Mortality and perinatal infectious complications following home birth in Washington State: 2003-2013

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Abstract

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Planned home birth is defined as a pregnancy in which the mother intends to deliver at home. Washington State has one of the highest proportions of home births in the United States (2.3%), more than double the national average. Despite the rapid rise in popularity of the home birth movement over the last decade, controversy remains over the safety of this practice and how women should best be counseled regarding their decision on where to give birth. We conducted a population based cohort study of births in Washington State from 2003-2013, with the planned place of care at the onset of labor as the exposure of interest (planned delivery in hospital versus planned home delivery) as defined by the Washington state birth filing form. The primary endpoint was all cause mortality during the first 28 days of life. The secondary outcome was a composite variable indicating hospitalization for a neonatal infection in the first 28 days after birth, obtained from linked hospital records data. After exclusions, 12,590 planned home births and 44,739 planned hospital births were included in analyses. The risk of neonatal death among infants born to women who planned to give birth at home was double that of infants whose mothers had planned a hospital delivery (RR 2.1, 95% CI 1.2, 3.6). Compared to planned hospital births, home births were associated with fewer infant hospitalizations for infection within 28 days of delivery (RR 0.6, 95% CI 0.4, 0.8), as well as with a lower risk of induced labor (RR 0.05, 95% CI 0.05, 0.06), maternal laceration (RR 0.4, 95% CI 0.3, 0.5), and neonatal ICU admission (RR 0.4, 95% CI 0.3, 0.4). Prolonged labor was also more common in the planned home birth group (RR 1.7, 95% CI 1.5, 1.9). The most common specific neonatal infectious etiologies requiring hospitalization were urinary and respiratory tract infections. While neonatal mortality was a rare event in our study, it is concerning that the relative risk of death remains elevated among a highly selected population of women choosing to give birth at home. Further studies are needed to explore the underlying mechanisms of increased neonatal mortality associated with planned home birth and to replicate our findings regarding the disparity in infectious diseases between planned home and hospital births.

Introduction

Planned home birth is defined as a pregnancy in which the mother intends to deliver at home. Of the approximately 35,000 home births that occur annually in the United States, 75% of these are planned home births (1). While rates of all live births in the U.S. were relatively constant from 2009-2014, home births during this time rose by over 77% and now represent over 1% of all live births in many areas of the country (2). Washington State has one of the highest proportions of home births in the United States (2.3%), more than double the national average (3).

Despite the rapid rise in popularity of the home birth movement over the last decade, controversy remains over the safety of this practice and how women should best be counseled regarding their decision on where to give birth (2,4). The most recent analysis of Washington State births from 1989-1996 found an increased risk of neonatal death, as well as post-partum bleeding and prolonged labor in home births relative to hospital births (5). This study was limited by challenges posed by birth filing forms at the time, which did not differentiate women planning to give birth at home from those who delivered at home because they were unable seek timely medical attention (e.g. precipitous labor). A more recent cohort study in Oregon found that planned out-of-hospital births were associated with a higher risk of perinatal death and neonatal seizure, but decreased risk of obstetrical procedures and admission to the neonatal intensive care unit (6).

The primary aim of the current study is to determine the risk of all-cause neonatal mortality among planned home deliveries relative to planned hospital deliveries within the first 28 days of life, among women who gave birth to full term, low-risk singleton fetuses in Washington State between January 1, 2003 and December 31, 2013. Because the birth filing form in Washington State now specifies whether a birth at home was planned or unplanned, there should be less

bias in estimates of the risks following planned home birth. Results from this study also update estimates in perinatal mortality among home births in Washington State, which were last examined almost 20 years ago. The secondary aim is to assess the incidence of neonatal infections requiring hospitalization within the first 28 days following planned home deliveries versus planned hospital deliveries. No studies have previously examined the risk of neonatal infection following planned home births, despite infectious associations with specific home birthing practices such as water birth (7). Estimates of maternal outcomes such as prolonged or precipitous labor, induced labor, maternal ICU admissions, delivery method and maternal lacerations following planned home birth will also be described.

Methods

We conducted a population based cohort study of births in Washington State from 2003-2013, with the planned place of care at the onset of labor as the exposure of interest (planned delivery in hospital versus planned home delivery) as defined by the Washington state birth filing form. Birth certificate data were linked to Washington State hospital discharge and death records to identify planned home and hospital births as well as and primary and secondary outcomes. Included in the definition of planned home births are births in which a delivery was planned or initiated at home, but occurred in a medical facility after transfer due to complications. This is because the exposure of interest is a delivery that was originally planned at home, regardless of the eventual place of birth. The study was restricted to women classified as "healthy with low risk pregnancy" as defined in a position statement by the American College of Obstetricians and Gynecologists (8). These guidelines require a singleton fetus with cephalic presentation; gestational age between 36 and 41 weeks with spontaneous labor or labor induced as an outpatient; and no pre-existing and pregnancy related maternal comorbidities. Note that in the current study, maternal comorbidities other than diabetes, hypertension, preeclampsia or eclampsia were unable to be identified based on birth certificate and CHARS data, though

women listed as having any maternal complications during the pregnancy (as determined by a checkbox on the birth certificate) were excluded. Planned home births meeting the above criteria were matched 1:4 to planned hospital births by birth year. Additional exclusions determined by check boxes on birth filing form data for both groups included women with prior cesarean delivery, previous poor outcomes (i.e., perinatal death, small-for-gestational age or intrauterine growth restricted birth), active herpes simplex virus, syphilis, hepatitis B or C. Adequacy of prenatal care was estimated by the Kotelchuck Index, a 2 factor score combining when prenatal care began during pregnancy and the total number of visits, adjusted for the expected number of visits by gestational age(9).

Outcome measures

The primary endpoint was all cause mortality during the first 28 days of life. The secondary outcome was a composite variable indicating hospitalization for a neonatal infection in the first 28 days after birth, obtained from linked hospital records data. Infection was determined as being present based on ICD-9 diagnosis codes and included respiratory infections (460-488), meningitis (320-322), sepsis (995), skin and soft tissue infections (680-686), urinary tract infections (590, 595, and 597), abdominal infections (008, 009) and ocular infections (372-376) as well as perinatal infections (771), a code describing infections in the perinatal period that are not otherwise specified.

Statistical analysis

Relative risk and 95% confidence intervals were estimated by stratified analysis using the Mantel-Haenszel method (10) with adjustment for potential confounders. Variables considered as potential confounders or effect modifiers included maternal age (<25, 25-34 and >25 years), race (White, Black, Hispanic and other), parity (nulliparous/1 or more) marital status (yes/no), education level (less than high school graduate vs high school graduate and above), smoking

(any smoking during pregnancy), residence (rural/urban, as determined by the 2000 U.S. census). and adequacy of prenatal care. Insurance status was explored descriptively but not examined for confounding or effect modification. Because many insurance companies do not reimburse for home births, payer status on the birth certificate was not thought to be an accurate proxy of a women's full insurance benefits. A variable was included in the final model if the crude relative risk differed from the adjusted by more than 10%. Age, parity and education were forced into the final model. A sensitivity analysis of mortality and low birth weight (<2500g) was performed as this is often associated with mortality and tends to be more common among hospital births (4,5). All analyses were performed using Stata version 14. The study was approved by the University of Washington Institutional Review Board and determined to be exempt by the Washington State Institutional Review Board.

Results

Birth certificate data were initially obtained for 13,233 planned home births and 52,932 planned hospital births that met initial inclusion criteria (Figure 1). After exclusions, 12,590 planned home births and 44,739 planned hospital births were included in analyses. A greater proportion of women in the planned home birth group were white (95.1% vs 72.2%), over the age of 35, married, non-smokers and to have completed high school (Table 1). In addition, a greater fraction of women who planned a home birth lived in rural areas. Adequacy of prenatal care were missing for 12.3% of hospital births and 4.4% of home births. Among those with non-missing data, relative to planned hospital births, a higher proportion of mothers with planned home births were multiparous (73.4% vs 52.8%) and received adequate or intensive prenatal care as determined by the Kotelchuck Index. Deliveries in the planned home birth group were almost exclusively performed by midwives (91.8% vs 8.4%); in contrast, 76.5% of planned hospital births were attended by physicians whereas physicians were present in only 0.7% of planned home births.

A greater proportion of infants born to mothers who planned to have a home birth were macrosomic (i.e. weigh >4500 grams) (4.1 vs 1.6%); both groups had a low proportion of low birth weight babies. Relative to planned hospital births, nearly all women who planned a home birth had spontaneous vaginal labor at home (99.9%) compared to 77.4% of planned hospital births. While just two women who planned a home birth had a cesarean delivery (0.01%), 16.9% of women planning to deliver in a hospital had a cesarean delivery.

The risk of neonatal death among infants born to women who planned to give birth at home was double that of infants whose mothers had planned a hospital delivery (RR 2.1, 95% CI 1.2, 3.6) (Table 2). Of the 18 neonatal deaths among women in the planned home birth group, 17 were Caucasian. Adjustment for other variables did not appreciably influence this risk estimate; it was also unaffected after excluding low birth weight infants. A total of 61 women (0.48%) in the planned home birth group required hospital transfer for delivery. Among those transferred, there were 4 neonatal ICU admissions and no deaths. With regard to timing of mortality, 41% of the deaths in the home birth group occurred within the first 3 days of life, compared to 22% in the hospital birth group.

In contrast, infants born to women who intended to give birth at home were significantly less likely to be hospitalized for an infection of any kind (RR 0.6, 95% CI 0.4, 0.8) after adjusting for maternal age, parity and education. The most common infections tended to be respiratory tract infections, “perinatal infections,” and urinary tract infections (figure 2).

Relative to planned hospital births, women who gave birth at home were also significantly more likely to have prolonged labor (RR 1.7, 95% CI 1.5, 1.9). They were significantly less likely to sustain a severe laceration (grade 3 or above) (RR 0.4, 95% CI 0.3, 0.5), undergo induction of labor (RR 0.05, 95% CI 0.05, 0.06) or have an infant admitted to the neonatal intensive care unit (RR 0.4, 95% CI 0.3, 0.4), after adjusting for age, education and parity. Planned place of birth was not associated with maternal admission to the intensive care unit.

Discussion

Planned home birth was associated with an elevated risk of neonatal mortality relative to planned hospital births over a 10 year period in Washington State. Compared to planned hospital births, home births were associated with fewer infant hospitalizations for infection within 28 days of delivery, as well as with a lower risk of induced labor, maternal laceration, and neonatal ICU admission. Prolonged labor was also more common in the planned home birth group, likely due to a lower frequency of induction and augmentation (6). The most common specific neonatal infectious etiologies requiring hospitalization were urinary and respiratory tract infections.

This is the first study to assess the risk of neonatal infectious complications following planned home birth. We hypothesized that planned home births would increase the risk of infectious complications due to delayed recognition of infectious syndromes, a mother's theoretical reluctance to engage in the medical system, or the nature of specific home birthing practices. However, this hypothesis was not supported by the data presented here. Instead, a higher incidence of hospitalization for infection among infants following planned hospital births may have resulted from a combination of nosocomial infections and potentially higher risk pregnancies in this study group. Another plausible factor may be the greater frequency of infectious diagnoses (or over-diagnoses) during the neonatal time period spent in the hospital, in part due to greater availability and use of diagnostic testing in this setting (11,12).

The size of the excess neonatal mortality associated with planned home births in the current study is similar to estimates from a recent Oregon study (OR 2.3, 95% CI 1.1, 4.7 (6) as well as an older study from Washington State (RR 2.0, 95% CI 1.1, 3.7) (5). In all of these studies the absolute risk of neonatal mortality across groups was low. Other earlier, high-quality studies in North Carolina (13) and Missouri (14) also observed increased neonatal mortality with planned home births compared to hospital births. It should be noted that many American studies prior to 2003 were limited in that birth filing forms in many states did not distinguish unplanned

home births (precipitous or premature out of hospital deliveries) from planned births; because of this, outcomes could be heavily biased by whether unplanned deliveries were classified as hospital transfers or births at home.

In contrast, European studies have been relatively more sanguine regarding the safety of planned home birth. A large contemporary study of healthy women giving birth in England looked at the composite primary outcome of perinatal mortality and morbidity by planned place of birth and found no difference in perinatal outcomes (15). Similarly, a meta-analysis of 12 studies from primarily Western European countries showed no differences in neonatal mortality among women with a planned home birth, but fewer pregnancy interventions and less maternal morbidity in this group (4). This analysis included only 2 older studies from the U.S. and most outcomes were heavily influenced by a Dutch cohort (16) of roughly 530,000 low risk women. When this cohort was excluded from analysis of perinatal mortality (the Dutch only looked at death within the first 7 days), Wax et al. found an increased risk among the home birth group, OR 2.0 (95% CI 1.2-3.3). Following this publication, the Dutch group reported that their rates of 28 day neonatal mortality did not differ by planned place of birth (17). Because these European studies were performed within single payer health systems that are often designed to support and integrate with home birth traditions, it may be challenging to extrapolate their conclusions to mothers in the United States (18).

There are a number of limitations to the present study that require consideration. Although we attempted to exclude women who would not be healthy enough to be candidates for home birth, maternal co-morbidities other than diabetes and hypertension were unavailable from birth certificates or hospitalization records. Incomplete information on comorbidities may have resulted in the women in the planned hospital birth group being “sicker” than women in the planned home birth and presumably many would not be considered low-risk pregnancies. Because women in our hospital birth group may be prone to higher frequencies of complications due to maternal or fetal illness not captured in our data, the relative risk of neonatal mortality

associated with a planned home birth presented here may be an underestimate. Similarly, the risk of subsequent hospitalization for infection among the planned home birth group could be an overestimation if the planned hospital group had higher risk births. Further details on underlying comorbidities in both groups as well as causes of neonatal death would help explain the mechanism behind our findings. Details of specific birthing practices as well as microbiologic data also were not available, but would be interesting to assess whether some births are particularly high risk for certain infections (e.g., legionella and water births) (7). The possible influence of the type of birth attendant could not be examined, though the number of physicians attending home births was quite small. Finally, misclassification of birth certificate information, particularly with regard place of planned birth is possible. If a planned home birth was subsequently transferred to a hospital because of medical complications and then incorrectly categorized as a hospital birth on the birth certificate, this misclassification would make home births appear safer than they were.

While neonatal mortality was a rare event in our study, it is concerning that the relative risk of death remains elevated among a highly selected population of women choosing to give birth at home. Although consensus regarding the safety of planned home births in the United States has been difficult to reach due to mixed results from older studies and methodological challenges of identifying women intending to give birth at home (4-6,19,20), our findings are consistent with other recent studies and emphasize the need to carefully weigh the risks and benefits when deciding where to give birth. Further studies are needed to explore the underlying mechanisms of increased neonatal mortality associated with planned home birth and to replicate our findings regarding the disparity in infectious diseases between planned home and hospital births.

Figure 1: Population and eligibility criteria for study of planned home vs. planned hospital birth in Washington State, 2003-2013.

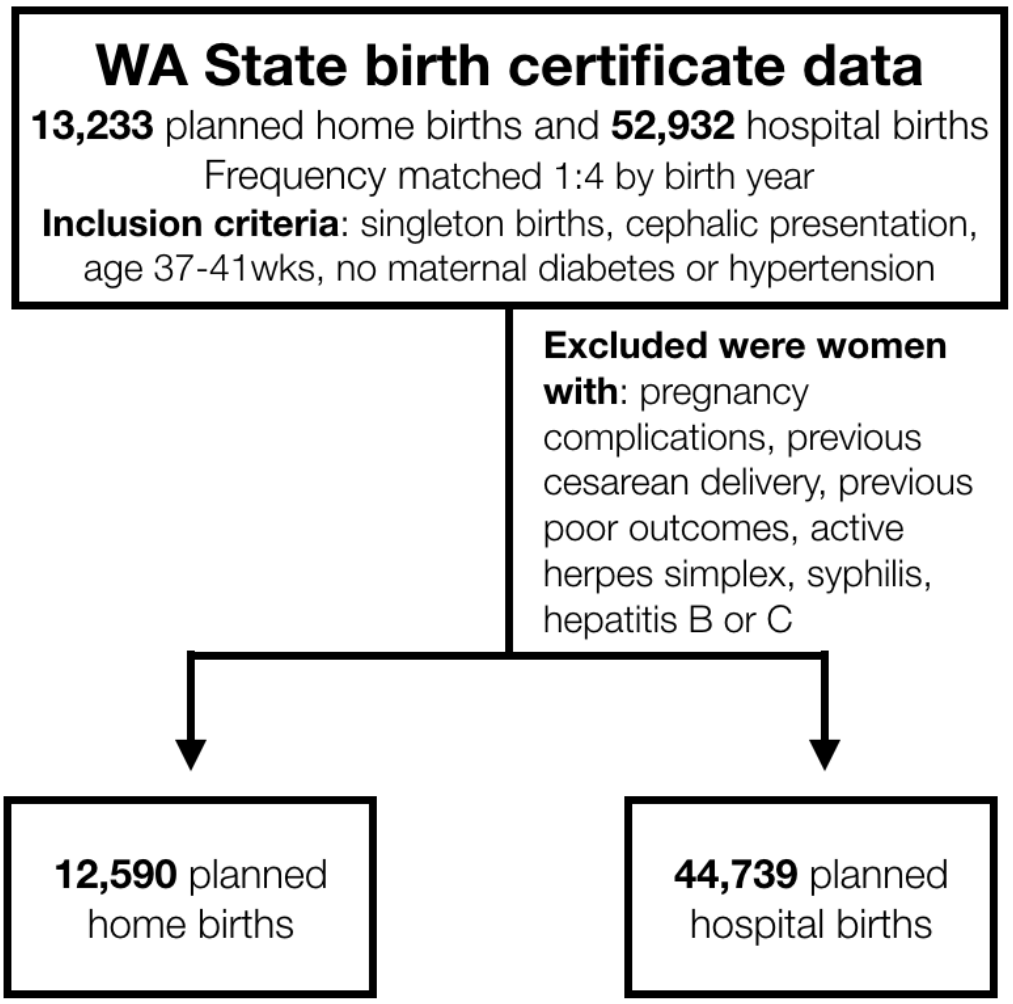


Table 1: Maternal Characteristics of women with Planned Home and Planned Hospital Births Prior to Onset of Labor in Washington State, 2003–2013

Characteristics		Planned home births (n=12,590)		Planned hospital births (n=44,739)	
		n	%	n	%
Age (years)					
	<25	1,938	**15.4**	15,139	**33.9**
	25-34	8,072	**64.2**	23,841	**53.5**
	≥35	2,568	**20.4**	5,748	**12.9**
Race/Ethnicity					

White	11,908	**95.1**	31,765	**72.2**
Black	137	**1.1**	2,129	**4.8**
Hispanic	85	**0.7**	4,678	**10.6**
Other	393	**3.1**	5,473	**12.4**
High school graduate or above	9,825	**78.0**	2,637	**59.0**
Married	10,870	**86.5**	29,586	**66.3**
Smoked cigarettes during pregnancy^	357	**2.8**	4,201	**9.5**
Residence*				
Urban	7,873	**63.5**	32,203	**73.6**
Rural	4,525	**36.5**	1,152	**26.4**
Insurance				
Government	3,551	**29.4**	21,671	**49.5**
Self-pay	2,253	**18.7**	409	**0.9**
Private	6,072	**50.3**	21,609	**49.4**
Other	189	**1.6**	52	**0.1**
Missing	*525*	***4.2***	*998*	***2.2***
Multiparous	9,208	**73.4**	23,270	**52.8**
Kotelchuck index				
Inadequate	1,618	**13.4**	6,089	**15.5**
Intermediate	1,797	**14.9**	9,508	**24.2**
Adequate	7,545	**62.7**	18,133	**46.2**
Adequate plus	1,077	**8.9**	5,488	**14.0**
Missing	*553*	***4.4***	*5,521*	***12.3***
Insurance				
Government	3,551	**29.4**	21,671	**49.5**
Self-pay	2,253	**18.7**	409	**1.0**
Private	6,072	**50.3**	21,609	**49.4**
Other	189	**1.6**	52	**0.1**
Median neighborhood household income (by census tract)* ($)				
<25,000	295	**2.3**	1,969	**4.4**
25,000-49,999	7,043	**56.0**	25,296	**56.5**
50,000-74,999	4,482	**35.6**	14,346	**32.1**
≥75,000	770	**6.1**	3,128	**7.0**
Birth attendant				
Physician	92	**0.7**	34,199	**76.5**

Midwife[†]	11,476	**91.8**	3,762	**8.4**
Nurse	158	**1.2**	419	**0.9**
Other (parent, admin, other)	782	**6.3**	6,353	**14.2**

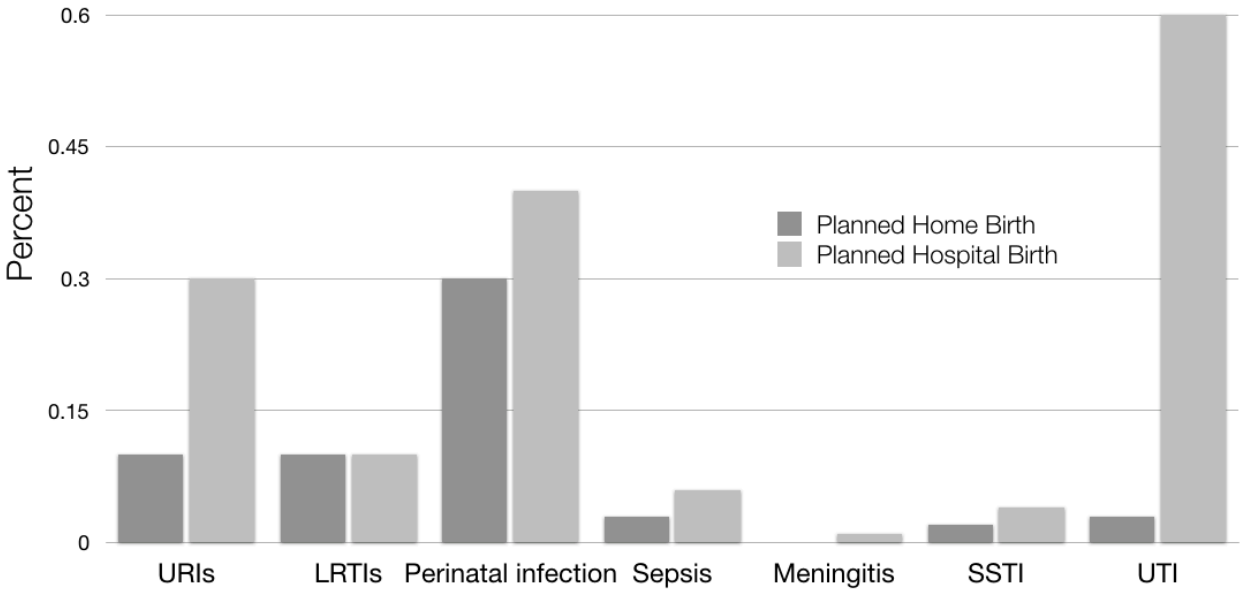
*Defined by 2000 U.S. Census
^Defined as any amount of smoking during current pregnancy
[†]Includes certified, licensed and "other" as listed on the WA State birth filing form
Numbers may not sum to total because of missing values. Unless specified, missing values less than 3% are omitted from this table. Percents were calculated from non-missing values. Missing percents were calculated from total (italicized).

Table 2: Relative risks of outcomes following planned home and hospital births in Washington State, 2003-2013

Outcomes	Planned home births (n=12,590) n	%	Planned hospital births (n=44,739) n	%	Crude RR	(95% CI)	Adjusted[†] RR	(95% CI)
Neonatal mortality*	18	**0.14**	32	**0.07**	**2.0**	(1.1, 3.6)	**2.1**	(1.2-3.6)
Neonatal hospitalization for infection*	46	**0.4**	310	**0.7**	**0.50**	(0.39, 0.72)	**0.57**	(0.41-0.77)
Neonatal ICU admission	110	**0.9**	1,269	**2.9**	**0.31**	(0.25, 0.37)	**0.36**	(0.29-0.43)
Prolonged labor (>20h)	388	**3.1**	1,113	**2.5**	**1.2**	(1.1, 1.4)	**1.7**	(1.5-1.9)
Precipitous labor (<3h)	1,155	**9.2**	1,436	**3.2**	**2.9**	(2.6, 3.1)	**2.2**	(2.0-2.3)
Induced Labor	158	**1.3**	10,087	**22.6**	**0.06**	(0.05, 0.06)	**0.05**	(0.05-0.06)
Maternal ICU admission	6	**0.1**	25	**0.1**	**0.85**	(0.35, 2.1)	**0.93**	(0.38-2.3)
Maternal laceration^	54	**0.4**	656	**1.5**	**0.29**	(0.22, 0.38)	**0.38**	(0.29-0.50)

*Within the first 28 days of life
^Grade 3 or 4
[†]Adjusted for maternal age, education and parity

Figure 2: Neonatal infectious diagnoses by ICD9 code within 28 days of life



URI: Upper respiratory tract infection
LRTI: Lower respiratory tract infection
Perinatal infection: Any infection occurring during the perinatal period, not otherwise specified
SSTI: Skin and soft tissue infection
UTI: Urinary tract infection

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