intuitions about the situation, that it just needed my mum to say, 'I think it might be best if you just take him to A&E. It might be nothing but I don't think it's good that he hasn't had a wet nappy for a while. For your peace of mind, you won't feel comfortable until you take him down'. That's what the decision maker was for us" (Mother ID 11)

When parents did not get the support from their trusted person, sometimes, it delayed seeking medical advice until their baby's health deteriorated.

"When she was one week old she was looking slightly more…she was getting a bit more irritated but nothing obvious so I didn't think anything of it and she was retching a lot and I said…I phoned up my sister and I asked her, I said 'is it normal?' and she said 'you are just worrying for no reason, it's absolutely normal' and I said 'fine' and then the following day, the day we ended up at the hospital…her behaviour just started changing and all of a sudden within two hours her behaviour was completely different. It only took two hours for her to just deteriorate completely and then we brought her straight to the hospital, A&E, and it just got worse and worse". (Mother ID 16)

One parent described that although a family member could advise, ultimately, it was their decision as parents to trust their own judgment about the condition.

So like mum's always giving us her advice and she's telling us to come and do this, come and do that, but at the end of the day we follow what we need to follow as a parent. (Father ID 19)

One parent described not seeking advice from health professionals straight away because they thought that the baby had an hereditary condition that he had experience of and therefore was not alarmed with the symptoms he had observed.

"I noticed little signs. It's purely because I know I do it so you kind of tend to notice little things more than anything but at the same time how far do you go with 'oh there's this wrong'. You'd be on the phone every two minutes so I kind of left it and just kept an eye, and then as it's got worse and as I say the day before yesterday I had to prompt her into breathing again." (Father ID 23)

A few parents described not being aware that their baby was ill and the baby's condition was detected at routine visit with the community health professionals or hospital postnatal appointment.

"No we didn't [know the baby was unwell], we didn't know whether we would have to stay one or two nights…and the doctor said we have to give you a room and stay here for like one night…but now yesterday morning they told her she has to stay another night" (Mother ID 12)

One parent described that if only she had been told about when and how often to feed her baby, the deterioration in the infant's health could have been avoided.

" I felt like after four days it would be nice if someone told me I should feed my baby eight times a day" (Mother ID 5).

Although parents who detected their child's condition were reassured by what they felt was evidence that they were successful in their role as protector, the converse was not true for parents who did not identify their child' ill health. Parents who did not realise their baby was ill explained that this had not affected their confidence as a parents and instead were grateful that health professionals were able to help them to act in order to keep baby well. These parents tended to be more trusting and willing to accept shared responsibility for their baby with health professionals.

"I felt really positive about the midwives… because of them wanting to do the [bilirubin] test and then basically persuading us that we should go to the Children's Hospital" (Mother ID 2)

5.5.3.2.2 Who knows best?

'Who knows best?' describes parents' perceptions about who they believed was the expert when it came to identifying signs that the baby was unwell, and then caring for the baby on readmission to hospital. The perceptions about health professional's knowledge continually changed depending on the parent, health professional and context.

When parents sought advice from health professionals, some parents described that their own knowledge was inferior to that of the health professionals.

> *"It's horrible because you want to help them but you can't [yes]. There's nothing you can do. You've just got to pretty much wait for the professionals to check him over and get your answers from them, but other than that, apart from being there for him and doing your best, it's as if you're just looking outside a glass window because you can't really do anything to make anything better" (Father ID 25)*

The view that health professionals knew best meant that some parents struggled to have a voice when seeking advice from them, particularly when they were concerned about their baby's wellbeing.

> *"We took him to out of hours GP [and the doctor said] 'yeah, it is colic'. But he's only four days old so, it can't be colic. But, we kind of took his word for it, you know, he's a professional? I suppose as parents, you listen to the professional, whatever they say". (Mother ID 20)*

These perceptions were shaped by parents' own confidence in caring for their baby, previous experience of seeking advice from health professionals and values and beliefs about the position of health professionals in society.

> *"They are professionals so you…they tell you something and you go, ok they are professionals, they are doing their job, you know, so you don't question it." (Mother ID 14)*

"As new parents, like I said earlier on, you're kind of relying on the professionals telling you". (Father ID 20)

When parents felt that their concerns were undermined by health professionals, they describe feeling that health professionals were not listening to them. In these circumstances, they described that health professionals failed to acknowledge the parent's concern, only providing reassurance that no immediate action was necessary.

"They've got this routine of waking up every three hours but this one would wake up but then that one wouldn't. I thought, 'Something isn't quite right'. He just didn't seem right but when the health visitor came in, she said, 'Oh, it's just because he's smaller' and not to worry". (Mother ID 9)

For these parents, the encounters in which concerns were dismissed resulted in them questioning their own judgement. This undermined confidence in their role as protector because it challenged their assessment of the baby's wellbeing, and then put the parent in control of what action to take next. Parents who had to come to the view that their baby needed further medical assessment had to ignore advice given by one group of health professionals and take alternative medical advice from others.

"Four am. So, we went and the thing is, like, yeah, it is colic. But he's only four days old so, it can't be colic. But, we kind of took his word for it, you know, he's a professional? I suppose as parents, you listen to the professional, whatever they say….So, we came home, gave him Infacol, nothing. And then it was nearly 24 hours since he'd done a wet nappy and then we called our midwife who said I think it's best to go to children's A&E". (Mother ID 20)

"We were just saying that you know what, not everyone's got the job for actually diagnosing a particular illness. And the community midwife, they're not a doctor are they? So they've got a limited understanding of it, similar to us possibly" (Father ID 19).

Many parents subsequently questioned the advice given by health professionals in community and describe that there were times when they were falsely advised by health professionals.

> *"The frustrating thing is that like those spots and everything were checked the other day and we were told they were fine and now we are here, it's kind of shocking" (Father ID 15)*

> *"But the doctors over here (at the children's hospital) have said 'I don't know where she (community midwife) got her judgment from, it's totally wrong'. (Father ID 19)*

Recognition that the advice given by health professionals was incorrect was important for those that had to seek alternative advice because it validated their role as protector and served as an acknowledgment that they were correct in pursuing the need to seek further medical advice.

> *"yes the community midwife…looked at him and she said he looks alert,' and as far as she was concerned, she didn't really think there was any massive concern, but actually interestingly when he did have his serum bilirubin done [at the hospital] he was above the threshold for treatment. (Mother ID 1)*

As a result of these experiences with health professionals, many parents describe regret for not trusting their own judgement, wishing they had been more assertive and had voiced their concerns with the health professional at the time. Several parents described feeling that had their concerns been listened to, there may not have been a delay in diagnosing the baby's illness which could have prevented the need for admission.

> *"Looking back I wish we'd followed our instincts and questioned it more and been like you said, no that's not right rather than just taking [it] because they are professionals so they tell you something and you go, ok they are professionals, they are doing their job…so you don't question it. I do wish we'd questioned more at that time, because I mean I know it's only*

been a few days, but those few days are vital when he's only eight days old…and it could have been sorted sooner, he could have been half way through with his antibiotics, with his treatment". (Father ID 15)

"Always go with your gut instincts is what I'd always say, you know your baby better than anyone else, and if you feel that your baby could do with some you know, medical assistance, or just some reassurance, always best to get it done. Don't leave it to chance". (Mother ID 1)

5.5.3.2.3 Getting to hospital

The route by which the baby was admitted to hospital varied widely from referral to Emergency Department (ED) via their GP, following consultation with NHS 111 (a helpline with fully trained advisors provided by the NHS (160), self-referring to ED or via ambulance.

One parent described phoning for an ambulance after trying to seek help advice from NHS 111. This parent described the frustration with the automated symptom checker in 111 and their need to get medical assistance immediately. Following calling for an ambulance, this parent described feeling relieved when they were able to discuss the symptoms with a health professional.

"To be fair it's the first time I used it but it's just automated and it was press this, but the options that were coming up wasn't really the options, it was just flu and stuff…it wasn't the options that I was sort of looking for. So like you can't go wrong with 999 I suppose. Someone's going to answer there. You're automatically speaking to an operator which helps. But yes they were great on the phone and he asked me the questions, I answered the questions and they were good". (Father ID 25)

Other parents described a conflict between following their instinct about their baby's ill health and not wanting to unnecessarily contact health services. These parents described

that they feared wasting health professionals' time by seeking advice and this worry impacted on how quickly they sought advice from a health professional.

> *"Sometimes, you're thinking, 'I've been told that he's fine' and you don't want to waste their time up there. You don't want to make the trek up there, just to be told there's nothing wrong and just come back again". (Father ID 10)*

When parents attended the hospital with their baby, many parents described the emotional distress and difficulty in taking their baby to where 'sick kids' go whilst they were waiting for their baby to be assessed.

> *"And when we got there I got really upset…you know, seeing all babies coughing and, you know all over and we have just five-days-old baby" (Mother ID 5)*

This seemed to challenge their instinct to keep their newborn baby away from potentially precarious environments where they may have acquired some infection/illness and many parents describe the comfort gained when they were taken to an informal but 'special' corridor or place in the emergency department where newborn babies wait to be seen. Sometimes this was at the expense of parents own physical comfort although this discomfort was reported and deemed as an appropriate sacrifice in order to fulfil their parental role as protector.

> *"When we got here, they asked us how old he was and he said he was 5 days on the Sunday, and they said, 'oh, please don't sit in the normal reception area', they put us in the side corridor… he was triaged very quickly and then put into one of the cubicles to see one of the paediatricians". (Mother ID 1)*

> *"Because he's so young and not vaccinated, we couldn't be outside any open plan area, he had to be in a treatment room. And so we were sat where people are usually examined and trying to get some rest there rather*

than at an actual bed. So, it was quite an uncomfortable night". (Father ID 21)

"We didn't want him, being a new-born, to be sat out with sick kids and stuff so they did put us in an aisle" (Mother ID 24)

5.5.3.2.4 Having a diagnosis

Despite the distress of their baby requiring an admission to hospital, having a diagnosis on readmission provided great reassurance to some parents. In many cases, parents described that it confirmed their concerns about their baby's health and justified their need for concern.

"We wanted to know what was wrong with him and they did lots of tests so they've just put it down to bronchitis now…We both now feel better now knowing that he's being treated for something because if we were to go home we'd end up back in again and it would be worse" (Mother ID 8)

For other parents the diagnosis was not reported as important but they describe being reassured because they had been successful in their role of protector because their concerns had been recognised by health professional and their baby was in hospital having investigations. Where parents had instigated the need to have a medical assessment at hospital, the readmission itself helped to validate the successful role of protector in identifying the need for admission and this in itself appeared to be confidence building for parents because their instinct had been proved to be correct.

"We haven't had a diagnosis yet …when you're observe it doesn't look that bad, but on the nappy there was some puss, so I just thought you know, there's something not right. Yeah, it's just observation, general observation of parents, that's it really" (Father ID 20)

It also paved the way for a trusting partnership with health professionals and enabled the parents to share the role of protector with the health professionals in caring for their baby.

5.5.3.3 Theme 3: Sharing responsibility

Parents described a range of relationships with health professionals with varying degrees of responsibility. The extent to which parents shared responsibility with health professionals varied: some parents were happy to relinquish the majority of medical care of baby to health professionals. These parents tended to be those who lacked confidence in their own capabilities and or parents who had previous experiences of health professionals making sound medical judgment meaning that they were trusting of their care. These parents did not describe wanting shared decision making in order to feel positive about their experience and the decisions made on their behalf were not considered to be disempowering.

"By the time we got there (the children's hospital) I was glad because I knew we were in safe hands" (Mother ID 2)

A few parents reported that they would have preferred health professionals to take on more responsibility at a time when they unable to fulfil the role as protector due to physical or emotional ill health. These parents were critical of health professionals for not identifying their needs.

"So thinking [that] someone is so weak, someone should come and just make sure that I'm feeding the baby and it didn't happen" (Mother ID 5)

By contrast, some parents reported being pleased to take on the role of 'novice' and sought opportunities to gain knowledge and skills from staff during the readmission experience which gave them confidence in caring for their baby and fulfilling the role as protector. These parents viewed their experience positively.

"I felt really positive about it because the nurses on the PAU had been amazingly helpful, not just with the treatment that they were giving her for the jaundice but everything to do with having a new baby. Like how to

comfort her and how to feed her and whether I was doing it right, you know all the things you just think like, 'I haven't got a clue what I'm doing' and they were so practised and helpful and nice about it that I really felt in safe hands there". (Mother ID 2)

Other parents described mutual decision making when plans of care options were discussed and when they felt that they were equal participants.

"I stayed in an extra night because they said they were happy for me to go home because he started latching a bit later but I wasn't still that confident so I spoke to the midwife and we had a discussion and she said 'I'm happy for you to stay, we can get it sussed and then we are happy to let you go' so that's what we did and she was really good to be fair". (Mother ID 14)

Parents who described a process of joint decision making about the plan of care viewed their experience positively. To view the readmission positively was emotionally protective as it prevented parents from feeling out of control. It was also protective because there was an acceptance that medical treatment fell outside of their role as protector and they were therefore still able to meet their parental duty. This also enabled a trusting relationship where parents were able to share the responsibility of parent as protector with health professionals.

"So I didn't want to go to the Children's Hospital, when they said I need to stay overnight, I didn't want to stay so I was like discussing 'cause I want to go home and the doctors…they were very diplomatic. They weren't telling me, 'You have to stay', and they were saying, 'Okay, let's see'. So they were like trying to calm me down and cope with the baby…when they told me about blood sugars, I got really worried because I didn't realise now it's quite serious. And when we stayed they…were taking care of us…so it was really good experience" (Mother ID 5)

The process of making a decision together helped to forge a mutually trusting relationship and was empowering for these parents.

"I said, 'No, I don't want to put it in her nose please'. He said, 'What do you think then? We gave her a bottle but she's not taking it and she needs her milk. She's hungry'… I said, 'Can I try and put her to my breast?' They said, 'I'd prefer the breast. If you try and she takes it, it's a good sign'. I tried and she took one hour and then two hours with little sucks and then she properly sucked and was fine. The doctor said, 'I'm happy now, Mum. She's taking it. That's good. We'll not put the wire in the nose. If you want to try the breast again, then do so or try the bottle one as well'. I tried with the bottle but she wouldn't take it. She took mine. I'm happy and the doctor said, 'I'm happy too'". (Mother ID 7)

One deviant case was apparent: one family sought to maintain full responsibility for their baby and were reluctant to share any responsibility at all, even when their baby was readmitted to hospital. These parents saw it as their role to question the decisions made by health professionals; they found that reviewing the plan of care set by health professionals became part of identifying sources of danger for their baby and were fearful of their baby being cared for by others. This family struggled to share the role and responsibility of protector with health professionals and describe questioning health professionals' judgement and plans of care.

"This morning, the cannula, the problem that we are having now, somebody else made a mistake and then this poor girl will have to suffer for six hours then, go hungry, because the girl, the nurse changed her, gave her the dose and left the whole tube must have come off while she was doing it. But she didn't bother checking. She wrapped up the foot and left the whole thing exposed, the needle, the whole thing was exposed. When I woke up this morning I have picked up that and I looked at the bandage and it was all wrapped up around her foot and I thought how did it slip out? Because it is all bandaged up. So, they basically didn't pay any attention to anything, they left the whole foot exposed to infection and when the doctor tried to flush it, the cannula was blocked. It's just so frustrating. Now my daughter is going to have to go through more pain now" (Father ID 17)

5.6 Discussion

The findings from this study provide an insight into parents' accounts of their child becoming unwell in the postnatal period, where and how they decided to seek health advice, and their experience of their child's readmission to hospital. Parents described various routes to their baby being readmitted to hospital with some taking the advice of health professionals and others acting solely on parenting instinct that their child was unwell. Parents described awareness of, and desire to, protect their baby and clearly defined this as their duty and responsibility. Parents reported that the deterioration of their baby's health was damaging to their self-confidence and sometimes resulted in feelings of guilt as they felt unable to protect their baby. In some cases, parents reported a lack of confidence in knowing when, where or how to access the appropriate health advice, and in some cases parents reported receiving incorrect health advice which resulted in a delay in receiving treatment. Parents' relationships with health professionals were different, and some parents reported being more comfortable with sharing responsibility. This discussion principally addresses the findings of the study in relation to the research objectives outlined in section 5.3.1, followed by a description of findings that were not anticipated.

5.6.1 Parents' experiences of the time leading up to postnatal infant readmission to hospital

Parents in this study described their experiences of the time preceding readmission to hospital in the context of their understanding of role as parents. Parents described awareness of, and desire to, protect their baby and clearly defined this as their duty and responsibility. Parents desire to protect their baby is consistent with findings of other qualitative studies (161, 162). A qualitative meta-synthesis of parents' experiences of early

discharge describes parents feeling responsible for the baby dominating the postnatal period (162). Many participants in our study described that the responsibility as a parent, the state of being accountable or 'to blame' for something, became a burden and this too has been documented in the literature (162-165).

The parents in this study described that the burden of responsibility was amplified by physical ill health following giving birth, emotional vulnerability and not being able to parent together as a couple. The deterioration of their baby's health was also a considerable burden and many parents felt overwhelmed when their baby was readmitted to hospital. Mothers who were breastfeeding were particularly vocal about the burden of responsibility in being the sole provider of nutrition for their baby. The burden of responsibility has been acknowledged in another qualitative study of mothers' experiences of breastfeeding. Spencer *et al.* (166) found that women felt overawed by a sense of responsibility and burden for not being able to hand over to somebody else (166).

Another important finding of this study was parents' descriptions of wanting and needing to be together as a family following the birth of their baby and this is described in the subtheme 'parenting together'. This is consistent with other studies of parents' experiences in the postnatal period (167, 168) and appeared to be a great motivator for being discharged home following birth hospitalisation. This is consistent with a study which found that being discharged 'early' after birth hospitalisation gave parents a feeling of security and provided an opportunity for the whole family to be together from the beginning. This was in contrast to postnatal hospital stay where parents viewed that it was a time for just the mother and baby to bond (167, 168). In our study, many fathers were described as essential to support

the mother whilst she was physically and emotionally vulnerable – they considered themselves to be a team and parents sometimes reported a perceived lack of awareness from health professionals about the importance of this relationship. The continuity and consistency of support from the other parent was beneficial even during times when there was disagreement between them about an aspect of the baby's illness.

5.6.2 Parents' descriptions of how they responded to their child's admission and process by which the infant was admitted to hospital

Many parents in the study described a period of indecision after recognising signs that their baby was becoming unwell. Despite parents in the study describing witnessing their signs that their baby was becoming unwell, parents often described that they were unsure of how to respond to their needs. Some parents sought advice from their social network, others feared seeking health care advice for fear of unnecessarily wasting health care time. For some parents, this delayed seeking advice from health professionals. By contrast, some parents sought the most immediate healthcare advice by phoning for an ambulance. Not knowing when or how to seek the most appropriate medical advice has been identified in a number of qualitative studies where parents described difficulty in determining when their child's illness required urgent care (136, 138). These studies identified that consistent advice from a trust source that addresses parents' concerns and decision making about help seeking whilst they are at home would be beneficial.

Whilst parents' help seeking behaviour in the qualitative study described in this chapter ranged from phoning the NHS out of hours telephone service '111' to attending the Accident and Emergency Department, parents were united in that their motivation for seeking help

was in order to protect their baby. Similar findings were found in a qualitative study of parents' decision making during acute childhood illness which found that the main factor reported to influence parents decision making was their concern to 'do the right thing' for their child (138). Some parents in the study described that their motivation for seeking help was to 'rule out' a more serious condition and this too is consistent with other literature. Hugenholtz *et al.* (137) found that parents often consult healthcare professionals when they want to rule out or prevent something serious, not because of the condition itself, and that not wanting to take a risk is an important motivation for parents (137).

For some infants in this qualitative study, there was a delay in receiving treatment that was attributable to parents' reluctance to access healthcare because they were afraid it might be seen as unnecessary by health professionals. Such parents described not wanting to be perceived as wasting health professionals' time and valuable NHS resources. The fear of being labelled as inappropriately using health care services has been described in other studies (135, 138). It has been suggested that this demonstrates the effect of social hierarchies on parents' interpretations of their encounters with healthcare practitioners (138), and highlights a potential barrier in accessing healthcare services for some.

5.6.3 Factors contributing to their infant's readmission to hospital from parents' perspectives

When provided with the opportunity to talk about the time preceding infant readmission to hospital, parents did not describe their experiences on the postnatal ward as a contributing factor in their baby's health deterioration. Mothers interviewed did not describe being discharged too early although a few did describe wanting more time with a midwife to have support with feeding issues. On the contrary, many of the mothers said they were very keen

to get home following the birth of their baby. This position might support the notion that a shorter stay in hospital is being led by women, rather than by a system keen to save resource (12, 16). Alternatively it could indicate that women were not aware that there were gaps in their care, or that they could have stayed in hospital for longer after the birth, as they made judgements about their postnatal care in their own 'frame of reference'. My professional knowledge as a midwife would support the latter theory because as parents described their experiences, I was aware that elements of their care as described could have been improved. For example, some parents described that their baby's weight loss was not appropriately monitored when there were clearly feeding difficulties and problems establishing breastfeeding.

Whilst no parents in the study described their postnatal ward experience as a contributing factor in their baby's readmission to hospital, a few parents described that a delay in receiving health information or inaccurate diagnosis resulted in their infant's condition getting worse. Similar missed opportunities for earlier intervention have been described in other qualitative studies. Francis et al (2010) found that delay in getting a GP appointment, inaccurate telephone triaging and poor clinical assessment during consultations all contributed to perceived delay in receiving the right treatment for their child (135). The findings from our study suggest that in some cases, parent felt that there was an absence of health information and/or inaccurate clinical assessment which contributed to their baby becoming unwell and being readmitted to hospital.

5.6.4 Additional Findings

The inductive nature of data collection and analysis meant that during the interview, parents were given the freedom and opportunity to describe what they felt was important in relation to their baby's readmission at the time of interview. The theme 'sharing responsibility' arose as a response to parents' descriptions of their experiences of their baby being readmitted to hospital. Although their descriptions related to the experience during the readmission phase, the types of relationships they described are also likely to relate to any encounter with health professionals and therefore provide an insight into the broader subject of how parents negotiated relationship with health professionals.

Whilst some parents described taking a passive role during the readmission, others were uncertain about sharing responsibility with health professionals and were unable to trust staff with the medical care of their baby. Whilst the severity and nature of their infant's condition may have exaggerated this, being a passive participant during their baby's admission could have also represented parents' lack of confidence. Such relationships with health professionals have been identified as potentially damaging because they reinforce the notion that parents did not have a part to play in caring for the baby (169). By way of contrast, in the deviant case identified, parents who questioned the judgment of health professionals on readmission to hospital reflected parent's lack of trust of health professionals— and in this situation, parents became fearful of health professionals. Patient centred care, in which patients and healthcare staff negotiate a mutually sharing partnership, is a primary focus for many health care systems (170). However, this study

suggests that parents could not, or did not, always see the benefit of adopting such a relationship with health professionals.

Previous studies have identified the importance of parents being involved in their child's care and how they view their participation as essential for themselves and their child (171-174). Partnership with health professionals constitutes power sharing and negotiation, and will result in patient empowerment which would be important for future contact with health professionals (175). It is possible to see how promoting a mutually sharing relationship with health professionals would have been beneficial to parents who were reluctant to share responsibility. Such an approach to healthcare reflects a patient centred approach which is considered a primary focus of healthcare systems because it improves patient satisfaction and improve outcomes (170).

5.6.5 Strengths and limitations

The methodological strengths and limitations of this study are described using Lincoln and Guba's definitions and strategies to ensure trustworthiness in qualitative research which includes credibility, transferability, dependability and reflexivity (176)

5.6.5.1 Credibility

As described by Lincoln and Guba (176), part of ensuring trustworthiness in qualitative research is the internal validity, or credibility — the confidence in the truth of the research findings (177). The following methods were used to enhance the credibility of this study: data triangulation (parents had the choice about where they were interviewed, a range of time periods between infant readmission and interview, and parents were either interviewed together or separately) and investigator triangulation (data were coded and

analysed by two researchers, one was experienced in qualitative research). A further description of these now follows.

Interviews took place in hospital or at home and this was considered a strength as it allowed parents to be interviewed in the environment in which they were most comfortable and convenient, thus creating an atmosphere in which they were more likely to talk freely (155). Interviews also took place a different time periods following the readmission—some interviews took place during the readmission (or second readmission) and others took place up to three months after the readmission. This provided a range of responses enabling exploration of parents' immediate thoughts about the readmission and parents' who had had some time between the readmission and the interview.

Parents who were interviewed in hospital were at a reduced risk of recall bias because the interview was being conducted shortly after the time preceding readmission to hospital and there was a reduced likelihood of inaccuracy between what was remembered happening and what actually happening. However, these interviews were opportunistic and had to fit around needs of baby in hospital. Sometimes the interview was cut short because of visiting times, medical interventions or the need to seek medical advice. Parents who were interviewed at home had a longer period to reflect on their experiences and it is possible that these parents were able to construct meaning about past events. As Mattingly and Garro (178) describe: parent's remembering became *'a reconstructive rather than reproductive act because participants recalled events following a period of reflection as well as what was once stored'* (178). Further exploration of the differences in the time period between the infant's readmission may be worth exploring.

In further data triangulation, interviews were either conducted with the mother individually or with both parents present. Whilst the advantages of conducting joint interviews have been discussed in the section 5.4.6, acknowledgement that data collection and analysis process for joint interviews would differ from that of individual interviews was important (154). During data collection, particular attention was given to ensuring that both parents were able to contribute. When one parent seemed to dominate, specific requests for one of the parents to expand on a particular theme was made by the interviewer.

During the analysis of the joint interviews, consideration was given to the interaction between participants and the dynamics of the relationships and how the data produced from individual interviews compared to that of joint interviews. Although a criticism of joint interviews is that they are more likely to produce a publicly rehearsed account rather than a private account and are therefore considered to be less 'true', it is argued that instead of focusing on truth, it is more appropriate to place emphasis on the validity of accounts which are co-constructed by the parents in the joint interview (153). Therefore, the truth is the story that the participants create and co-create together in the joint interviews, regardless of whether their individual accounts may have differed (153). This fits well within the interpretive lens that the study was approached. Further exploration of any patterns in the data that related to the presence of partners during the interview may be worth exploring.

Investigator triangulation was also used; data were coded and analysed by two researchers, one was experienced in qualitative research. Codes, potential themes and findings were discussed at supervisory meetings and transcripts were read and reread and the codes relabelled and redefined accordingly.

5.6.5.2 Transferability

The degree to which the findings can be applied to other contexts, or transferability, (176, 177) is achieved through thick description of the data (176, 177). In order to know how transferable the findings might be to different contexts, in addition to describing the parents' experiences, it was important to describe the context of the study so that the experiences of parents were meaningful. As described in section 5.4.4, the study was conducted in a large urban children's hospital and a maximum variation sampling strategy was used resulting in a study population that was demographically diverse. There was also a wide range of infant conditions that varied in severity. It enabled exploration of patterns and variations in the data relating to parity, birth experience, and severity of the infant's illness and method of feeding. For example, women who were breastfeeding described a distinct burden of responsibility that was not described by bottle feeding mothers, and women who had a traumatic delivery or a birth that did not go to plan described being more overwhelmed by the readmission than parents who had a straightforward birth. Deviant cases were explored and one was found in the sharing responsibility theme: one particular family were reluctant to share any responsibility with health professionals during the readmission to hospital which differed from the other parents who described some degree of trust of health professionals. Having a balanced representation of these variables enabled a breadth of narratives which enhance the trustworthiness and transferability of the findings.

There was not the opportunity to interview single parent families or young parents and this meant that it was not possible to explore the experiences of single parents who did not have

a partner and this would have been particularly useful in exploring motivations for discharge home from birth hospitalisation. In addition, it was not possible to interview cases with complex medical or social factors which would have provided further insight into the experiences of these families.

5.6.5.3 Dependability

Dependability, the consistency and repeatability of the findings, can be demonstrated by recording and describing the research steps taken from the beginning to end of a research project, or audit trail (176, 177). Throughout the development of the research project, notes about research decisions made at supervision meetings were kept, indicating when and why changes were made to the research project. To ensure that the data collection and analysis process was consistent, Braun and Clarke's six step process for thematic analysis was followed (83). During data collection, memos were made during and following each interview providing information on context, nuances and any additional information which was not provided by the audio file. During data analysis, all coding framework iterations were saved, enabling a trail from initial coding to the finished overall themes and subthemes to ensure transparency about coding and analysis (Appendix 12). This ensured that the interpretation was not based on my own particular preferences and viewpoints but grounded in the data.

5.6.5.4 Reflexivity

I approached this qualitative study from an interpretivist perspective and accepted that meanings would be negotiated between me and the participants within a particular social context. To ignore my position therefore, would discount a major component of the

research process. I recognised that my position as a researcher who had also been a service user and service provider would be fairly unusual, and to ensure that my accounts were credible representations, I would need to be reflexive about my positions across the pre-research, data collection and data analysis stages of the project (179).

As a consequence, throughout this study, I have attempted to be reflexive about how my position as a researcher, a mother and a midwife may have affected research decisions in the different phases of the research. Maintaining reflexivity and awareness of how my personal beliefs and perspectives may affect the process and frequent discussion at supervision meetings ensured transparency of the data collection and analysis process. I was aware that data collected was co-constructed between me and the parent and that I did not just collect data, I worked together with the parents to create, to construct the stories together (153, 180).Throughout the study period, I completed a reflexive journal detailing thoughts and reflections on my professional knowledge as a researcher, midwife and mother and discuss these separately.

My midwifery knowledge made me cognisant of parents' reports of potential missed opportunities for earlier intervention and both good and poor clinical practice. For example, a baby who was seen at the general practitioner for weight loss related issues should have been weighed during the consultation and it was clear that this delayed the baby being readmitted to hospital for dehydration and jaundice which related to breastfeeding problems. This may have impacted on my ability to be impartial when parents were talking about their experiences especially when parents described blaming themselves or feeling guilty for not adequately protecting their baby from becoming unwell. It also made the

analysis process more difficult; although parents did not recognise that there had been a problem with the care given, it was clear that the parents had been misinformed. For example, breastfeeding mothers did not criticise or recognise that the information about breastfeeding had not been sufficient, which on reflection from a midwifery perspective could have been a major factor in the baby becoming unwell and needing readmission to hospital.

My position as a midwife may have also affected my relationships with the participants. Although I would have preferred my position as a midwife not to be declared to parents as part of the recruitment process, this was not possible because the recruiting clinician made my role clear despite requesting this not to the case and parents were aware of my dual role of researcher and midwife. This may have impacted on how honest parents were about the care they received, especially if they felt that they had been let down by health professionals. By way of contrast, they may also have provided answers that they perceived would please me (155). In addition, how I conducted the interviews would also have been shaped by my experiences of being a midwife. It is possible that I adopted more of a 'midwife-like role' which may have changed the dynamics of the interview by being more clinically driven and asking more directive questions rather than letting participants speak openly. However, in an effort to address this, I did critically appraise a pilot interview in order to identify questions or language that may be too directive or closed.

I considered that being a mother of three young children would make the parents feel more comfortable in talking to me about their experiences and therefore I made all parents aware that I was a parent. As a mother who had experienced similar readmission to hospital, I was

likely to recall my own emotions and feelings at the time of my own son's readmission to hospital as parents in the study described their own experiences. My own experiences of having a baby admitted to hospital may have affected the interpretation during analysis process as my own emotions and feelings of this experience were relived through the participant's descriptions of their experience. For example, whilst one participant was describing their lack of trust for the health professionals caring for their baby on readmission, I was able to recall my own hesitancy and fear in sharing responsibility with health professionals during my son's readmission to hospital. It is possible that this case became more prominent as a result of my own experiences and such a finding may not have been so prominent if another researcher who had not had that experience had completed the analysis.

As a researcher, I was aware of the literature on this topic, and findings from the quantitative study which was driven by the notion that many admissions in the neonatal period could be potentially avoidable. I was aware that there was a considerable rise in admissions to hospital within the first seven days of life, and many admissions being unnecessary or amenable to earlier intervention. This may have affected my relationship with participants if there was feeling that the admission could have been avoided, or with me searching for parents' descriptions of missed opportunities in the care pathway. Early on in the data collection process, I recognised that my topic guide was too directive, leading parents to look for missed opportunities in line with the assumption that such admissions could be avoidable, and to rectify this, I changed the first question from "I wonder whether we could start by telling me about your experiences of the postnatal period in hospital/birth

centre/home (for home birth) following the birth of your baby?" to "Could you tell me a little bit about how you've ended up in hospital?" which aimed to be more open and to enable parents to talk about what was significant or important to them. This took the emphasis away from the postnatal ward experience allowing the parents to speak about what they felt was important. As expected, the first three interviews conducted with the original topic guide were more focussed on their postnatal ward experience promoted by the first question compared to the later interviews which were led from the point of readmission.

5.7 Conclusion of chapter and summary

This chapter has described the background literature on parents' experiences of caring for a child who is unwell in the community and the methods and findings of the qualitative study exploring infant readmissions within the first four weeks of life from parents' perspectives. The findings from the qualitative study presented in this chapter have provided an insight into parent's accounts of their child becoming unwell in the postnatal period, where and how they decided to seek health advice and their experience of their child's readmission to hospital. Parents in this study describe their experiences of the time preceding readmission to hospital in the context of their role as protector. Many parents in the study describe a period of indecision after recognising signs that their baby was becoming unwell. Parents often describe that they were unsure of how to respond to the needs of their baby. Broadly, parents did not perceive that their infant's illness was avoidable, although a few described that a delay in receiving health information or inaccurate diagnosis resulted in their infant's condition getting worse. On admission to hospital, parents described great diversity in how they desired their relationship to be with health professionals ranging from no involvement

with caring of the baby to reluctance to share any responsibility at all, even when their baby was readmitted to hospital.

Chapter 6 Discussion, conclusions, future research priorities and implications for practice

6.1 Purpose of chapter

This chapter presents a summary and discussion of the findings presented throughout the thesis and provides its conclusion. It addresses the overarching aims of the thesis followed by a description of the contributions to literature, future research opportunities and implications for practice.

6.2 Overview of findings and contribution to literature

The main aims of the thesis were to:

- describe the existing evidence on the effects of early postnatal discharge from hospital: using systematic review methods and presented in chapter 3
- explore the current trends in infant admissions to hospital in the first 28 days with particular emphasis on admissions which could be considered potentially preventable in the context of postnatal care: using the cross sectional study and presented in chapter 4
- explore parents whose infant is readmitted to hospital within the first four weeks after birth and their experiences and perspectives of the time leading up to the infant readmission to hospital: using the qualitative interview study and presented in chapter 5

These aims were planned to explore the possible implications that postnatal care, and a shorter postnatal LoS may have on infant readmission to hospital, and the findings of the quantitative and qualitative studies are discussed in conjunction in this chapter. Conducting these studies has offered original contributions to the literature and the collective findings

from the systematic review, cross sectional study and qualitative interview study add to what was previously known on this topic. A summary of the main findings from the overall study follows and is presented using the research aims outlined in the introduction to the thesis.

6.2.1 The possible effects of postnatal LoS on infant readmission to hospital

Findings from the systematic review and meta-analysis of ten trials and five ITS studies presented in chapter 3 indicated that a shorter postnatal length of stay in hospital (< 48 hours following vaginal birth and < 96 hours following caesarean section) is associated with infant readmission rates to hospital. Findings from the meta-analysis of trials demonstrated that more infants who were discharged 'early' were readmitted to hospital compared to infants who stayed in hospital for > 48 hours. Similarly, the pooled estimate from interrupted time series (ITS) studies suggested that a policy on postnatal minimum stay law significantly reduced the proportion of infant discharged < 48 hours following vaginal birth and < 96 hours following caesarean delivery. These findings are particularly convincing because both the meta-analyses of the trial data and ITS data found an effect of early postnatal discharge in the same effect direction.

These findings contrast to the existing Cochrane review (3) which found no evidence of an effect of early postnatal discharge on infant or maternal health outcomes. The systematic review presented in this thesis was different to the Cochrane review (3) because it included more recent data from two trials and predefined the definition of early postnatal discharge rather than using the trial author's definition which reduced heterogeneity between studies. It also had broader inclusion criteria for the types of studies that were to be included in the

review. As the Cochrane Effective Practice and Organisation of Care (EPOC) (89) details, this was appropriate because it was identified that the evidence from RCTs alone was limited (3). Furthermore, the study aimed to evaluate the effects of a health system intervention (a policy of early postnatal discharge) and adding additional types of studies would improve the capacity to answer the research questions. Additional findings from the trial data indicated that a blanket policy of a specified length of stay was unappealing to some women, hence the large number of cross over and participant withdrawal from the RCTs.

There was considerable heterogeneity with regard to mode of delivery with some trials and ITS studies excluding women if they had given birth via caesarean section and others only including women who had given birth via caesarean section. The largest RCT in the meta-analysis for the primary outcome of infant readmission to hospital within 28 days only included women who had given birth via caesarean section. Without this study, the effect size would not have been statistically significant. This indicates that the evidence from the RCTs on the effect of 'early' postnatal discharge for vaginally delivered infants is less clear, and the overall findings must be interpreted with caution.

The evidence on the effects of 'early' postnatal discharge for primiparous and multiparous women was also unclear. Although all the trials included both primiparous and multiparous women in the study, outcomes were often not reported by parity and therefore it was not possible to review the evidence for this subgroup. There was also very little evidence on the effects of postnatal LoS < 24 hours, which is increasingly common in England (1). This would have been helpful because it may have enabled the identification of a subgroup of women

and infants who are more at risk of readmission, thus enabling targeted interventions to potentially reduce the risk of readmission for this group.

6.2.2 Trends in infant admissions to hospital, with particular emphasis on admissions in the first 28 days which could be considered 'potentially avoidable' in the context of postnatal care

Consistent with earlier studies, findings from the cross sectional study presented in chapter 4 showed that the overall rate of admission increased significantly over the six year period 2008/09-2013/14. The cross sectional study however, has gone further to provide much more detail on the age specific and condition specific rates of admissions for infants under the age of one. Contrary to previous research which found that admissions for infants up to one year were increasing (2, 56, 59), findings from the cross sectional study showed that most of the increase in admission rates was for infants in the first 6 months of life, and that the rate of admissions for infants aged 6-12 months is not increasing considerably.

The increase was most marked in the 0-6 days age category where infants born in 2013/14 were 1.26 times more likely to be admitted within the first 6 days of life compared to infants born in 2008/09 (Relative Risk 1.26, 95% CI 1.24-1.29), a finding not previously shown in the literature. The rate of hospital admission in the first year of life for the three conditions defined as potentially preventable increased by 39% relative to an overall increase of 6% (6.92 per 1000 live births (RR 1.26 95% CI 1.24-1.29) compared to 1.05 per 1000 live births (RR 1.07 95% CI 1.04-1.10) once the potentially avoidable admissions were removed. Over the first year of life, the biggest increase in admission occurred in the first 0-6 days and 85% of the increase in this period was for the identified potentially preventable conditions of jaundice, feeding difficulties and gastroenteritis. The former two conditions, jaundice and

feeding difficulties, may be particularly amenable to intervention and may very plausibly relate to the provision of care on the postnatal ward and in the community midwifery care. This is because if infants are discharged before health professionals are able to detect a problem (such as feeding problems or jaundice) and the mother and baby go home and do not receive a visit until the following day, it is likely that the infant's health would deteriorate more than if they had stayed in hospital because they are not being as closely observed and supported than if they were on the postnatal ward. These findings are particularly important in the potential development of interventions which aim to reduce the readmission rate for infants and is discussed in more detail in section 6.5.3 and 6.7.3.

6.2.3 Experiences and perspectives of parents whose infants are readmitted to hospital during the early postnatal period, focusing on the time preceding the readmission to hospital

The findings from the qualitative study presented in chapter 5 provided an insight into parents' accounts of their baby becoming unwell in the postnatal period. Findings also provided insight into where and how they decided to seek health advice and their experiences of their baby's readmission to hospital. Parents described awareness of and desire to protect their baby and clearly defined this as their duty and responsibility. The deterioration of their baby's health was reported to be damaging to parents' self-confidence, and sometimes resulted in feelings of guilt as they felt unable to protect their baby. Parents were not always confident in knowing when, where or how to access the appropriate health advice, and in some cases parents received incorrect health advice which resulted in a delay in receiving treatment. Parents' relationships with health professionals were variable, and highly dependent on context. There were clear differences in how parents perceived their relationship with health care professionals, and in particular, shared

decision making. Importantly, when provided with the opportunity to talk about the time preceding infant readmission to hospital, parents did not describe their experiences on the postnatal ward as a contributing factor in their baby's health deterioration.

It was expected that the evidence from the qualitative study would provide some understanding of how parity may effect parenting confidence and decision making. From parents' descriptions, it was not possible to distinguish obvious patterns between primiparous and multiparous parents. One explanation for this could be that some of the primiparous mothers were partnered with somebody who was an existing parent (or vice versa) which may have masked the relative 'inexperience' of the primiparous parent.

Another explanation which has been explored in the literature is that parenting confidence may not necessarily relate to parity but rather readiness and preparedness for discharge from birth hospitalisation (181) (182). Several cohort studies conducted in the United States found that healthcare use in the postnatal period correlated to 'unreadiness' to leave at the point of discharge home in addition to parity, marital status, and whether they were breastfeeding (181-183). The authors concluded that being 'unready' at the time of discharge affects how parents cope in the early postnatal period at home and how they navigate health services for support. This adds an interesting dimension to the postnatal LoS debate, shifting the emphasis from length of stay and relative experience of parents to better understanding whether parents have the knowledge, skills and experience in looking after and coping with their baby before being discharged home from hospital.

As described in 5.6.2, it was notable that when provided with the opportunity to talk about the time preceding infant readmission to hospital, parents did not describe their experiences

on the postnatal ward as a contributing factor in their baby's health deterioration. Mothers interviewed did not describe being discharged too early although a few did describe wanting more time with a midwife to have support with feeding issues. On the contrary, many of the mothers said they were very keen to get home following the birth of their baby. This position might support the notion that a shorter stay in hospital is being led by women, rather than by a system keen to save resource (12, 16). Alternatively it could indicate that women were not aware that there were gaps in their care, or that they could have stayed in hospital for longer after the birth, as they made judgements about their postnatal care in their own 'frame of reference'. As described in section 5.5.3, my professional knowledge as a midwife would support the latter theory because as parents described their experiences, I was aware that elements of their care as described could have been improved. For example, from parents' descriptions, it was clear that their baby's weight loss was not appropriately monitored when there were clearly feeding difficulties and problems establishing breastfeeding.

The desire to go home following birth hospitalisation could also indicate that women wanted to be at home with their partner and wider family network (as described in section 5.4.3.1). It is known that the societal role of the father has changed over the last few decades (184) with fathers wanting greater involvement with their children. Whilst employment rights such as improved paternity leave and pay have made it easier to facilitate the sharing of childcare for pre-schoolers (185), support and facilitation of shared responsibility between parents in postnatal care remains outdated with many fathers feeling unwelcome in postnatal hospital care (186). Some women wish to be discharged so that they can share the role of looking

after the baby with their partner and this was clearly described by some women in the qualitative interview study. This highlights the disparity between the expectation of the involvement of partners in the postpartum period and the service having the capacity to facilitate this. For example, currently, very few NHS hospitals in England are able to accommodate overnight arrangements for partners on the postnatal ward, resulting in partners having to go home outside of visiting times (187).

Although parents in the study sometimes reported that they regretted not being more assertive in voicing their concerns about their baby's health, no parents in the study suggested that their child's admission could have been entirely prevented or avoided and this was consistent across all the conditions. This does not necessarily mean that their infant's readmission was avoidable— it may have related to parent's describing their experiences in their own 'frame of reference' or parents being reluctant to attribute blame because of my position as a health professional.

6.3 Methodology

This thesis has demonstrated novel methods for meta-analyses of ITS studies, the development of a working definition of 'potentially avoidable admission' in the context of postnatal care, and recording and coding of Hospital Episode Statistics data. This thesis has used both quantitative and qualitative research methods and has demonstrated that this approach to conducting research offers a broader understanding of the research topic compared to only using one method. This thesis provides a good example of how a cross sectional study can be used to observe the 'macro level'; infant readmissions to hospital, whilst the qualitative study provided the 'micro level'; parent's experience and perspectives

of the time preceding infant readmission to hospital. A further description of these now follows.

The novel methods for conducting a meta-analysis for ITS studies has also demonstrated how findings from large ITS studies can be synthesised to provide reliable and robust results. The systematic review presented in chapter 3 is distinct in that it synthesises evidence from both RCTs and ITS studies in meta-analyses and was appropriate because the effect of a policy of early postnatal discharge was being explored rather than a patient level intervention. The findings therefore provide a broader understanding of the effect of postnatal LoS in both a trial and naturalistic setting.

The systematic review is the first known study to carry out ITS meta-analyses on this topic and provides an insight into the effect of federal and state law across several different populations in the USA and Denmark. Inclusion of these studies has provided an understanding of the health related outcomes for all infants, regardless of medical status or gestation at birth. This was not possible with inclusion of trial data only because only low risk infants were able to participate in the primary studies. The systematic review in this thesis is also different because it clearly defined early postnatal discharge allowing more meaningful comparison across trials. The existing Cochrane review (3) does not specify what constitutes 'early' discharge in days or hours making interpretation for practice challenging and only included randomised controlled trial studies.

The development of a working definition of 'potentially avoidable infant admission' as part of the development of the cross sectional study is considered an important contribution to methodology. The definition was pre specified before calculating admission rates, and the

inclusion and exclusion criteria were developed using the expertise of paediatricians, research data analysts and clinical coders in order to create a meaningful set of codes to identify specific conditions within the dataset. The exclusion criteria further strengthened the validity of the definition by ensuring that infants with underlying conditions were excluded from the data set. For example infants who were admitted for feeding difficulties but had a congenital abnormality such as cleft lip and palate that would make feeding much more difficult. Publication of the inclusion and exclusion criteria enables future research to use the same definition to allow greater comparability between studies.

This thesis has demonstrated that quantitative and qualitative research can be used in conjunction to offer a broader understanding of a health topic reflecting the researcher's epistemological position as described in section 2.3.1. This thesis supports a pluralists theory that relying on a single method of inquiry is limiting (74), and demonstrates that different conclusions could have be drawn from the findings if the studies were considered in isolation. For example, based on findings from the systematic review, meta-analysis and HES infant data studies, a conclusion that a policy of minimum postnatal LoS following birth may be a solution to reducing infant readmission rate to hospital could be drawn. Findings from the qualitative study however, would paint a different picture suggesting if a policy of minimum length of stay was implemented, many women may still choose to go home before the recommended time. Both research methods were necessary in understanding how findings of research could best be implemented into practice.

This thesis has also demonstrated how utilising both quantitative and qualitative research methods can be used to test assumptions about elements of the study. For example, the

systematic review and cross sectional study were based on a clinically driven hypothesis about postnatal LoS and infant readmission, with assumptions that inadequate support in the hospital postnatal ward is likely to increase readmission to hospital (because there is a lack of information and support provided by health professionals and inadequate time to detect maternal and physical health problems). The qualitative study offered the opportunity to explore this assumption by asking parents to describe their experience of the time preceding infant readmission to hospital, and the inductive open-ended topic guide enabled parents to describe what they considered to be important themes in the time preceding their infants' admission to hospital. The qualitative study findings highlight that broadly, parents did not perceive the postnatal ward experiences to be an important contributing factor to their baby's admission. This finding is interesting because although it does not indicate that that postnatal care on the ward was both adequate quality and duration, it suggests that it was not perceived by parents to be an important aspect of their infant's readmission to hospital. Therefore, the qualitative study offered a different view of the scene and highlighted paradoxes and contradiction in the postnatal LoS debate.

6.5 Implications for Practice

The implications for practice arising from this work brings together findings from the systematic review, cross sectional study and qualitative study. The recommendations for practice relate to:

- postnatal length of stay in hospital and 'early' discharge;
- the implementation of 'early' discharge and/or minimum stay policies including women's preferences about postnatal LoS and

- Integration of patient pathways across hospital and community based care to reduce the readmission rate to hospital for jaundice and feeding related difficulties.

6.5.1 Postnatal LoS and 'early' discharge

The findings from the systematic review and meta-analyses of trials and interrupted time series studies presented in chapter 3 show that postnatal length of stay affect infant readmission rates to hospital. The results provide evidence that a minimum 48 hour stay following vaginal birth and 96 hours following caesarean delivery may reduce infant readmission rates within 28 days.

Whilst this finding contrasts with the Cochrane review (3), this finding is consistent with much of the other existing evidence from other studies (28-30, 46, 188, 189). Such a finding is plausible: if infants are discharged before appropriate support can be given to prevent the problem in the first place, or before health professionals detect a problem (such as feeding problems or jaundice) and the mother and infant go home and do not receive a visit until the following day, it is likely that the infant's health would deteriorate more than if they had stayed in hospital because they are not being as closely observed and supported than if they were on the postnatal ward.

Policy makers should be aware that the findings must be interpreted with caution due to the clinical heterogeneity specifically, the mode of birth. Furthermore, the ITS studies were conducted in the United States where there is very little postnatal care provision in the community. It is possible that the same effect may not be observed in England where

women and infants have on average, three postnatal visits from midwives in the community following discharge from hospital (7, 10).

In addition, despite these findings, given the enormous strain on NHS resources (16), it is unlikely that there will be capacity to extend the postnatal length of stay for all women and babies in England. Instead, it is recommended that groups at high risk of readmission should be identified so that interventions can be put in place to reduce the risk of the commonest avoidable admissions. Women's preferences about postnatal LoS would also need to be considered and this is discussed in more detail in section 6.5.2.

6.5.2 The implementation of postnatal LoS policies including women's preferences about postnatal LoS

Evidence on women's preferences on postnatal LoS from the systematic review (chapter 3) and the qualitative study (chapter 5) provide important implications for practice including: the implementation of a minimum postnatal LoS; understanding the relationship between women's perspectives on quality of inpatient postnatal care and discharge timing; and the need for enhanced postnatal community based interventions to support women and babies at home.

Findings from the systematic review (chapter 3) and qualitative study (chapter 5) show that a policy of minimum postnatal LoS in hospital may be challenging to implement. In a trial setting, women did not want to be constrained to a particular postnatal LoS (31, 35-38, 40, 98) and findings from the qualitative study (chapter 5) indicate that women and their families were important drivers in being discharged home from hospital, questioning the

widespread assumption that postnatal LoS policy has been predominantly resource-led rather than needs-led (12, 16).

Women's preferences about postnatal LoS in hospital also highlights an important question: Do women want to go home because the quality of care is not perceived to be good enough, or do women prefer to be at home soon after giving birth? Whilst findings from the qualitative study suggested that women were motivated by a desire to be reunited with their partner in their familiar surroundings, some women also alluded to a lack of adequate support on the postnatal ward motivating them to be discharged. Whilst the CQC survey found that around 72% women felt that their postnatal LoS in hospital was about right (10), it does not detail the quality or aspects of care that women felt could be improved. In any implementation of a minimum postnatal LoS policy, the postnatal ward environment, attitudes of staff, breastfeeding support and unmet information needs, as identified in a quality improvement qualitative study (190), in addition to the capacity for fathers to stay on the postnatal ward, would all be important issues to address. Such a policy would also have to consider alterative provision for women who choose to give birth at home.

If women's motivations for going home are being led by the desire to be at home (rather than poor quality postnatal inpatient care), then capacity for alternative community care pathways should also be explored as an alternative to minimum postnatal LoS in hospital. As identified in the qualitative study, women described a desire to be at home with their partner in a familiar surroundings and this finding is supported by existing literature on this topic (167, 168). Possible integrated care pathways and community based interventions to

better support women and infants in the early postnatal period, particularly with establishing breastfeeding, are described in the following section (6.5.3).

6.5.3 Integrated care pathways and community based midwifery interventions to reduce the infant readmission rate to hospital for jaundice and feeding related difficulties

Despite the evidence from the systematic review suggesting that a minimum postnatal LoS reduces infant readmissions to hospital, the NHS has long been striving to reduce hospital length of stay across all areas of healthcare, including maternity services (16). Given the NHS's limited resources (16) and evidence from the systematic review and qualitative study that a minimum postnatal LoS policy may be difficult to implement due to women's preferences about how long they stay in hospital after giving birth, alternative integrated care pathways between hospital and community, in addition to community based interventions to reduce infant readmissions to hospital, should be considered.

Findings from the cross sectional study presented in chapter 4 provide clear direction for practice: admissions for jaundice and feeding difficulties account for the majority of the increase in readmission rate for infants in the first seven days of life and these conditions are amenable to interventions. The National Maternity Review has highlighted that more support for women is required, describing the current provision as '*under-resourced and overlooked*' and the Government's recent Ten Year Plan to improve the NHS in England, including specific recommendations for maternity services, would provide an important opportunity to address this problem (15). In the government's pledge, emphasis has been placed on implementing evidence based programmes to improve breastfeeding rates, which

in turn, would be to decrease instances of neonatal weight loss that requires readmission to hospital.

In light of the findings of the systematic review, further policies could also target women and infants who are discharged 'early' from hospital with the aim of developing an 'early discharge care pathway'. This would better support women and infants in the community following discharge home. Findings from the qualitative study presented in chapter 5 suggest that community policies would be appealing to women because it would enable them to be at home whilst still receiving close midwifery support. Whilst this would probably not exceed the costs of inpatient postnatal care, it would incur additional cost implications for maternity services. In such a care model, the role of maternity support workers could also be explored. Specific interventions that could be developed and evaluated are described in section 6.7.3.

6.7 Future research

This thesis has offered a better understanding of infant readmission to hospitals in England in the context of early postnatal discharge from hospital. It is inevitable that there are questions that require further exploration and these pertain to:

- the relationship between postnatal length of stay under 24 hours and infant and maternal health outcomes;
- women's motivations for being discharged from hospital following birth;
- whether integrated care pathways and community interventions are beneficial in reducing the infant readmissions rate for jaundice and feeding related difficulties.

6.7.1 The relationship between postnatal LoS and maternal and infant outcomes

Future research could provide a better understanding of the potential relationship between postnatal LoS under 24 hours and maternal and infant outcomes using routine datasets with appropriate adjustment of potential confounders. This is particularly important given the trend towards a shorter stay in hospital and the increase in proportion of women and infants who are discharged < 24 hours (10). The capacity to conduct robust analyses on the association between postnatal LoS and infant readmission rate would rely on routine measurement of postnatal LoS in hours rather than days. The Maternity Services Dataset, implemented in 2014 (1) may help facilitate such research, in addition to introduction of electronic patient records (14, 15). As part of future research, it would be helpful to further identify infants most at risk of readmission to enable the development and testing of targeted interventions, with the ultimate aim of reducing the readmission rate to hospital.

6.7.3 Why women go home following birth hospitalisation

Future research could also explore why women go home when they do following birth hospitalisation. Although the qualitative study (chapter 5) explored this topic, only the views of parents whose infant was readmitted to hospital were examined and it would be beneficial to understand all postnatal women's views on this topic. Qualitative research could also explore health professionals' perspectives on the drivers for women and babies being discharged from hospital. A study conducted in Australia found that staffing significantly contributed to the provision of quality of postnatal care, and that there were identified issues associated with inadequate staff to patient ratios, staffing mix and care

needs of mothers and infants and the use of non-permanent staff (194). Further qualitative research and or surveys conducted in England could whether women's desire to go home following birth hospitalisation are linked to either the quality of care received on the postnatal ward and or the information and support provided. It is notable that maternal and infant health related outcomes may not be related explicitly to postnatal LoS but rather to: quality of care, contact time with health professionals and the qualifications and skill mix on the postnatal ward (in addition to family and wider support networks and cultural context). Such research could also explore whether women and partners would like the opportunity to stay in hospital together overnight and whether this would alter women's desire to go home. Also, how this may be accommodated in an already stretched resource.

6.7.3 The effectiveness of integrated care pathways and community interventions to reduce the infant readmission rate for jaundice and feeding related difficulties.

Findings from the cross sectional study and systematic review highlight the need to explore potential interventions to improve postnatal care. This applies both to hospital and community settings, for women and infants discharged 'early', and for infants with feeding difficulties or physiological jaundice. Further research could explore interventions aimed at reducing the readmission rate for infants by developing new care pathways in the transition from hospital to community. Also, additional research could explore more comprehensive support in the community. This would ensure that any problems are detected and proactively managed, that handover of care to community midwives is comprehensive and that women and infants are adequately supported in the community to prevent readmission to hospital.

Research could explore the effectiveness of having a 'discharge midwife' who is already part of the postnatal ward team, and allocated to caring for women and babies who are due to be discharged from the postnatal ward that day. Whilst this has been informally adopted at a local NHS trust, the efficacy and efficiency of this care model has not been reviewed. Such a service may help to improve information continuity so that there is a better handover of care from hospital staff to community staff, and that women receive consistent advice about when, where and with whom they seek advice from if they need to.

Community care interventions could ensure better support for women establishing breastfeeding, and closer monitoring of infant serum bilirubin levels and weight management. Maternity community services could be enhanced through breastfeeding peer support programmes which are recommended by the WHO (191) but not well integrated within NHS service in the United Kingdom at present (192). For better management of jaundice in the community, further research could explore the effect of greater availability of transcutaneous serum bilirubinometers and whether this reduces the burden placed on secondary care services—NICE guidance of the management of jaundice recommends the use of transcutaneous bilirubinometers to monitor jaundice levels in the postnatal period (54). Evidence locally however, suggests that there may be reduced availability of the equipment needed (transcutaneous serum bilirubinometers) for midwives to do this adequately (Cheatham, C 2018, community matron, Birmingham Women's and Children's NHS Foundation Trust, oral communication, Nov 6th). This specific intervention may increase the admission rate for jaundice but ensure that infants are appropriately referred to secondary services.

As an alternative to increased midwifery contact, research could explore the effectiveness of 'breastfeeding and infant weight management pathway' interventions that are facilitated by maternity support workers. Such interventions would aim to increase breastfeeding support and improve the proactive management of infant weight management to reduce the risk of readmission to hospital. In addition, the effectiveness of interventions using telemedicine could be examined in the UK. This has been explored in Denmark (193), where researchers introduced and examined the benefit of an 'app' that was available to women who were discharged early in the first week following birth. It had a 'chat with a midwife' facility, a knowledge base and automated messages. Such an intervention could ensure that women who are discharged early receive consistent health information whilst reducing the need for midwifery contact in the postnatal period.

6.8 Conclusion

This thesis has investigated the link between postnatal length of stay on infant readmissions to hospital. The systematic review and meta-analysis of ten trials and five ITS studies found that a shorter postnatal length of stay in hospital (< 48 hours following vaginal birth and < 96 hours following caesarean section) is associated with infant readmission rates to hospital. Findings from the cross sectional study indicate that admissions to hospitals within the first 28 days have increased over the period 2008/09-2013/14 and much of the increase in admission rate for infants in the first 0-6 days was attributable to physiological jaundice and feeding difficulties, which were defined as potentially preventable conditions in the neonatal period. Findings from the qualitative study found that broadly, parents did not perceive their postnatal care in the ward to be an important factor in the readmission to hospital and were

strongly motivated to go home following the birth hospitalisation. In light of these findings, and given the enormous demand on NHS services, integrated care pathways and community postnatal care interventions should be developed to better support infants and families who are discharged < 48 hours after vaginal birth, in addition to infants who are at risk of being admitted for feeding related problems and jaundice.

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Appendices

Appendix 1 Systematic review protocol publication

Jones E, Taylor B, MacArthur C, et al. The effect of early postnatal discharge from hospital for women and infants: a systematic review protocol. Systematic Reviews 2016;5(1):24. doi: 10.1186/s13643-016-0193-9

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Systematic Reviews

PROTOCOL Open Access

The effect of early postnatal discharge from hospital for women and infants: a systematic review protocol

Eleanor Jones*, Beck Taylor, Christine MacArthur, Ruth Pritchett and Carole Cummins

Abstract

Background: The length of postnatal hospital stay has declined over the last 40 years. There is little evidence to support a policy of early discharge following birth, and there is some concern about whether early discharge of mothers and babies is safe. The Cochrane review on the effects of early discharge from hospital only included randomised controlled trials (RCTs) which are problematic in this area, and a systematic review including other study designs is required. The aim of this broader systematic review is to determine possible effects of a policy of early postnatal discharge on important maternal and infant health-related outcomes.

Methods/design: A systematic search of published literature will be conducted for randomised controlled trials, non-randomised controlled trials (NRCTs), controlled before-after studies (CBA), and interrupted time series studies (ITS) that report on the effect of a policy of early postnatal discharge from hospital. Databases including Cochrane CENTRAL, MEDLINE, EMBASE, CINAHL and Science Citation Index will be searched for relevant material. Reference lists of articles will also be searched in addition to searches to identify grey literature. Screening of identified articles and data extraction will be conducted in duplicate and independently. Methodological quality of the included studies will be assessed using the Effective Practice and Organisation of Care (EPOC) criteria for risk of bias tool. Discrepancies will be resolved by consensus or by consulting a third author. Meta-analysis using a random effects model will be used to combine data. Where significant heterogeneity is present, data will be combined in a narrative synthesis. The findings will be reported according to the preferred reporting items for systematic reviews (PRISMA) statement.

Discussion: Information on the effects of early postnatal discharge from hospital will be important for policy makers and clinicians providing maternity care. This review will also identify any gaps in the current literature on this topic and provide direction for future research in this area of study.

Systematic review registration: PROSPERO CRD42015020545

Keywords: Postnatal care, Early discharge, Length of stay

Background

The average length of postnatal stay in England has decreased over the last 40 years. In 1975, 32 % of women were discharged within 3 days of giving birth compared to 91 % of women in 2013–2014 [1, 2]. The proportion of women and babies who are discharged on the date of delivery has also increased. In 2005–2006, 16.5 % of women were discharged on the same day that they gave birth compared to 20.3 % of women in 2013–2014 [2]. Despite an increase in medical intervention during childbirth and more complex needs of women who become pregnant, there is some evidence to suggest that low-risk women and babies are being discharged from 4–6 h following birth [3, 4]. The decline in postnatal stay in hospital is consistent with the USA, Australia and Canada and is considered to be primarily policy driven in efforts to accommodate a rising birth rate [5, 6].

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There is little data and some concern about whether early discharge of mothers and babies is safe. It has been suggested that early discharge from hospital leaves insufficient time for women and babies to establish breastfeeding and, as a result, leads to feeding-related problems [7]. In addition, it is argued that early discharge may increase the delay in the identification and treatment of maternal and infant morbidity [8, 9]. In contrast, others have suggested that early discharge from hospital creates opportunities for family-centred care, creates greater opportunities for families to bond in their home environment and is a safe and cost-effective way to provide postnatal care [10, 11].

The existing evidence on the effects of early postnatal discharge from hospital is inconclusive. The most recent Cochrane systematic review including 10 randomised controlled trials (RCTs) (involving 4489 women) compared early postnatal discharge with a standard length of stay. The pooled estimate of the included trials showed no statistically significant difference between early discharge and standard length of stay for infant readmission to hospital (relative risk (RR) 1.29 95 % CI 0.60–2.79) or other important outcomes [5]. One of the main limitations of this review is the methodological and clinical heterogeneity within included studies.

Firstly, the review authors used the definition of 'early discharge' given by each trial team, and these ranged from 12 h to 3.5 days postpartum [12–14]. As a result, early discharge in one trial was the equivalent of standard length of stay in another trial. Secondly, the definition of 'healthy women and infants' differed among trials where some studies excluded women with comorbidities such as diabetes and others did not [12, 13]. Finally, the trials had different co-interventions in the early discharge groups ranging from being monitored at home for the first 24 h after birth [15] to only having two home visits once discharged from hospital [12]. Statistical heterogeneity was found when data from the trials were pooled in meta-analysis, and this is likely due to the varying definitions of early discharge, differing co-interventions and populations which were not clinically comparable. As a result, it is difficult to draw meaningful conclusions about the impact of shortened or 'early' postnatal stay in hospital.

To look more specifically at the RCTs included in the existing systematic review, one RCT which included 2324 women found that infants were twice as likely to be readmitted to hospital in the first month postnatally if they were discharged early (<48 h) compared to a standard length of stay in hospital (>48 h) (RR 2.14 95 % CI 1.2–7.5). Although this trial is the largest of its kind, its validity and reliability were compromised by non-compliance in the allocated intervention (50 % non-compliance in the intervention group), poor recruitment (only 20 % of women eligible chose to take part) and a sample size which was not large enough to detect significant differences between the intervention and comparison groups. Other trials had similar methodological constraints [16–19]. Although an RCT is generally the best method to evaluate the effects of an intervention, in the context of evaluating early postnatal discharge from hospital, an RCT design is likely to be both problematic and impractical. This has discouraged researchers from conducting further RCTs to assess the effect of early discharge from hospital on infant or maternal morbidity.

To this end, several large retrospective cohort studies have been conducted looking specifically at maternal and infant readmission rates to hospital within 28 days of birth. More specifically, researchers have assessed infant readmission to hospital for jaundice, gastroenteritis, dehydration and poor weight gain [8, 20–23]. Researchers examining maternal readmission rates have looked specifically at readmissions for postpartum haemorrhage, retained products of conception, infection and postpartum psychosis [24, 25]. These causes of readmission are particularly relevant in exploring the effect of postnatal length of stay in hospital. It is suggested by some that these causes of readmission may reflect an inadequate assessment of readiness for discharge from hospital and could possibly be avoided if sufficient support is available in the early postnatal period [5, 8, 12]. However, several of these studies were conducted using routine hospital data and from healthcare insurance claims data and not all known confounding factors were measured or adjusted for in data analysis. It is not possible to infer any causal relationship between early discharge and infant morbidity using these types of studies alone.

Despite the existing literature available on early postnatal discharge from hospital, there is insufficient evidence to inform policy. Although there is an existing Cochrane review with clearly specified outcome measures [5], it is limited by significant clinical and methodological heterogeneity. In addition, it is clear that an RCT design in this context is compromised by poor recruitment and participant crossover. Taking this into consideration, this systematic review will address the same research questions and use the same objectives and outcome measures as the Cochrane review but will broaden the study design criteria to include both RCTs and quasi-experimental studies. In addition, to allow meaningful comparison across studies, this systematic review will further describe the clinical characteristics and discharge criteria for the women and infants included in primary studies and will explore the effect of clinical variation in subgroup analysis. Early discharge will be defined as <48 h to reflect contemporary postnatal discharge practices [2]. To ensure rigour, the protocol

for this systematic review has been guided by the PRISMA P checklist (Additional file 1).

The aim of this systematic review is to determine the effects of a policy of early postnatal discharge (<48 h) for women and infants. It will consider whether there is an association between early postnatal discharge and readmission to hospital. It is hypothesised that early postnatal discharge may increase maternal and infant utilisation of health services.

As guided by the Cochrane review [5], the primary objective of this systematic review is to assess how effective an early postnatal discharge policy is in terms of important maternal and infant health related outcomes.

Specific objectives are to identify whether a policy of early discharge is associated with:

- infant readmission to hospital;
- duration of infant readmission;
- attendance at hospital emergency departments for infant health issues;
- the number of contacts with health professionals regarding infant health issues postdischarge;
- maternal readmission to hospital;
- duration of maternal readmission;
- attendance at hospital emergency departments for maternal health issues;
- the number of contacts with healthcare professionals regarding maternal issues post discharge;
- maternal depression, anxiety and fatigue after the birth;
- occurrence of breastfeeding problems and/or duration of breastfeeding .

Methods/design

Criteria for considering studies for the review

Types of studies

Included studies must be either a RCT, non-randomised controlled trial (NRCT), controlled before-after study (CBA) or interrupted time series study (ITS). As guided by Effective Practice and Organisation of Care group (EPOC), all RCTs and non-randomised control trials must have at least two intervention and control sites [26]. All interrupted times series studies must have a clearly defined point in time when the early discharge policy occurred and a minimum of three data points before and three after the intervention. Because terminology used to describe study designs can be ambiguous, the EPOC study design algorithm will be used to help determine the study design [26].

If there is a paucity of the studies described above, a supplementary review will also include good-quality cohort studies located at a single site.

Types of participants

Women and infants who are considered 'fit for discharge' by their healthcare practitioners. Women may have given birth in a consultant led unit, co-located midwife led unit or stand-alone midwife led unit. It is recognised that there will be considerable variation in how 'fit for discharge' is defined and this will be explored in subgroup analysis.

Types of interventions

A policy of early discharge from hospital where 'early discharge' refers to discharge that is <48 h following birth and earlier than standard care in the setting in which the intervention is implemented.

Types of outcome measures

Maternal and infant outcome measures will be guided by the Cochrane review [5].

Primary infant outcomes

- Proportion of infants readmitted to hospital within 7 days and within 28 days after birth

Secondary infant outcomes

- Proportion of infants readmitted for conditions which may be considered avoidable (including jaundice, dehydration, poor weight gain, gastroenteritis) in the first 28 days after birth
- Duration of infant readmission for infants admitted within 7 and within 28 days after birth
- Total duration of infant hospitalisation over the first 28 days
- Proportion of infants attending accident and emergency department within 7 days and within 28 days after the birth
- Proportion of infants seen by a health professional in a primary care setting for a health related problem in the first 28 days after birth
- Number of contacts with health professionals regarding the infant within 28 days after birth

Primary maternal outcomes

- Proportion of women readmitted for complications related to childbirth (including postpartum haemorrhage, retained products of conception, infection, postpartum psychosis) in the first 6 weeks after birth

- Proportion of women breastfeeding (exclusively or partially) at 48 h, 6 weeks and 6 months after birth
- Proportion of women scoring above the cut off score indicating probable depression on a validated standardized instrument for measuring depression

Secondary maternal outcomes

- Duration of readmission for women readmitted after birth
- Total duration of maternal readmission hospitalisation
- Proportion of women attending hospital accident and emergency department
- Number of contacts with health professionals regarding maternal health issues within 4 weeks after birth
- Proportion of women reporting infant feeding problems within 4 weeks after birth

Methods for identification of studies

Electronic searches

The following electronic databases will be searched:

- CENTRAL (Cochrane Central Register of Controlled Trials)
- MEDLINE
- EMBASE
- CINAHL
- Science Citation Index

Searches for relevant literature on these databases will be done using a combination of free text and indexed terms (for example MeSH terms) and will be combined using Boolean operators. Search terms will be adjusted for each electronic database. Due to wide variation in the definitions of study designs, the search strategy will not be limited by study design type.

Proposed search strategy

Database: Ovid MEDLINE:

1. exp postnatal care/
2. postnatal.ti,ab.
3. postpartum period/
4. puerperium.ti,ab.
5. puerperium/
6. postpartum.ti,ab.
7. "length of stay"/
8. patient discharge/
9. discharge.ti,ab.
10. hospital stay*.ti,ab.
11. (early adj3 discharge).ti,ab.
12. patient readmission/
13. readmission*.ti,ab.
14. admission*.ti,ab.
15. hospitalization/
16. outcome*.ti,ab.
17. hospitali*.ti,ab.
18. safety.ti,ab.
19. complication*.ti,ab.
20. patient admission/
21. 1 or 2 or 3 or 4 or 5 or 6
22. 7 or 8 or 9 or 10 or 11
23. 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20
24. 21 and 22 and 23

Citation searching

Citation searching using key papers which meet the inclusion criteria for the review will enable identification of further potentially eligible studies.

Grey literature

Grey literature will also be searched using Popline, Trip database and Web of Science conference proceedings citation index. The Department of Health, Royal College of Midwifery, Royal college of Obstetricians and Gynaecologists, National Childbirth trust and electronic theses (EThOS) websites will also be checked for relevant material. Internet searches will be performed in Google for any relevant unpublished studies.

No time, language or geographical restrictions will be applied.

Searching other resources

Reference lists of key full text articles included in the review will be checked to identify any potentially eligible studies.

Data collection and analysis

Selection of studies

All studies identified using the search strategy described will be screened for inclusion in the review using the eligibility criteria specifically designed to answer the research questions. Initially, a decision for potential inclusion of study will be based on titles and abstracts and where there is uncertainty about whether a study meets the eligibility criteria, over caution will be applied and the full article will be obtained for detailed assessment against the inclusion criteria.

Assessment of studies for potential inclusion will be performed independently and unblinded by two reviewers without consideration for the results. Any differences in opinions will be resolved through discussion until a consensus is reached. Any papers that are not unanimously excluded or included by both reviewers will be examined by both reviewers until an outcome is agreed. If necessary, a third person may be consulted.

This process will ensure that bias is minimised when deciding whether to include or exclude certain studies.

It is possible that the eligibility criteria may need to be adjusted if it becomes apparent that relevant studies are being excluded from the review or irrelevant studies are being included. Reference management software EndNote will be used by one reviewer to keep a record of decisions made for each article in addition to paper form.

If there is a lack of information about a particular study, the authors will be contacted for clarification. Duplicate publications of research results will be identified and treated as a single study for the purpose of the review. In order to maintain transparency in the review study selection process, a flow diagram will portray the number of studies remaining in each stage of the selection process. In addition, a list of the studies excluded from the review will be documented as an appendix with brief reasons for exclusion for studies.

Data extraction

As guided by University of York Centre for Reviews and Dissemination [27], data extraction will be performed independently by two reviewers and disagreements will be noted and resolved by consensus among researchers or by arbitration by a third researcher. The EPOC data collection form has been adapted to answer the specific research questions for the systematic review. The form will enable data collection of potential confounding factors in primary studies and methods used to control confounding.

In line with good practice, data extraction forms will be piloted on a sample of included studies to ensure that all the relevant information is captured and that resources are not wasted on extracting data that is not required [27].

Assessment of methodological quality of included studies

It is likely that the methodological rigour of the included studies for this review will vary considerably, and it is recognised that that poor-quality studies may obscure important intervention effects or lack of effects. Due to the inclusion of quasi-experimental studies which may be more susceptible to bias than RCTs, thorough assessment of the study quality will be required.

Two review authors will independently assess the risk of bias of the included studies using a descriptive approach and guided by the EPOC criteria for 'risk of bias' tool. Risk of bias for each study included in the review will be qualitatively summarised as part of the summary of findings tables.

The quality assessment tool will be piloted on a small selection of included studies. It is recognised that the quality assessment of studies may involve a degree of subjective judgement and any differences in opinion will be resolved through discussion.

In addition to this, if a supplementary review which includes good-quality cohort studies is necessary, the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cohort studies [28] will be used as a quality assessment tool and risk of bias will be qualitatively summarised in a risk of bias table.

Measures of intervention effect

For RCTs, quasi-RCTs and CBAs, categorical data (e.g. proportion of infants readmitted) will be reported as RRs with 95 % confidence intervals. Continuous data (e.g. duration of infant hospitalisations in the first 28 days) will be reported as mean difference (MD) and 95 % confidence intervals. To aid the interpretation of clinical significance, the absolute risk may also be reported. Guidance will be sought from a statistician if meta-analysis of continuous outcomes requires standardisation across studies.

For ITS, as guided by Ramsey et al. [29], two effect sizes will be reported including the change in the outcome immediately after the introduction of the intervention and the change in slope of the regression lines.

Unit of analysis errors

Methods for reanalysis of RCT and CBAs with potential unit of analysis error

As guided by EPOC [30], cluster RCTs which have been analysed incorrectly by not accounting for clustering will be reanalysed if possible. If the unit of analysis error cannot be corrected, the effect size will be reported without a standard error and confidence interval as they are unlikely to be accurate.

Methods of reanalysis for ITS comparisons with inappropriate analysis

Where possible, as guided by EPOC, segmented time series regression will be used to reanalyse the data using methods described in Ramsay et al. [29].

Dealing with missing data

In line with good practice, authors of primary studies will be contacted to obtain missing data in order to appropriately describe the study results or perform meta-analysis [28]. The potential impact of missing data will be addressed in sensitivity analysis.

Assessment of heterogeneity

It is likely that there will be much diversity in the included studies, and the variety of study designs included in the review may result in significant heterogeneity. Forest plots will be visually examined and poor overlap

between the confidence intervals will give an indication of statistical heterogeneity. The χ^2 test of heterogeneity will help to determine whether differences between results are compatible with chance alone and the I^2 statistic will describe the percentage of variability in the effect estimates that can be attributed to heterogeneity rather than chance [31]. Where meta-analysis has been conducted, heterogeneity will also be explored through subgroup analysis.

Data synthesis

A summary of findings table of included studies will be produced for primary outcomes and will include key information concerning the type of study, number and characteristics of participants, interventions, outcomes and outcome measures.

Where appropriate, meta-analysis using a random effects model will be used to combine data. It is anticipated that there will be much diversity in the included studies and there will be considerable variation in what constitutes 'early discharge'. Where it is not appropriate to perform meta-analysis, included studies will be combined in a narrative synthesis and the results of the included studies will be combined in a forest plot with omission of the pooled estimate. To ensure the synthesis is a rigorous and transparent process, a narrative synthesis framework produced by Rodgers et al. [32] will be used. High-quality evidence will be given priority and results that are highly prone to bias will be interpreted with great caution.

Sensitivity analyses

Where meta-analysis is performed for primary outcomes, sensitivity analyses will explore the effect of

- study quality (by performing two meta-analyses, one which includes all eligible studies and another which only includes high-quality studies as defined by EPOC quality assessment criteria).
- missing data (by using a range of assumptions about the outcomes for participants lost to follow-up in the intervention versus the control arms varying from 100 % intervention participants having a poor outcome to 0 %).

These sensitivity analyses have been decided a priori; however, further sensitivity analyses may be conducted if necessary.

Subgroup analyses

Subgroup analyses will investigate the effect of variables which may moderate the primary outcomes examined in the review and explore potential effect modifiers for primary outcomes. Using evidence from existing literature [5, 9, 24], the following subgroups have been identified:

- Parity (primiparous women versus multiparous women)
  - Gestation (<37 weeks, 37–40 weeks, 40+ weeks)
  - Timing of early discharge (≤12 h, ≤24 h, ≤48 h)
  - Mode of delivery (vaginal delivery, operative vaginal delivery, elective caesarean, emergency caesarean)
  - Co-intervention: early discharge accompanied by co-interventions (antenatal preparation or not, midwife home visits or not)
  - Type of hospital delivered at (consultant led unit, co-located midwife led unit, stand-alone midwife led unit)
  - Clinical characteristics of participants (low-risk women/infants, high-risk women/infants)
  - 'Fit for discharge' criteria (for example, some primary studies may consider women who had blood loss of >500 ml or third degree perineal trauma as ineligible for early discharge and other studies may not).

Discussion

There is little evidence to support a policy early discharge from hospital. This systematic review aims to build on the work of the existing Cochrane review [5] by further describing the participant inclusion criteria and utilising a wider range of study designs to determine the effects of early postnatal discharge from hospital for mothers and infants. To reflect current postnatal practices, this systematic review will also further define early discharge as <48 h after delivery. It is anticipated that this review will identify any gaps in the current literature on this topic and provide direction for future research in this area of study.

Additional file

Additional file 1: PRISMA-P 2015 checklist: recommended items to include in a systematic review protocol. Completed PRISMA-P 2015 checklist for systematic review protocol: the effects of early postnatal discharge for women and term infants. (DOCX 16 kb)

Abbreviations

CBA: controlled before-after studies; EPOC: Effective Practice and Organisation of Care; ITS: interrupted time series; MD: mean difference; NRCTs: non-randomised controlled trials; RCT: randomised controlled trials; RR: risk ratio.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions
EJ, CC, BT and CM conceived the study. EJ wrote the first draft, and CC, BT, CM and RP revised the protocol. All authors read and approved the final manuscript.

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Appendix 2

PRISMA statement adapted from Moher D *et al.* (195)

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	39
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	n/a
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	41
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	44 (appendix 1 in full)
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	41
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	43
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	41
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Figure 3.1
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	43

Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	42
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	46
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	45
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	46
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	46
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	46
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre specified.	46
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	47
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	48
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	68-70
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	76
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	77-80
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	72-76

Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	87
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	89
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	90
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	n/a

Appendix 3

Systematic review excluded studies and reason for exclusion

Author	Year published	Reason for exclusion
Ade-Conde	2011	Study design
Amir-Mohammed	2015	Study design
Avery	1982	Study Design
Bar-Zeev	2012	Study design
Barkmeyer		Study design
Batu	2015	Study Design
Behram	1998	Study Design
Benitz	2015	Study Design/Policy statement
Berkane	2015	Study design
Bernstein	2002	Study Design
Bernstein	2007	Study Design
Bernstein	2013	Study Design
Biddle	2014	No control/comparator
Blandthorn	2015	Intervention not ED
Bossert	2001	Study design
Boubred	2016	Study design
Braveman	1996	CBA - no control
Britton	1999	Study design
Brooten	1994	Intervention not ED
Brown	1999	Study Design
Brown	2004	Study Design
Brown	1998	Study Design
Brumfield	1996	Study design/No comparator
Burgos	2008	Study design
Burnell	1982	Intervention not ED
Burgoa-Larranaga	2016	Study design
Calado	2009	Unable to access full text
Cambonie	2010	Study Design
Chandran	1997	Intervention not ED
Cleophax	1999	Intervention not ED
Cooper	1996	Study Design
Dalby	1996	Study Design
Danielsen	2000	Study Design
Darj	2000	Study Design
Dato	2000	B/A study - no before
de la Fuente Fonnest	1998	Study design

Delores	2000	ITS - not enough time points
Dore	1998	Study Design
Dowswell	1997	Study Design
Edmonson	1997	Study Design
Elattar	2008	Unable to access full text
Ellberg	2005	Study Design
Escobar	2001	Intervention not ED
Escobar	2005	Study Design
Farhat	2011	Study Design
Fishbein	1998	Study Design
Flanagan	2014	Study Design
Folks	2013	Intervention not ED
Ford	2012	Study Design
Forster	2014	No outcomes of interest
Fox	1995	Study Design
Galbraith	2003	Study Design
Gonzalves	1993	Study Design
Goulet	2007	Study Design
Gözüm	2005	Study Design
Grupp-Phelan	1999	Study Design
Gupta	2006	Study Design
Harron	2017	study design
Hascoet	2014	Study Design
Hateley	2010	Study Design
Hatzidaki	2001	Study Design
Heck	2003	Study Design
Hellman	1962	Intervention not ED
Hickey	1997	Intervention not ED
Janson	1998	Intervention not ED
Ji	2015	Study design
Johnson	2002	Study Design
Kavehmanesh	2008	Study Design
Kennedy	2004	Study Design
Kotagal	1999	Study Design
Kotagal	2003	No outcomes of interest
Lain	2014	Study Design
Lain	2015	Study Design
Lancaster	2010	Study Design
Lane	1999	Study Design
Lee	1996	Study Design
Lemmer	1987	Study Design
Lieu	2000	Intervention not ED
Liu	1997	Study Design

Liu	2005	Study Design
Liu	2002	Study Design
Liu	2002	Study Design
Lutfi	2013	Study Design
Mabiala-Babela	2007	Study Design
Madlon-Kay	2005	Study Design
Madlon-Kay	2003	Study Design
Maisels	1998	Study Design
Malkin	2000	Study Design
Malkin	2003	No outcomes of interest
Mandl	1997	Study Design
Mandl	2000	Study Design
Marbella	1998	Study Design
Margolis	2000	Study Design
Mascarenhas	1992	No outcomes of interest
Mehl	1976	Study design
Meikle	1998	Study design
Millar	2000	Study design
Moore	2003	Study design
Norr	1989	Study design
Oddie	2005	Study design
Ouattara	2014	Study design
Panda	2012	Study design
Parsons	2015	Intervention not ED
Quinn	1997	Study design
Radmacher	2002	Study design
Ramirez-Villalobos	2009	Study design
Ransjo-Arvidson	1986	Study design
Raube	1999	Study design
Rhodes	1994	Study design
Romero Sanchez	1999	Study design
Ronald	2017	Study design
Rouse	2006	Study design
Saslow	1995	Study design
Shiva	2003	Intervention not ED
Smith-Hanrahan	1995	Intervention not ED
Straczek	2008	Study design
Sword	2001	Study design
Taiba	2012	Intervention not ED
Taniguchi	1999	Study Design
Thompson	2003	Study Design

Thompson	1999	Study Design
Thurston	1985	Study Design
Tomashek	2006	Study Design
Tripathi	2014	No outcomes of interest
Waldenstrom	1989	Intervention not ED
Waldenstrom	2004	Study Design
Wallace	2015	Study design
Wang	2017	Study design
Watt	2005	Study Design
Watt	2005	Study Design
Weiss	2009	Study design
Welt	1993	No outcomes of interest
Williams	1993	No outcomes of interest
Yanicki	2002	Study design
Young	2013	Study design

Appendix 4

Systematic review risk of bias tables for RCTs

Study	Types of bias		Judgement	Support for judgement
Boulvain (2004)	Selection bias	Random sequence generation (allocation sequence)	LOW	Page 809 'consenting women were allocated to home or hospital care by opening consecutively numbered, opaque, sealed envelope. The envelopes were opening by a third party during a phone call with the research midwife. The allocation sequence was prepared with a computer program generating random sequence of number in blocks of varying size (4,6, and 8) arranged in random order
		Allocation concealment	LOW	(see above)
		Baseline characteristics similar	LOW	Page 811 'slightly higher proportion of nulliparas and of smokers in the intervention group. There were more women planning to work following maternity leave, more instrumental deliveries and postpartum haemorrhages and third/fourth degree tears.
	Performance bias	Blinding of participants and personnel	HIGH	Not possible to blind participants and personnel
	Detection bias	Blinding of outcome assessment	HIGH	Page. 809 self-reported in questionnaires Comment: Not stated whether researchers were blinded.
	Attrition bias	Incomplete outcome data	LOW	4.5% incomplete outcome data Intention to treat (ITT) analysis
	Reporting bias	Selective outcome reporting	LOW	Reported on outcomes specified in methods

		Adequate protection against contamination	HIGH	Comment: Likely that control group received the intervention because clinical and nursing staff trained that early postnatal discharge is safe
	Any other bias			Page 811 differential 50% noncompliance (n=115) in the intervention group and 29 % (n=67) noncompliance in the control group. (although mean LOS in Intervention group was 65 hours and 106 hours in control group). Low uptake bias: 20%
Bueno (2005)	Selection bias	Random sequence generation (allocation sequence)	LOW	Page 715 ' A randomisation by blocks (opaque sealed envelopes) was performed within two strata defined by the parity variable (Primiparous, Multiparous); the sample size within each group in these two strata was fixed, taking into account the distribution of the parity variable within our area of study'.
		Allocation concealment	LOW	See above
		Baseline characteristics similar	LOW	Intervention group higher for university education and 12-15% state no education at all) More meconium at birth in intervention group,
	Performance bias	Blinding of participants and personnel	HIGH	Not possible to blind participants and personnel
	Detection bias	Blinding of outcome assessment	HIGH	Blinding of researchers assessing outcome not stated

	Attrition bias	Incomplete outcome data	LOW	5.1% Incomplete outcome data ITT analysis
	Reporting bias	Selective outcome reporting	LOW	Reported on outcomes specified in methods
		Adequate protection against contamination	HIGH	Likely that control group received the intervention because clinical and nursing staff trained that early postnatal discharge is safe
	Any other bias			More women in the intervention group did not accept their allocation (2.6% v 0.9%)
Carty (1990)	Selection bias	Random sequence generation (allocation sequence)	LOW	Page 199 'Using a table of random numbers, sealed opaque envelopes containing the assignments were placed on the file of each prospective participant and opened by the nurses at the time of the home visit'.
		Allocation concealment	LOW	See above. Comment: at home, did women decide once envelope was opened. ? More robust if done in clinic
		Baseline characteristics	HIGH	Page 201 'The demographic characteristics of the women in the three groups did not differ significantly after randomisation' Comment: no data given in a table by group allocation
	Performance	Blinding of	HIGH	Not possible to blind participants and personnel

	bias	participants and personnel		
	Detection bias	Blinding of outcome assessment	HIGH	Page 200 self-reported by women in questionnaires, blinding of researchers assessing outcome not stated
	Attrition bias	Incomplete outcome data	HIGH	Page 201 30.7% incomplete outcome data (mainly due to post randomisation exclusions) Not ITT analysis
	Reporting bias	Selective outcome reporting	UNCLEAR	reported on outcomes pre specified in methods
		Adequate protection against contamination	HIGH	Comment: Likely that control group received the intervention because clinical and nursing staff trained that early postnatal discharge is safe
	Any other bias			None identified
Gagnon (1997)	Selection bias	Random sequence generation (allocation sequence)	LOW	Page 206 'subjects were stratified by recency of immigration and parity and randomised at 32 and 38 weeks gestation in blocks of 8 according to a table of random numbers. Group assignment was placed in opaque sealed envelope. Subjects were randomised before birth'.
		Allocation concealment	LOW	See above

		Baseline characteristics	HIGH	Page 209 baseline characteristics table
	Performance bias	Blinding of participants and personnel	HIGH	Not possible to blind participants and personnel
	Detection bias	Blinding of outcome assessment	UNCLEAR	Page 207 'Outcomes were assessed at one month postpartum via medical record review and mailed questionnaires' Comment: Unclear whether researchers were blinded to group allocation
	Attrition bias	Incomplete outcome data	HIGH	51% incomplete outcome data: More attrition and data missing in Intervention group: 20/183 (10.9%) C:6/ 177 (3.4%) Total: 26/360 (7.2%) Not ITT analysis
	Reporting bias	Selective outcome reporting	LOW	Reported on outcomes specified in methods
		Adequate protection against contamination	HIGH	Comment: Likely that control group received the intervention because clinical and nursing staff trained that early postnatal discharge is safe
	Any other bias			Low uptake bias: 38% eligible chose to take part in the study.
Mckeever	Selection	Random	UNCLEAR	Page 260 'Using central randomisation procedures, eligible mother-newborn pairs were

(2002)	bias	sequence generation (allocation sequence)		stratified as term or near term (35-37 weeks gestations) and allocated to either standard or experimental group'
		Allocation concealment	UNCLEAR	See above. Comment: at home, did women decide once envelope was opened. ? More robust if done in clinic
		Baseline characteristics	HIGH	Page261.baseline characteristics table Comment: Slightly more primiparous women in full term intervention group compared to the full term control group (51.3% compared to 45.5%), and also longer gestation in the control group (19% at 41 weeks compared to 8% in the intervention group). Many parameters not measured/presented
	Performance bias	Blinding of participants and personnel	HIGH	Not possible to blind participants and personnel
	Detection bias	Blinding of outcome assessment	UNCLEAR	Outcomes were assessed during a home visit scheduled from 5-12 days postpartum. Researchers were blinded at onset of interview, but become clear during interview which group the participant had been assigned to.
	Attrition bias	Incomplete outcome data	HIGH	26% incomplete outcome data. Differential post randomisation exclusions (23% in intervention group compared to 31% in control group)
	Reporting bias	Selective outcome reporting	LOW	Comment: reported on outcomes pre specified in methods section

		Adequate protection against contamination	HIGH	Comment: not a cluster randomised trial, Likely that control group received the intervention because clinical and nursing staff trained that early postnatal discharge is safe
	Any other bias		HIGH	Low uptake bias: 156 mothers of term newborns eligible, 101 agreed to participate, 58 mothers of near term infants eligible, 37 agreed to participate.
Tan (2012)	Selection bias	Random sequence generation (allocation sequence)	LOW	Page 1274: 'The randomisation sequence was generated using an online random number generator in blocks of four or eight on a 1:1 ratio. Numbered opaque envelopes were prepared containing the allocation to day one or day 2 discharge'
		Allocation concealment	LOW	Sealed numbered opaque envelope containing allocated discharge protocol was attached to the chart of each participant. The envelope was opened on post caesarean day one 1 morning ward round by the healthcare provider to reveal allocation
		Baseline characteristics	LOW	Page 1277. Baseline characteristics table (table 1). Comment: baseline characteristics similar and table provided
	Performance bias	Blinding of participants and personnel	HIGH	Not possible to blind participants and personnel
	Detection bias	Blinding of outcome assessment	HIGH	Page 1275. patient self-reported outcomes, blinding out researcher assessing outcome unknown
	Attrition	Incomplete	LOW	5% incomplete outcome data

	bias	outcome data		ITT analysis
	Reporting bias	Selective outcome reporting	LOW	Comment: reported on outcomes prespecified in methods section
		Adequate protection against contamination	HIGH	Comment: Likely that control group received the intervention because clinical and nursing staff trained that early postnatal discharge is safe
	Any other bias			
Winterburn (2000)	Selection bias	Random sequence generation (allocation sequence)	UNCLEAR	Page 1154.'women were randomly allocated to one of two groups'
		Allocation concealment	HIGH	Page 1154. 'Selecting sealed envelopes containing instructions for either short or long stays'.
		Baseline characteristics	HIGH	No data on baseline characteristics and not in text either
	Performance bias	Blinding of participants and personnel	HIGH	Not possible to blind participants and personnel
	Detection	Blinding of	UNCLEAR	Page 1154: telephone interview.

	bias	outcome assessment		Comment: not clear whether the researcher was blinded to group allocation or not.
	Attrition bias	Incomplete outcome data	LOW	2.7% incomplete outcome data ITT analysis
	Reporting bias	Selective outcome reporting	UNCLEAR	Outcomes not prespecified in methods
		Adequate protection against contamination	HIGH	Likely that control group received the intervention because clinical and nursing staff trained that early postnatal discharge is safe
	Any other bias			Differential noncompliance to group allocation 90/121 (74%) in Intervention group moved to Control group 20/127 (17%) moved to Intervention group from Control group.
Waldenstrom (1987)	Selection bias	Random sequence generation (allocation sequence)	UNCLEAR	Page 727. 'participants…randomly allocated'
		Allocation concealment	UNCLEAR	See above
		Baseline characteristics	UNCLEAR	Page 728. 'No statistically significant differences in 25 different variables concerning demographic, socioeconomic and psychological background, or obstetrical complications during pregnancy and delivery'.

				Comment: Described but no table available. When comparing baseline characteristic of women who chose not to take part, women included in the study had fewer years in education, were more confident about parenthood and viewed hospital care more negatively.
	Performance bias	Blinding of participants and personnel	HIGH	Not possible to blind participants and personnel
	Detection bias	Blinding of outcome assessment	HIGH	Patients self-reported diaries,
	Attrition bias	Incomplete outcome data	HIGH	37% incomplete outcome data Not ITT analysis Attrition bias: Non-compliance in the trial was treated differently in each study group. For example, 13 women in the intervention group were excluded because they went home later than allocation, whereas 5 women allocated to SC who went home early were included in analysis.
	Reporting bias	Selective outcome reporting	LOW	Comment: reported on outcomes prespecified in methods section
		Adequate protection against contamination	HIGH	Comment: Likely that control group received the intervention because clinical and nursing staff trained that early postnatal discharge is safe
	Any other bias			Low uptake bias: only 10.2% of eligible women chose to take part in the study.

Yanover (1976)	Selection bias	Random sequence generation (allocation sequence)	UNCLEAR	Page 703 'Assigned enrolees randomly to the control group or to the study group'.
		Allocation concealment	UNCLEAR	See above
		Baseline characteristics	HIGH	No data on baseline characteristics and not in text either
	Performance bias	Blinding of participants and personnel	HIGH	Not possible to blind participants and personnel
	Detection bias	Blinding of outcome assessment	UNCLEAR	Outcomes assessments 'interview, chart review, and questionnaire' Comment: Not clear whether the researcher was blinded to group allocation
	Attrition bias	Incomplete outcome data	HIGH	31.3% incomplete outcome data Not ITT analysis
	Reporting bias	Selective outcome reporting	UNCLEAR	Outcomes not prespecified in methods
		Adequate protection against	HIGH	Comment: Likely that control group received the intervention because clinical and nursing staff trained that early postnatal discharge is safe

		contamination		
	Any other bias			Differential noncompliance to group allocation: 12/44 (27.4% moved from intervention group to control group, 5/44 (11.3%) moved from control group to intervention group).

Appendix 5

RCT EPOC tool for Risk of Bias

EPOC risk of bias tool for studies with a separate control group (RCTs, CCTs, CBAs)

Was allocation sequence adequately generated?	Score “Yes” if a random component in the sequence generation process is described (eg Referring to a random number table). Score ”No” when a nonrandom method is used (eg performed by date of admission). CCTs and CBAs should be scored “No”. Score “unclear” if not specified in the paper.
Was allocation adequately concealed?	Score “Yes” if the unit of allocation was by institution, team or professional and allocation was performed on all units at the start of the study; or if the unit of allocation was by patient or episode of care and there was some form of centralised randomisation scheme, an on-site computer system or sealed opaque envelopes were used. CBAs should be scored “No”. Score “unclear” if not specified in the paper.
Were baseline outcome measurements similar?	Score “Yes” if performance or patient outcomes were measured prior to the intervention, and no important differences were present across study groups. In RCTs, score “Yes” if imbalanced but appropriate adjusted analysis was performed (e.g. Analysis of covariance). Score “No” if important differences were present and not adjusted for in analysis.** If RCTs have no baseline measure of outcome, score “Unclear”.**
Were baseline characteristics similar?	Score “Yes” if baseline characteristics of the study and control providers are reported and similar. Score “Unclear” if it is not clear in the paper (e.g. characteristics are mentioned in text but no data were presented). Score “No” if there is no report of characteristics in text or tables or if there are differences between control and intervention providers. Note that in some cases imbalance in patient characteristics may be due to recruitment bias whereby the provider was responsible for recruiting patients into the trial.

Was incomplete outcome data adequately addressed?	Score “Yes” if missing outcome measures were unlikely to bias the results (e.g. the proportion of missing data was similar in the intervention and control groups or the proportion of missing data was less than the effect size i.e. unlikely to overturn the study result). Score “No” if missing outcome data was likely to bias the results. Score “Unclear” if not specified in the paper (Do not assume 100% follow up unless stated explicitly).
Was knowledge of the allocated interventions adequately prevented during the study?	Score “Yes” if the authors state explicitly that the primary outcome variables were assessed blindly, or the outcomes are objective, e.g. length of hospital stay. Primary outcomes are those variables that correspond to the primary hypothesis or question as defined by the authors. Score “No” if the outcomes were not assessed blindly. Score “unclear” if not specified in the paper.
Was the study adequately protected against contamination?	Score “Yes” if allocation was by community, institution or practice and it is unlikely that the control group received the intervention. Score “No” if it is likely that the control group received the intervention (e.g. if patients rather than professionals were randomised). Score “unclear” if professionals were allocated within a clinic or practice and it is possible that communication between intervention and control professionals could have occurred (e.g. physicians within practices were allocated to intervention or control)
Was knowledge of the allocated interventions adequately prevented	Score “Yes” if the authors state explicitly that the primary outcome variables were assessed blindly, or the outcomes are objective, e.g. length of hospital stay. Primary outcomes are those variables that correspond to the primary hypothesis or question as defined by the authors. Score “No” if the outcomes were not assessed blindly. Score “unclear” if not specified in the paper.

during the study?	
Was the study free from selective outcome reporting?	Score “Yes” if there is no evidence that outcomes were selectively reported (e.g. all relevant outcomes in the methods section are reported in the results section). Score “No” if some important outcomes are subsequently omitted from the results. Score “unclear” if not specified in the paper.
Was the study free from other risks of bias?	Score “Yes” if there is no evidence of other risk of biases
* If some primary outcomes were imbalanced at baseline, assessed blindly or affected by missing data and others were not, each primary outcome can be scored separately. **If “UNCLEAR” or “No”, but there is sufficient data in the paper to do an adjusted analysis (e.g. Baseline adjustment analysis or Intention to treat analysis) the criteria should be re scored to “Yes”.	

Part B: Risk of bias summary for interrupted time series studies

If the ITS study has ignored secular (trend) changes and performed a simple t-test of the pre versus post intervention periods without further justification, the study should not be included in the review unless reanalysis is possible.

Was the intervention independent of other changes?	**Score "Yes" if there are compelling arguments that the intervention occurred independently of other changes over time and the outcome was not influenced by other confounding variables/historic events during study period.** ***If Events/variables identified, note what they are.*** **Score "NO" if reported that intervention was not independent of other changes in time.**
Was the shape of the intervention effect pre specified	Score "Yes" if point of analysis is the point of intervention OR a rational explanation for the shape of intervention effect was given by the author(s). Where appropriate, this should include an explanation if the point of analysis is NOT the point of intervention; Score "No" if it is clear that the condition above is not me
Was the intervention unlikely to affect data collection?	Score "Yes" if reported that intervention itself was unlikely to affect data collection (for example, sources and methods of data collection were the same before and after the intervention); Score "No" if the intervention itself was likely to affect data collection (for example, any change in source or method of data collection reported).
Was knowledge of the allocated interventions adequately prevented during the study?* **	Score "Yes" if the authors state explicitly that the primary outcome variables were assessed blindly, or the outcomes are objective, e.g. length of hospital stay. Primary outcomes are those variables that correspond to the primary hypothesis or question as defined by the authors. Score "No" if the outcomes were not assessed blindly. Score "unclear" if not specified in the paper.
Were incomplete outcome data adequately addressed?* **	Score "Yes" if missing outcome measures were unlikely to bias the results (e.g. the proportion of missing data was similar in the pre- and post-intervention periods or the proportion of missing data was less than the effect size i.e. unlikely to overturn the study result). Score "No" if missing outcome data was likely to bias the results. Score "Unclear" if not specified in the paper (Do not assume 100% follow up unless stated explicitly).
Was the study free from selective outcome reporting?	Score "Yes" if there is no evidence that outcomes were selectively reported (e.g. all relevant outcomes in the methods section are reported in the results section). Score "No" if some important outcomes are subsequently omitted from the results. Score "unclear" if not specified in the paper.
Was the study free from other risks of bias?	Score "Yes" if there is no evidence of other risk of biases.

	e.g. should consider if seasonality is an issue (i.e. if January to June comprises the pre-intervention period and july to December the post, could the “seasons’ have caused a spurious effect).
*** If some primary outcomes were assessed blindly or affected by missing data and others were not, each primary outcome can be scored separately.	

Appendix 6 Risk of bias tables (ITS studies)

Author	Type of bias	Judgement	Support for judgement
Datar and Sood (2006)	Methods to adjust for confounders	LOW	Multivariate logistic regression model with infant readmission and infant mortality as dependant variables. Impact of law on newborn LoS and outcomes were estimated using multivariate linear regression model where LoS was dependant variable Regression model included: - Constant term - A time trend variable (to control for secular time trends) - 3 terms estimating changes in LOS at 1,2,3 yrs after the passage of the law. - Other control variables: - maternal characteristics (race, education, age at birth, insurance status and parity), newborn gender, - infant risk factors at time of birth (trauma, seizures, infection respiratory problems), - indicators for pregnancy (preeclampsia, eclampsia, pyelonephritis, hypertension, renal disease, anaemia, lung disease, cardiac disease, haemoglobinopathy, polyhydramnios, genital herpes, STIS, hepatitis, rubella, incompetent cervix, tobacco use during pregnancy, uterine bleeding before labour, previous history of premature births, low birth weight) - indication for LSCS, delivery complications - Labour complications (seizure during labour, feto-pelvic disproportion, shoulder dystocia, breech or other abnormal presentation, precipitous labour (< 3 hours), prolonged labour (> 20 hours), premature rupture of membranes, induction of labour, placental abruption, placenta previa, sepsis, pyrexia, cord prolapse, fetal distress, anaesthesia complication and maternal blood transfusion
	Intervention independent of other changes	UNCLEAR	

	Shape of the intervention effect prespecified	LOW	Point of analysis is the point of intervention
	Intervention unlikely to affect data collection	LOW	Sources and methods for data collection where the same before and after the intervention
	Knowledge of the intervention adequately prevented during the study	HIGH	Unable to blind participants to intervention
	Incomplete outcome data adequately addressed	UNCLEAR	proportion of missing data unclear
	Study free from selective outcome reporting	LOW	No evidence that outcomes were selectively reported
	Any other bias		
Evan et al 2008	methods to adjust for confounders	LOW	Statistical analysis: interrupted time series model (two stage least squares estimate) Confounders adjusted for: 6 subsamples based on mode of delivery and insurance type: vaginal deliveries without/with complications/Caesarean births either private or Medicaid insurance
	Intervention independent of the changes	UNCLEAR	Authors state that intervention occurred independently of other changes over time although there was an outbreak of flu which may have affected readmission rates.
	Shape of the intervention effect pre specified	LOW	Point of analysis is the point of intervention
	Intervention unlikely to	LOW	Sources and methods for data collection where the same before and after the intervention

	affect data collection		
	Knowledge of the allocated intervention adequately prevented during the study	HIGH	Unable to blind participants to intervention
	Incomplete outcome data adequately addressed	UNCLEAR	Proportion of missing data unclear
	Study free from selective outcome reporting	LOW	No evidence that outcomes were selectively reported
	any other bias	N/A	N/A
Meara et al (2006)	methods to adjust for confounders	LOW	Segmented linear regression used to estimate sudden changes in level or trend in newborns' rates of utilisation and outcomes Regression model included: - Constant term - Term for linear time trend - Term to estimate change in level - Term to estimate change in slope/trend - Model also controlled for first order correlation (correlation between two consecutive observations) Models were also estimated for subgroups: vaginal birth, primiparous women (but result similar so not presented) Sensitivity analyses of result to potential confounding of trends : adjusted rates came from linear models of each outcome controlling for:

			Maternal education, age, marital status, parity, race, gestational age categories, birth weight, AN visits, metropolitan residence, perinatal service/education regions of the state (results confirm unadjusted findings) Significance of regression coefficients were computed using 2 tailed t tests.
	Intervention independent of the changes	LOW	intervention occurred independently of other changes over time on the outcome was not influenced by other confounding variables/historic events
	Shape of the intervention effect prespecified	LOW	Point of analysis is the point of intervention
	Intervention unlikely to affect data collection	LOW	Sources and methods for data collection where the same before and after the intervention
	Knowledge of the allocated intervention adequately prevented during the study	HIGH	Unable to blind participants to intervention
	Incomplete outcome data adequately addressed	UNCLEAR	Proportion of missing data unclear
	Study free from selective outcome reporting	LOW	No evidence that outcomes were selectively reported
	Any other bias	UNCLEAR	Exclusion criteria based on poor quality data rather than patient characteristics. Neonates who were born to mothers who were enrolled in health maintenance organisation plans because these plans reporting of health services use in claims data were believed to be incomplete.

Madden et al (2002)	methods to adjust for confounders	HIGH	Segmented time series regression models to estimate changes in all rates (or means) at point of change in LoS polices. Regression model included: - constant term - baseline trend - term to estimate change in level - term to estimate change in trend/slope - % primiparous women - % 'poor' Report absolute % change in rates
	Intervention independent of the changes	HIGH	Authors state that trend in long term increase in breastfeeding rates and public became more aware of infant health issues over the study period.
	Shape of the intervention effect prespecified	LOW	Study may underestimate the rates of follow up visits within first 10 days, especially if these were home visits which are not billed through Medicaid.
	Intervention unlikely to affect data collection	LOW	Sources and methods for data collection where the same before and after the intervention
	Knowledge of the allocated intervention adequately prevented during the study	HIGH	Unable to blind participants to intervention
	Incomplete outcome data adequately addressed	UNLCEAR	Proportion of missing data unclear
	Study free from selective outcome reporting	LOW	No evidence that outcomes were selectively reported

	Any other bias	UNCLEAR	Exclusion criteria based on poor quality data rather than patient characteristics. Neonates who were born to mothers who were enrolled in health maintenance organisation plans because these plans reporting of health services use in claims data were believed to be incomplete. June births (inability to match births and claims across fiscal years) Study may underestimate the rates of follow up visits within first 10 days, especially if these were home visits which are not billed through Medicaid.

Appendix 7

Systematic review results tables for ITS studies

Appendix 7.1 Pre postnatal discharge law versus post postnatal discharge law

Appendix 7.2 Change in neonatal readmission to hospital within 28 days after birth

Appendix 7.3 Proportion of infants admitted for cause specific conditions

Appendix 7.4 Proportion of women readmitted to hospital within 28 days of giving birth

Appendix 7.5 Proportion of women breastfeeding at 6 weeks

Appendix 7.6 Proportion of infants seen by a health professional in a primary health care setting for a health related problem in the first 28 days after birth

Appendix 7.7 Proportion of infants attending Emergency Department (ED) within 7 days and within 28 days after the birth

Appendix 7.8 Proportion of mothers seen by a health professional in a primary health care setting for a health related problem in the first 28 days after birth

Appendix 7.1 Pre postnatal discharge law versus post postnatal discharge law

<table>
<tr><th>Study</th><th>Results</th><th>Additional Notes</th></tr>
<tr><td>Datar and Sood (2006)</td><td>
Length of stay (hours) adjusted
<table>
<tr><td>Variable</td><td>Overall</td><td colspan="3">Insurance type</td></tr>
<tr><td></td><td></td><td>Medicaid</td><td>Non Medicaid</td><td>uninsured</td></tr>
<tr><td>Pre law time trend (1991-1997)</td><td>-1.0 (p < 0.01)</td><td>-1.0a(p < 0.01)</td><td>-1.0a (p < 0.01)</td><td>-0.48 (p < 0.01)</td></tr>
<tr><td>1 yr after law (1998) h</td><td>9.5 (p < 0.01)</td><td>6.8 (p < 0.01)</td><td>11.8 (p < 0.01)</td><td>5.8 (p < 0.01)</td></tr>
<tr><td>2 yr after law (1999) h</td><td>11.9 (p < 0.01)</td><td>10.0 (p < 0.01)</td><td>13.6 (p < 0.01)</td><td>9.0 (p < 0.01)</td></tr>
<tr><td>3 yr after law (2000) h</td><td>13.7 (p < 0.01)</td><td>12.1 (p < 0.01)</td><td>15.3 (p < 0.01)</td><td>10.8 (p < 0.01)</td></tr>
<tr><td>Mode of delivery: Caesarean</td><td>-1.9</td><td>11.3a</td><td>15.2a</td><td>17.9a</td></tr>
<tr><td>Mode of delivery: Vaginal</td><td>-0.8</td><td>9.0</td><td>11.0</td><td>12.7</td></tr>
<tr><td>Parity: Multiparous</td><td>-1.0</td><td>8.8</td><td>11.1</td><td>12.9</td></tr>
<tr><td>Parity: Primiparous</td><td>-1.0</td><td>10.6a</td><td>13.2a</td><td>15.0a</td></tr>
</table>
a: refers to whether estimates are statistically different from the corresponding estimates for other subgroups at
</td><td>Length of stay is reported as change in hours (estimated using hour of birth, number of nights hospitalised and assumptions about time of discharge)</td></tr>
</table>

Study	Results	Additional Notes
	the 5% level of significance	
Meara et al (2004)	Pre-legislation: 37%, Legislative: 55%, post-legislative: 33% Trends within and between periods: Pre-legislation: increased from 20% to 61% (2.5% points per quarter, P< 0.001) Legislative: 55%, fell by 1.9% point to 53% at end of period (P< 0.001 for change in trend) Post legislative: dropped by 10.8% when legislation passed and to 30% by end of period (no significant change in trend relative to legislative period)	Authors report LoS as absolute % change in rates of infants with short stay.
Madden et al (2004)	After state mandate went into effect, the proportion of short stays dropped sharply by 42.2% points (P< 0.001) and the average proportion of infants discharged early was 13.7%. Rates of short stay among vulnerable subgroups decreased to 15.1% after mandate	Length of stay (expressed as Proportion of mother infant pairs with LoS < 2 days Authors report absolute % change in rates reported
Evans et al (2008)	Early discharge rates for newborns, before and after federal law	Length of stay is measured as % change in newborn discharged early

<table>
<tr><th>Study</th><th>Results</th><th>Additional Notes</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td colspan="2">Uncomplicated vaginal deliveries</td><td colspan="2">Complicated vaginal deliveries</td><td colspan="2">C-section deliveries</td></tr>
<tr><td></td><td>private</td><td>medicaid</td><td>private</td><td>medicaid</td><td>private</td><td>medicaid</td></tr>
<tr><td>Discharged Early</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>(1) 7/1/95–8/31/97</td><td>0.859 (0.00064)</td><td>0.749 (0.00082)</td><td>0.707 (0.0013)</td><td>0.578 (0.015)</td><td>0.845 (0.0011)</td><td>0.812 (0.0012)</td></tr>
<tr><td>(2) 1/1/98–12/31/00</td><td>0.467 (0.00076)</td><td>0.515 (0.00086)</td><td>0.373 (0.0011)</td><td>0.365 (0.0013)</td><td>0.656 (0.0011)</td><td>0.724 (0.0012)</td></tr>
<tr><td>Difference (2)- (1)</td><td>−0.391 (0.0011)</td><td>−0.234 (0.0011)</td><td>−0.334 (0.0017)</td><td>−0.214 (0.0019)</td><td>−0.188 (0.0016)</td><td>−0.088 (0.0017)</td></tr>
</table>
Standard errors are reported in ()
</td><td></td></tr>
<tr><td>Sievertsen (2017)</td><td>There was a 25% point increase in the probability of same day discharge for multiparous mothers following introduction of the same day discharge policy

Point estimate from the regression model: 0.247 (SE 0.027)</td><td></td></tr>
</table>

Appendix 7.2 Change in neonatal readmission to hospital within 28 days after birth

<table>
<tr><th>Study</th><th>Results</th><th>Additional comments</th><th>Reanalysis using ARIMA model</th></tr>
<tr>
<td>Datar and Sood (2006)</td>
<td>
<table>
<tr><th rowspan="2">Regression sample</th><th rowspan="2">Prelaw linear time trend</th><th colspan="3">Percentage change in Odds</th></tr>
<tr><th>1y after law</th><th>2 year after law</th><th>3yr after law</th></tr>
<tr><td>Total</td><td>1.3</td><td>-9.3a</td><td>-11.8a</td><td>-19.7a</td></tr>
<tr><td>Delivery type: vaginal</td><td>1.4</td><td>-8.5a</td><td>-11.7a</td><td>-19.4a</td></tr>
<tr><td>Delivery type: caesarean</td><td>0.6</td><td>-13.0a</td><td>-12.0b</td><td>-20.6a</td></tr>
<tr><td>Parity: primiparous</td><td>1.3</td><td>-8.5</td><td>-12.5</td><td>-18.5</td></tr>
<tr><td>Parity: Multiparous</td><td>1.2</td><td>-9.8a</td><td>-11.3a</td><td>-20.6</td></tr>
</table>
a: P< 0.01
b: P< 0.05
</td>
<td>Authors report percentage change in odds of readmissions within 28 days.</td>
<td>Change in Slope: -1.941 (SE 1.17)

Change in level 1 yr: -3.343 (SE 1.992)

Change in level 2 yr: -5.284 (SE 1.889)</td>
</tr>
<tr>
<td>Meara et al (2004)</td>
<td>
Infant rehospitalisation within 10 days of birth
<table>
<tr><th>Type of hospital admission</th><th>Pre-legislation</th><th>legislative</th><th>Post legislative</th></tr>
</table>
</td>
<td>Authors report absolute percentage change in proportion of infants readmitted to hospital</td>
<td>Change in slope: -0.023 (SE 0.025)

Change in level 1 yr: -0.149 (SE</td>
</tr>
</table>

<table>
<tr>
<td></td>
<td>
<table>
<tr><td>Any rehospitalisation</td><td>1.2</td><td>1.2</td><td>0.9</td></tr>
</table>

Regression analyses:

Overall re-hospitalisations within 10 days no significant trend during pre-legislative period (P< .934) and the later changes in rates of rehospitalisation between 1995 and the end of the study period (P = .220 and P = .257 for changes in trends from period 1-2 (pre to during legislation) and period 2-3 (during and post legislation)
</td>
<td>within 10 days for the pre legislative, legislative and post legislative periods.

Authors report regression analyses and change in trends between the pre legislative, legislative and post legislative periods.</td>
<td>0.138)

Change in level 2yr: -0.242 (SE 0.178)</td>
</tr>
<tr>
<td>Madden et al 2004</td>
<td>The rate of readmission to hospital remained constant at 1.5% during the pre-legislative, legislative and post legislative period.</td>
<td></td>
<td>Change in slope:0.036 (SE 0.095)
Change in level 1 yr: -0.45 (SE 0.389)
Change in level 2yr: -0.307 (SE 0.561)</td>
</tr>
<tr>
<td>Evans et al (2008)</td>
<td>
<table>
<tr><td></td><td colspan="3">Proportion infants readmitted</td></tr>
<tr><td>Regression sample</td><td>Uncomplicated vaginal del</td><td>Complicated vaginal del</td><td>LSCS</td></tr>
<tr><td>Federal law x private</td><td>0.0011 (0.0011)</td><td>-0.0007 (0.0014) NS</td><td>-0.0031 (0.0012) SS</td></tr>
<tr><td>Federal law Medicaid</td><td>-0.0001 (0.0012) ns</td><td>-0.0028 (0.0019) NS</td><td>-0.0003 (0.002)</td></tr>
</table>
</td>
<td>Statistical methods:

Two stage least squares model
- Time trend variable (secular rends)

3 subsamples: vaginal deliveries without/with complications

Caesarean births</td>
<td>Evans vaginal complicated private
Change in slope: 0.024 (SE 0.016)
Change in level 1 yr: 0.349 (SE 0.353)
Change in level 2yr: 0.636 (SE 0.502)
Evans vaginal complicated Medicaid
Change in slope: -0.029 (SE 0.024)
Change in level 1 yr: -0.178 (0.531)</td>
</tr>
</table>

Expanded state law x Medicaid	-0.0028 (0.0011)	-0.0041 (0.0017) SS	-0.0009 (0.0015)
State law x private	0.0047 (0.001)	0.0003 (0.0016)	0.0014 (0.0015)
State law x Medicaid	0.0043 (0.0015)	0.0039 (0.0024)	0.0016 (0.0022)

For **privately insured vaginal del without complications**, there was an increase in readmissions rates of 0.11% point after the passage of **federal law**.

For **Medicaid uncomplicated vaginal deliveries**, the **federal law** is estimated to reduce readmissions by 0.01% points, (not SS)

There is a significant reduction in readmission rates for **Medicaid patients** after the **expanded state law** (to include all Medicaid patients). In the same subsample, there was a significant increase in readmissions after the passage of the **state law** for **both insurance types**. This could be attributed to the law, but more likely, this is due to the fact that there was a large spike in admissions in Dec 1997 during a severe flu season in California and this cannot be perfectly controlled for in analysis.

For **vaginal deliveries with complications**, there is a reduction in readmission rates after the **federal law** and for **both insurance types,** but results are not significant.

The effect on readmission rate of the **expansion of the state law** for Medicaid patients -0.41% point is significant.

Change in level 2yr: -0.524 (SE 0.766)

Evans vaginal uncomplicated private
Change in slope: 0.008 (SE 0.022)
Change in level 1yr: 0.243 (SE 0.4551)
Change in level 2yr: 0.338 (SE 0.667)

Evans vaginal uncomplicated Medicaid
Change in slope: -0.018 (SE 0.021)
Change in level 1 yr: 0.203 (0.454)
Change in level 2yr: -0.019 (0.658)

Evans LSCS private
Change in slope: -0.012 (SE 0.015)
Change in level 1 yr: -0.16 (0.327)
Change in level 2yr:-0.306 (SE 0.466)

LSCS Medicaid
Change in slope: 0.001 (SE

	<u>For privately insured LSCS</u>, there was a significant decrease in readmission rates of a little more than 0.3% points after the passage of the **federal law**.		**0.024)** **Change in level 1 yr: 0.332 (0.515)** **Change in level 2yr: 0.341 (SE 0.743)**
Sievertsen (2017)	A policy of same day discharge (early discharge) resulted in a 3% point increase in readmission rates (within 28 days of birth) Point estimate from the regression model: 0.031 (SE 0.011) (p< 0.01)		

Appendix 7.3 Proportion of infants admitted for avoidable conditions

<table>
<tr><th>Study</th><th>Results</th><th>Additional notes</th></tr>
<tr><td>Datar and Sood (2006)</td><td>
<table>
<tr><th rowspan="2">Regression sample</th><th rowspan="2">Prelaw linear time trend</th><th colspan="3">Percentage change in Odds</th></tr>
<tr><th>1y after law</th><th>2 year after law</th><th>3yr after law</th></tr>
<tr><td>Total</td><td>1.3</td><td>-9.3a</td><td>-11.8a</td><td>-19.7a</td></tr>
<tr><td>Jaundice</td><td>1.5</td><td>7.1b</td><td>-5.4</td><td>-10.9</td></tr>
<tr><td>Infection</td><td>2.8</td><td>-8.7</td><td>-21.5b</td><td>-30.3b</td></tr>
<tr><td>Respiratory problems</td><td>2.8</td><td>-13.8</td><td>-6.2</td><td>-14.6</td></tr>
</table>
a: P< 0.01

b: P< 0.05

Jaundice: There was a statistically significant increase in jaundice-related readmissions in the first year after the law compared with the prelaw trend (7%; P< .05). However, in years 2 and 3 after passage of the law, there was a 5.4% and 11% decline in the odds of jaundice-related readmissions, although it was not statistically significant at the 5% level of significance.
</td><td></td></tr>
</table>

	Infection: There was a decline in odds of admission for infection 1 year post law although this was not statistically significant at the 5% level. In years 2 and 3 post law, there was a decline the odds of infection related admissions (-21.5%, P< 0.05) and (-30.3%, P< 0.05) **Respiratory:** There was a decline in the odds of readmissions to hospital for respiratory related problems although this was not statistically significant at 5% level	
Meara et al (2004)	**Jaundice admissions**. Jaundice admissions increased 0.1% points at start of legislative period (P=0.057 for level change) but fell 0.103 % points per quarter from 0.78% to 0.47% by the end of the period (P=0.034 for change in trend). Trends for hospitalisations within 21 days are similar (not displayed). **Quarterly rates of infection and dehydration:** were measured with substantial error and time series results therefore not reported	
Madden 2004	**Proportion of infant admitted for avoidable conditions (in first 21 days) (jaundice, and feeding problems)** The rate of hospitalisation for jaundice was constant at 0.5%. Although ED visits for jaundice were rare, 30 newborns had them during the early discharge program and post mandate years combined. This virtual disappearance, a drop from a constant 0.3% to a constant 0.0% at Q4 1994 was significant (P< 0.001). Summary: no significant difference in rate of admission for jaundice Readmission and ED visits for feeding/dehydration problems were too rare and unevenly distributed to permit reliable statistical analysis (n= 43 and 41 respectively).	

Appendix 7.4 Proportion of women readmitted to hospital within 28 days of giving birth

Study	Results	Additional notes
Sievertsen (2017)	Same day discharge increases maternal readmission within 28 days by 2.2% points but is not statistically significant at the 5% level. Point estimates from the regression model: 0.022 (SE 0.018)(P< 0.1)	

Appendix 7.5 Proportion of women breastfeeding at 6 weeks

<table>
<tr><th>Study</th><th>Results</th><th>Additional notes</th></tr>
<tr><td>Madden (2004)</td><td>No statistically significant changes in breastfeeding (b/f at 3 months) were found at either of the two policy intervention groups. Overall, 23.6% of infants were fed formula exclusively from birth and 76.4% initiated breastfeeding. Of infants who initiated b/f, 40.1% b/f exclusively for 3 months, 32.6% mixed fed, and 27.4% switched to A/F. The rate of b/f rose steadily over time, increasing an estimated 0.4% points per quarter (P< 0.0001) from 70.1% in Q4 1990 to 81.9% in Q1 of 1998. Continuation among imitators remained constant at an estimated 72.6% throughout the study period.</td><td></td></tr>
<tr><td>Sievertsen (2017)</td><td>At least four month exclusive breastfeeding (in three groups based on propensity score 0-33, 34-66, 67 - 100):

Propensity score 0-33: point estimate from:

The effect of same day discharge on exclusive breastfeeding at 4 months
<table>
<tr><td>Propensity score</td><td>1-33</td><td>34-66</td><td>67-100</td></tr>
<tr><td>Point estimate (from first stage and two stage least</td><td>-0.311 (SE 0.139)</td><td>-0.213 9SE 0.146)</td><td>-0.015 (SE 0.244)</td></tr>
</table>
</td><td></td></tr>
</table>

	squares regression models)				
	Mothers in the lowest propensity score are less likely to breastfeeding for at least 4 months if they are discharged on the day of birth. Mothers from the highest propensity score group who experiences a same discharge are not less likely to breastfeed for 4 months.				

Appendix 7.6 Proportion of infants seen by a health professional in a primary health care setting for a health related problem in the first 28 days after birth

<table>
<tr><th>STUDY</th><th>Results</th><th>Additional notes</th></tr>
<tr><td>Madden (2004)</td><td>NON URGENT visits per newborn to the HMO health centres in the first 10, 21 and 45 days after birth (only day 21 is reported)

During the first 10 days, 33.2% of newborns had a non-urgent visit at the health centre. There was an estimated steady increase in rate of non-urgent visits from 25.7% at the start of the study to 33.4% just before the implementation of the ROLOS program (P=0.002). After the ROLOS was implemented the rate of non-urgent visits increased by 10.2 % points more than it would have been expected to increased had baseline trend continued (P< 0.001); the rate reached 44.7% in the Q4 1994, then began a slow decrease of 1% point per quarter (P< 0.001) that continued during the period after the mandate.</td><td></td></tr>
<tr><td>Sievertsen (2017)</td><td>GP contacts at one month in three categories (propensity score)
<table>
<tr><td>Propensity score</td><td>1-33</td><td>34-66</td><td>67-100</td></tr>
<tr><td>Point estimate (from first stage and two stage least squares regression models)</td><td>0.209 (P< 0.05)</td><td>0.203 (P< 0.1)</td><td>0.217 (P< 0.05)</td></tr>
</table></td><td>Authors report this outcome as: increase in number of GP visits in the first month of life.</td></tr>
</table>

Appendix 7.7 Proportion of infants attending Emergency Department (ED) within 7 days and within 28 days after the birth

<table>
<tr><th>Study</th><th>Results</th><th>Additional notes</th></tr>
<tr><td>Meara (2004)</td><td>
<table>
<tr><td>Type of hospital admission</td><td colspan="3">% ED visits to hospital within 10 days</td></tr>
<tr><td></td><td>Pre-legislation</td><td>legislative</td><td>Post legislative</td></tr>
<tr><td>ED visit</td><td>3.4</td><td>4.0</td><td>3.7</td></tr>
</table>

Rates of ED visits within 10 days moved together with short stays, rising from 2.7% to 3.8% during the pre-legislative period (P< 0.001 for trends) and reversed trend when the legislation was introduced. In the year after legislation was introduced, ED use within 10 days fell from 4.2% to 3.8% (P=.088 for change in trend) during the legislative period and levelled off during the post legislative period.

ED visits with 21 days.

Rates of ED attendances rose from 6.1% -8.0% during pre-legislative period (P < 0.001 for trends)(and reversed when legislation was introduced)

In year after legislation was introduced, ED use within 21 days fell from 9.1% to 8.0% (P=0.016 for change in trend) during the legislative period and levelled off during the post legislative period.</td><td></td></tr>
<tr><td>Madden 2004</td><td>No of URGENT visits per newborn to the HMO health centres in the first 10, 21 and 45 days after birth (only day 21 is reported)

During first 10 days, 7.4% infants had an urgent visit to hospital. There were no sudden changes in the rate of urgent visits associated with 2 interventions. The rate of urgent visits was 5.2%, increased by 0.2% per quarter during the baseline and ROLOS period (P< 0.001) and declined by 0.2% points per quarter</td><td></td></tr>
</table>

	(P=0.001) after the mandate.	

Appendix 7.8 Proportion of mothers seen by a health professional in a primary health care setting for a health related problem in the first 28 days after birth

<table>
<tr>
<td>Sievertsen (2017)</td>
<td>GP contacts at one month in three categories (propensity score)
<table>
<tr><td>Propensity score</td><td>1-33</td><td>34-66</td><td>67-100</td></tr>
<tr><td>Point estimate (from first stage and two stage least squares regression models)</td><td>0.752 (p< 0.05)</td><td>0.888 (P< 0.01)</td><td>1.207 (P< 0.01)</td></tr>
</table>
</td>
<td></td>
</tr>
</table>

Appendix 8 BMC Pediatrics publication

Jones E, Taylor B, Rudge G, MacArthur C, Jyothish D, Simkiss D, et al. Hospitalisation after birth of infants: cross sectional analysis of potentially avoidable admissions across England using hospital episode statistics. BMC Pediatrics. 2018;18(1):390

Jones et al. BMC Pediatrics (2018) 18:390
https://doi.org/10.1186/s12887-018-1360-z

BMC Pediatrics

RESEARCH ARTICLE Open Access

Hospitalisation after birth of infants: cross sectional analysis of potentially avoidable admissions across England using hospital episode statistics

Eleanor Jones[1*], Beck Taylor[1], Gavin Rudge[1], Christine MacArthur[1], Deepthi Jyothish[2], Doug Simkiss[3] and Carole Cummins[1]

Abstract

Background: Admissions of infants in England have increased substantially but there is little evidence whether this is across the first year or predominately in neonates; and for all or for specific causes. We aimed to characterise this increase, especially those admissions that may be avoidable in the context of postnatal care provision.

Methods: A cross sectional analysis of 1,387,677 infants up to age one admitted to English hospitals between April 2008 and April 2014 using Hospital Episode Statistics and live birth denominators for England from Office for National Statistics. Potentially avoidable conditions were defined through a staged process with a panel.

Results: The rate of hospital admission in the first year of life for physiological jaundice, feeding difficulties and gastroenteritis, the three conditions identified as potentially preventable in the context of postnatal care provision, increased by 39% (39.55 to 55.33 per 1000 live births) relative to an overall increase of 6% (334.97 to 354.55 per 1000 live births). Over the first year the biggest increase in admissions occurred in the first 0–6 days (RR 1.26, 95% CI 1.24 to 1.29) and 85% of the increase (12.36 to 18.23 per 1000 live births) in this period was for the three potentially preventable conditions.

Conclusions: Most of the increase in infant hospital admissions was in the early neonatal period, the great majority being accounted for by three potentially avoidable conditions especially jaundice and feeding difficulties. This may indicate missed opportunities within the postnatal care pathway and given the enormous NHS cost and parental distress from hospital admission of infants, requires urgent attention.

Keywords: Infant admission, Avoidable readmission, Postnatal care

Background

Hospital admissions, especially emergency ones place a huge cost on health services [1, 2] and there is evidence from studies using Hospital Episode Statistics (HES) data for England that emergency admissions of children have increased substantially. In children under 15 between 1999 and 2010 in England all emergency admissions increased with the greatest increase in infants: in 2010 over a third of infants had an admission some time in their first year [3]. While emergency admissions between 2006 and 2016 increased in all age categories 0–24, this was greatest in those under one [4]. Short-stay (< 2 days) unplanned admissions among children up to age 10 increased between 1996 to 2006, again with the greatest increase in children less than one [4]. A study of infant admission in England using HES data showed that between 2005 and 2014, 5.2% of infants were readmitted unexpectedly within 30 days of postnatal discharge and that the risk of readmission increased by 4.4% annually from 4.4% in 2005 to 6.3% in 2014 [5]. Whilst similar trends have been observed in Scotland [6] in the United States and Canada the proportion of hospital

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stays for children has decreased or remained relatively unchanged over the period 2000–2012 [5, 7].

Over the last 30 years, the postnatal length of stay in hospital in the UK has reduced considerably: in 1989–90, only 44% women were discharged within two days of giving birth compared to 81% women in 2016–17 [8]. Over the last decade, the number of women going home on the same calendar day that they gave birth has increased considerably from (16.5% in 2005/06 to 19.8% in 2016/17 [8]. Following discharge from hospital, women and babies also have fewer visits from community midwifery services before being discharged to the care of the community health visitor and GP [9, 10].

We wanted to know whether the changes to postnatal care provision coincided with the increase in infant admissions which in some cases may have been potentially avoided. We sought to investigate whether the increase in infant admissions was predominantly in the early neonatal period and whether it was confined to a sub-group of conditions more sensitive to the quantity and quality of postnatal care, and therefore amenable to intervention earlier in the care pathway. If findings showed this to be the case, the current five year national maternity review programme in England [11] would provide an opportunity to consider the potential for intervention.

Methods

Data on all admissions to hospital in the first year of life across England from 1st April 2008 to 31st March 2014 from Hospital Episode Statistics (HES) were included. We developed clinical definitions of potentially avoidable conditions. Admission rates were calculated with denominator data on all live births from Office for National Statistics (ONS). Main outcomes were admissions to hospitals for potentially preventable conditions across different ages within the first year and overall admissions.

An anonymised extract of inpatient data from Hospital Episode Statistics (HES) for all NHS hospitals in England from 1st April 2008 to 31st March 2014 was obtained. HES collects routine demographic data, administrative information and clinical information based on World Health Organisation (WHO) ICD 10 (2008, 2010 and 2014 versions) and OPCS4 and is suitable for research purposes [12]. All admissions (planned and unplanned) of infants less than one year old at the start of their admission episode were extracted. Since the vast majority of infant admissions are unplanned, that is, emergencies, it was decided to include all admissions in these analyses. An inpatient admission was defined as a 'continuous inpatient spell' which is the continuous time spent in hospital from admission to discharge regardless of any within-hospital transfers [12]. This may have included several 'episodes of care' under different medical teams at various NHS care providers. Clinical diagnosis data were obtained from the final discharge episode of the spell. This method was chosen because using the diagnosis from the admission episode might underestimate the case-mix severity in multi-episode spells. The majority of inpatient spells only have one episode which is both the admission and discharge episode. Duplicate cases and cases with an implausible admission/discharge date were removed and readmissions were explored using the HES identification variable.

To avoid capturing routine admissions to the postnatal ward which frequently occur with a hospital birth, based on the HES data dictionary [12] cases with method of admission codes of '31 (admitted antenatally),'32 (admitted postnatally)', i.e. immediately following delivery, '82 (the birth of a baby in this healthcare provider)'; or '83 (baby born outside the healthcare provider except when born at home as intended)' were excluded. Also excluded were cases with episode type given as 'Birth episode'; diagnosis ICD10 coded as 'Z37-Z38' (Singleton, born in Hospital) or admission source coded as '79' (Babies born in or on the way to hospital) (Additional file 1).

The data recorded in HES for each admission included a code for infant age category on admission. Codes for gender, region of admission and ethnicity were also included and a score for social deprivation was assigned, allowing exploration of rate variations by these characteristics. Ethnicity within HES is self-reported and the 16 Census ethnic groups [13] were merged into 5 groups to avoid risk of de-anonymisation for any very small groups when merged with the ONS data: White (British, Irish, Any other white background), Asian (Indian, Pakistani, Bangladeshi, Any other Asian Background), Black (Caribbean, African, Any other black background), Other (White and Black Caribbean, White and Black African, White and Asian, Any other mixed Background, Chinese, Any other ethnic group), Not stated (not stated, missing/null).

Each infant admitted was assigned a Local Authority District and Government Office Region (GOR) of residence based on their lower super output area (LSOA) of residence. A LSOA is a small unit of United Kingdom census geography [14] and contains a mean resident population of approximately 1600 individuals [14]. An index of multiple deprivation 2010 score was assigned to each individual based on the LSOA [15]. The index of multiple deprivation (IMD) is an area based score that combines housing, social and economic indicators to indicate the level of deprivation in each area. The income domain score is the one that most accurately reflects material deprivation as it is based on the Government definition of poverty. These were converted into quintiles by subdividing the ranks of the 32,480 areas in England, quintile 1 being most deprived and quintile 5 least deprived.

Denominator data on all live births across England was provided by Office for National Statistics (ONS), providing

frequencies of live births by financial year of birth, Region (mothers' area of usual residence), gender, ethnicity (White, Black, Asian, Other, Not stated) and IMD quintile.

Pre-specified definitions of ICD-10 codes of potentially avoidable admissions were produced before analysis of admission rates. The definition of potentially avoidable in this context was a condition or illness which could have been identified before postnatal discharge from hospital or in the community and adequately treated during birth hospitalisation or through community care services. The process for identifying conditions/illness that could be considered potentially avoidable within the HES dataset was undertaken with an advisory panel comprising a consultant general paediatrician, a consultant community paediatrician/professor of child health and a clinical coding manager at a specialist children's hospital. The selection of conditions/illnesses and corresponding coding framework was developed in a four stage approach (Fig. 1). Firstly, frequencies of common illnesses/conditions with the relevant ICD-10 codes by age on admission were produced from the dataset and the paediatricians considered the clinical care pathways, in addition to the physiological and aetiological factors associated with the conditions. Secondly, the list of potentially avoidable conditions and corresponding coding framework was refined. Thirdly, discussion with an expert clinical paediatric coder identified specific HES diagnosis coding rules and standards relevant to the dataset. Finally, a formal list of conditions and corresponding ICD-10 codes was agreed (Additional file 2). Conditions identified as potentially avoidable were physiological jaundice, feeding difficulties and gastroenteritis and these were pre-specified as the main outcomes prior to data analysis. Potentially avoidable implies that although the infant may require admission to hospital at the point of contact with secondary care services, the risk of developing the illness or the severity of the illness may have been reduced had the problem been identified and an intervention taken place earlier.

Patient involvement was via the National Institute for Health Research Collaboration for Leadership in Applied Health Research and Care West Midlands Patient and Public Involvement Supervisory Committee.

Analyses

SPSS (V.22) was used to analyse all infant admissions. Summary statistics were used to describe the proportion of avoidable infant admissions in 0–6 days and 7–28 days, 1 to under 3 months, 3 to under 6 months, 6 to under 9 months and 9 to 12 months after birth by condition/illness, ethnicity, deprivation indices, region in England and year of admission. Frequency of admissions by hospital trust was also explored in addition to exploring readmission rates. Unadjusted annual infant admission rates and annual rates for specific conditions and 95% confidence intervals were calculated by (N admissions for each year/N live births 2008–09) × 100. Change in admission rates were

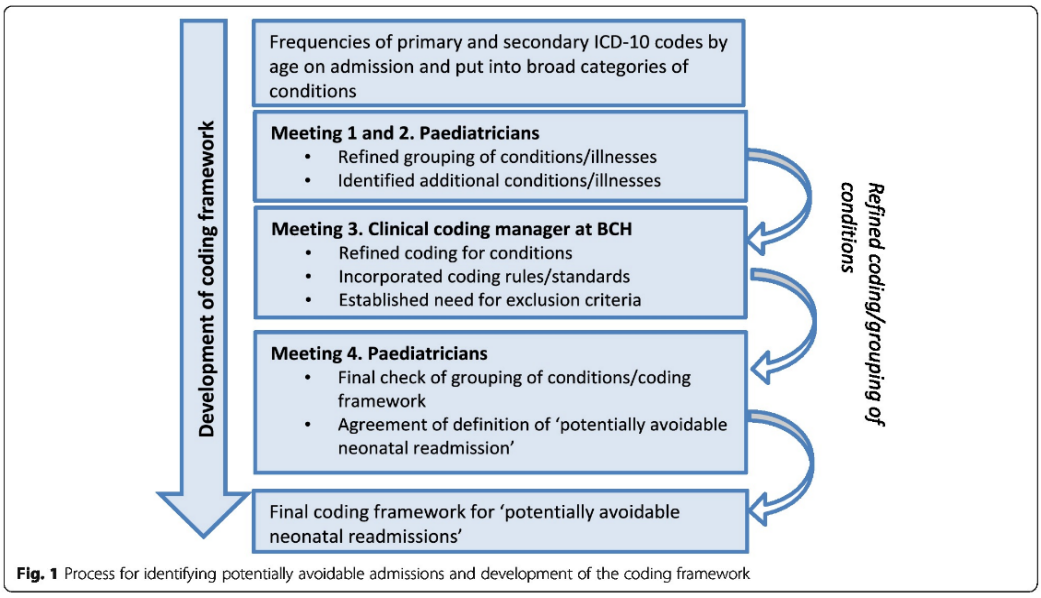

Fig. 1 Process for identifying potentially avoidable admissions and development of the coding framework

calculated as follows: (rate in 2013–14/rate in 2008–09) × 100. Where appropriate, Cochrane Armitage tests for trend were conducted to assess significance of the year on year trend over the 6 year period. A sample size calculation was not necessary due to the exploratory and descriptive nature of the study. The following sensitivity analyses were conducted: comparison of the rates of admissions by episodes of care versus spells of care and selecting the primary diagnosis code versus all diagnostic codes.

Results

There were 1,387,677 admissions in the first year of life and 4,063,050 live births from 1st April 2008 to 31st March 2014. The overall rate of admission increased significantly over the period from 335·0 (95% CI 333·8–336·1) to 354·6 (95% CI 353·6–355·9) per 1000 live births (Table 1). Infants born in 2013/14 had 1·06 times the risk of being admitted to hospital within the first year of life compared to infants born in 2008/09 (Relative risk 1·06, 95% CI 1·05–1·06). Infants who had one admission were 47% more likely to be readmitted at least once more within the first year of life. The increase in admissions was most marked for the 0–6 day age category where admission rate increased from 26·39 per 1000 live births (95% CI 26·01–26·78) in 2008/09 to 33·31 per 1000 live births in 2013/14 (95% CI 32·88–33·74) ($P < 0.0001$). Infants born in 2013/14 had 1·26 times the risk of being admitted within the first 6 days of life compared with infants born in 2008/09 (Relative risk 1·26, 95% CI 1·24–1·29) (Fig. 2).

Admission rates also varied considerably by ethnicity where the highest rate of admission was in the 'not stated' ethnicity category (528·22 per 1000 live births (95% CI 525·93–530·52) compared to 216·85 per 1000 live births (95% CI 215·11–218·60) in the Black ethnicity category.

The rate of admission for the *potentially avoidable conditions* increased by 39% from 39·79 to 55·33 per 1000 live births (Table 2). In the 0–6 day age category the increase in admissions to hospital for these three conditions from 12·36 to 18·23 per 1000 live births contributed 85% of the increase in admission rate. The rate of admission for infants under 7 days increased by 6·92 per 1000 live births (RR 1·26, 95% CI 1·24–1·29) however, once the potentially avoidable admissions were removed the rate only increased by 1·05 per 1000 live births (RR 1·07 95% CI 1·04–1·10) (Table 2).

For *physiological jaundice* there were a total of 73,403 admissions over the study period, the rate of admission increasing from 16·30 (95% CI 16·00–16·61) to 22·35 (95% CI 21·99–22·70) admissions per 1000 live births ($P < 0.0001$) (Table 3). The admission rate in 2013/14 was 1·37 times the risk of being admitted in 2008/09 (RR 1·37 95% CI 1·34–1·.40), an absolute risk increase of 6 per 1000 live births. The increase was concentrated in the 0–6 day category where the admission rate rose from 8.40 to 12·45 per 1000 with statistically significant increases confined to the first 28 days. (Table 3) The duration of hospital admission for physiological jaundice was short with a median length of stay of 1·6 days. The vast majority of infants (94%) admitted for physiological jaundice had a hospital duration of ≤3 days.

The admission rate for physiological jaundice differed significantly by gender: 44,153 male infants (21·20 per 1000 live births (95% CI 21·03–21·37) were admitted over the period compared to 29,251 female infants (14·77 per 1000 live births (95% CI 14·63–14·92). The infant admission rate for physiological jaundice varied by IMD quintile (Table 4), the lowest in the most deprived quintile (16·97 per 1000 live births, 95% CI 16·73–17·21)). The rate of admission for physiological jaundice differed by ethnicity (Table 4). The lowest rate was for black infants where the rate was 6·97 per 1000 live births (95% CI 6·62–7·33) and the rate of admission was four times higher for infants with an ethnicity code 'not stated' (26·14 per 1000 live births, 95% CI 25·41–26·87).

The admission rate for *feeding difficulties* rose from 11·35 (95% CI 11·10–11·60) per 1000 live births in 2008/09 to 13·12 (12·85–13·40) in 2013/14 ($P < 0.0001$). The age specific admission rate for feeding difficulties varied considerably over the period. The largest increase in risk of admission over the period was in the 0–6 day age category where there was a 46% increase in 2013/14 compared with 2008/09 (RR 1·46, 95% CI 1·39–1·54) ($P < 0.0001$). Admissions to hospital for feeding difficulties after one month of age were much less common and the rate consistently decreased with age up to one year (Table 3). The median length of admission for feeding difficulties was 1 day and the majority of infants (91·7%) had an admission of 3 days or under.

There was no significant difference in the rate of admission by gender: the rate for male infants was 12·57 per 1000 live births (95% CI 12·42–12·72) compared to 12·37 per 1000 live births (95% CI 12·22–12·53) for females. There was a small but significant difference in the admission rate for feeding difficulties by IMD quintile with the lowest rate in the most deprived quintile 11·31 per 1000 live births, (95% CI 11·11–11·50). The lowest rate of admission was observed for black infants (6·59 per 1000 live births, 95% CI 6·26–6·94) compared to 16·69 in the 'not stated' ethnicity category (95% CI 16·10–17·28).

For *gastroenteritis* the rate of infant admission per 1000 live births rose from 12·14 in 2008/09 (95% CI 11·88–12·40) to 19.86 (95% CI 19·52–20·19) ($P < 0.0001$). The rate of admission for gastroenteritis significantly increased across all age categories but admission was least frequent in infants in the first 28 days. It was greatest in the 9–12 month age category, although infants aged 1–3 months had the largest relative increase in risk of admission (RR 2·04, 95% CI 1·90–2·19) from 2008/09–2013/14

Table 1 Number and incidence (per 1000 live births) of infants admitted by year of birth and age group in England 2008/09–2013/14

YEAR	Total No. admissions	No. Live births	Rate* (95% CI)	Age specific rates of admissions per 1000 population (95% CI)					
				0–6 days	7–28 days	1–3 months	3–6 months	6–9 months	9–12 months
2008/09	223,735	667,932	334·97 (333·83–336·10)	26·39 (26·01–26·78)	47·96 (47·44–48·47)	77·38 (76·74–78·02)	65·56 (64·97–66·15)	58·43 (57·86–58·99)	59·25 (58·69–59·82)
2009/10	225,130	674,949	333·55 (332·43–334·68)	27·96 (27·56–28·35)	46·81 (46·30–47·31)	77·11 (76·47–77·74)	65·04 (64·45–65·63)	58·20 (57·65–58·76)	58·44 (57·88–59·00)
2010/11	235,288	682,892	344·55 (343·42–345·67)	30·07 (29·66–30·47)	48·82 (48·31–49·33)	80·69 (80·05–81·34)	67·49 (66·89–68·08)	58·27 (57·72–58·83)	59·20 (58·64–59·76)
2011/12	228,534	689,582	331·41 (330·30–332·52)	28·95 (28·55–29·34)	48·03 (47·52–48·53)	78·20 (77·56–78·83)	63·81 (63·24–64·39)	55·78 (55·24–56·32)	56·64 (56·09–57·18)
2012/13	240,090	685,174	350·41 (349·28–351·54)	31·14 (30·73–31·55)	50·66 (50·14–51·18)	82·94 (82·29–83·59)	67·46 (66·86–68·05)	57·91 (57·36–58·47)	60·59 (60·03–61·16)
2013/14	234,900	662,521	354·55 (353·59–355·89)	33·31 (32·88–33·74)	51·49 (50·96–52·02)	84·40 (83·73–85·07)	68·77 (68·16–69·38)	58·19 (57·63–58·76)	58·39 (57·82–58·93)
Cochran Armitage test for trend			775·7362 ($P < 0·0001$)	611·4452 ($P < 0·0001$)	166·0960 ($P < 0·0001$)	959·3922 ($P < 0·0001$)	58·8150 ($P < 0·0001$)	3·7260 ($P = 0·0536$)	0·0190 ($P = 0·8904$)

*per 1000 live births

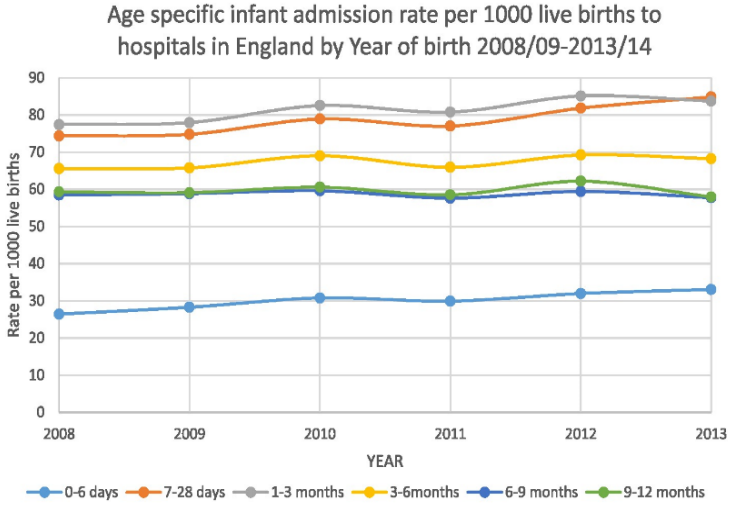

Fig. 2 Age specific infant hospital admission rates in England per 1000 live births by year of birth 2008/09 to 2013/14

(Table 3). The median length of stay was less than one day and 96.8% infants were discharged within 3 days.

There was a small but significant difference in rate of admission for gastroenteritis by gender; the rate for male infants was 15·73 per 1000 live births (95% CI 15·56–15·90) and 14.07 (95% CI 13·90–14·23) for female infants. The highest rate was noted in the most deprived IMD quintile (17·01 per 1000 live births, 95% CI 16·77–17·25) (Table 4). There was also considerable variation by ethnicity, where the rate of admission per 1000 live births was more than double for infants with 'not stated' ethnicity, 18·04 per 1000 live births, (95% CI 17·43–18·65) compared to 8·31 per 1000 live births (95% CI 7·92–8·69).

The number of admissions for the conditions identified as potentially avoidable varied considerably with high numbers of admissions to bigger paediatric hospitals.

Discussion

The rate of hospital admission in the first year of life for the three conditions identified as potentially preventable increased by 39% relative to an overall increase of 6%. Over the first year the biggest increase in admissions occurred in the first 0–6 days and 85% of the increase in this period was for the identified potentially preventable conditions of jaundice, feeding difficulties and gastroenteritis for which admissions rose from 12·36 to 18·23 per 1000 live births.

This study used a large routinely collected national dataset and a robust method to develop a working definition of 'potentially avoidable' infant admissions in the context of postnatal care provision, drawing on the expertise of paediatricians, research data analysts and clinical coders. The potentially avoidable conditions were pre-specified prior to calculation of admission rates. The

Table 2 Frequency and rate (per 1000 live births) of admission for infants aged 0–6 days (overall and potentially preventable conditions (physiological jaundice, feeding difficulties and gastroenteritis))

YEAR	overall No. admissions	No. avoidable conditions	No. live births	rate[a] overall admission	admission rate[a] for potentially avoidable conditions
2008/09	17,629	8257	667,932	26·39	12·36
2009/10	18,869	8798	674,949	27·96	13·04
2010/11	20,534	9932	682,892	30·07	14·54
2011/12	19,962	10,313	689,582	28·95	14·96
2012/13	21,334	11,373	685,174	31·14	16·60
2013/14	22,067	12,079	662,521	33·31	18·23

[a]per 1000 live births

Table 3 Number and incidence (per 1000 live births) of infant admissions for potentially preventable conditions for infants by Year and Age group on admission 2008/09–2013/14

YEAR	No. admissions	Rate [a] (95% CI)	Age specific rates of admissions per 1000 live births (95% CI)					
			0–6 days	7–28 days	1–3 months	3–6 months	6–9 months	9–12 months
Gastroenteritis								
2008/09	8108	12·14 (11·88–12·40)	0·02 (0·01–0·03)	0·38 (0·33–0·43)	1·77 (1·67–1·87)	2·48 (2·36–2·60)	3·37 (3·23–3·51)	4·11 (3·96–4·26)
2009/10	8257	12·23 (11·97–12·50)	0·01 (0·00–0·02)	0·35 (0·31–0·40)	1·80 (1·70–1·90)	2·43 (2·31–2·54)	3·53 (3·39–3·68)	4·11 (3·95–4·26)
2010/11	7785	11·40 (11·15–11·65)	0·01 (0·00–0·010	0·28 (0·24–0·32)	1·56 (1·46–1·65)	2·46 (2·34–2·58)	3·20 (3·07–3·34)	3·89 (3·75–4·04)
2011/12	7859	11·40 (11·15–11·65)	0·01 (0·00–0·01)	0·26 (0·22–0·30)	1·55 (1·46–1·64)	2·34 (2·23–2·45)	3·27 (3·14–3·41)	3·96 (3·81–4·11)
2012/13	15,451	22·55 (22·20–22·90)	0·04 (0·03–0·06)	0·58 (0·53–0·64)	3·61 (3·47–3·76)	4·58 (4·42–4·74)	6·24 (6·06–6·43)	7·49 (7·29–7·69)
2013/14	13,155	19·86 (19·52–20·19)	0·03 (0·02–0·05)	0·56 (0·50–0·61)	3·61 (3·47–3·75)	4·32 (4·16–4·47)	5·30 (5·12–5·47)	6·04 (5·86–6·23)
Cochran Armitage test for trend:		3170·9178 ($P < 0·0001$)	10·2750 ($P = 0·013$)	57·4530 ($P < 0·0001$)	805·7172 ($p < 0·0001$)	748·2772 ($P < 0·0001$)	742·1982 ($P < 0·0001$)	779·7762 ($P < 0·0001$)
Physiological jaundice								
2008/09	10,890	16·30 (16·00–16·61)	8·40 (8·18–8·62)	6·14 (5·95–6·32)	1·66 (1·56–1·76)	0·02 (0·01–0·04)	0·05 (0·03–0·07)	0·03 (0·02–0·05)
2009/10	10,637	15·76 (15·46–16·06)	8·22 (8·01–8·44)	5·93 (5·74–6·11)	1·54 (1·45–1·64)	0·02 (0·01–0·03)	0·03 (0·02–0·02)	0·01 (0·01–0·02)
2010/11	11,305	16·56 (16·25–16·86)	8·96 (8·73–9·18)	6·16 (5·98–6·35)	1·37 (1·28–1·46)	0·02 (0·01–0·03	0·02 (0·01–0·04)	0·01 (0·02–0·02)
2011/12	11,947	17·33 (17·02–17·63)	9·35 (9·12–9·58)	6·76 (6·57–6·95)	1·42 (1·36–1·51)	0·02 (0·01–0·04)	0·04 (0·02–0·05)	0·02 (0·01–0·04)
2012/13	13,823	20·17 (19·84–20·51)	10·80 (10·59–11·05)	7·65 (7·44–7·85)	1·63 (1·53–1·72)	0·04 (0·03–0·05)	0·04 (0·03–0·06)	0·02 (0·01–0·03)
2013/14	14,806	22·35 (21·99–22·70)	12·45 (12·19–12·27)	8·22 (8·00–8·36)	1·61 (1·51–1·71)	0·02 (0·01–0·03)	0·03 (0·02–0·04)	0·02 (0·01–0·03)
Cochran Armitage test for trend:		1053·1403 ($P < 0·0001$)	800·999 ($P < 0·0001$)	430·788 ($P < 0·0001$)	0·0260 ($P = 0·8719$)	0·4890 ($P = 0·4844$)	1·4770 ($P = 0·2242$)	1·3500 ($P = 0·2453$)
Feeding difficulties								
2008/09	7581	11·35 (11·10–11·60)	3·94 (3·79–4·09)	4·14 (3·99–4·29)	2·06 (1·95–2·16)	0·77 (0·70–0·83)	0·28 (0·24–0·33)	0·16 (0·13–0·19)
2009/10	8046	11·92 (11·66–12·18)	4·80 (4·63–4·96)	4·12 (3·96–4·27)	1·93 (1·82–2·03	0·68 (0·62–0·74)	0·24 (0·21–0·28)	0·15 (0·12–0·18)
2010/11	8784	12·86 (12·60–13·13)	5·58 (5·40–5·75)	4·27 (4·15–4·43)	1·97 (1·87–2·08)	0·70 (0·64–0·77)	0·22 (0·18–0·25)	0·12 (0·10–0·15)
2011/12	8879	12·88 (12·61–13·14)	5·60 (5·43–5·78)	4·23 (4·08–4·39)	1·95 (1·8–2·05)	0·74 (0·68–0·81)	0·23 (0·19–0·26)	0·13 (0·10–0·15)
2012/13	8706	12·71 (12·44–12·97)	5·75 (5·74–5·93)	4·10 (3·95–4·25)	1·80 (1·70–1·90)	0·70 (0·64–0·77)	0·21 (0·18–0·24)	0·14 (0·11–0·17)
2013/14	8694	13·12 (12·85–13·40)	5·75 (5·56–5·93)	4·29 (4·14–4·45)	1·91 (0·81–2·02)	0·79 (0·73–0·86)	0·25 (0·21–0·29)	0·12 (0·10–0·15)
Cochran Armitage test for trend:		97·70 ($P < 0·0001$)	260·5501 ($P < 0·0001$)	54·0300 ($P < 0·0001$)	6·1920 ($P = 0·0128$)	0·6870 ($P = 0·4072$)	2·7600 ($P = 0·0966$)	3·3200 ($P = 0·0684$)

[a] per 1000 live births

Table 4 Number and incidence (per 1000 live births) of infant admissions for potentially preventable conditions by Ethnicity, Gender, and IMD quintile 2008/09–2013/14

	Feeding difficulties		Gastroenteritis		Physiological Jaundice	
	No admissions	Rate (95% CI)	No admissions	Rate (95% CI)	No admissions	Rate (95% CI)
Ethnicity[a]						
White	37,746	12·81 (12·68–12·94)	47,616	16·16 (16·01–16·30)	51,082	17·34 (17·19–17·48)
Asian	5102	12·19 (11·86–12·52)	4570	10·92 (10·60–11·23)	9517	22·74 (22·28–23·19)
Black	1415	6·59 (6·25–6·94)	1783	8·31 (7·92–8·69)	1497	6·97 (6·62–7·33)
Other	3391	11·26 (10·89–11·64)	3365	11·18 (10·80–11·55)	6556	21·78 (21·26–22·30)
Not stated	3036	16·69 (16·10–17·28)	3282	18·04 (17·43–18·65)	4756	26·14 (25·41–26·87)
Gender						
Male	26,183	12·57 (12·42–12·72)	32,761	15·73 (15·56–15·90)	44,153	21·20 (21·03–21·37)
Female	24,502	12·37 (12·22–12·53)	27,854	14·07 (13·90–14·23)	29,251	14·77 (14·63–14·92)
IMD Index[a]						
1	12,708	11·31 (11·11–11·50)	19,122	17·01 (16·77–17·25)	19,077	16·97 (16·73–17·21)
2	10,860	11·89 (11·67–12·11)	13,967	15·29 (15·04–15·55)	16,111	17·64 (17·37–17·91)
3	9899	13·14 (12·82–13·40)	10,903	14·47 (14·20–14·74)	14,084	18·69 (18·39–19·00)
4	8952	13·63 (13·35–13·91)	8953	13·63 (13·35–13·91)	12,367	18·83 (18·50–19·16)
5	7995	12·99 (12·71–13·27)	7254	11·78 (11·51–12·05)	11,245	18·27 (17·93–18·60)

[a]Missing data:
Gastroenteritis: 0.7% IMD index, 0.6% Ethnicity
Physiological Jaundice: 0.9% IMD index, 0.6% Ethnicity
Feeding difficulties: 0.8% IMD index, 0.4% ethnicity

coding framework used to identify such admissions incorporated inclusion and exclusion criteria to ensure that infants with underlying conditions were excluded from the sample population (for example, infants born with cleft lip and palate, and subsequent feeding difficulties). It is reassuring that the incidence of admissions for physiological jaundice and feeding difficulties over the age of 3 months was very small, suggesting that the selection of codes for these conditions was accurate. Although a systematic review of coding accuracy studies suggested that HES data has improved significantly over time [16], it is unlikely that this would have affected our study findings because the NHS Payment by Results system, a key driver for improving HES data accuracy, had been fully implemented by 2007 [17, 18].

HES is widely accepted as a database for health research and suitable for studies identifying trends in healthcare [19], although there are a number of limitations. The ethnicity variable was not as complete as other data fields with 7% of infant admissions having a 'missing' or 'not known' code. Previous research has indicated that missing ethnicity data may not be random and instead relates to service pressures, a lack of opportunity for health professionals enquiry or the circumstances of hospital admission [20, 21]. Additionally, the broad denominator ethnicity categories necessary to maintain confidentiality prohibited a thorough assessment of admission rates by ethnicity. It was not possible to explore hospital level admission rates because denominator data were not available at hospital level but we anticipate that variation would be affected by patient and hospital level factors. Finally, we did not have data on smoking status and breastfeeding status.

Use of age specific admission rates for infants under one year showed that the increase in admission over the period 2008 to 2014 only existed within the first 6 months of life, and had increased most in the 0–6 day category. The admission rate for infants from 6 to 12 months remained stable over the period. Our findings are consistent with those of other studies that explore unplanned infant admissions to hospital [6]. It is also consistent with the literature in the finding that the rate of admissions varied by IMD [22]. The overall admission rate to hospital by IMD quintiles supports existing evidence that admission rates are strongly correlated with measures of social deprivation [22]. For admission rates for jaundice and feeding difficulties however the admission rate was highest in the least deprived quintiles and may reflect variation in infant feeding practices with women in the least deprived quintiles more likely to breastfeed. Inability to initiate and establish breastfeeding resulting in an insufficient milk supply is a known risk factor for physiological jaundice [23]. Exclusive initial breastfeeding initially rose from 65% in 2005 to 69% in 2010 when 46% of babies were still

exclusively breastfed at one week [24]. While breastfeeding may be a factor influencing the trends seen, it does not provide a sufficient explanation of them. Increases in admission rates for gastroenteritis showed a different pattern from jaundice and feeding difficulties as the increase for this was greatest in infants after the first month and may possibly be related to feeding practices and insufficient support for infant feeding.

The change in infant admission rates we observed over the period was concentrated in those under 7 days of age and for the potentially avoidable conditions, particularly jaundice and feeding difficulties. In England over a similar period of time women and infants have had less routine contact with health professionals as the length of stay in hospital after birth and the median community visits following discharge from birth has reduced [9, 10]. Over the period of this study, the average postnatal length of stay hospital reduced slightly from 1.7 days in 2008/09 to 1.5 days in 2013/14 [25]). Several large surveys of women's experiences of postnatal care have shown that a large proportion felt that they needed more support, particularly establishing breastfeeding [11, 26–29]. Although temporal association does not prove causation, the increase in admissions may in part prove to be attributed to changes in the postnatal care provision and management of neonates in the community. Other possible causes to the increase observed in this study include an increase in parents being advised by NHS 111 system to take their child straight to hospital, and a decrease in training and experience for doctors to triage neonates in primary care [3]. If the reduction in postnatal care provision does have a part to play in the increase in infant admission rate, the current National Maternity Review in England [11] aimed at transforming maternity services has the opportunity to ensure that women's needs are being met prior to discharge from hospital. It could also ensure that women are able to have more effective community provision including more frequent home visits where needed and easy access to midwifery advice in order to identify potential infant health problems to improve this situation.

Conclusion

Our findings show that most of the increase in the rate of admission to hospital for infants up to age one over the period 2008–2014 was in the early neonatal period; and the great majority of this increase is explained by the three conditions, physiological jaundice, feeding difficulties and gastroenteritis, predominantly the former two. Potential missed opportunities within the postnatal care pathway require urgent modification given current NHS capacity and resource issues.

Additional files

Additional file 1: Flow chart of the process for identifying infant admissions under the age of 1 year unrelated to birth admissions in Hospital Episode Statistics. (DOCX 43 kb)

Additional file 2: Coding framework for potentially avoidable infant admissions. (DOCX 17 kb)

Abbreviations

GOR: Local Authority District and Government Office Region; HES: Hospital Episode Statistics; IMD: Index of multiple deprivation; LSOA: Lower super output area; ONS: Office for National Statistics; WHO: World Health Organisation

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Availability of data and materials

The data that support the findings of this study are available from the HSCIC but restrictions apply to the availability of these data, which are used under license for the current study, and so are not publically available. Data provided by ONS are available at: https://www.ons.gov.uk/.

Authors' contributions

EJ, CC, CM and BT conceived the study. GR extracted the data. EJ, CC, CM, BT, DS and DJ developed the definition of potentially avoidable infant admission and ICD 10 and OPCS 4 coding framework. EJ, CC, CM and BT were responsible for statistical analysis and interpretation. All authors contributed to the manuscript draft and critical revision of the manuscript for intellectual content. All authors read and approved the final manuscript.

Ethics approval and consent to participate

An application to HSCIC to hold a national extract of admitted patient care data was approved by the Data Access Advisory Group at the Health and Social Care Information Centre. A self-assessment form was submitted to University of Birmingham Ethics Committee indicating that access to the data had been granted.

Consent for publication

N/A

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

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Appendix 9

COREQ (COnsolidated criteria for REporting Qualitative research) Checklist

A checklist of items that should be included in reports of qualitative research. You must report the page number in your manuscript where you consider each of the items listed in this checklist. If you have not included this information, either revise your manuscript accordingly before submitting or note N/A

. **Topic**	**Item No.**	**Guide Questions/Description**	**Reported on Page No.**
Domain 1: Research team and reflexivity			
Personal characteristics			
Interviewer/facilitator	1	Which author/s conducted the interview or focus group?	125/139
Credentials	2	What were the researcher's credentials? E.g. PhD, MD	125/139
Occupation	3	What was their occupation at the time of the study?	125/139
Gender	4	Was the researcher male or female?	125
Experience and training	5	What experience or training did the researcher have?	139
Relationship with participants			
Relationship established	6	Was a relationship established prior to study commencement?	137
Participant knowledge of the interviewer	7	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	137-139
Interviewer characteristics	8	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	139
Domain 2: Study design			
Theoretical framework			
Methodological orientation and Theory	9	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	130-133
Participant selection			
Sampling	10	How were participants selected? e.g. purposive,	135

		convenience, consecutive, snowball	
Method of approach	11	How were participants approached? e.g. face-to-face, telephone, mail, email	137
Sample size	12	How many participants were in the study?	143
Non-participation	13	How many people refused to participate or dropped out? Reasons?	143
Setting			
Setting of data collection	14	Where was the data collected? e.g. home, clinic, workplace	137
Presence of non-participants	15	Was anyone else present besides the participants and researchers?	137
Description of sample	16	What are the important characteristics of the sample? e.g. demographic data, date	143
Data collection			
Interview guide	17	Were questions, prompts, guides provided by the authors? Was it pilot tested?	137
Repeat interviews	18	Were repeat inter views carried out? If yes, how many?	n/a
Audio/visual recording	19	Did the research use audio or visual recording to collect the data?	140
Field notes	20	Were field notes made during and/or after the interview or focus group?	139
Duration	21	What was the duration of the inter views or focus group?	144
Data saturation	22	Was data saturation discussed?	140
Transcripts returned	23	Were transcripts returned to participants for comment and/or	n/a

Appendix 10 Patient information sheet for the qualitative interview study (version 3)

Birmingham Children's Hospital NHS
NHS Foundation Trust

Parents' experiences of the time preceding infant admission to hospital in the first 4 weeks after birth: A qualitative interview study

Information sheet for participants

Thank you for taking interest in our study to explore infant admissions to hospital in the first 4 weeks of life. Please take time to read this information carefully and decide whether to participate in the study or not. Please take the opportunity to ask questions if anything is unclear.

What is the purpose of the study?

The aim of this study is to understand why some infants are admitted to hospital in the first 4 weeks of life. We understand that parents may be able to offer a valuable insight into period of time leading up to the admission to hospital.

Why have I been chosen?

You are being invited to take part in this study because your baby is under 4 weeks of age and has been unexpectedly admitted to hospital. Your baby will have been born at near term or term (> 34weeks) and will have been healthy on discharge from the hospital or by the midwife if you gave birth at home.

Do I have to take part?

No, it is up to you to decide whether you participate or not. If you decide to take part, you are free to withdraw at any point during the study and you do not have to give a reason for doing so. If you decide not to take part, or withdraw from the study at any point, your child's care will not be affected in any way.

If your child was born prematurely (under 34 weeks gestation); has a congenital malformation (such as cleft lip/palate or heart defect); suffered trauma during the birth or was admitted to the neonatal unit immediately after birth, you will not be asked to take part in the study. Also, if your baby is being admitted to hospital for planned surgery, you will not

be asked to take part in the study. This is because the focus of the study is to explore unplanned admissions to hospital for infants aged 4 weeks or younger.

What will participation involve?

If you decide to take part you will be given this information sheet to keep and asked to sign a consent form. An interview will be arranged at a time to suit you. The interview can be

carried out at the hospital or at your home, whichever would be more convenient for you. If you have to travel to the interview, you will be refunded your transport costs.

The interview will be based around an interview schedule and will take approximately 30-60 minutes. The interview is intended as an opportunity for you to talk about your experience of the time preceding your child's admission and any support that was available to you during this time.

The interview will be audio recorded so that we have an accurate record of what you said. You do not have to answer all of the questions and you are free to change your mind at any time. Your name will not be put on the recording.

The researchers doing this study are not involved directly with Birmingham Children's hospital and will only have the contact details that you provide. The researcher will not have access to your baby's medical notes.

The audio tapes from the interview will be typed up on a computer. Your name will not appear on the transcript.

Please note that:

- You can decide to stop the interview at any point
- You need not answer questions that you do not wish to
- Your name will be removed from the information and anonymised (it should not be possible to identify anyone from the study reports).

It is up to you to decide whether you take part or not. If you decide to take part you are still free to withdraw during the interview or anytime without giving a reason. If you withdraw from the study, all data will be withdrawn and deleted.

What are the possible risks and benefits of taking part?

We do not expect any risks or benefits of taking part, although it is possible that you may become upset if discussing aspects of your postnatal experience that you have found distressing or traumatic. Please be aware that you do not have to answer any questions that

You are uncomfortable with and you can withdraw at any point during the interview. At the end of the interview, we will check that you are still happy for us to use the information you have provided.

Will my taking part in the study be confidential?

All information collected for the purpose of the study will be kept strictly confidential. The only situation in which it may not be possible to maintain confidentiality is if you disclose a risk of harm to you or anyone else during the interview. In this situation, clinical staff at the

hospital will be notified. The University of Birmingham's code for practice guidance will be adhered to and a hard copy of the interviews will be stored securely at the university for 10 years. Any personal data collected at interview will be stored in a secure locked filing cabinet for a maximum of 3 months after the study has ended.

What will happen to the results of the study?

Once all interviews have been completed, a report of the findings will be prepared and the findings may also be published in a medical journal and at conferences. This process may take several months. As part of the presentation of the results, your own words may be used in text form. Your name will be removed so that it will not be possible to identify you. You will be very welcome to have a copy of the report.

Who has reviewed this study?

It is a requirement that all research in the NHS is reviewed by a research ethics committee. This is to ensure that your safety, rights, wellbeing and dignity are protected.

Who is organising and funding this research?

The research is being funded by the Collaboration for Leadership and Applied Health Research and Care Research (CLAHRC) West Midlands which is part of the National Institute for Health Research. The study is based at the University of Birmingham and the maternity theme lead is Professor Christine MacArthur. This interview study will form part of Ellie Jones' PhD research which explores infant readmission to hospital. The study is sponsored by the University of Birmingham.

For further information about the study please contact:
Ellie Jones (PhD student)
[redacted] the Learning Centre
University of Birmingham
Edgbaston
Birmingham, B15 2TT
Email: [redacted]
Tel: [redacted]

Support organisations

If you feel that you require further support and guidance after taking part in this study you may wish to contact your Health visitor, GP or Midwife. You may also wish to contact one of the following support organisations:

Patient Advice and Liaison Services (PALS)	
National Childbirth Trust (NCT) Helpline	**0300 33 00 700 (8am-midnight)**

Appendix 11

Participant consent form for the qualitative interview study (version 1.0)

Birmingham Children's Hospital NHS
NHS Foundation Trust

Parent's experiences of the time preceding their infant's admission to hospital in the first 4 weeks after birth: A qualitative interview study

Project lead: Eleanor Jones
Supervisors: Dr Carole Cummins, Professor Christine MacArthur and Dr Beck Taylor

Please complete in black ball point pen

Participant consent form

Please initial each box

1. I confirm that I have read and understood the information Sheet (version 3 30/08/2016) for the above study and had the opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason. ☐
3. I agree to the interview being digitally audio recorded. ☐
4. I agree to the use of anonymised quotes in any reports or publications. ☐
5. I agree that the data gathered in this study will anonymised and stored at the University of Birmingham for 10 years. ☐
6. I agree to take part in this study. ☐

Name of participant	Date	Signature
Name of Researcher	Date	Signature

Appendix 12

Qualitative study topic guide used for interviews (version 1)

Parents' Experiences of the time preceding infant readmission to hospital: A qualitative interview study

Interview topic guide

The questions may not be discussed in the order they are presented here.

Welcome and introductions

Recap reasons for interview

Thank for agreeing to be interviewed

Practical questions:
Find out baby's name, age, reason for admission to hospital and duration or expected duration of readmission
Find out parents' age, parity and ethnic group

Answer any questions

Confirm informed consent (written)

How was the birth experience, was it as you expected?

The time preceding infant admission to hospital

And what happened after the birth? *Where did you go? Who stayed? Who was there to support you? Was it as you thought it would be? Were any members of staff particularly significant for you? What help were you given to help care for your baby?*

How did you feel when you were discharged home from hospital? *Prompts: were you glad/ worried to be going home? How did you feel when you arrived home? Who did you contact for support in the early days? How did these people help you?*

Could you tell me a little more about what happened the time from discharge home from hospital up until the point that your child was admitted to hospital? *Prompts: how would you describe this period of time? Was it as you expected? How did you feel during this time? If describe large time gap…prompt on this.*

How parents conceptualise/make sense of readmission

How did you feel when you were told that your child would need to be admitted to hospital? *Prompts: Relieved? Upset? Angry? Confused? That the admission was unavoidable? Avoidable? Inevitable? Do you feel differently about it now?*

Important factors contributing to infant being admitted to hospital

From your perspective, were there any important factors which contributed to your child's admission to hospital? *Prompts: what support did you have from midwife/HV/GP? Did you feel prepared at time of discharge from hospital? Did you have family support?*

Do you feel that there is anything which could have been done differently during the postnatal period? *Prompts: would you have preferred more/less contact with health professionals, would you have preferred a longer/shorter postnatal stay in hospital? Did you have contact details for support in your local area e.g. children's centre?*

Do you have any advice that you would give to their parents in a similar situation to you?

Support from health professionals/family support

In what ways do you feel that you have been supported by health professionals since giving birth? Do you feel that you have been supported by health professionals since giving birth? *Prompt: could you tell me about you experiences of midwife/Health Visitor contacts once discharged from hospital? Did you have your midwife visit you at home or did you go to the hospital/GP/children's centre? Did you feel that you had the right number of visits at home?*

In what ways were you supported by family members? *Prompts: Do you have family members close by who were able to help? Did they give you any helpful advice?*

Anything not covered

Is there anything you don't think that we covered today, or that you would like to tell me about?

Closing

Thank you very much for taking the time to be interviewed.

Answer any questions.

Probes which may be used at any point during the interview schedule

Could you tell me a bit more about……?

Could you give me an example of……?

Could you describe……a little bit more for me?

How did that make you feel?

Appendix 13 Example of transcription

Transcription file. (Study ID 11)

I: Can you tell me a little bit about how you've ended up here today?

IV: Obviously, I had a previous stillbirth and this pregnancy time round we were obviously considered high risk and had a lot of growth scans. He's actually always been above the 90th centile in all the growth scans. At the last growth scan, he slightly dipped underneath the 90th centile. I was always due to be induced at 38 weeks; I think probably more for my anxiety and concerns for what happened previously. With that slight dip of growth, the consultant decided to bring my induction date forward to 37 weeks. The induction went to plan. I had to have three pessaries. By the third one, we were rocking. That was on Friday morning. We went through to the Delivery Suite and I had an epidural. By 8.40, he was born. There were no problems. I had slightly above average blood loss but nothing alarming. We then went up to the ward that evening. I did struggle and I'm getting better now but we were kind of left to our own devices a little bit when we were sent up to the ward. My husband left and so the first night was a bit distressing and a bit overwhelming. On Saturday, they were happy that he could latch on and I could feed him. All tests on him were absolutely fine at that point. They didn't notice any jaundice. Sorry, that was the other thing. When we came here yesterday, we noticed that, the day before, he had a bit of jaundice that had developed but at the time of discharge, there was no jaundice. We took him home on the Saturday at around 9 o'clock in the evening. Since then, we've been finding our feet really as new parents. It was just that the next day, we had the standard midwife come and just do an assessment and that's when she noticed there was a bit of jaundice on his nose. That was obviously in the back of my mind then. I had had trouble then for him to latch on and it was giving me more stress. He was obviously getting stressed and the concern was that he wasn't getting enough. He was doing the poos regularly but we noticed, before we brought him in yesterday, that he hadn't weed enough. That was the final thing that we thought, 'Enough. Let's take him to A&E' and that's what we did yesterday morning.

I: What happened then?

IV: He was assessed pretty quickly. They took some bloods and they obviously found that he was jaundiced. He was slightly below the line, at that point, where he needed the light. Yesterday, we were just waiting to be assessed and I think the main concern was getting the food into baby. By the end of yesterday, or was it the day before... sorry, I'm trying to think how long we've been here for...

I: No, it's fine.

IV: They decided to put a tube in, just in case I couldn't breastfeed for whatever reason or I couldn't express enough, then we can fill him up with Aptamil and then go from there and the pressure is off me a little bit more. That's what was done. We then moved up to this room yesterday and have been here ever since really. They've just been great and just monitoring him. The doctors decided that from a day of being fed and monitored, he didn't need the light. Luckily, he didn't actually have the light for that long yesterday. He's fluids have gotten better. His sodium level of was slightly elevated which meant he was slightly dehydrated and that's all levelled out. The doctor came round this morning and was very happy with his progress. It's all positive now but a bit scary at the start.

I: If I just backtrack a little bit, you went to the Post-Natal ward and you described it as 'left to your own devices'. Could you talk me through a little bit more about that?

IV: We were so looked after on the Delivery Suite. We had two assigned midwives that literally didn't leave our sides the whole time. It was a lovely room. It was me, my mother and my husband and we just felt incredibly looked after. They were lovely and the whole experience was very, very nice. That was our bubble for the day and evening and then suddenly, it was like, 'Right, you're going up to the ward. You can get settled in'. Obviously, by the time that I did deliver and got cleaned up, it was quite late in the night really that I went up there. Obviously, my husband couldn't stay. Sorry, I'm getting upset.

I: Yeah, it's okay.

IV: It was just a bit overwhelming really. I've never had a baby before and they were just saying, 'Try and latch on'. It wasn't that they weren't giving support but it was just a different type. I just felt a bit overwhelmed really, yeah.

I: I can understand that.

IV: Yeah, and I was exhausted at that point as well. It's like exhaustion coupled with a new environment in the middle of the night and my husband's not there. It was just a bit like, 'What do I do? What do I do?'

I: Was that as you expected it to be? Did you expect that your partner going to be whisked off?

IV: No, I didn't. No, it wasn't and I think it was a bit of a shock.

I: Yeah, and especially when you've had the freedom of being together and making your own space in the Delivery Suite.

IV: Yes, exactly and then suddenly, you're sharing it with four other people, sharing a toilet and all of those things. That's the situation that it was but it was just a bit too overwhelming really.

I: You say that you were getting support with breastfeeding on the ward. Is that right?

IV: Kind of, yeah. I just would keep pressing the buzzer and saying, 'He's not latching on' and they'd say, 'It will come'. They couldn't say anything that was really helping me and they weren't doing anything that was really helping me. I was exhausted and the baby was exhausted. I was just conscious that he needed to eat. The midwives that I had in the Delivery Suite, I just clicked with them really well and I had a really good bond with them. I just didn't feel that I had that bond to be able to speak, probably, as openly as I did. I was only with them for a day but you create a huge bond with people that are helping you deliver your baby. Yeah, that's kind of how I felt.

I: I presume that you developed... I don't want to put words into your mouth but the following day, you must have felt in a position where you knew how to feed and were confident going home or not really?

IV: Yeah well, it was almost a bit like 'Get me out of here'. He'd latched on a few times. A few times it was a real struggle. I was told by everyone, and my mum who breastfed, 'It will come. It doesn't happen overnight. Colostrum is not your milk. That's the bit before. You're going to have just fluid milk coming straightaway'. After one night, I thought, 'I can't be here another night without my husband'. He was absolutely fine. There was nothing wrong with him. They were doing all the checks and monitoring, so that reassured me that he seemed fine. I thought, 'It might just be me and I'm putting too much pressure on myself'. By the time that we were discharged, we were just really anxious to get home and thinking, 'It will be different once we're in our home environment'. You can come and go as you please.

I:

Appendix 14 Example of list, codes and maps used during the analysis

Appendix 14.1 List of codes (version 1)

Appendix 14.2 List of codes (version 10)

Appendix 14.3 Schematic diagram of the theme 'Who knows best?'

Appendix 14.1 List of codes (version 1)

access to care
admission as 'fate'
baby's health - deterioration
baby's vulnerablity
barrier to health information
barriers to access care
BCH A and E environment
BCH care
birth story
breastfeeding baby
caring for siblings
community care
confidence in caring for baby - cultural upbringing
conflicting advice
continuity of carer
difficulty breastfeeding
dominating language
emotion - going home
emotion - going home from BCH
emotion - on PN ward
emotion readmission
emotion the journey to BCH
empowerment
family or peer support
feeling looked after by HP
feeling out of control
'finding our feet as new parents'
gaining skills
going home
guilt or attributing blame on self
hearing other womens' birth stories
Instinct
'left to our own devices'
Length of PN stay
loss of confidence in HP
loss of control
not going to plan
not trusting HP
parental concern played down
parenting together
parents disagreeing
peer support
physical health-mother
postnatal hospital care

seeking reassurance from HP
seeking reassurance from other parent
sharing responsibility
taking responsibility
The journey to BCH
'they've not really listened to what I've been saying'
tiredness
trusting health professionals

Appendix 14.2 List of codes (version 15)

- confidence in caring for baby - cultural upbringing
  - emotion readmission
    - inevitable or 'fate'
  - 'just in case' precautionary care
  - parents not wanting to be a burden
  - The journey to BCH
  - things that made PN experience more difficult
    - things not going to plan
    - unexpected birth events
- HP KNOWS BEST
  - loss of ownership
  - loss of parental voice
    - assertiveness
      - being assertive with HP
        - advice - be assertive with HP
      - not being assertive with HP
        - not speaking English
  - protective effect of HP knows best
    - feeling positive - opportunity to gain skills
    - feeling relieved hospital staff as 'saviour' or 'they're in the best place'
    - gaining confidence
    - opportunity to confess inexperience
      - describing lack of confidence
      - parents describing inexperience
  - trust
    - advice - trust medics
    - not trusting HP
    - trusting HP
- MEETING PARENTS NEEDS
  - consistent and timely health information
    - conflicting advice1
    - continuity of carer
    - lack of timely health information
      - gaining health information or knowledge from elsewhere
        - bf advice from family
        - information seeking - internet
    - practical advice
    - updates on health of baby or good communication
  - help with establishing breastfeeding
    - good examples of bf advice

- lack of bf advice
- respecting role of parent as protector
  - advice - trust instinct
  - feeling listened to
- the right kind of care
  - physical needs of mother
    - awareness of physical needs of mother or feeling looked after
    - not aware of physical needs of mother
  - emotional support
    - relieving parental guilt
- timely medical interventions i.e. not having to wait

PARENT AS PROTECTOR

- baby's health - deterioration
  - Baby's deterioration
  - Baby's vulnerability
    - having a diagnosis for baby
    - invasive procedures
    - special place in ED for newborn
  - coping considering relative seriousness of condition
- burden of responsibility
  - BREASTFEEDING burden of responsibility
    - difficulty bfeeding
    - feelings of inadequacy around bf
    - sharing feeding responsibility
  - Emotions described
    - extremely stressful
    - feeling out of control or helpless
    - feeling overwhelmed
    - feeling overwhelmed or feeling the burden of responsibility
    - feeling scared
    - feeling upset - sitting with sick children
    - guilt
    - worse than we ever expected
      - didn't realise how ill baby was
  - Things that made burden of responsibility worse
    - caring for siblings
    - physical health-mother
    - tiredness or exhaustion
- family or peer support
  - considering parents who are worse off or showing empathy
  - emotional support
  - isolation from wider family network
  - practical support

- seeking advice from family
  - falsely advised by family
- parenting together
  - key change night time
  - parents disagreeing
    - parents disagreeing about health of infant
  - separation from partner

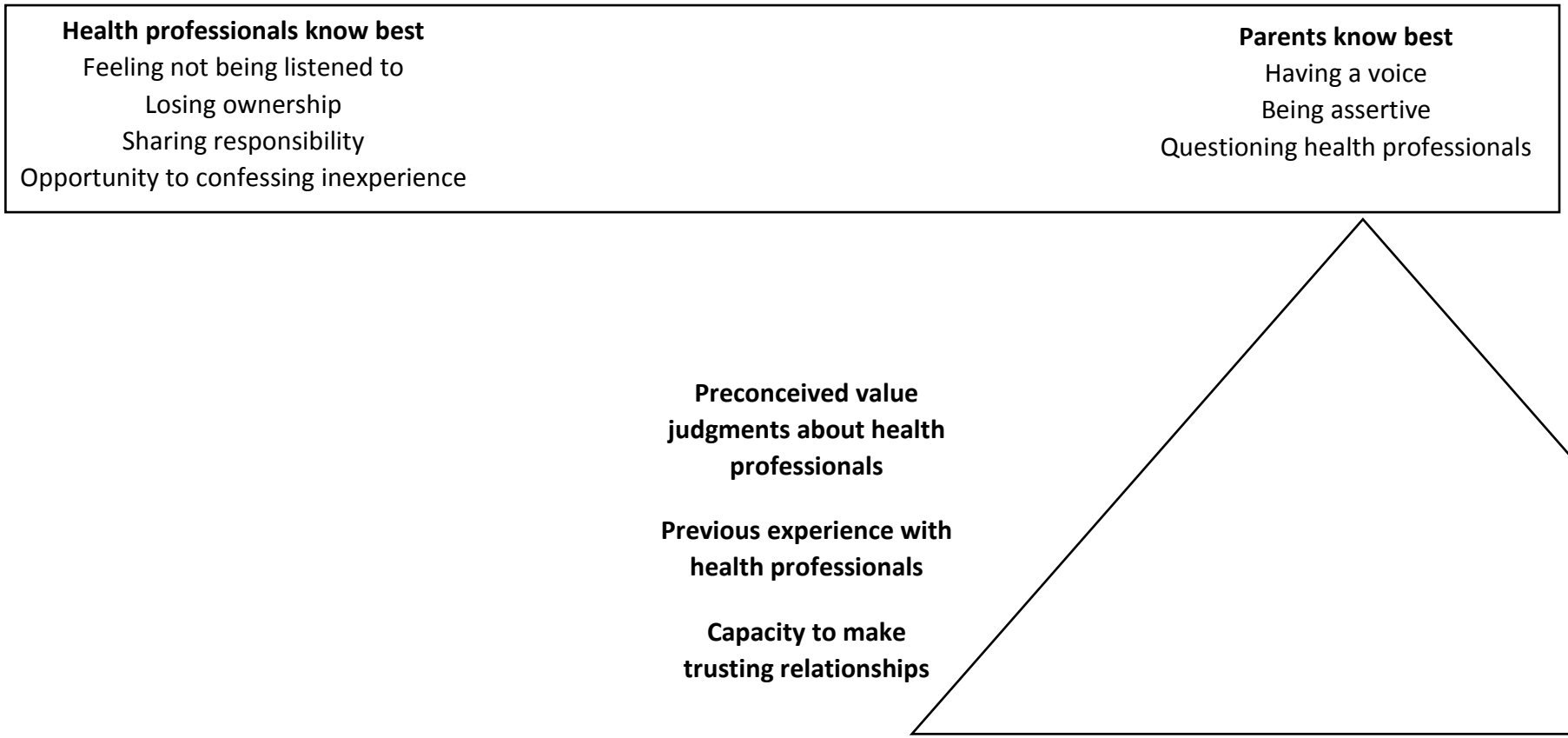
PRACTICAL OR DESCRIPTIVE CODES

- birth story
- community care
  - negative community care
  - positive community care
- decision to go to hospital
  - problem detected by HP
  - problem detected by parent
- Length of PN stay
- reason for admission

THERE'S NO PLACE LIKE HOME or home is best

- 'falling behind schedule'
- going home

Appendix 14.3 Schematic diagram of the theme ‘Who knows best?’



Appendix 15

NHS Ethics Approval for the qualitative study

Health Research Authority

East of England - Essex Research Ethics Committee
The Old Chapel
Royal Standard Place
Nottingham
NG1 6FS
Telephone: [redacted]

Please note: This is the favourable opinion of the REC only and does not allow you to start your study at NHS sites in England until you receive HRA Approval

23 June 2016

Miss Eleanor Jones
Doctoral Student
CLAHRC-WM
[redacted] The Learning Centre
University of Birmingham
Edgbaston
B15 2TT

Dear Miss Jones

Study title:	**Parents' experiences of the time preceding infant readmission in the first 4 weeks after birth: a qualitative interview study**
REC reference:	**16/EE/0268**
Protocol number:	**Version1**
IRAS project ID:	**206017**

Thank you for your letter of 15 June 2016, responding to the Proportionate Review Sub-Committee's request for changes to the documentation for the above study.

The revised documentation has been reviewed and approved by the sub-committee.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this favourable opinion letter. The expectation is that this information will be published for all studies that receive an ethical opinion but should you wish to provide a substitute contact point, wish to make a request to defer, or require further information, please contact the REC Manager Helen Poole, at

Under very limited circumstances (e.g. for student research which has received an unfavourable opinion), it may be possible to grant an exemption to the publication of the study.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised.

Conditions of the favourable opinion

The REC favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements. Each NHS organisation must confirm through the signing of agreements and/or other documents that it has given permission for the research to proceed (except where explicitly specified otherwise).

Guidance on applying for HRA Approval (England)/ NHS permission for research is available in the Integrated Research Application System, www.hra.nhs.uk or at http://www.rdforum.nhs.uk.

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance

should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of management permissions from host organisations.

Registration of Clinical Trials

All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database. This should be before the first participant is recruited but no later than 6 weeks after recruitment of the first participant.

There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g. when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.

To ensure transparency in research, we strongly recommend that all research is registered but for non-clinical trials this is not currently mandatory.

If a sponsor wishes to request a deferral for study registration within the required timeframe,

they should contact The expectation is that all clinical trials will be registered, however, in exceptional circumstances non registration may be permissible with prior agreement from the HRA. Guidance on where to register is provided on the HRA website.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Ethical review of research sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" above).

Approved documents

The documents reviewed and approved by the Committee are:

Document	*Version*	*Date*
Contract/Study Agreement [Chief Investigator declaration]	1	31 May 2016

Contract/Study Agreement [confirmation of insurance]	1	31 May 2016
Covering letter on headed paper [covering letter on headed paper]		29 April 2016
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [evidence of sponsor insurance]	1	20 July 2015
Interview schedules or topic guides for participants [Topic Guide for Interviews]	2	15 June 2016
IRAS Application Form [IRAS_Form_07062016]		07 June 2016
Letter from sponsor [Confirmation of sponsorship]	1	31 May 2016
Other [Schedule of events]	1	31 May 2016
Other [statement of activities]	1	31 May 2016
Other [UoB lone worker policy]	1	01 November 2012
Other [Transcription service confidentiality agreement]	2	15 June 2016
Other [Localised Activity Specific Assessment]	1	16 June 2016
Participant consent form [Consent form]	1	05 April 2016
Participant information sheet (PIS) [Participant Information Sheet]	2	15 June 2016
Referee's report or other scientific critique report [Peer review 1]		09 March 2016
Referee's report or other scientific critique report [Peer review 2]	1	
Research protocol or project proposal [protocol]	1.2	16 June 2016
Summary CV for Chief Investigator (CI) [CV for Chief Investigator]	1	08 April 2016
Summary CV for student [Eleanor Jones CV]	1	08 April 2016
Summary CV for supervisor (student research) [CV academic supervisor]	1	03 May 2016
Summary CV for supervisor (student research) [CV academic supervisor]	1	07 June 2016
Summary CV for supervisor (student research) [CV academic supervisor]	1	07 June 2016

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document "After ethical review – guidance for researchers" gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The HRA website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the HRA website:

http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance

We are pleased to welcome researchers and R & D staff at our NRES committee members' training days – see details at http://www.hra.nhs.uk/hra-training/

16/EE/0268 **Please quote this number on all correspondence**

With the Committee's best wishes for the success of this project.

Yours sincerely

Dr Alan Lamont Chair