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Patterns and outcomes of preterm hospital admissions during pregnancy in NSW, 2001–2008

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Abstract

Objective: To assess the magnitude, factors associated with, and outcomes of preterm hospital admissions during pregnancy, with a focus on transfers to higher levels of care.

Design: Population-based cohort study using linked population data.

Study population: Women who delivered a liveborn singleton infant in New South Wales in 2001–2008 and were admitted to hospital in weeks 20–36 of the pregnancy (preterm).

Main outcome measure: Outcome of preterm pregnancy admission as discharged undelivered, transferred to higher care, or delivery.

Results: 110,439 pregnancies (16.0%) involved at least 1 preterm admission. Outcomes of preterm admission were 71.9% discharged, 6.3% transferred and 21.8% delivered. The median gestational age at admission was 33 weeks and the median length of stay was 1 day. Most women who were transferred or who delivered had been admitted for preterm rupture of membranes or preterm labour. Compared with other admitted women, young women (<20 years), smokers, and women in low socioeconomic and rural areas were more likely to be transferred. Infants delivered after maternal transfer had lower gestational age and more adverse outcomes than those delivered without maternal transfer.

Conclusions: Morbidity requiring preterm hospital admission during pregnancy affects 1 in 6 pregnant women in NSW. Most women are discharged without delivery and it is unclear whether admission was actually required. Morbidity for infants born after pregnancy transfer suggests women with high-risk pregnancies are being appropriately identified for transfer.

Introduction

In Australia, regionalised maternity care aims to ensure provision of the appropriate level of care to all women, via assessment of risk, referral and transfer. An important element of this care is providing quality, safe and accessible services to women and babies in rural and remote areas.[1,2] For women who experience pregnancy complications, this means care is not necessarily provided at their local hospital. A woman experiencing complications requiring hospitalisation during pregnancy may be admitted and then be discharged or transferred or deliver her baby. Where pregnancy complications arise, better outcomes for babies result when the mother is transferred before delivery.[3,4] There has been limited study of transfers during pregnancy,[5] and the magnitude and outcomes of maternal transfer are unknown.

Pregnancy and childbirth is the one of the most common reasons for hospital admission in Australia, accounting for about 8% of all overnight acute admissions in 2009–2010.[6] Decisions to admit or transfer women who present to hospital with complications during pregnancy depend on various factors, including the severity of the complication, stage in pregnancy or labour, bed availability, availability of specific clinical expertise, hospital services (including availability of day assessment), proximity of services to home, women's or clinician preferences, and support at home.

The few studies that have examined admissions during pregnancy or the subsequent pathways for these admitted women have been limited by non-representative populations[7] or inability to track individuals through multiple admissions and transfers.[8-10] There is little information on the numbers of women admitted, having multiple admissions during pregnancy, or being transferred between facilities. Without this information, it is not possible to evaluate how well policy aims of equitable and efficient use of resources and optimal outcomes for neonates[11] are being met.

The aim of this study was to assess the magnitude, factors associated with, and outcomes of preterm admission to hospital, with a focus on transfer to a higher level hospital.

Methods

Data

The study population comprised women who delivered a liveborn singleton infant ≥24 weeks gestation in 2001–2008 in New South Wales and who were admitted to hospital during weeks 20–36 of the pregnancy. Women were included for each pregnancy that met the criteria.

Data were obtained from the NSW Midwives Data Collection (MDC) and the NSW Admitted Patients Data Collection (APDC). The MDC ("birth" records) is a population-based surveillance system covering all livebirths and stillbirths ≥20 weeks gestation or ≥400 g birthweight, and includes demographic, medical and obstetric information and information on the condition of the infant. The APDC ("hospital" records) is a census of all inpatient admissions (public and private) in NSW. It includes demographic, administrative and clinical information. Diagnoses related to the admission are coded according to the 10th revision of the *International Statistical Classification of Diseases and Related Health Problems, Australian Modification* (ICD-10-AM).

Linkage of birth and hospital records for the mothers and babies was conducted by the Centre for Health Record Linkage and was approved by the NSW Population and Health Services Research Ethics Committee.

For each birth, records of the mother's hospital admissions (including hospital-to-hospital transfers) where the admission occurred at 20–36 weeks gestation were retained. Day stay admissions were included. Gestational age (in weeks) at admission was estimated from the baby's date of birth and gestational age in the birth record, and the date of admission in the hospital record.

Outcomes

The primary outcome was whether a preterm admission ended in discharge, maternal transfer to a hospital with a higher level of maternity care, or delivery of the infant. Outcomes of transfer admissions were also examined, as discharge, transfer to higher care, transfer to the same or lower care, or delivery. Neonatal outcomes of women admitted preterm were investigated, including neonatal discharge, transfer, morbidity and mortality.

Explanatory factors

Maternal characteristics (age, number of previous pregnancies, smoking during pregnancy, Indigenous status and area of residence) were obtained from the birth records. Quintile of socioeconomic status was determined by the Index of Relative Disadvantage and remoteness category by the mean ARIA+ score for postcode of residence.[12,13] Reason for admission was based on the principal admission diagnosis on the hospital record. Hospitals were classified into 7 groups (Table 2) based on available neonatal care and number of deliveries, and urban or regional area.[14,15]

Results

Study population

From 2001 to 2008, of 688,902 liveborn singleton births ≥24 weeks gestation, there were 110,439 (16.0%) where the mother was admitted to hospital during weeks 20–36 of the pregnancy. These 110,439 births were to 98,183 women, with 68,458 (69.7%) having preterm admission in 1 pregnancy, 23,970 (24.4%) in 2, and 5755 (5.9%) in 3–6 pregnancies. The proportion of pregnancies in which the mother was admitted increased from 15.5% in 2001 to 16.2% in 2008.

During these 110,439 pregnancies, the mothers had 153,936 preterm hospitalisations (admission and subsequent transfers) (22.3 per 100 pregnancies). The women had 1 preterm hospitalisation in 75.2% of the pregnancies, 2 in 16.8%, 3 in 4.9%, and 4–33 hospitalisations in 3.2% of these pregnancies. If transfers are included as separate admissions, there were 165,174 admissions, giving an admission ratio of 24 per 100 pregnancies. Counting only admissions that did not result in delivery gives a ratio of 18.4 non-delivery admissions per 100 pregnancies.

Compared with other pregnant women, women admitted preterm were more likely to be <25 years (24.8% vs 17.2%) and more likely to be in their first pregnancy (43.5% vs 41.5%) or to have had more than 1 previous pregnancy (26.2% vs 24.3%). They were also more likely to be Aboriginal (5.8% vs 3.0%), report smoking during pregnancy (21.6% vs 13.5%) and live in regional areas (31.7% vs 28.1%), and less likely to be in the highest socioeconomic group (19.1% vs 23.8%).

Characteristics of preterm admissions

The median gestational age at which women were admitted was 33 weeks. The median time from admission until discharge, transfer to another facility or delivery was 1 day (IQR 1–2 days; mean 2.3 days). The most common reasons for admission were preterm labour (18.7%), hypertension (11.5%) and haemorrhage (11.0%). The highest proportion of admissions (34.6%) was among tertiary hospitals.

Reasons for admission varied by hospital group and gestational age. Hypertension and premature rupture of membranes accounted for more admissions as gestational age increased, while vomiting and abdominal pain decreased. The proportion admitted each hospital group generally remained constant over the course of the pregnancy, although after 32 weeks the proportion increased at large urban hospitals and decreased at tertiary hospitals.

Most preterm admissions (71.9%) ended with the woman being discharged without giving birth. In 6.3% of admissions, the woman was transferred to a higher level of care. Admissions were more likely to result in transfer if the woman was Aboriginal, younger than 20 years, smoked during pregnancy, or had more than 1 previous pregnancy (Table 1). Compared with women in the least disadvantaged areas, women in the most disadvantaged areas were twice as likely to be transferred. Most women who were transferred or who delivered had been admitted for preterm labour or premature rupture of membranes (Table 2).

Transfers

There were 9647 maternal transfers during pregnancy following an initial preterm hospital admission. Overall, 76.4% were to tertiary hospitals, 15.4% to large regional hospitals, 7.1% to large non-tertiary hospitals able to provide continuous positive airways pressure (CPAP) respiratory support to neonates, and the remaining 1.1% to small regional or large urban hospitals. Of 1653 transfers from large regional hospitals, 96.7% were to tertiary hospitals, 3.0% to CPAP hospitals and the remainder to large urban hospitals. There were 3210 transfers from small regional and "other" hospitals, and 46.1% of these were to large regional hospitals, 35.7% to tertiary hospitals and 14.7% to CPAP hospitals.

Of the women transferred to higher care, 4418 (45.8%) were discharged without delivery, 4439 (46.0%) delivered in the transfer admission, 411 (4.3%) were further transferred to higher care or between tertiary hospitals, and 377 (3.9%) were transferred to another hospital at the same or lower level of care. Preterm labour (27.3%) and premature rupture of membranes (19.1%) were the main diagnoses in the transfer admission for women who delivered or were further transferred to higher care, but 62.2% of the 2220 women with preterm labour in the transfer admission were discharged or transferred back to lower care. Time from transfer to discharge, transfer or delivery was longest for women who were eventually transferred to lower care (median 6 days; IQR 3–12 days) and shortest for those who delivered (median 1 day, IQR 1–4 days).

Infants born after maternal transfer had lower gestational age than those born in the initial preterm admission (median 32 [IQR 29–34] vs 35 [IQR 34–36] weeks). After adjusting for gestational age, infants born after maternal transfer had similar mortality to those born in the initial admission, but had higher morbidity and were less likely to be discharged home (Table 3).

There were 1876 neonatal transfers from non-tertiary to tertiary hospitals (including 212 to a children's hospital). Where a neonatal transfer occurred after delivery in the initial admission,

the median time from maternal admission to delivery was 1 day (IQR 1–1 days), compared with 2 days (IQR 1–6 days) from initial maternal admission to delivery if maternal transfer occurred.

Discussion

This is the first study to use linked population data to examine preterm hospital admissions in Australia, and shows that preterm admission has a significant impact on the health system. Over an 8 year period, about 1 in 6 pregnant women were admitted to hospital at least once during weeks 20–36 of the pregnancy. This translates to about 19,000 preterm admissions per year, most of which end in discharge without delivery within 2 days. The proportion discharged ranged from 51% of those admitted for fetal anomalies to 98% of women admitted for vomiting. In about 6% of admissions (1200 per year) the woman was transferred to higher care, and almost half these women (45%) were subsequently discharged without delivering after a median 3 days.

An earlier study in NSW reported 25,710 non-delivery pregnancy-related admissions (counting transfers as separate admissions) in 1995–96 (30 per 100 pregnancies).[8] That is a higher admission ratio than in our study (18.4 per 100), but includes admissions before 20 weeks and after 36 weeks. Our observed admission ratio is higher than in the US and Canada in the early 2000s, where reported non-delivery admission ratios were 12.8 to 15.1 per 100 pregnancies,[9,10] but included pregnancy-related conditions only.

The main reasons for admission in our study were consistent with earlier studies.[8-10] Preterm labour accounted for the greatest number of preterm admissions and a quarter of the deliveries, while premature rupture of the membranes accounted for 14% of delivery admissions. Similarly, in the US, the main reasons for delivery-associated admissions were premature rupture of membranes and hypertension, and preterm labour was the overall main reason for admission during pregnancy.[16]

Previous studies were based on admission records and could not determine the number of women admitted nor examine when in the course of the pregnancy these admissions occurred or the subsequent outcomes or pathways (Figure 1). One study in the US did consider whether admissions resulted in discharge or delivery.[16] In that study, 8.7% of women had at least 1 admission during pregnancy, just over half the rate we observed in NSW, although admissions resulting in delivery were included only if the admission date was at least 4 days before delivery. Admissions ended in discharge without delivery for 66% of those admitted, compared with 71.9% in NSW. These differences in admission and discharge rates imply differences in admission policy or care between the US and NSW. Clinicians in NSW appear to have a lower

threshold for admitting pregnant women. The large proportion being discharged undelivered in NSW indicates some admissions may be unnecessary. There is a paucity of evidence for keeping women in hospital for bed rest once their condition has been stabilised.[17-19]

Where risk to the baby is identified before birth, optimal care is provided by maternal transfer to a tertiary centre which has the expertise and facilities to provide appropriate care.[20] On the other hand, unnecessary transfer raises costs to the health system and, especially for women in rural areas, may remove a woman from her family and other social supports. We found young women (<20 years), smokers, and women in low socioeconomic areas — factors associated with poor pregnancy outcomes — were more likely to be transferred, which is consistent with an earlier study of transfers of rural women in NSW.[5]

In our study, infants born after maternal transfer had lower gestational age and were less likely to be discharged home, suggesting transfer was appropriate for these pregnancies. However, the large proportion of transfers resulting in discharge or transfer to a hospital providing a lower level of care implies some transfers may not have been necessary. Almost half the women transferred were discharged without delivery, about twice the rate observed in a population-based study in the United Kingdom.[21] The difference probably reflects the differing hospital systems and geography, with NSW having a much greater number of small rural hospitals which may not have obstetric staff available at all times.

Occurrence of a neonatal transfer implies that a potential maternal transfer was missed. Our results suggest many "missed" transfers were due to rapid progression of labour — clinicians may well have identified that these women should be transferred, but not had time to effect transfer before delivery. Confirmation of this would require a depth of data that is beyond that available from routinely collected sources.

Although the hospital data contain diagnosis and procedure codes for each hospital record, there is little information on severity and insufficient clinical or social information to assess whether admission or transfer was appropriate. Even when clinical circumstances are similar, the decision to admit or discharge may depend on a range of factors, and decisions to transfer must balance medical risks with women's desire to stay close to home.

This study adds to our understanding of pregnancy care in NSW. Using linked data allowed us to calculate population rates of admission and transfer, unlike previous studies which were limited to calculating ratios of admissions to pregnancies. No previous study has examined transfers during pregnancy at a population level. This study focused on the whole population, but the

subgroups of women who have multiple admission–discharge cycles or multiple transfers between higher and lower care require more detailed study.

Overall, morbidity resulting in maternal preterm admission to hospital affects 1 in 6 pregnant women in NSW, and most are discharged undelivered. There is no evidence that hospitalising pregnant women for bed rest is beneficial.[17-19] Our results indicate that clinicians discharge women quickly after appropriate examination, while identifying and transferring those who need higher levels of care. Although generally short, such admissions consume resources, most importantly at a time when workforce is insufficient and facilities are running at unacceptably high occupancy rates. We suggest that processes surrounding the assessment and triaging of maternity admissions are targeted to improve efficiencies in maternity service delivery.

Tables

Table 1: Maternal demographic profile and outcomes of preterm admission, New South Wales, 2001–2008*

	Discharge		Transfer		Delivery		Total	
	Number	%	Number	%	Number	%	Number	%
Aboriginality								
Non-Aboriginal	104,518	94.4	8,684	90.0	31,812	94.8	145,014	94.2
Aboriginal	6,214	5.6	963	10.0	1,745	5.2	8,922	5.8
Age group (years)								
<20	7,597	6.9	843	8.7	1,699	5.1	10,139	6.6
20–24	22,060	19.9	2,013	20.9	5,104	15.2	29,177	19.0
25–29	30,832	27.8	2,577	26.7	8,719	26.0	42,128	27.4
30–34	30,477	27.5	2,511	26.0	10,435	31.1	43,423	28.2
35–39	15,855	14.3	1,357	14.1	6,033	18.0	23,245	15.1
≥40	3,898	3.5	345	3.6	1,559	4.6	5,802	3.8
Previous pregnancies								
0	46,465	42.0	3,978	41.2	15,089	45.0	65,532	42.6
1	34,253	30.9	2,553	26.5	9,500	28.3	46,306	30.1
>1	30,014	27.1	3,116	32.3	8,968	26.7	42,098	27.3
Smoking during pregnancy								
No	86,534	78.1	6,858	71.1	26,223	78.1	119,615	77.7
Yes	24,198	21.9	2,789	28.9	7,334	21.9	34,321	22.3
Socioeconomic status								
Most disadvantaged	18,034	16.3	2,157	22.4	5,754	17.2	25,945	16.9
2nd quintile	22,515	20.4	2,389	24.8	6,090	18.2	30,994	20.2
Middle quintile	25,215	22.9	2,216	23.0	8,051	24.1	35,482	23.1
4th quintile	23,982	21.7	1,640	17.0	6,781	20.3	32,403	21.1
Least disadvantaged	20,591	18.7	1,218	12.7	6,741	20.2	28,550	18.6
ARIA+ category								
Major cities	75,616	68.5	4,818	50.1	24,062	72.0	104,496	68.1
Inner regional	22,045	20.0	2,341	24.3	6,217	18.6	30,603	20.0
Outer regional	10,836	9.8	1,927	20.0	2,701	8.1	15,464	10.1
Remote/Very remote	1,840	1.7	534	5.6	437	1.3	2,811	1.8
Total	**110,732**	**100.0**	**9,647**	**100.0**	**33,557**	**100.0**	**153,936**	**100.0**

* Numbers refer to admissions, not pregnancies or women. The 153,936 admissions occurred in 110,439 pregnancies among 98,183 women.

Table 2: Maternal admission characteristics and outcomes of preterm admission, New South Wales, 2001–2008*

	Discharge		Transfer		Delivery		Total	
	Number	%	Number	%	Number	%	Number	%
Reason for admission								
Preterm labour	17,069	15.4	3,420	35.5	8,307	24.8	28,796	18.7
Hypertension	13,450	12.1	1,089	11.3	3,227	9.6	17,766	11.5
Haemorrhage	13,176	11.9	1,455	15.1	2,308	6.9	16,939	11.0
Premature rupture of membranes	1,665	1.5	1,616	16.8	4,675	13.9	7,956	5.2
Abdominal pain	7,672	6.9	182	1.9	19	0.1	7,873	5.1
Digestive system diseases	7,266	6.6	164	1.7	259	0.8	7,689	5.0
Urinary tract infection	4,857	4.4	85	0.9	42	0.1	4,984	3.2
Vomiting	4,611	4.2	78	0.8	17	0.1	4,706	3.1
Fetal anomalies	1,913	1.7	202	2.1	1,621	4.8	3,736	2.4
Antenatal screening	3,668	3.3	28	0.3	3	0.0	3,699	2.4
Other pregnancy-related	10,192	9.2	467	4.8	10,596	31.6	21,255	13.8
Other genitourinary	3,001	2.7	158	1.6	1,130	3.4	4,289	2.8
Other	22,192	20.0	703	7.3	1353	4.0	24,248	15.8
Gestational age at admission (weeks)								
20–28	35,064	31.7	2,683	27.8	1,656	4.9	39,403	25.6
29–32	28,153	25.4	3,785	39.2	3,112	9.3	35,050	22.8
33–35	33,286	30.1	2,664	27.6	13,743	41.0	49,693	32.3
36	14,229	12.8	515	5.3	15,046	44.8	29,790	19.4
Hospital group								
Tertiary	40,536	36.6	405	4.2	12,377	36.9	53,318	34.6
CPAP†	18,048	16.3	1,521	15.8	5,189	15.5	24,758	16.1
Large urban	23,419	21.1	2,711	28.1	8,943	26.7	35,073	22.8
Small urban	566	0.5	147	1.5	128	0.4	841	0.5
Large regional	14,580	13.2	1,653	17.1	4,868	14.5	21,101	13.7
Small regional	10,581	9.6	2,176	22.6	1,992	5.9	14,749	9.6
Other	3,002	2.7	1,034	10.7	60	0.2	4,096	2.7
Admission								
First preterm admission	79,833	72.1	7,177	74.4	23,429	69.8	110,439	71.7
Subsequent preterm admission	30,899	27.9	2,470	25.6	10,128	30.2	43,497	28.3
Total	**110,732**	**100.0**	**9,647**	**100.0**	**33,557**	**100.0**	**153,936**	**100.0**

* Numbers refer to admissions, not pregnancies or women. The 153,936 admissions occurred in 110,439 pregnancies among 98,183 women. † The CPAP hospitals are 5 large non-tertiary hospitals with facilities and trained staff able to provide continuous positive airway pressure (CPAP) respiratory support to neonates.

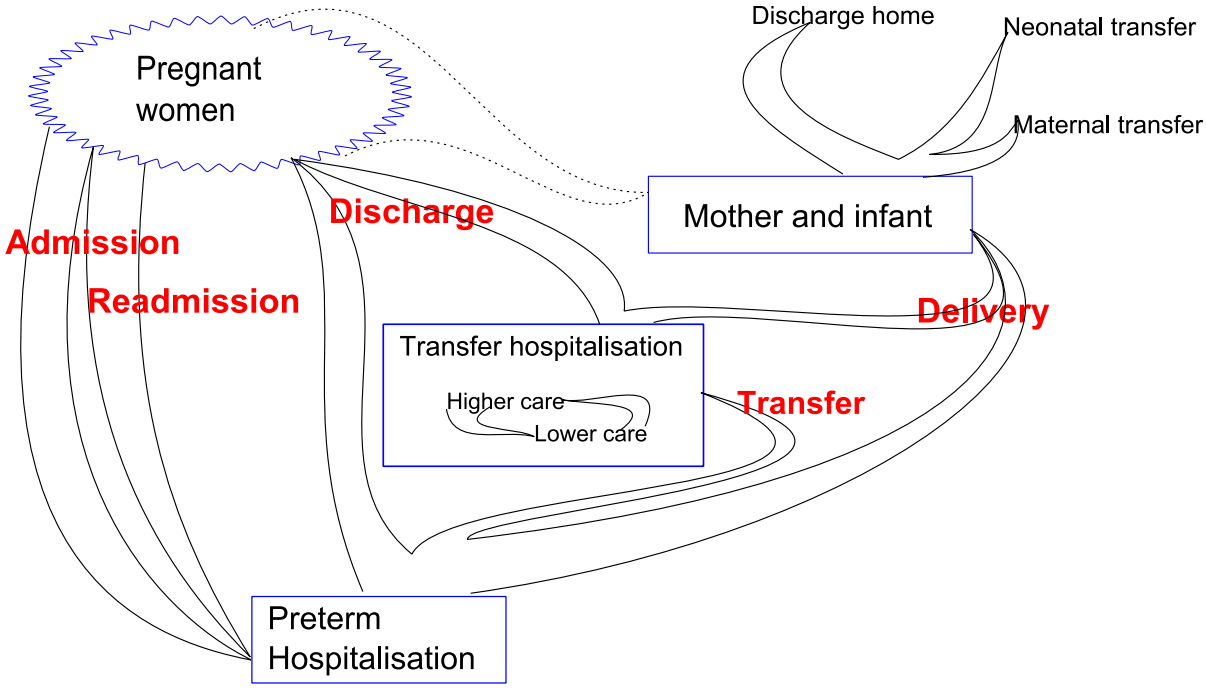
Table 3: Infant and maternal outcomes by maternal transfer status, New South Wales, 2001-2008

	Outcome of the initial admission	
	Delivery (*n* = 33,557)	**Maternal transfer then delivery (*n* = 4439)**
Infant outcome*		
Neonatal mortality	1.2%	4.8%
Adjusted for gestational age	1.7%	1.4%
Severe neonatal morbidity[22]	28.6%	72.0%
Adjusted for gestational age	33.3%	38.9%
Neonatal transfer to higher care (including children's hospital)	7.6%	12.1%
Adjusted for gestational age	8.6%	9.1%
Discharge home	84.7%	23.2%
Adjusted for gestational age	82.3%	43.7%
Maternal outcome*		
Severe maternal morbidity[23]	3.2%	5.4%
Postnatal transfer to higher care	3.3%	2.2%
Discharge home	94.6%	87.4%

* Outcomes are not mutually exclusive.

Figures

Figure 1: Possible pathways for women admitted to hospital during pregnancy



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