Review of Late Preterm Birth at Mowbray Maternity Hospital

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Abbreviations

ACOG	American College of Obstetricians and Gynaecologists
ARV	Antiretroviral
BBA	Born Before Arrival
BMI	Body Mass Index
CFU	Colony Forming Units
CPD	Cephalopelvic Disproportion
CTG	Cardiotocography
DALY	Disability Adjusted Life Years
DUP	Daily Urinary Protein
ENND	Early Neonatal Death
ETB	Early Term Birth
EUS	Early Ultrasound Scan
FD	Fetal Distress
FLM	Fetal Lung Maturity
FTP	Failure to Progress
GA	Gestational Age
GDM	Gestational Diabetes Mellitus
GSH	Groote Schuur Hospital
HCU	High Care Unit
HIV	Human Immunodeficiency Virus
HMD	Hyaline Membrane Disease
HREC	Human Research Ethics Committee

IGT	Impaired Glucose Tolerance
IOL	Induction of Labour
IUGR	Intrauterine Growth Restrictions
IVH	Intraventricular Haemorrhage
KMC	Kangaroo Mother Care
LNMP	Last Normal Menstrual Period
LPT	Late Preterm
LPTB	Late Preterm Birth
LUS	Late Ultrasound Scan
MDG	Millennium Development Goals
MMH	Mowbray Maternity Hospital
MOU	Midwife Obstetric Unit
MRSA	Methicillin-Resistant Staphylococcus
MSU	Midstream Urinary Sample
NEC	Necrotising Enterocolitis
NICE	National Institute for Clinical Excellence
NICHD	National Institute of Child Health and Human Development
NICU	Neonatal Intensive Care Unit
NVD	Normal Vertex Delivery
OGTT	Oral Glucose Tolerance Test
PET	Preeclampsia
PPROM	Preterm Prelabour Rupture of Membranes
RCOG	Royal College of Obstetricians and Gynaecologists

RDS	Respiratory Distress Syndrome
ROP	Retinopathy of Prematurity
RPR	Rapid Plasma Reagen
SDG	Sustainable Development Goals
TPHA	Treponema Pallidum Haemagglutination
TTN	Transient Tachypnoea of the Newborn
UN	United Nations
USA	United Sates of America
VBAC	Vaginal Birth After Caesarean Section
VL	Viral Load
WHO	World Health Organization

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Abstract

Review of Late Preterm Birth at Mowbray Maternity Hospital.

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Introduction: Preterm births are common in all obstetric hospitals and present multiple challenges to both the obstetrician and the paediatrician. Preterm delivery is an important cause of perinatal morbidity and mortality, and places significant psychosocial stress on all involved. Late Preterm Birth (LPTB) is an important topic with many consequences for mother, child and society. It would be of interest to quantify the problem of late preterm birth at Mowbray Maternity Hospital (MMH); quantifying the deliveries into spontaneous versus medically indicated, and to explore the reasons and outcomes for each category.

Aims and Objectives: To review the causes, indications for, and outcomes (maternal and neonatal) of all late preterm births delivered at Mowbray Maternity Hospital.

Methods: This was a retrospective descriptive study, conducted at Mowbray Maternity Hospital, between January 1st 2016 and March 31st 2016. The study population, consisting of 231 patients, includes all deliveries at MMH during the above time period, which fit the inclusion criteria of a gestational age (GA) of between 34^{+0} and 36^{+6} weeks. All data pertaining to the patient's previous history, risk factors and current pregnancy were captured and analyzed using Stata. This study was approved by the UCT Ethics Committee (HREC) and institutional approval was obtained from Mowbray Maternity Hospital. All information was treated with confidentially and in accordance with the Helsinki Declaration.

Results: During the study period, 1st January 2016 and 31st March 2016, there were a total of 2342 deliveries. Of these deliveries 36 (1.5%) were found to have a GA < 28 weeks (these included those that were categorised as miscarriages); 24 (1%) were between 28 – 31^{+6} weeks; 56 (2.4%) were between 32 – 33^{+6} weeks and 1833 (78.2%) had a GA above 37 weeks. 162 (6.9%) folders were missing and therefore GA was not calculated, leaving 231 (9.9%) deliveries of late preterm infants. Of the 231 patients included, 64 (27.7%) were noted to have a poor obstetric history, 38 (16.5%) had a history of a previous preterm delivery. Gestational age was calculated by Early Ultrasound Scan (EUS) in 44.2% of cases; Late Ultrasound Scan (LUS) in

36.4 % of cases; Last Normal Menstrual Period (LNMP) in 14.3% of cases and booking palpation in 5.12% of cases. At least one maternal characteristic associated with preterm labour was seen in 131 (56.7%) of the included patients. There were 20 (8.7%) sets of twins. Of the 231 patients, 129 (55.8%) presented in spontaneous labour and 102 were delivered late preterm for medical reasons; this included 70 (30.3% of 231) who had labour induced and 32 (13.9% of 231) who were delivered via caesarean section despite not being in labour for reasons that prevented an Induction of Labour (IOL)/vaginal birth. There were 251 babies delivered in the late preterm category, and of these, 250 (99.6%) were born alive, with 1 Early Neonatal Death (ENND) and 1 macerated stillborn. Of the 251 newborns, 63 (25.1%) were admitted to at least one of the neonatal wards during their hospital stay. Of these, 64.1% spent time in the High Care Unit (HCU), 28.1% spent time in the Neonatal Intensive Care Unit (NICU) and 68.8% spent time in Kangaroo Mother Care (KMC) unit (majority of these newborns had been in either HCU or NICU prior to KMC). Of the 63 neonates admitted to a neonatal ward; there were 37 (36.3%) from the 102 mothers delivered for medical reasons and 26 (20.2%) from the 129 mothers who had presented in spontaneous labour. The overall correlation between gestational age calculated by EUS/LUS/LMNP and Ballard score was calculated as 37%. The average length of stay in the hospital for the newborns, whether admitted or with mom, was 4.96 days.

Discussion and Conclusion: Late Preterm Birth accounts for 9.9% of all births and 66.6% of all preterm births at Mowbray Maternity Hospital. This is a substantial proportion of MMH deliveries, putting pressure on already strained resources. This pressure is confounded by the fact that 25.1% of these neonates are admitted to a neonatal ward. 44.2% of these births are medically initiated and this should give cause for thought as to whether our protocols that govern certain medical conditions in pregnancy could possibly be altered to prolong pregnancies and reduce the incidence of Late Preterm Birth.

Review of Late Preterm Birth at Mowbray Maternity Hospital

1. Introduction

Preterm births are common in all obstetric hospitals and present multiple challenges to both the obstetrician and the paediatrician. Preterm delivery is an important cause of perinatal morbidity and mortality, and places significant psychosocial stress on all involved.

The World Health Organization (WHO) defines preterm birth as any birth that occurs before 37 weeks of gestation (i.e 36^{+6} weeks) (1, 2). Preterm births can further be subdivided into extremely preterm (< 28 weeks), very preterm (28-31^{+6} weeks) and moderate preterm (32-37 weeks). In this last category, late preterm birth is further defined as a birth between 34^{+0} to 36^{+6} weeks gestation (2, 3). The 37 week cut off is an arbitrary number, and it is well documented that the risk of complications associated with prematurity increases with decreasing gestational age. Neonates delivered at 37 and 38 weeks still have a higher risk of complications than those delivered at 40 weeks (2).

Mowbray Maternity Hospital (MMH) is a secondary level, public maternity hospital, which accommodates and manages referral cases from 5 different Midwife Obstetric Units (MOU's) as well as low risk patients from the surrounding suburbs. There are strict referral criteria, one of which is preterm labour at a gestational age ≥ 30 weeks, or with an estimated birthweight ≥ 1200g, are referred to MMH as these babies would require specialist neonatal care. Preterm labour < 30 weeks or an estimated birthweight of <1200g are referred to Groote Schuur Hospital as their neonatal facilities are better equipped for very small newborns. Other indications for referral include, amongst others, preterm pre labour rupture of membranes (PPROM), intrauterine growth restriction, antepartum haemorrhage, and hypertensive disorders of pregnancy. (See appendix A).

The perception is that late preterm births constitute a large proportion of the workload at MMH,

from both an obstetric and neonatal aspect. It would be interesting and of value to quantify the proportion of late preterm births in relation to all deliveries at MMH, and to establish the causes for these preterm deliveries, whether iatrogenic or spontaneous. This information could be used to better rationalize resources and possibly asses if any of these births and their consequences may be avoided. This constitutes the subject matter of the research being proposed.

2. Literature Review

2.1 Importance of Preterm Births

Preterm birth and its sequelae for both mother and child is a global problem that has recently come into the international spotlight on health care. Studies have shown that globally, 15 million babies are born prematurely, the consequences of which need to be addressed (4). The 'Born Too Soon: The global action report on preterm birth' article which was published by the WHO in 2012, is a collaboration between 50 organizations in which preterm birth statistics are evaluated and plans recommended to help curb the rise in the incidence of preterm birth. The aim of this effort is to improve child and maternal health (4).

In 2010, one in ten babies worldwide were born premature. In total, one million of these babies died as a direct consequence of the complications of prematurity (4). Prematurity also plays a significant role in childhood deaths, with it now being recognized as the second leading cause of death in children under 5 years of age, the proportion of which is said to be nearly 40% (4, 5).Prematurity also accounts for approximately one third (+/ - 27%) of all neonatal deaths (4, 5). Other important causes of neonatal mortality include birth asphyxia and infection (5).

Mortality is not the only significant consequence that prematurity has on the newborn and developing child. Morbidity and/or disability is significant and accounts for 3.1% of all Disability Adjusted Life Years (DALYs) in the Global Burden of Disease (4).
Short term morbidity for these infants could include admission to the neonatal intensive care unit (NICU), respiratory morbidity (respiratory distress syndrome (RDS), transient tachypnea of the newborn (TTN), mechanical ventilation); sepsis (meningitis, pneumonia); central nervous system morbidity (convulsions, intraventricular haemorrhage); as well as jaundice, hypothermia and hypoglycaemia (6).

The above short term complications may lead to longer term morbidities such as retinopathy of prematurity (ROP) and subsequent eye sight problems, intraventricular haemorrhage or meningitis that may result in cerebral palsy or seizures, and mechanical ventilation that may cause long term lung complications. Other long term consequences include increased infant and

young adult mortality, asthma in childhood, diabetes in young adults and problems at school such as developmental delay and learning difficulties (7, 8).

This topic is vitally important in order for the world to keep on track with the Millennium development goals (MDG's). In the year 2000, at the Millennium Summit, world leaders committed to support the United Nations (UN) Millennium Declaration and its goals to fight poverty by 2015 (9). Two of these goals pertained directly to child and maternal health, specifically MDG's 4 and 5. MDG 4, 'Reduce Childhood Mortality', aimed to decrease under 5 childhood mortality by two thirds, and MDG 5, 'Improve Maternal Health', aimed to reduce maternal mortality rate by three-quarters and achieve universal access to reproductive health (9).

2015 has come and gone, and even though maternal and child health have received more attention, the goals have yet to be met, in particular, in sub-Saharan Africa and South Asia. This is thought, in part, to be due to the failure to reduce neonatal deaths, especially those caused by prematurity (4).

On the 1st of January 2016, the Sustainable Development Goals (SDG's) were implemented as a continuum to the MDG's. These 17 goals were developed by world leaders as part of the 2030 Agenda for Sustainable development at a United Nations summit held in 2015 (10). Goal 3: 'Ensure healthy lives and promote well-being for all at all ages' encompasses maternal and neonatal health. It aims to "reduce the global maternal mortality ratio to less than 70 per 100 000 live births" and to "end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1000 live births and under-5 mortality to at least as low as 25 per 1000 live births" by 2030 (10).

Although under-5 mortality rates have decreased, largely due to strategies focusing on causes of death after the first four weeks of life (pneumonia, diarrhea, vaccine related illness), neonatal deaths have risen and now account for 44% of under-5 mortalities (4).

It has been shown that children born into poverty are more likely to die before the age of five than those with wealthier parents, and those of educated mothers are more likely to survive (10).

It is thus hoped that the new SDG's will address many of the issues which contribute to neonatal deaths, including poverty and lack of maternal education.

2.2 Importance of Late Preterm Births

As described above, preterm births play a major role in neonatal and childhood morbidity and mortality, but what is the significance of the late preterm birth (LPB) subgroup?

Fetal lung maturity (FLM) and its development at 34 week's gestation plays an important role in how preterm pregnancies and labours are managed. FLM is dependent on the production of a complex mixture of phospholipids and proteins known as surfactant. Surfactant is produced by the type two alveolar cells (pneumocytes) that differentiate between 24 and 34 weeks gestation (11). Determining FLM can theoretically give the obstetricians and paediatricians an indication of the risk of neonatal respiratory distress syndrome, however, recent studies have shown that despite mature FLM testing, infants born before 39 weeks have more adverse outcomes than those delivered at 39 weeks. These adverse outcomes include jaundice, temperature irregularities, sepsis, and metabolic abnormalities (12, 13). It has also been reported that the late preterm period is an important time for significant brain maturation (12). The fetal brain undergoes rapid growth and development in the last few weeks of gestation. This is thought to be due to important signals received from the placenta, and early disconnection of these signals resulting from premature delivery, may have severe consequences for brain development. These consequences include cerebral palsy and developmental delays as well as educational and behavioural problems (14). The late preterm period is also noted to be a time of unstable haemodynamics related to cerebral perfusion and blood pressure regulation, and disruption/trauma in this period is likely to compromise medical and neuropsychological outcomes (15).

It is generally accepted that FLM is in effect at 34 weeks of gestation due to the production of surfactant. Many hospital policies are guided by this when informing decisions on timing of delivery, as it has been thought that gestations greater than 34 weeks are relatively safe. Both obstetricians and neonatologists, have been seen to consider newborns born between 34 and 36^{+6}

weeks as having similar risks to those born at term (16). This assumption is thought to be based on the studies by Goldenberg et al (1984), "Delay in Delivery: Influence of Gestational age and the Duration of Delay on Perinatal Outcome" (17) and De Palma et al (1992) "Birthweight threshold for postponing Preterm Birth", that looked solely at preterm births and did not compare preterm to term infants (8, 16). It must also be remembered that the presence of pulmonary surfactant, and consequently, lung maturity, does not necessarily denote maturity of other organ systems (18).

The production of surfactant at 34 weeks is an important indicator of pulmonary maturity but it is not the only aspect of lung development that needs to be considered. The development of the fetal lungs spans from the embryonic period right through into post-natal life; from the pseudoglandular (days 52 to week 16) to canalicular (17 – 26 weeks) and saccular periods (24 – 36 weeks to term) to the alveolar period, which begins at 36 weeks and continues into postnatal life (19). The alveolar period encompasses the most rapid period of lung development (19) and it stands to reason that infants born in this late preterm period are more likely to develop respiratory complications in the future. A systematic review and meta-analysis done in 2011, stated that "late preterm infants are at higher risk of neonatal respiratory morbidities, including respiratory distress syndrome, transient tachypnoea of the newborn, persistent pulmonary hypertension, apnoea, pneumothorax and pneumonia" (19).

The evidence regarding timing of inductions/ planned deliveries for most conditions is limited and based largely on expert consensus (20). It is therefore important to look at each case individually, and manage according to the risks and benefits of the specific condition.

LPB's account for the largest proportion of births among preterm deliveries (70-74%) (3, 21, 22). The rates of LPB's are increasing (6, 23), and are associated with higher risks of respiratory complications (6, 24), intraventricular haemorrhage (IVH) (24), adverse neurodevelopment (2, 22), necrotizing enterocolitis (NEC) (24), sepsis (24), feeding problems, hypoglycaemia (6, 23), and neonatal jaundice (25), compared to term infants.

It has been shown that 8% of late preterm infants are hospitalized for respiratory complications

compared to 1% of term infants (26).
A study conducted in a Canadian hospital showed that of the overall Neonatal Intensive Care Unit (NICU) admissions, 38% were late preterm infants compared to 4.5% term infants. Of these admissions 3.5% were due to respiratory complications, 17% of these being in the LPB group and 3.7% in the term group (27).
Gouyon et al (2012) reported that in the United States of America (USA), late preterm infants are 3.5 times more likely to be admitted to the NICU than term infants, and represent 1/3 of all admissions to the NICU. Additionally, the mortality rate in the late preterm group was found to be 4.6 times higher than that of term deliveries (28). A large study done in 19 USA hospitals showed 10.5% of late preterm infants were admitted with respiratory complications compared to 1.13% of term infants (29).
A study conducted in India including >4000 newborns, showed that of the newborns admitted for jaundice, 41.6% were late preterm infants compared to 15.3% term infants.
Late preterm infants were also more likely to develop hypoglycaemia than term infants, with rates of 16% and 6,5% in the respective groups (30).

The rates of NEC in late preterm infants vary from study to study but have been noted to be higher in late preterm births compared to term infants. Intraventricular haemorrhage is more commonly seen in very preterm infants, but is noted more commonly in late preterm compared to term infants (28).
Another important aspect of development to consider is immunity, a process that reaches maturation only midway through the first year of life. LPT infants are more likely to develop respiratory tract infections because of immature humoral immunity. This is due to the interruption of maternal antibody transfer, which occurs in the late fetal period (19).

As with extreme prematurity the concern of morbidity and mortality in late preterm infants extends beyond the neonatal period. Morbidity has been shown to manifest later in life as well. A study done in the USA, looked at children under the age of 2 years who were admitted into intensive care units for respiratory illness, they found that 30% of these children were born premature, 1/3 of these being in the late preterm period (19).

A meta-analysis conducted by Isayama et al (2017) investigated the use of Health Services by late preterm and term infants. They followed these groups from infancy to adulthood, looking specifically at the cause specific admissions. They found that late preterm infants had a higher likelihood of admission than term infants through all periods of life (neonatal to adolescence) however this difference decreased as time passed (25).

In low resource settings, such as South Africa, the financial implications of these additional hospital admissions need to be considered as they have an impact on society in general. Additional costs that need to be considered are those incurred by the need for specialty schools and facilities that may be required to educate and support infants who have suffered from long term neurodevelopmental complications such as cognitive deficits, behavioural issues and seizures (31).

Studies have shown that LPT infants and preschoolers often have poor growth and tend to be underweight which negatively impacts development and medical outcomes (15). Comparisons have been done between LPT girls versus boys, and it has been shown that boys are at the disadvantage, having lower mental developmental index (MDI) scores than girls at age 12- to 18-months. LPT boys also have higher risks of nonverbal dysfunction when compared to term boys (15). Studies looking at the neurodevelopmental outcomes in adolescents and adulthood are scarce, and those that are available were mostly conducted in a time where neonatal facilities were less advanced and thus the data is difficult to interpret (15).

The above information regarding potential complications and risks of preterm deliveries is based on the gestational age at birth, with complications being more common the earlier the gestation. It is therefore important to ensure that the gestational age of a pregnancy is calculated as accurately as possible, thereby enabling the obstetrician and paediatrician to anticipate the possible outcomes at delivery and manage the pregnancy as optimally as possible. Gestational age can be calculated by many methods including history of the last menstrual period (LMP), measurement of the 1st symphysis-to-fundal height and ultrasonographic measurements.

Currently in the Western Cape, policy allows for routine ultrasound examination between 18 and

23 weeks, in low risk patients, if the patient is thought to be clinically within this gestational age range (32). This has been shown to reduce the number of presumptive post and pre- term deliveries (33). A study done by Geerts et al (2013), set in the Western Cape, compared the accuracy of different pregnancy dating methods. They found that ultrasound dating was the most accurate method, especially when done early and by an experienced sonographer (33). They also found that "ultrasound dating > 24 weeks was superior to the LMP and fundal height methods" and "not much worse than ultrasound done at 20-24 weeks" therefore suggesting that routine US dating for later gestational ages has some merit (33). Having said this, the study did show that the accuracy of dating US <20 weeks was far superior to that of those done > 20 weeks (33).

It has been suggested that the increase in morbidity in the late preterm group may be related to pregnancy complications that result in either spontaneous or indicated premature delivery (6). It is therefore important to look at the indications/ causes of these LPB's to analyze whether the morbidity is due to gestation alone, obstetric complications or a combination of the two. LPB's can be divided into those occurring spontaneously and those that are medically indicated for an obstetric or fetal reason. There is concern that the latter may be playing a significant role in the increase in proportion of LPB's (3).

2.3 Spontaneous Late Pretem Birth's

There are many recognized causes of spontaneous late preterm births. These include multiple pregnancy, infection, chronic conditions such as hypertension and diabetes, uterine anomalies, as well as congenital abnormalities. There are also maternal risk factors that have been identified as being associated with preterm labour. These include extremes of age, short inter-pregnancy intervals, low body mass index, smoking, and a previous history of preterm delivery.
A study done in Canada by Bassil et al (2014), looking at the relationship between obstetric interventions and late preterm birth, found several risk factors independent of obstetric intervention that were associated with an increased likelihood of LPTB. These included a history of previous caesarean section (28% increased likelihood), and smoking during pregnancy (30% increased likelihood) (3). In the majority of cases of late preterm birth, however, a risk factor or cause is not identified (2). Spontaneous preterm deliveries exceed the number of medically

indicated deliveries, in particular after 34 weeks, and account for 80% of late preterm births (19).

2.4 Medically Indicated Late Preterm Birth's

These are also referred to as non-spontaneous births, and are often associated with obstetric, fetal or placental conditions such as preterm pre labour rupture of membranes (PPROM), fetal growth restriction, placental insufficiency and pregnancy induced hypertension (22), as well as a prior stillbirth, congenital malformations, multiple pregnancies, previous uterine surgery and placenta praevia/accrete (18).

These conditions can result in either stable non-emergent cases (non-life threatening to mother or fetus) or emergency situations requiring urgent delivery to prevent maternal/ fetal compromise (22).

The American College of Obstetricians and Gynaecologist (ACOG) advises against non-indicated delivery before 39 weeks due to the neonatal risks associated with LPTB's. Certain maternal, fetal and placental complications, however, may warrant delivery, and risk versus benefit to the infant and mother must be considered (20).

The Royal College of Obstetricians and Gynaecologists (RCOG) and the National Institute for Health and Care Excellence (NICE) have published guidelines with respect to delivery of late preterm pregnancies. They advise induction of labour prior to term in certain cases where risk versus benefit for mother and child have been considered. Some of these cases include preterm pre labour rupture of membranes (34, 35), preeclampsia (36) and intrauterine growth restriction (35).

Due to the increasing burden of LPTB and early term births (ETB) ($37 – 38^{+6}$ weeks), the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) together with the Society for Maternal Fetal Medicine held a workshop in February 2011 on "Timing of Indicated Late Preterm and Early Term Births". This workshop aimed to collaborate all information regarding possible conditions that may result in indicated LPTB and ETB, and to use this information to determine potential risks and benefits of delivery, the optimal gestational age for delivery and to inform future research in this field (18). It is stated that determination of optimal timing is complex and there is potential for conflict between maternal and fetal

wellbeing, and that timing of delivery should take into consideration relative risk to mother and fetus; the presence of maternal co morbidities; underlying risk factors; practice setting and patient preferences (18).

Risks of early delivery to the fetus are well documented, but risks to the mother also need to be considered. These may include risks associated with induction of labour, including increased risk of caesarean delivery, haemorrhage, infection and prolonged hospital stay (18). The benefits of early delivery for the fetus include avoidance of stillbirth and removal from a potentially hostile environment due to infection or placental insufficiency. Benefits for the mother include resolution of the underlying disease process such a pre-eclampsia (18).

The management of stable non-emergent cases is an area in which health care provider variations come into play and one which may be a source for potentially modifiable rates of LPB's (22). Although medically indicated late preterm deliveries have been associated with a decrease in stillbirths, and may be unavoidable in certain cases, due to the adverse complications caused by prematurity, it is important to fully understand the relative risks and benefits of delivery prior to any intervention (19).

2.5 Conclusion

Late preterm birth is an important topic with many consequences for mother, child and society. It would be of interest to quantify the problem of late preterm birth at MMH and the workload associated with these births; quantifying the deliveries into spontaneous versus medically indicated, and to explore the reasons and outcomes for each category.

3. Aims and Objectives

3.1 Aim

To review the causes, indications for, and outcomes (maternal and neonatal) of all late preterm births born in Mowbray Maternity Hospital.

3.2 Specific objectives

1. To quantify the proportion of Late Preterm Births in relation to all births at Mowbray Maternity Hospital to estimate the burden on the hospital and its resources.
2. To describe the characteristics of women with Late Preterm Births.
3. To describe the proportion of spontaneous Late Preterm Births compared to those delivered late preterm for medical indications, and the causes for each.
4. To describe neonatal outcomes following late preterm delivery.
5. To compare the results from Mowbray Maternity Hospital with those found in the literature

4. Methodology

4.1 Study Design

This was a retrospective descriptive study conducted at Mowbray Maternity Hospital (MMH) between January 1st 2016 and March 31st 2016.

4.2 Study Setting

This study was conducted at Mowbray Maternity Hospital. MMH is a very busy secondary level, public maternity hospital that is situated in the southern suburbs of Cape Town in the Western Cape, South Africa. MMH receives referrals from the primary level Midwife Obstetric Units (MOU's), and provides maternity care for low risk women residing in the surrounding suburbs. MMH conducts approximately 10 000 deliveries a year, and is staffed by midwives, interns, community service doctors, medical officers, registrars, and specialists. The MOU's, namely Mitchell's Plain MOU, Hanover Park MOU, Retreat MOU, Gugulethu MOU and False Bay Hospital, are primary health care units that are staffed exclusively by midwives, and provide antenatal care and delivery facilities to patients in the surrounding communities who are considered to be low risk. The prevailing management policies of the Metro West and thus MMH, include provider initiated deliveries at gestational ages ≤ 37 weeks in cases of confirmed preterm prelabour rupture of membranes ± chorioamnionitis, confirmed preeclampsia ± HELLP syndrome and IUGR with fetal compromise. The obstetric service is well supported by a tertiary level neonatal unit that is based at MMH.

Preterm delivery is a pregnancy complication which requires the attention of trained medical doctors, and because of this, most late preterm deliveries/ pregnancies with complications such as preterm prelabour rupture of membranes, will be referred to deliver at MMH. Very early preterm deliveries are referred to the tertiary referral hospital, Groote Schuur, as their neonatal facilities are better equipped for very small newborns.

4.3 Study Population

The patient population at MMH consists predominantly of women from a middle to lower socio-economic background.

4.4 Study Subjects and their Selection

The names and folder numbers of patients with newborns with birth weights between 1.5 and 3.5 kg and/or gestational age between 34^{+0} and 36^{+6} weeks, were identified from the labour ward and theatre registers at MMH, between January 1st 2016 and March 31st 2016.
The above weights were taken from the Babson and Benda's updated chart (37) which correlates with the 10th centile weight category of a 34^{+0} weeks' gestation and the 90th centile weight category of a 36^{+6} weeks gestation (i.e. late preterm births).

These folders were retrieved by a MMH clerk (hired for this study) and were all reviewed by the principle investigator. A 6th year medical student volunteered to assist with data collection to gain some research exposure, and was involved for the first two weeks of the project.

4.4.1 Inclusion Criteria

- All patients who had a certain gestational age between 34^{+0} and 36^{+6} weeks, determined by early ultrasound (EUS), late ultrasound (LUS), sure dates/ last normal menstrual period (LNMP), booking palpation or a combination of these.
- All singleton and multiple births
- All live births and stillbirths
- All babies delivered at MMH and those born before arrival at MMH.

4.4.2 Exclusion Criteria

- Any patient who was noted to have an uncertain gestational age or a confirmed gestation before 34^{+0} weeks or after 37^{+0} weeks.

These births were still, however, captured and recorded, per gestational age, so that the percentage of Late Preterm Births in relation to all deliveries at MMH during this time could be calculated.

4.5 Definitions and Data Collection

Gestational age (GA) was determined by one or a combination of methods. Early ultrasound scan (EUS) was defined as any scan done before 24 weeks' gestation and late ultrasound scan (LUS),

any scan above 24 weeks. These definitions are in keeping with the criteria used in a Cochrane review, Ultrasound for Fetal Assessment in Early Pregnancy (38). When a combination of ultrasound and last normal menstrual period (LNMP) was available, the gestational age was determined per the ACOG guidelines: in the first trimester if the LMP and ultrasound differ by ≥ 7 days, preference should be given to the ultrasound date. In the early second trimester (14 -20^{+6} weeks) if the LMP and ultrasound differ by ≥ 10 days' preference is given to the ultrasound. In the late second trimester (21 – 27^{+6} weeks) if LMP and ultrasound differ ≥ 14 days then preference is given to ultrasound. In the third trimester if the LMP and ultrasound differ ≥21 days then preference is given to the ultrasound (39).

Body Mass Index (BMI, kg/m^2) was calculated using height and weight measurements and was classified into 4 categories: underweight (BMI ≤18.5), normal (BMI 18.6 -24.9), overweight (BMI 25 – 29.9), obese (BMI 30 – 39.9) and morbidly obese (BMI ≥ 40) (40).

A patient was said to have a maternal risk factor if she was known with any co-morbidities such as hypertension, cardiac disease, diabetes mellitus, anaemia or asthma; was known with any maternal infections such as syphilis or HIV; or had a positive smoking history or any history of substance abuse (including alcohol).

In this study, we defined hypertension, in accordance with the NICE guidelines, as a systolic blood pressure as ≥ 140mmHg and a diastolic blood pressure as ≥ 90 mmHg. Chronic hypertension was defined as hypertension that is present before 20 weeks' gestation. Gestational hypertension was defined as hypertension presenting after 20 weeks without significant proteinuria, and unclassified hypertension classified as hypertension diagnosed after 20 weeks, when blood pressures prior to 20 weeks are unknown (36). Pre-eclampsia was classified as new hypertension presenting after 20 weeks with significant proteinuria, which was defined as urinary dipstix of ≥ 1 + protein or daily urinary protein (DUP) of ≥ 0.3g/24 hours (36).

For the definitions of diabetes in pregnancy we used our local classifications which are based on the WHO criteria for the diagnosis of Diabetes Mellitus (41). Following an oral glucose tolerance test (OGTT) of 75g glucose, impaired glucose tolerance (IGT) was defined as fasting

glucose of 5.5 – 7.0 mmol/L or 2-hour glucose of 7.8 – 11.0 mmol/L, and gestational diabetes (GDM) was defined as fasting glucose ≥ 7.0 or 2-hour glucose ≥ 11.0 mmol/L. It has been noted that the definitions of diabetes in pregnancy have been changed according to the updated NICE guidelines in which gestational diabetes is defined as a fasting plasma glucose level of 5.6 mmol/L or above, or a 2 – hour plasma glucose level of 7.8 mmol/L or above (42). This update was made after the dates selected for our data collection therefore the folders we collected had patients classified as either IGT or GDM.

When classifying infection as a possible cause for late preterm birth we used the following definitions.

1. Urinary tract infection was defined as urinary tract signs and symptoms (dysuria, frequency, renal angle tenderness) with a temperature of ≥ 38 degrees Celsius or a midstream urine sample (MSU) with >10 000 colony forming units (cfu) and an organism cultured.
2. Uterine infection was based on clinical findings of maternal or fetal tachycardia, maternal pyrexia with an irritable uterus, and or documentation of foul smelling liquor.
3. Respiratory tract infection was defined as respiratory symptoms (upper or lower) with a temperature ≥ 38 degrees Celsius with or without chest x-ray findings.
4. Other infections were grouped together in cases of maternal pyrexia of ≥ 38 degrees Celsius and/or maternal tachycardia where the source is unknown.

When looking at HIV infection, we looked at whether the patient was HIV positive or negative and if positive whether they were on treatment or not; whether they had a suppressed viral load or not and whether they had a CD4 count greater than 250 or not. Viral load was defined as being suppressed if found to be < 1000 copies as per the WHO Guidelines on Antiretroviral Therapy for HIV Infected Adults and Adolescents (43).

Syphilis testing is done routinely on all patients who are seen in their antenatal course or post-delivery if the patient never booked for antenatal care. This may be done either by finger prick Rapid Plasma Reagin (RPR) testing or by the identification of Treponema pallidum antibodies in

the serum. The test results were documented as positive or negative. If positive, treatment was recorded as complete or incomplete (i.e. the patient had not received three, weekly intramuscular benzathine benzylpenicillin injections).

Poor obstetric history was recorded when a patient had previously lost a pregnancy at any gestation, i.e. any previous miscarriages (first and/or second trimester), previous ectopic pregnancy, previous stillborn or early neonatal death (ENND). A termination of pregnancy was not documented as a poor obstetric history unless it was medically indicated. Previous preterm deliveries were also documented.

Preterm prelabour rupture of membranes was defined as spontaneous rupture of membranes, at least one hour before the onset of uterine activity, occurring from 24 to 37 completed weeks (44).

As all our study entrants delivered preterm infants, it was documented whether they had received any intervention to prevent preterm labour, such as tocolysis, or if they received betamethasone to aid with fetal lung maturity at any point in the current pregnancy.

Indications for induction of labour (IOL) included pre eclampsia (PET); preterm prelabour rupture of membranes (PPROM); fetal causes (multiple pregnancy, intrauterine demise, intrauterine growth restriction, abnormal dopplers, oligo/anhydramnios, non reassuring CTG) and maternal causes (recurrent antepartum haemorrhage, suspected infection).

Indications for caesarean section were as documented; ≥1 previous caesarean section; fetal distress; antepartum haemorrhage; breech presentation; cephalopelvic disproportion (CPD); failed IOL; PPROM in a patient with a contraindication to IOL; intrauterine growth restriction (IUGR); PET and failure to progress (FTP).
It must be noted that many medical practitioners still use the term ‘fetal distress’ to describe pathological or abnormal CTGs. For the purposes of this study, the term ‘fetal distress’ is interchangeable with pathological/abnormal CTGs, as on retrospective review of the folders we were unable to determine which CTG criteria were used in each case and therefore had to rely on the documented terms used in the folders to describe the indication for caesarean section.

Mode of delivery was divided into normal vaginal delivery (NVD); assisted vaginal delivery (vacuum or forceps); emergency caesarean section; elective caesarean section; vaginal birth after caesarean section (VBAC); and birth before arrival (BBA).

Fetal outcome was documented as alive; fresh stillborn; macerated stillborn; and early neonatal death (ENND), defined as death within the first 7 days of life.
Neonatal outcomes were categorized as the baby either being well enough to go to mom i.e. no admission needed, or requiring admission to the neonatal nursery/neonatal ICU/ kangaroo mother care room.
Reasons for admission included sepsis; jaundice; respiratory distress; temperature regulation concerns; hypoglycaemia and seizures.

It was also documented whether neonates who had been sent to their mothers experienced any complications requiring treatment, such as neonatal jaundice, sepsis requiring workup and antibiotics, or poor glucose control requiring top up feeds.
Day of discharge for the neonate was documented to evaluate the burden of disease and pressure on resources.

4.6 Sample Size

Based on a short period of overview data collected in May 2016, it was estimated that the prevalence of late preterm birth at Mowbray Maternity Hospital is approximately 12%. This translates to approximately 300 patients over a 3-month period. We anticipated that some records may be lost or incomplete and that 80% of the records will be suitable for inclusion in the study. Therefore, a convenience sample of 240 patients was thought to be adequate for the sample size. A total of 231 patients were included by the end of the study.

4.7 Data Analysis

All data from the included files was entered onto a specific data collection sheet and this information was later captured onto an excel spreadsheet on a password protected computer. Data was then analyzed by a statistician and the principal investigator, using the statistical program, STATA version 12. Continuous variables were analyzed and measured for central

tendency (mean) and measures of dispersion (minimum and maximum). Both the t-test and chi2 calculations were used.

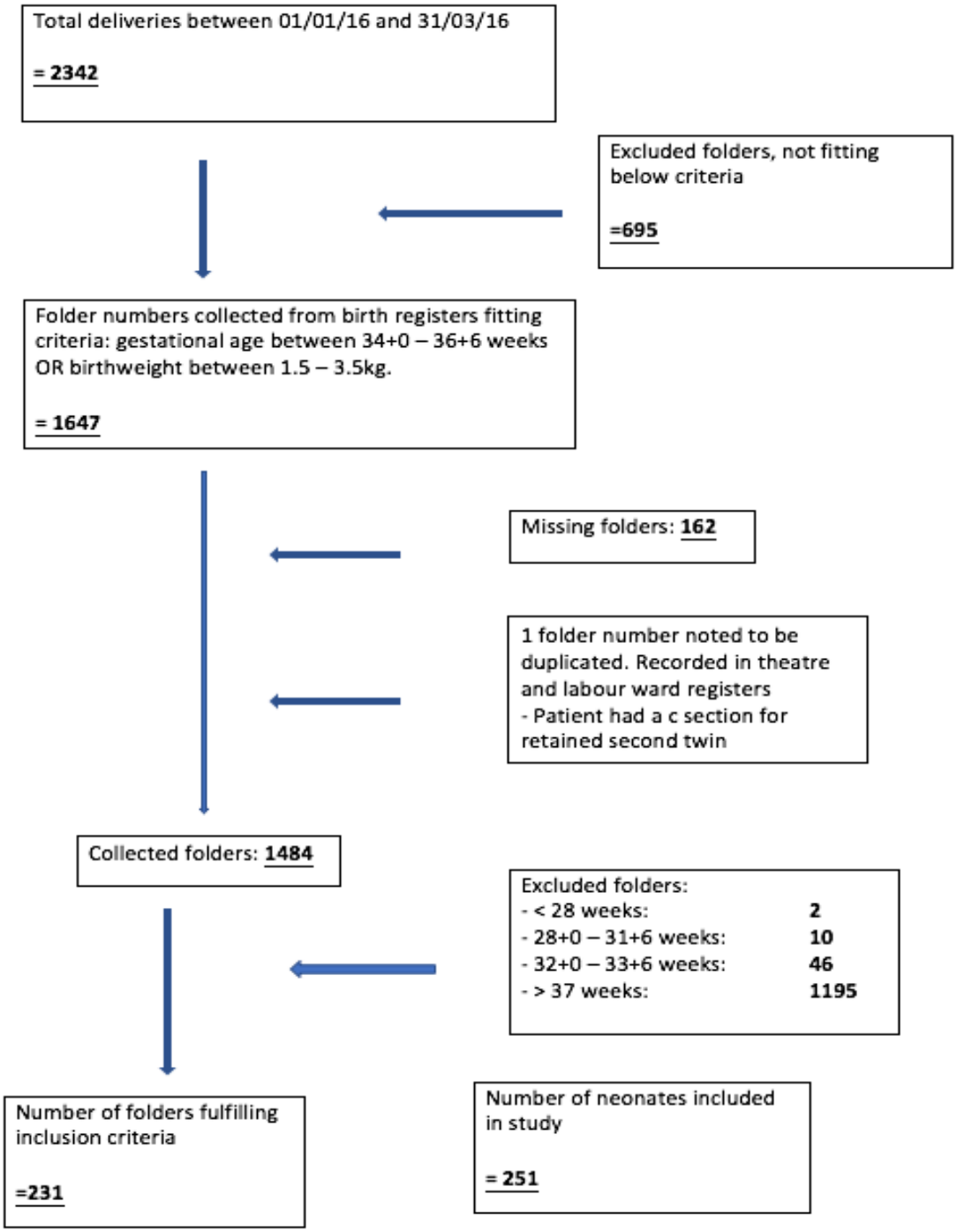
4.8 Ethics

All patient details were kept on a password protected computer, only accessible by the principle investigator, to ensure patient confidentiality.

This study was approved by the UCT Faculty of Health Sciences Human Research Ethics Committee (HREC) reference 696/2016 and institutional approval was obtained from Mowbray Maternity Hospital. All information was treated with confidentiality and in accordance with the Helsinki declaration (45).

5. Results:

Figure 1: Numbers Flow Diagram



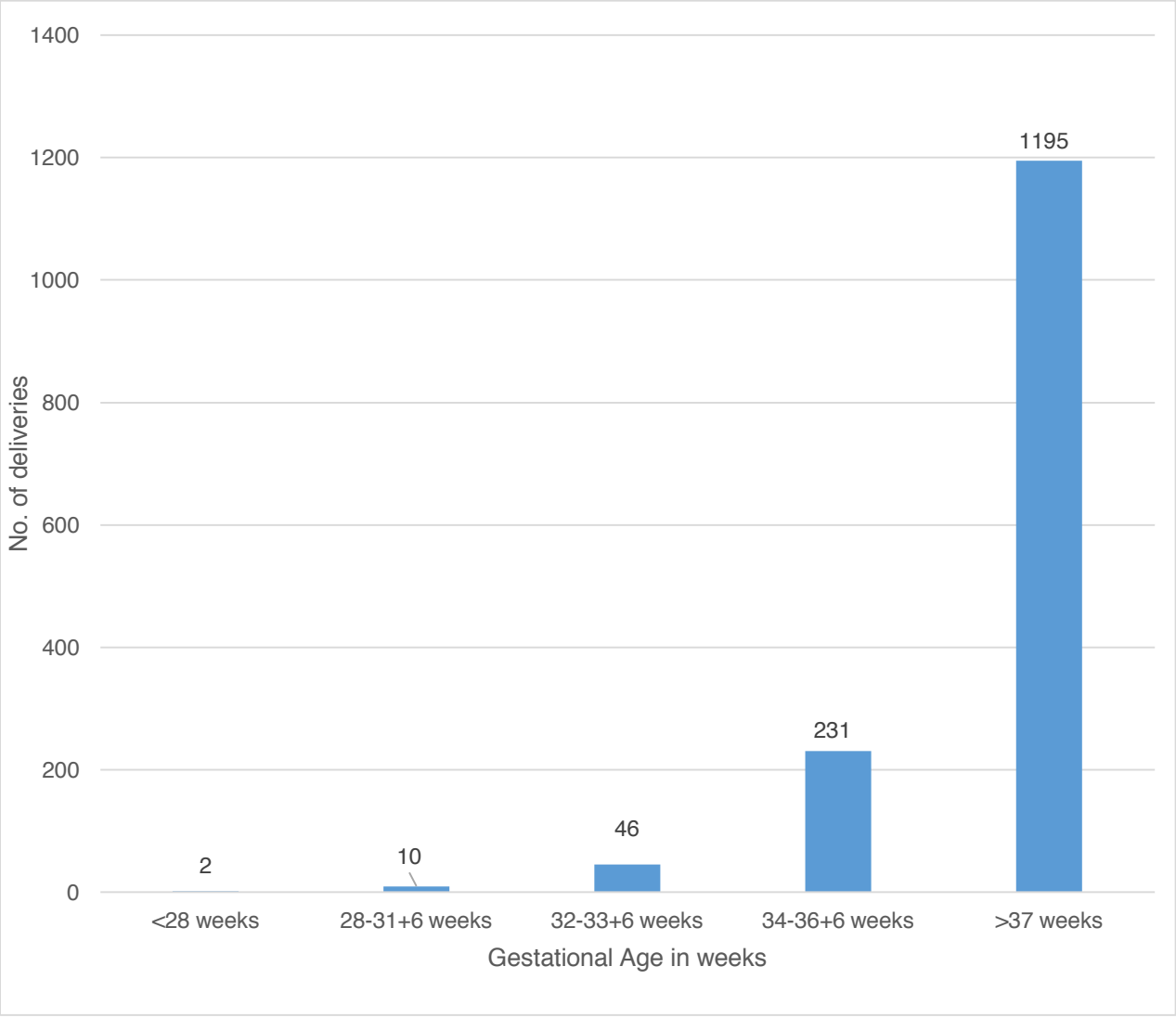
During the study period, 1st January 2016 and 31st March 2016, there were a total of 2342 deliveries. Of these, a total of 1647 folder numbers corresponded with the inclusion criteria for our study, and were collected from the MMH labour ward and theatre registers. Of these 1647 folder numbers, 162 folders were missing and thus not retrieved for data collection. One folder number was noted to be duplicated, as the patient had been recorded in both the theatre and labour ward registers having delivered twin A via normal vaginal delivery and twin B via caesarean section. This left, 1484 folders, which were retrieved and the gestational age was calculated.

Of these 1484 folders, 1253 patients were excluded, due to confirmed gestational age (GA) outside of the study criteria, and 231 patients were included. Once these folders had been identified and analysed, the corresponding paediatric folders were collected and their data documented. From the 231 patients included in the study, 251 babies were born.
Of the total 2342 deliveries, 36 (1.5%) were found to have a GA < 28 weeks (these included those that were categorised as miscarriages); 24 (1%) were between $28^{+0} – 31^{+6}$ weeks; 56 (2.4%) were between $32^{+0} – 33^{+6}$ weeks, 231 (9.9%) were between $34^{+0} – 36^{+6}$ weeks and 1833 (78.2%) had a GA above 37 weeks.

5.1 Incidence of Late Preterm Births at MMH

Of the 1484 folders collected that fit the inclusion criteria, 2 (0.1%) were found to be < 28 weeks; 10 (0.7%) were between 28^{+0} – 31^{+6} weeks; 46 (3.1%) were between 32^{+0} – 33^{+6} weeks; 231 (15.6%) were correctly categorised as between 34^{+0} – 36^{+6} weeks and 1195 (80.5%) were ≥ 37 weeks when the GA was correctly calculated. This is depicted in Figure 2.

Figure 2: Breakdown of Collected Folders into Gestational Age



5.2 Patient Demographics

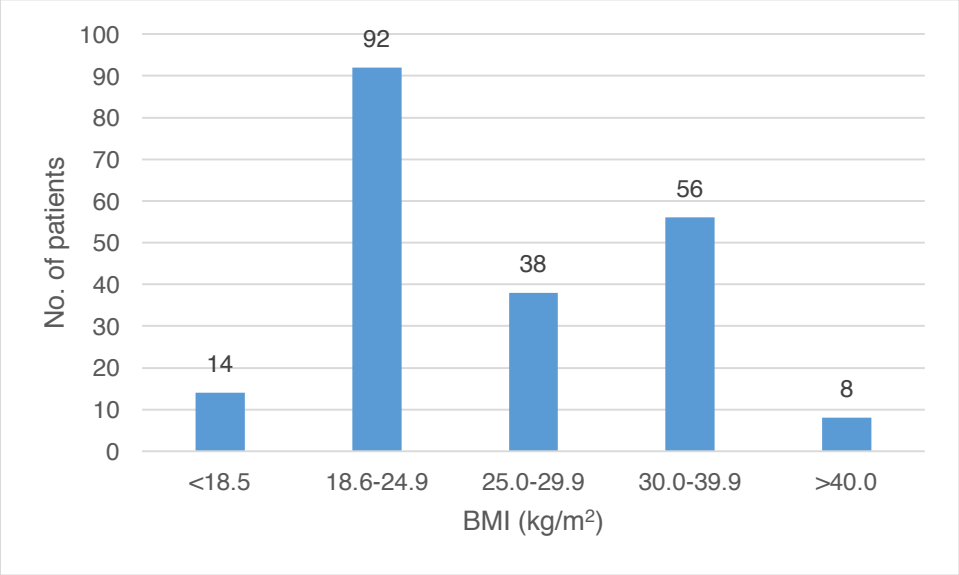
Table 1: Patient Demographics

	Minimum	Maximum	Mean	Median
Age	14	43	26.85	N/A
Gravidity	1	8	N/A	2
Parity	0	8	N/A	1
BMI (kg/m^2)	15.1	50.9	27.0	N/A

The demographics of the 231 patients included in the study are represented in Table 1. Maternal ages ranged from a minimum of 14 years to a maximum if 43 years (mean 26.8) and gravidity and parity ranged from G1P0 to G8P8.

Of the 231 patients included in the study, data for BMI calculation was collected in 208 patients (in the other folders either the height or weight were missing). BMI ranged from a minimum of 15.1 kg/m^2 to a maximum of 50.9 kg/m^2 (mean 27.0kg/m^2). Of the 208 BMI's calculated, as seen in Figure 3, 102 (49.0%) were classified into the overweight and above ranges (38 patients were overweight, 56 were obese and 8 were morbidly obese).

Figure 3: Distribution of BMI (kg/m^2)



5.3 Results from History and Previous Pregnancies

Table 2: Past Obstetric History

Characteristics, n 231	Yes, n (%)
Poor obstetric history	64 (27.7)
Previous stillborn (n64)	13 (20.3)
Previous ENND (n64)	4 (6.3)
Previous Miscarriage (n64)	31 (48.4)
T1 (n31)	27 (87.1)
T2 (n31)	4 (12.9)
Previous preterm birth	38 (16.5)
< 28 weeks (n38)	7 (18.4)
28 – 33+6 weeks (n38)	17 (44.7)
34 – 36+6 weeks (n38)	14 (36.8)
One previous PTB (n38)	23 (60.5)
Multiple previous PTB (n38)	15 (39.5)

Of the 231 patients included, 64 (27.7%) were noted to have a poor obstetric history; 13/64 (20.3%) patients had had at least one previous stillborn; 4/64 (6.3%) patients had had a previous ENND (one patient had had 3 previous ENND's and three patients had had one previous ENND); 31/64 (48.4%) patients had had a previous miscarriage (87.1% were first trimester and 12.9% were second trimester) 7 of these 31 patients had had more than one previous miscarriage, as depicted in Table 2.

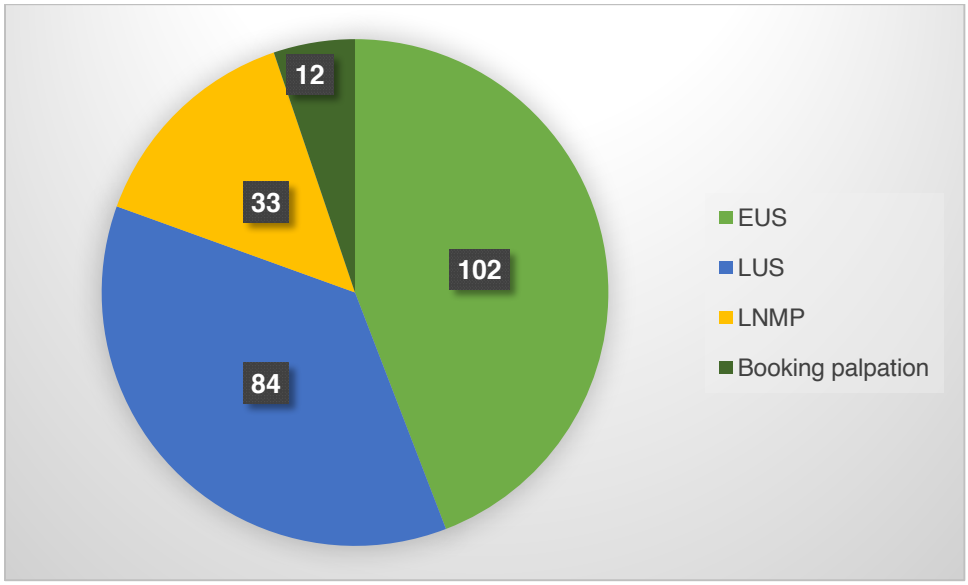
Of the 231 patients, 38 (16.5%) had a history of a previous preterm delivery (7 patients had a delivery prior to 28 weeks, 17 had a delivery between 28-33^{+6} weeks and 14 had a previous late preterm birth); 23 had one previous preterm delivery, 11 had two, 3 had three and 1 had four previous preterm deliveries, as seen in Table 2.

5.4 Results for the Index Pregnancy

Of the 231 patients included in the study, 47 (20.3%) were documented to have a GA of between 34^{+0} – 34^{+6} weeks; 81 (35.1%) were between 35^{+0} – 35^{+6} weeks and 103 (44.6%) were between 36^{+0} – 36^{+6} weeks gestation.

The above gestational ages were calculated by EUS, LUS, LNMP and booking palpation as seen in Figure 4 below. Gestational age was calculated by EUS in 44.2% of cases; LUS in 36.4 % of cases; LNMP in 14.3% of cases and booking palpation in 5.12% of cases. In 165 of the patients only one method was used/available to calculate the GA, however in 66 cases there were 2 methods used.

Figure 4: Method of Gestational Age Calculation



5.4.1 Index Pregnancy Characteristics

Table 3: Index Pregnancy Characteristics

Characteristics, n 231	Yes, n (%)
Maternal risk factor	131 (56.7)
Smoking (n131)	72 (55)
Comorbidity (n131)	18 (13.7)
Substance use (n131)	10 (7.6)
Hypertension	75 (32.5)
PET (n75)	60 (80.0)
Gestational HPT (n75)	11 (14.7)
Chronic HPT (n75)	8 (10.7
Unclassified HPT (n75)	1 (1.4)
Infection	31 (13.4)
UTI	14 (6.1)
Other (include syphilis)	12 (5.2)
Respiratory	6 (2.6)
Uterine	1 (0.4)
HIV	35 (15.2)
On treatment (n35)	34 (97.1)
Virally suppressed (n35)	
Yes	21 (60.0)
No	3 (8.6)
Unknown	11 (31.4)
CD4 count (n35)	
<250	4 (11.4)
>250	30 (85.7)
unknown	1 (2.9)
PPROM	51 (22.1)
Chorioamnionitis (n51)	1 (1.9)
IUGR	25 (10.8)
Multiple pregnancy	20 (8.7)
APH	17 (7.4%)
APHUO (n17)	14 (82.4)
Abruptio (n17)	2 (11.8)
Cervicitis (n17)	1 (5.8)

At least one maternal characteristic associated with preterm labour was seen in 131 (56.7%) of the included patients. These were divided into smoking (72/131 patients, 55%), substance use (10/131 patients, 7.6%), and comorbidities which included DM, asthma, epilepsy, thyroid disease, renal disease and one patient with ankylosing spondylitis (18/131 patients, 13.7%). Only 3 patients were documented with IGT, and none with GDM/DM, although this was not unexpected, as any patient with GDM would have been referred to GSH for tertiary level care.

Hypertension was seen in 32.5% of patients. Of these patients 10.7% were classified as chronic hypertension, 80.0% as PET, 14.7% as gestational hypertension and 1.4% as unclassified hypertension. Of the 8 patients who had chronic hypertension, 5 developed superimposed PET.

Infection as a risk factor (seen in 13.4% of patients) was categorized as uterine (0.4%), urinary tract (6.1%), respiratory tract (2.6%, mostly TB) and other (5.2%, including syphilis, herpes and cervicitis). Of the 8 patients who were documented syphilis positive, 2 were fully treated, 5 were incompletely treated and 1 was not treated at all.

HIV status was documented separately. 35 patients were documented to be HIV positive, 34 of which were on Antiretroviral treatment (ARV's). 60% of the HIV positive patients were noted to be virally suppressed, 31.4% had not yet had a Viral Load (VL) taken and 8.6% were unsuppressed. 11.4% of the positive patients had a CD4 count of less than 250.

51 of the 231 patients (22.1%) had been admitted and treated for PPROM however only 1 of these patients was thought to have chorioamnionitis. 25 of the 231 (10.8%) patients were diagnosed with IUGR and there were no infants born with congenital abnormalities.

There were 20 (8.7%) sets of twins. 10 of which delivered via vaginal delivery and 11 via caesarean section (One set of twins was delivered via NVD (twin A) and caesarean section (twin B)). 12 sets of twins presented in spontaneous labour, 5 sets were induced (monochorionic diamniotic twins, PET, PPROM) and 3 had a caesarean section prior to labour (all due to the leading twin being breech with PET or PPROM).

Of the 17 (7.4%) patients who presented with antepartum haemorrhage, 2 had an abruptio placenta, 1 was diagnosed with cervicitis and 14 had an APH of unknown origin. There were no cases of placenta praevia in our study.

5.4.2 Pregnancy Interventions

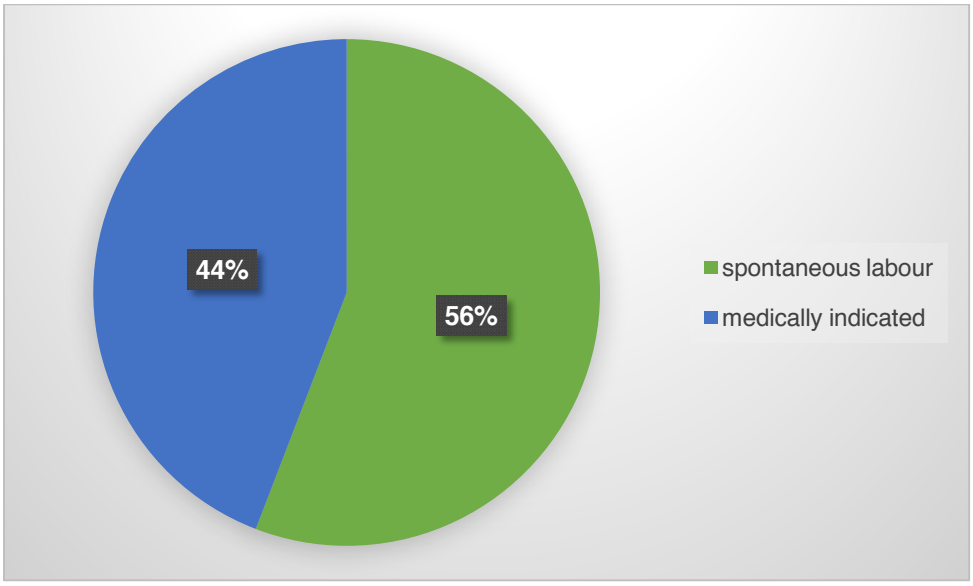
Table 4: Type of Intervention

Characteristics, n 231	Yes, n (%)
Intervention	42 (18.2)
BMZ alone (n42)	25 (59.5)
BMZ + tocolysis (n42)	17 (40.5)

As seen in Table 4, of the 231 patients, 42 (18.2%) patients had received some form of intervention in this pregnancy related to preterm labour (59.5% received BMZ only while 40.5% received BMZ and tocolysis). BMZ ± tocolysis was given to patients who had presented to MMH prior to 34 weeks, with either preterm labour, preterm prelabour rupture of membranes or preeclampsia.

5.4.3 Labour and Delivery Characteristics

Figure 5: Spontaneous and Medically Indicated Delivery



As depicted in Figure 5, of the 231 patients, 129 (55.8%) presented in spontaneous labour and 102 (44.2%) were delivered for medical reasons. Of the 102 medically initiated deliveries, 70 (68.6%) underwent induction of labour and 32 (31.4%) were delivered via caesarean section despite not being in labour for reasons that prevented an IOL/vaginal birth. Some of these reasons included breech presentation ± a previous caesarean section/PET/PPROM or PET requiring delivery in a patient with a previous caesarean section, as seen in Table 5.

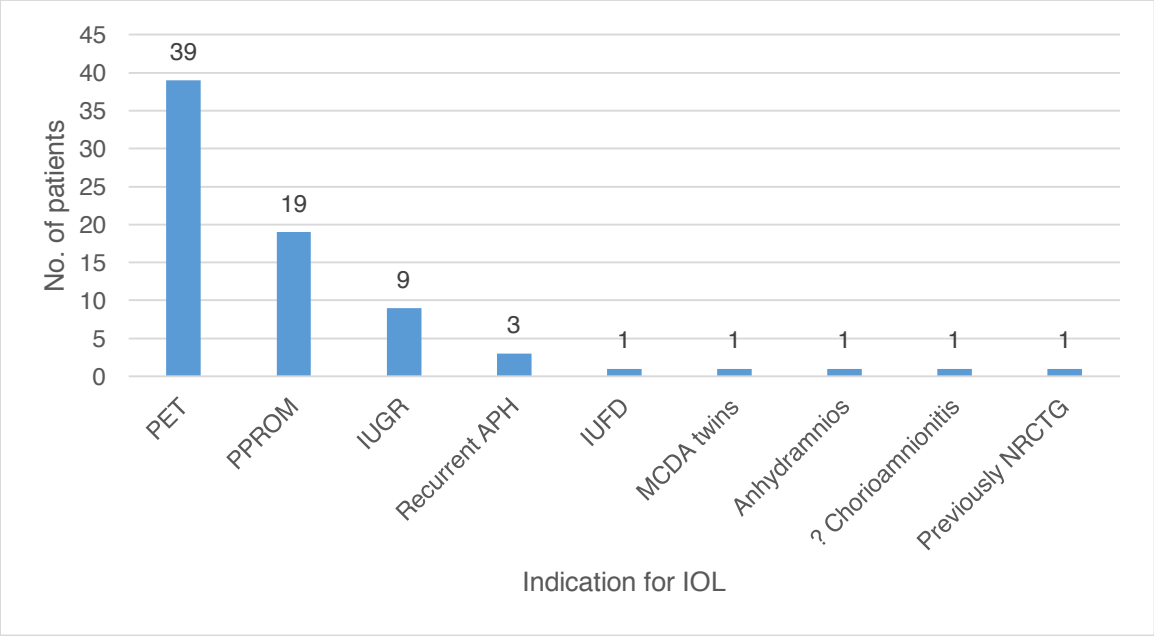
Table 5: Labour Characteristics

Characteristics, n 231	Yes, n (%)
Spontaneous Labour	129 (55.8)
Medically indicated delivery	102 (44.2)
Induction of labour (n102)	70 (68.6)
Caesarean section prior to labour (n102)	32 (31.4)

Of the 129 cases that presented in spontaneous preterm labour, an underlying cause for the preterm labour was identified in 33 cases. The causes identified were multiple pregnancy (12 patients, 9.3%), antepartum haemorrhage (4 patients, 3.1%), and PPROM (18 patients, 14.0%). No cause was found in 95 patients (73.6%).

Induction of labour was performed in 70 of the 231 cases of LPTB. Indications for induction of labour, as seen in figure 6, included PET (39 patients, 55.7%), PPROM (19 patients, 27.1%), IUGR (9 patients 12.9%), recurrent APH (3 patients,4.3%), IUFD (1 patient, 1.4%), MCDA twins (1 patient, 1.4%), anyhydramnios (1 patient 1.4%), possible chorioamnionitis (1 patient, 1.4%) and a previously NRCTG (1 patient,1.4%).

Figure 6: Indication for Induction of labour



Mode of delivery, as depicted in Figure 7, included 111 (48.0%) normal vaginal births, 8 (3.5%) assisted vaginal births (all of which were vacuum deliveries), 6 (2.6%) vaginal birth after caesarean sections, 105 (45.5%) caesarean sections, 1 (0.4%) complete birth before arrival and 1 (0.4%) vaginal breech delivery. It must be remembered when looking at the above figures, there were technically 232 deliveries as one patient had both a caesarean section and a normal vaginal delivery.

A caesarean section was performed in 105 of the 231 patients. This group includes 35 patients who presented in spontaneous labour and required an emergency caesarean section; 38 patients who underwent an IOL who required emergency caesarean section and 32 patients who had a caesarean section prior to labour for medical reasons. Indications for these medically indicated deliveries included one or a combination of, previous caesarean section (14 patients), PPROM (9 patients), fetal distress (9 patients), PET (8 patients), breech presentation (7 patients), antepartum haemorrhage (2 patients), and hypertension (1 patient).

Figure 7: Mode of Delivery

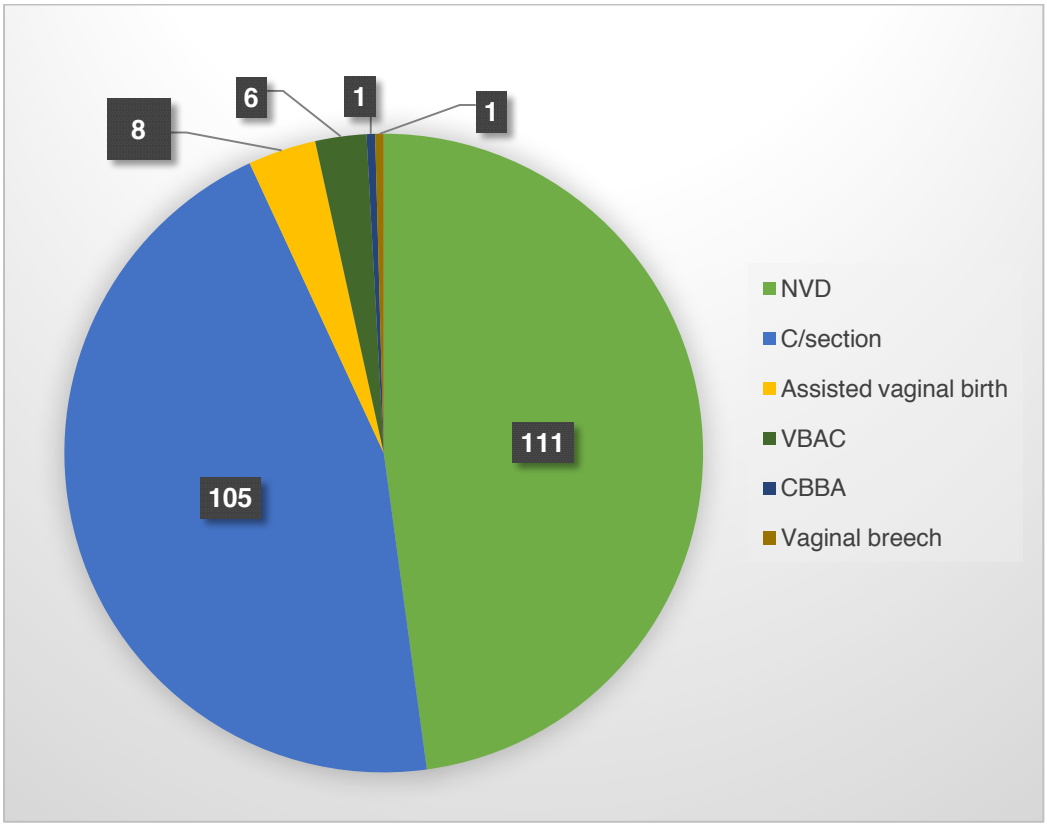


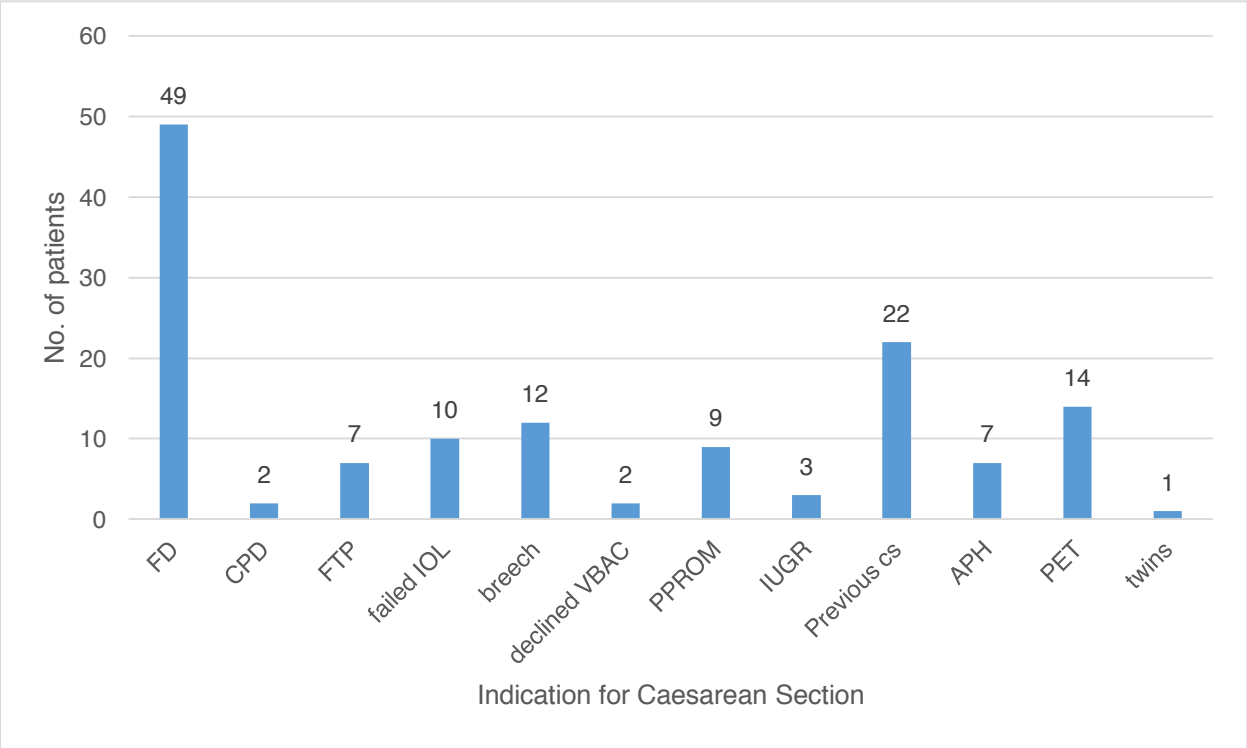
Table 6 depicts the mode of delivery in both the spontaneous labour group as well as in the patients who were delivered for medical reasons.

Table 6: Mode of Delivery in Spontaneous vs Medically Indicated Birth

	Spontaneous n 129 (%)	Medically Indicated n 102 (%)	Total n 232 (%)
Vaginal delivery	87 (67.4)	31 (30.4)	119 (51.3)
Caesarean Section	35 (27.1)	70 (68.6)	105 (45.3)
Assisted delivery	7 (5.4)	1 (1.0)	8 (3.4)

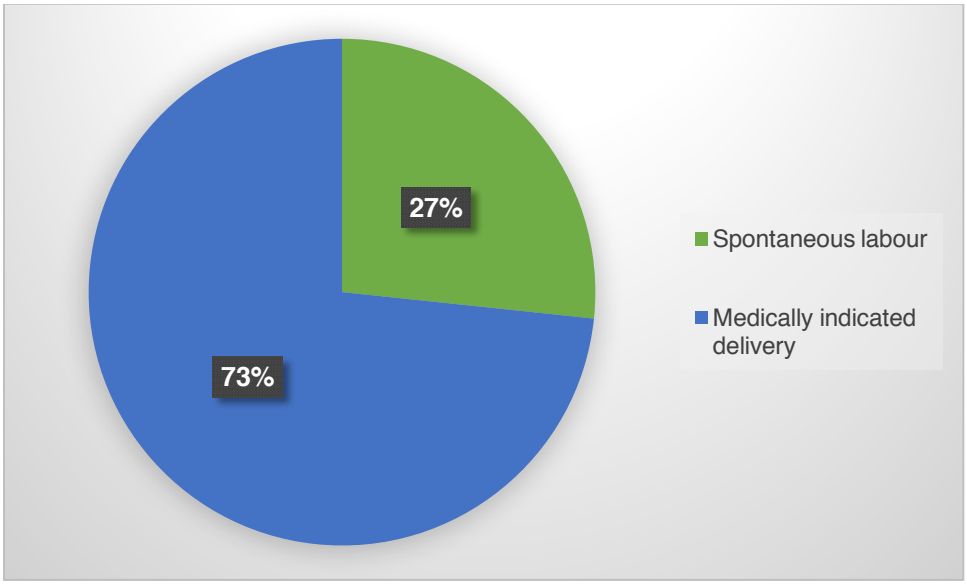
Indications for caesarean section in both the spontaneous and medically indicated groups included previous caesarean section with PPROM, breech presentation, IUGR, previous caesarean section with PET, breech presentation with PET, fetal distress, IUGR, APH, breech, and previous caesarean section with APH, as seen in Figure 8.

Figure 8: Indication for Caesarean Section



Pre eclampsia as a risk factor for medically indicated LPTB was noted to be significant, as seen in Figure 9. Of the 60 patients with PET, 16 (26.7%) presented in spontaneous labour, and 44 (73.3%) patients were intentionally delivered for PET (P value < 0.001). This equates to 12.4% of patients who presented in spontaneous labour having PET and 43.1% of patients who had a medically indicated delivery, being delivered for PET.

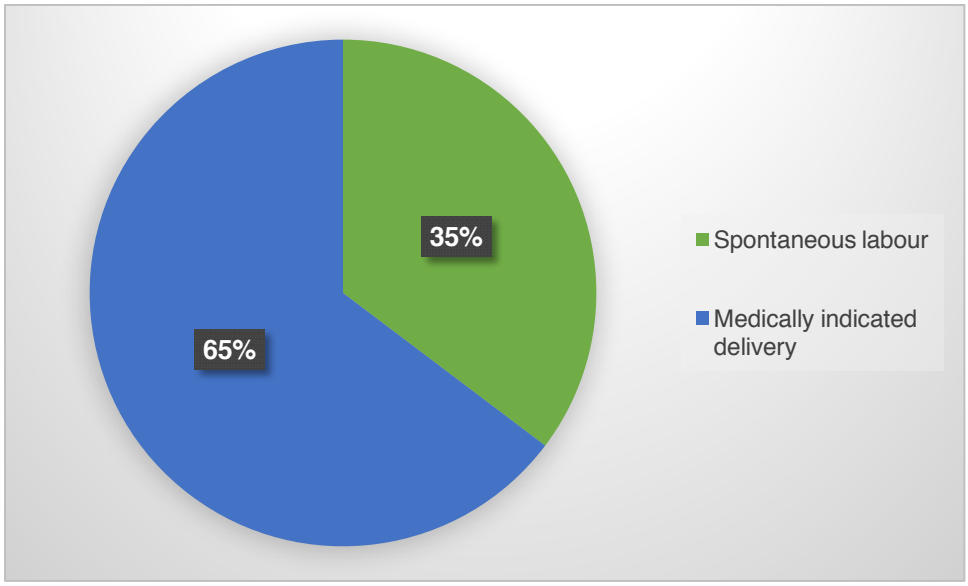
Figure 9: Incidence of PET and Mode of Labour



Of the 208 patients whose body mass index was calculated, 115 presented in spontaneous labour. The mean BMI in this group was 25.4kg/m^2. The remaining 93 patients were delivered for medical reasons, either via induction of labour or caesarean section, and they had a mean BMI of 29.0kg/m^2 (P value 0.009).

As depicted in Figure 10, preterm prelabour rupture of membranes was seen in a total of 51 of the study patients. Of these 51 patients, 18 (35.3%) presented in spontaneous labour and 33 (64.7%) underwent a medically indicated delivery, either for PPROM alone or for a combination of reasons, such as PPROM and fetal distress. Preterm prelabour rupture of membranes accounted for 14.0% of the total spontaneous labours and 32.4% of the total medically indicated deliveries (19/70 induced labours and 14/32 patients delivered prior to labour).

Figure 10: Incidence of PPROM and Mode of Labour

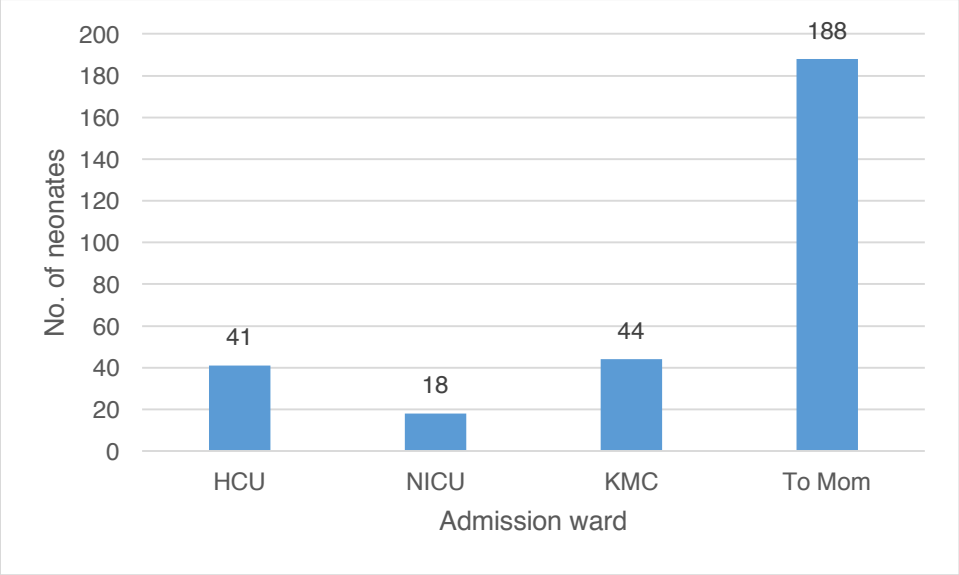


5.5 Results for Neonatal Outcomes

There were 231 patients included in the study with 20 sets of twins, which translates to 251 newborns being included in the study. Of these 251 newborns, 250 (99.6%) were born alive, with 1 ENND (died on day 2 of life secondary to MRSA/IVH/HMD) and 1 macerated stillborn. The average birthweight in the study was 2507.7g.

Newborns were documented to have either been admitted to the Neonatal High Care Unit (HCU), the Neonatal Intensive Care Unit (NICU) or the Kangaroo Mother Care Unit (KMC) or were well enough to go to the ward with their mother, as seen in Figure 11.
Of the 251 newborns, 63 (25.1%) were admitted to at least one of the neonatal wards during their hospital stay, many were admitted to at least two different wards. Of these, 64.1% spent time in the HCU, 28.1% spent time in the NICU and 68.8% spent time in KMC (majority of these newborns had been in either HCU or NICU prior to KMC).

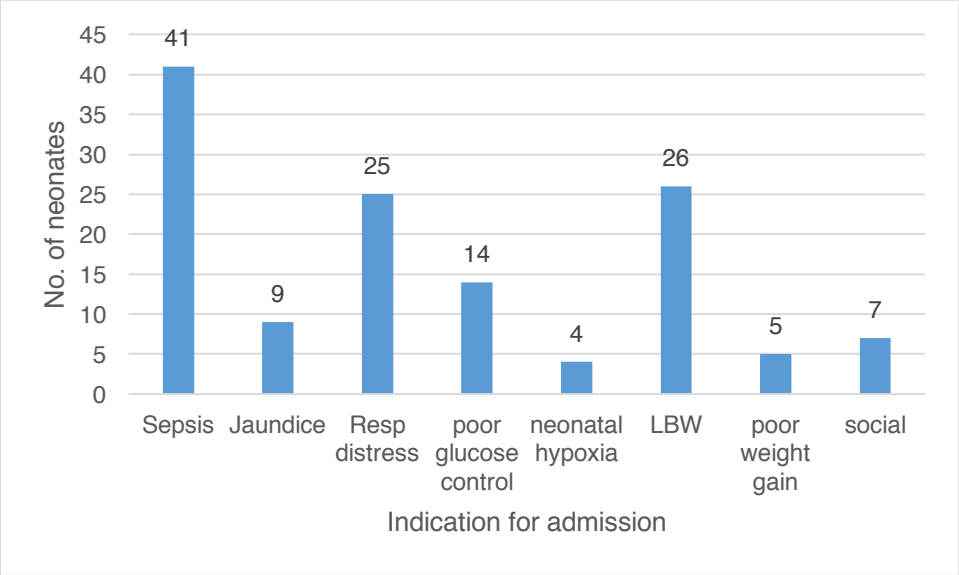
Figure 11: Neonatal Admission Status



Reasons for admission, as depicted in Figure 12, included one or a combination of reasons. 41 newborns were admitted and worked up or treated for sepsis, 9 newborns were admitted for jaundice, 25 were admitted for some form of respiratory distress, including respiratory distress

syndrome and the need for CPAP, 14 were admitted for poor glucose control, 4 were admitted for suspected neonatal hypoxia, 26 were admitted due to low birth weight, 5 were admitted for poor weight gain, and 7 were admitted for social reasons, such as maternal substance abuse and adoption.

Figure 12: Reasons for Neonatal Admissions



It was also documented if newborns who had been sent to the wards with their mothers had any complications requiring treatment. 188 neonates were documented to be well enough to go to the maternal wards post delivery. Of these neonates, 63 required additional medical care as follows: 24 were treated for neonatal jaundice requiring phototherapy, 23 required top up feeds for low visidex readings, 24 neonates were worked up for possible sepsis and received antibiotics, 7 neonates were kept in the ward and monitored closely for poor weight gain/ excess weight loss, and 3 neonates were worked up for other reasons such as low platelets and possible Downs Syndrome.

Ballard scores, as seen in Figure 13, were calculated for 202 of the 251 neonates. 49 scores were not done. 20 scores were documented as being consistent with a term neonate, but with no numerical number given to specify gestational age. Of the 182 Ballard scores that were

calculated, in the LPTB group, 102 (56.0%) scores documented the neonate as ≥ 37 weeks i.e. term, leaving 80 (44.0%) neonates that were scored correctly as late preterm deliveries.
In this category, the 20 sets of twins were scored as the same gestational age and therefore the numbers have not been duplicated.

Figure 13: Ballard Scores

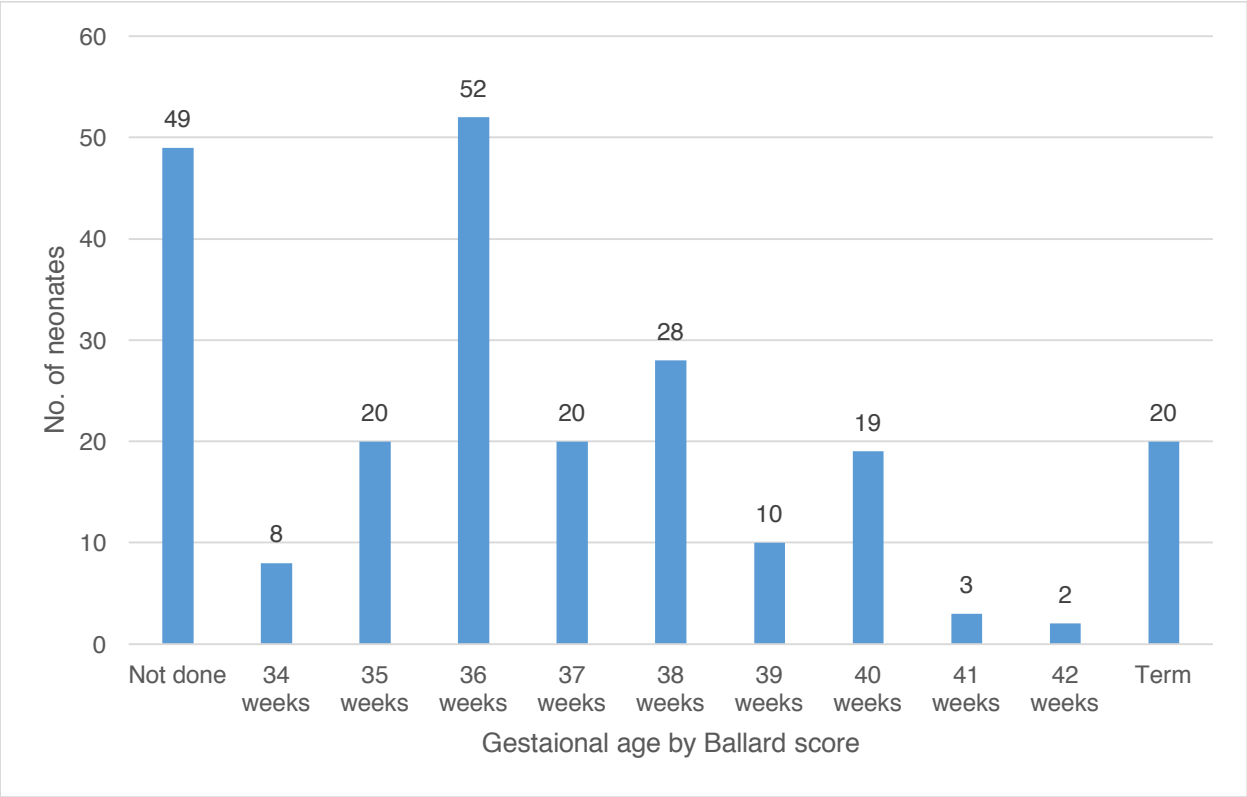


Table 7: Gestational Age by Ballard Score Vs Gestational Age by Documented Means

	Ballard Scores									
	34	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**Term**
34-34+6	5	8	15	5	3	2	2	0	0	3
35-35+6	2	11	22	8	9	4	4	1	1	7
36-36+6	1	1	15	7	16	4	13	2	1	10

The above Table, number 7, demonstrates each gestational age category calculated by

EUS/LUS/LNMP/booking palpations and how each patients Ballard score compares.
On discussion with a subspecialist neonatologist, we allocated the Ballard scores that were documented as 'term' to the 38 week category, for the purpose of working out correlations.

Table 8: Correlation Between Ballard Score and Method of Gestational Age Calculation

	Total Number	Correlation
Total	182	0.37
EUS	84	0.48
LUS	66	0.42
LNMP	22	0.45
Booking SFH	10	0.13

Of the 182 neonates that had documented Ballard scores, the corresponding gestational ages were calculated by the following: 84 by EUS, 66 by LUS, 22 by LNMP and 10 by booking palpation.
The overall correlation, as seen in Table 8, between gestational age calculated by EUS/LUS/LNMP and Ballard score was calculated as 37%.

The average length of stay in the hospital for the newborns, whether admitted or with mom, was 4.96 days, the earliest discharge being on day 0 of life and the longest admission being 42 days.

Table 9: Neonatal Outcomes in Spontaneous vs Medically Indicated Births

	Spontaneous N=129	Medically indicated N=102	Total n (%)
SB/ENND	0	2	2
Ballard GA ≤ 36+6	36 (45%)	44 (55%)	80 (100%)
Ballard GA ≥ 37	57 (55.9%)	45 (44.1%)	102 (100%)
Admission to nursery	26 (41.3%)	37 (58.7%)	63 (100%)
Further treatment on ward	32 (50.8%)	31 (49.2%)	63 (100%)

Table 9 above depicts the neonatal outcomes in the spontaneous vs the medically indicated delivery groups. Of the 63 neonates admitted to a neonatal ward, 37 of these were delivered for a medical reason, while 26 of the 63 neonates admitted had presented in spontaneous labour. Of the neonates admitted to the maternal wards with their mothers an equal number of the neonates delivered spontaneously and for medical reasons required further treatment in said ward (32 vs 31 respectively). Considering the 129 women with spontaneous labour, 27.9% had a Ballard score $\leq 36^{+6}$ weeks, 20.2% were admitted to the nursery and 24.8% were treated in the ward. This compares with the women with medically indicated delivery for whom 43.1% women had a Ballard score $\leq 36^{+6}$ weeks, 36.3% were admitted to nursery, and 30.4% required treatment in the ward.

6. Discussion

6.1 Incidence

There is a scarcity of literature that states the possible incidence for LPTB as an entity but rather more information on the rates of LPTB as a percentage of preterm birth in general. Rates of preterm birth have been said to be highest in low-income countries accounting for 11.8% of births (2). LPTB's account for the largest proportion of births among preterm deliveries (70-74%)(3, 22). During our study period, there were a total of 2342 deliveries at Mowbray Maternity Hospital, of which LPTB accounted for 9.9%. Of these 2342 deliveries 347 (14.8%) deliveries were classified as preterm (<37 weeks) and the LPTB's accounted for 66.6% of these preterm deliveries, which is in keeping with the literature. It must, however, be noted that our study was not aimed at calculating the percentage of preterm births that LPTB accounted for but rather to look at the burden of LPTB at MMH, and so exact data on all preterm deliveries was not collected, and the few miscarriages that occurred at MMH were included in the delivery numbers.

6.2 Patient Demographics and Risk Factors

A history of previous poor obstetric outcome or previous preterm deliveries is an important detail to capture at the start of any new pregnancy, as it may give an indication as to what previous causes were and whether it can be prevented in the index pregnancy. Of the 231 patients in this study 64 (27.7%) had a history of a previous poor outcome, and 16.5% had a previous preterm delivery. This is in keeping with results seen in a study done in Malawi where patients with preterm births reported a previous preterm delivery in 19.1% of cases vs 6.1% of patients with a term birth (46). Another study conducted in Canada found that 17.4% of patients with preterm deliveries had had a previous preterm birth (31).

Obesity is a growing concern in not only South Africa but across the world and is now said to be one of the most common complications of pregnancy in both developed and developing countries (47). Body mass Index (BMI) was calculated in 208 of the included patients in this study, 49% of these patients were classified into the overweight and above ranges.
Literature with regards to the impact of weight on preterm deliveries is conflicting. A study done

in Malawi by Van Den Broek et al (2013) found an association between low BMI and reduced weight gain, and preterm delivery. They stated that the odds of preterm delivery increased with a BMI < 18.5 at booking and that the odds of a late preterm birth decreased if the patient increased her BMI during pregnancy (46). On the other side of the spectrum a systematic review done by McDonald et al (2010) to "determine the relation between overweight and obesity in mothers and preterm birth" found that "overweight and obese women have an increased risk of preterm birth before 32 weeks, induced preterm birth before 37 weeks and accounting for publication bias, preterm birth before 37 weeks overall" (47). The findings in our study are in keeping with this latter study, as the mean BMI was significantly higher in the patients who were delivered for medical reasons. This is to be expected as a raised BMI is associated with a higher incidence of chronic diseases such as hypertension and diabetes mellitus.

Maternal weight is an independent risk factor for preterm birth and something that can potentially be modified during and before pregnancy to decrease the incidence of preterm deliveries.

Smoking is another potentially preventable risk factor that has a well-known association with extreme prematurity. Recent studies have also shown that a lifestyle of smoking and substance abuse increases the risk of LPTB as well as extreme prematurity (48). In our study, there were 82 (35.5%) patients who were known to smoke or use substances such as alcohol. This is a substantial proportion of patients and an area of concern not only because of the risk of LPTB but also because of the health risks to both mother and child.

6.3 Index pregnancy

When analyzing preterm births it is important to ensure that the gestational ages are calculated correctly. It is said that ultrasound is the most accurate method for pregnancy dating if done early in the pregnancy but becomes more unreliable as gestational age increases. Newer studies have, however, shown that even late ultrasound (> 24 weeks) is more accurate than other methods of dating a pregnancy such as last normal menstrual period and measurement of symphysis fundal height (33). In this study, 80.5% (44.2% had EUS and 36.4% had LUS) of patients had had an ultrasound scan in this pregnancy. This data is encouraging as it shows that a large proportion of patients are undergoing ultrasounds in their pregnancies which ensures accurate dating and planning for the duration of the pregnancy as well as the delivery. Booking palpation was used to

date only 5.2% of the pregnancies included in this study, which has been shown to be the least accurate dating method (33) especially in our population where obesity is of growing concern.

We decided to include twin pregnancies in this study as it is well known that a twin pregnancy is at greater risk of preterm birth, and up to 50% deliver prior to 37 weeks gestation (49, 50). Twins account for between 2-3% of all births (49) and in our study there were 20 sets of twins which accounted for 8.7% of the deliveries in the study, which is a significant proportion. The management of twins is complicated and depends on the chorionicity and well-being of each twin. It has been shown that dichorionic twins have a similar stillbirth risk at 38 - 39 weeks as post term singleton pregnancies (51) and this is the basis for early elective delivery of twin pregnancies. The NICE guidelines recommend that women with uncomplicated dichorionic twin pregnancies are electively delivered from 37^{+0} weeks and that uncomplicated monochorionic twin pregnancies are electively delivered from 36^{+0} weeks, in order to reduce the increased risk of fetal death.

Of the 20 sets of twins in our study, 12 presented in spontaneous labour and 8 were delivered for medical reasons. It would stand to reason that delivering 8 sets of twins prior to 37 weeks goes against the recommended management of twins, however 7 of these deliveries were undertaken for medical reason such a PROM, PET and concern for the fetal well-being i.e. IUGR and only one was done for the sole reason of being a monochorionic diamniotic twin pregnancy, as per the guideline.

One of the main objectives of this study was to look at the proportion of LPTB's at MMH that were spontaneous versus iatrogenic. We felt that this would be important as it has been noted that the rates of preterm births may be increasing because of an increase in "provider-initiated" births as stated in one of the components of the "Born Too Soon" report. This report states that the described proportion of preterm births in low to middle-income countries that are said to be provider-initiated "ranged from 20% in Sudan and Thailand to nearly 40% in Latin America and Ghana" (2). This latter percentage is in keeping with what we found in our study, with medically indicated deliveries (including IOL and caesarean section prior to labour) accounting for 44.2% of the LPTB's at MMH. It must, however be remembered that this study only looked at the births

at MMH and did not include the possible spontaneous LPTB that may have occurred at the Midwife Obstetric Unit's prior to transfer or the LPTB's referred directly to GSH (e.g. abruptio IUFD's) and therefore the number may be skewed.

In our study, 129 (55.8%) patients presented in spontaneous labour, a possible cause for which was only found in 33 cases. These possible causes included multiple pregnancy, as discussed above, antepartum haemorrhage (4 patients) and preterm prelabour rupture of membranes (18 patients). No cause was found in 74.4% of patients, and even though this is in keeping with the literature it is disappointing as when there is no cause to correct we are unable to prevent preterm delivery in the future.

PPROM is associated with 40% of preterm deliveries (34) and is one of the commonest reasons for IOL after 34 weeks. The RCOG Green-top Guideline on the management of preterm prelabour rupture of membranes suggests that in patients greater than 34 weeks with PPROM delivery should be considered due to the risk of chorioamnionitis (34) and this is the basis for management of PPROM at MMH. However, the evidence is conflicting and many sources are now arguing that conservative management, under the right circumstances, should be undertaken. A Cochrane looking at "planned early birth versus expectant management for women with preterm prelabour rupture of membranes prior to 37 weeks gestation for improving pregnancy outcome" did not conclusively find that immediate induction of labour for PPROM after 34 weeks gestation presented any reduction in neonatal sepsis (52).
32 patients in our study who were delivered intentionally had PPROM (19 were induced and 14 were delivered via caesarean section). This accounts for 31.4% of our medically indicated preterm births. This is an area that could be reevaluated and possible new protocols instated in order to reduce the burden of LPTB.

Another important indication for medical delivery was Pre eclampsia. The incidence of PET was statistically higher in the patients who were delivered intentionally vs those that presented in spontaneous labour (73.3% vs 26.7%, $P < 0.001$). This is to be expected as the complications of PET in pregnancy are well documented and guidelines recommend delivery after 34 weeks if possible (36). At MMH intentional delivery of late preterm infants is part of many protocols

regarding management of certain pregnancy complications. For example, patients who have confirmed pre eclampsia (raised blood pressures with a significant daily urinary protein of > 0,3g/dL) are electively delivered at 34 weeks gestation due to the risk of poor outcomes for both mother (eclampsia and HELLP) and infant (placental insufficiency and intrauterine death) should the pregnancy be continued. Another example would be the elective delivery of infants with intrauterine growth restriction (< 3rd centile) despite normal amniotic fluid indeces and dopplers due to the risk of fetal demise. The elective delivery of these infants and the possible increase in burden of work and on resources needs to be carefully balanced against the possible risks associated with continuing the pregnancy. These decisions are not made lightly and are made by senior clinicians with consent from the mothers.

6.4 Neonatal outcomes

A lot has been said about the antenatal methods of determining gestational age such as EUS and LMNP, however we also looked at the postnatal gestational age scoring system: the Ballard score. This is a score used by neonatologists, which considers the clinical assessment of the infants physical and neurological maturity when deciding on a likely gestational age. We documented the gestational ages calculated by antenatal means and the corresponding Ballard Score to see if there was any correlation.

In our study, there were 182 neonates that had a documented score. None of the study neonates were scored below 34 weeks but many were often scored above the calculated gestational age, with 5 neonates being said to be above 41 weeks gestation. Even though the range was varied the overall correlation of 37%, was significant. This is not in keeping with a study done in Gambia that demonstrated that gestational age assessments derived from Ballard scores compared poorly to EUS (53).

The wide variety in scores seen in our study may be explained by the fact that they are often calculated by junior doctors and this may account for some of the errors.

Of the 182 patients who had a Ballard score 102 (56%) were scored ≥ 37 weeks and thus were not technically LPTB. This proportion was greater in the spontaneous labour group, who also had less admissions to nursery and less treatment. The medically indicated delivery group where delivery was planned were likely to have had more accurate GA assessment than the women who arrived in spontaneous labour.

A large study done in Turkey which looked at > 18 000 admissions to the NICU found that 30 % of LPT infants were admitted, either due to respiratory distress (46.5%), low birth weight (17.5%), jaundice (13.7%), feeding difficulties (13.1%), polycythaemia (8.1%) and hypoglycaemia (4%) (54).

In our study, 63 (25.1%) out of the 251 newborns were admitted to a neonatal ward (not only NICU), 51 of which were admitted to either the NICU or HCU, which accounts for 22.1% of LPTB's at MMH. Of these 63 admitted neonates, 37 (58.7%) were delivered via a medically initiated delivery. Since this study only looked at LPTB and did not have a control for term infants we are unable to say whether these admission numbers are significant or not. We are also unable to exclude for bias with regards to whether these infants are being admitted solely for reasons associated with prematurity or whether the indication for delivery, such as PPROM, and possible neonate sepsis was the reason for admission.

This number may be lower than that found in the literature since many of our newborns who require additional medical care (such as phototherapy and antibiotics) receive this care in the wards with their mothers. Due to severe bed constraints newborns with minor medical conditions, that can be seen daily by neonatal doctors and treated in the maternal wards, board in with their mothers. At MMH newborns who are not overtly septic are worked up and receive antibiotics in the maternal wards, if they become unwell or require closer observation they are only then admitted to a neonatal ward. Phototherapy is also often administered in the maternal wards with portable lights.

188 newborns in our study were thought to be well enough to go to the maternal wards with their mothers. Of these 188 newborns 63 required additional medical care. Therefore, if we take into consideration both the groups of newborns, the 63 that were admitted and the 63 that received medical care in the wards, 50.6% of the LPTB newborns at MMH required medical care and may have been admitted to a neonatal unit in a higher socio-economic country.

Considering the 129 women with spontaneous labour, 27.9% had a Ballard score ≤ 36^{+6} weeks, 20.2% were admitted to the nursery and 24.8% were treated in the ward. This compares with the women with medically indicated delivery for whom 43.1% women had a Ballard score ≤ 36^{+6} weeks, 36.3% were admitted to nursery, and 30.4% required treatment in the ward.

A large study done in 19 USA hospitals showed 10.5% of late preterm infants were admitted with respiratory complications compared to 1.13% of term infants (29). Another study presented that 8% of LPTB were admitted for respiratory complications (26), both of which are in keeping with our data, as 9.9% of the LPTB at MMH were admitted for some form of respiratory complication.

The most common reason for admission found in our study was sepsis, or septic workup, accounting for 64.1% of admissions. Sepsis or infection is not commonly mentioned in the literature as a separate cause for admission but rather causes of infection, such a pneumonia, are categorized under respiratory cause etc. One study showed that late preterm births had an odds ratio of 6.23 of developing pneumonia compared with term births (8). Another study that looked at infection in Late Preterm infants in Italy, showed that the incidence of infection was 16.6% in their study population (55).
Low birth weight (LBW) was another common indication for admission, accounting for 40.6% of admissions. This is considerably higher than seen in the literature

A study conducted in India including >4000 newborns, showed that of the newborns admitted for jaundice, 41.6% were late preterm infants compared to 15.3% term infants.
Late preterm infants were also more likely to develop hypoglycaemia than term infants, with rates of 16% and 6,5% in the respective groups (30). In our study, we found that jaundice accounted for 22.0% of admissions and 34.1% were admitted for poor glucose control. It must however also be remembered that another 24 newborns were treated with phototherapy in the maternal wards making a total of 13.1% of all newborns that required treatment for jaundice.

In our study, we found that LPTB was more common with female infants (51.4%) than with male infants (48.6%). This is not in keeping with the numbers stated in the “Born Too Soon: The global epidemiology of 15 million preterm births” documents published in 2013, where they state that preterm birth is more common in boys accounting for approximately 55% of preterm births (2).

An important aspect to consider when looking at burden of disease on the hospital and its

resources is the number of days the newborns are staying in hospital. In the United States of America the average length of stay for a preterm newborn is 13 days compared to 1.5 days for a term newborn (4). In a study done in Turkey the overall mean for hospital stay was 7.5 ± 9.1 days (54). In our study, we found that the average length of stay was 4.96 days (ranging from 0 days to 42 days). This is considerably shorter than that stated for the USA however, our data only includes LPTB's. It would be interesting to consider the different criteria used in South Africa compared to the first world countries, that are used when discharging newborns from the hospital. Perhaps due to bed constraints and resource limitations we are less stringent with discharge criteria.

6.5 Limitations

One of the greatest limitations of this study was the missing folders. Of the 1647 folder numbers that were collected that fit the initial retrieval criteria, 162 folders were missing. These missing folders were either not found in the records department or they had been transferred to another hospital with the patient. These were 162 potential Late Preterm Births which could have added value to the data collected.

Another limitation to note is that the LPTB figures and statistics are MMH specific and do not represent the entire Metro West population, this is because some late preterm births may have occurred at the surrounding MOU's (prior to transfer to MMH) or at the tertiary level hospital, for example abruptio IUFD's which are transferred to GSH as per protocol.

As this is a retrospective descriptive study that looked only at the LPTB group and did not include a control group, we were unable to compare LPTB with term births and therefore can only describe factors associated with LPTB and not specific risk factors.

A study that is based upon the gestational age of a population is reliant on accurate gestational age calculation. This is a limitation in our population as many patients present late and therefore do not receive early ultrasound scans to accurately date the pregnancy.

One of the objectives of this study was to determine the burden of LPTB on the obstetric and

neonatal facilities. We could give a description of the LPT newborns and their reasons for admission however we are unable to determine if these admission indications were based solely on the prematurity of the newborn or whether they were confounded by underlying pathology such as PPROM or PET.

6.6 Recommendations

After completing this study, we can see that LPTB is an important aspect of both the obstetric and neonatal workings at MMH, however it would be recommended to do further studies on all births at MMH to compare the indications and underlying pathology for LPTB vs term deliveries. This would give a better indication of the true burden on the resources.
It would also be of interest to look at a longer period to gauge whether medically indicated deliveries are in fact increasing at MMH, and if so whether they can be reduced. This would require doing further studies into the already existing protocols that govern our management of certain medical conditions in late preterm pregnancies.

7. Conclusion

Late Preterm Birth accounts for 9.9% of all births and 66.6% of preterm births at Mowbray Maternity Hospital. This is a substantial proportion of Mowbray Maternity Hospital births putting pressure on already strained resources. This pressure is confounded by the fact that 25.1% of these neonates are admitted to a neonatal ward. 44.2% of these births are medically initiated and this should give cause for thought as to whether our protocols that govern certain medical conditions in pregnancy could possibly be altered to prolong pregnancies and reduce the incidence of Late Preterm Birth. Having said this, protocols are in place to prevent adverse pregnancy outcomes and continuing a pregnancy with a confirmed medical complication, to reduce the incidence of late preterm birth needs to be carefully considered, keeping those possible adverse outcomes in mind. When considering to deliver or not, we must also take into consideration the fact that, yes, late preterm infants increase the burden on resources but as seen in this study, the average hospital stay was not particularly long and majority of these infants did well, with very high survival rates.

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9 Appendices

9.1 Appendix A: Metro West Referral Criteria

METRO WEST REFERRAL CRITERIA FOR MOU's & MOU SUPPORT: ANTENATAL, INTRAPARTUM & POSTPARTUM

CONTENTS

1. ADMISSIONS

1.1. The Groote Schuur Hospital Maternity Centre admits all tertiary care patients.
1.2. Patients requiring transfer from an MOU for secondary level care will usually be referred/admitted to the appropriate referral hospital as follows:

• False Bay Hospital • Retreat MOU • Guguletu MOU • Mitchells Plain MOU • Liesbeeck MOU	→	Mowbray Maternity Hospital (MMH)
• Hanover Park MOU • Vanguard MOU • Westfleur Hospital • Vredenburg Hospital	→	New Somerset Hospital (NSH)

1.3. Admissions must be arranged with the Registrar on call for the particular referral hospital. If this is NSH or MMH, and further referral to GSH is required, this must be arranged by the Registrar at these hospitals.
1.4. The mode of transport (ordinary, urgent or Flying Squad) should be determined:

- By the registrar at the referral hospital.
- IF Flying Squad is required, this must be arranged by the base hospital doctor or sister, and this must be done through the B Side Registrar at GSH- Labour Ward.

2. REFERRAL TO HOSPITAL FOR ANTENATAL CARE DIRECTLY AFTER BOOKING OR WITH NEW PROBLEM

No need for patient to be seen by a doctor prior to referral:

- Phone GSH on 021-4046005 or 021-4044495 to make ANC appointments.
- For MMH, refer on the appropriate day (Tel: 021-6595916).
- For NSH, phone 0214026454.

2.1 Medical Conditions:

- Cardiac:
  - Known cardiac condition → GSH
  - Known valve replacement → GSH
- Diabetes:
  - Known diabetes on treatment → GSH
  - Abnormal GTT in current pregnancy → referral hospital
- Previous DVT or pulmonary embolus → GSH
- Previous cerebrovascular accident "stroke" → GSH
- Anaemia: Booking Hb< 8 g/dl → referral hospital

- Hypertension:
  - Previous early onset GPH < 32 weeks → GSH
  - Previous eclampsia → GSH
  - Previous GPH plus abruptio placentae + IUD → GSH
  - Previous abruptio placenta/live baby → referral hospital
  - Chronic HPT on treatment → referral hospital/GSH
- Thyroid disease: hyper or hypothyroidism → GSH
- Renal disease: known or transplant → GSH
- Collagen vascular disease e.g. SLE → GSH
- Myasthenia gravis → GSH
- Haematological disorder e.g. haemophilia→ GSH
- Inflammatory bowel disease → GSH
- Severe kyphoscoliosis→ GSH
- RVD, kaposi's sarcoma → GSH

2.2 Rhesus Disease:

- Rhesus negative plus antibodies → GSH
- All atypical antibodies → GSH

2.3 Previous Poor Obstetrical Outcomes:

- ≥ 3 consecutive first trimester losses immediately preceding the present pregnancy and if patient is less than 16 weeks pregnant → GSH
- ≥ 2 second trimester losses in the 2 most recent pregnancies and if the patient is less than 28 weeks pregnant → GSH
- Previous stillbirth, neonatal death, birth asphyxia and previous T2 loss x1 in recent pregnancy → referral hospital
- Previous congenital abnormality, history of genetic disease and if patient is less than 22 weeks pregnant → GSH Wednesday am clinic

2.4 Maternal age > 38 years:

- If < 22 weeks pregnant → GSH Wednesday Genetic Screening Clinic
- If < 13 weeks pregnant → book NT SCAN at GSH

2.5 Twins in current pregnancy, as soon as diagnosis made → referral hospital
2.6 Fetal anomaly in the current pregnancy → GSH Wednesday Fetal Medicine Clinic
2.7 Substance abuse:

- Heroin/opiate addiction → GSH
- Other substances → Doctors Clinic MOU

3. REFERRAL TO DR'S CLINIC AT MOU: ASAP

3.1 If uncertain if patient fits any of previous criteria
3.2 Previous hypertension at term
3.3 Previous gestational diabetes *(do GTT before Drs clinic)*
3.4 Previous low birth weight baby
3.5 Previous preterm labour < 34 weeks *(send MSU)*
3.6 Suspected IUGR in current pregnancy *(organise USS)*
3.7 Uncertain about presentation *(organise USS)*
3.8 Large for Gestational Age/ suspected polyhydramnios *(organise USS)*
3.9 Suspected prolonged pregnancy (> 41 weeks)
3.10 Age < 18 years
3.11 Asthma on treatment
3.12 Epilepsy
3.13 Complicated HIV
3.14 BMI >40 *(organise GTT and USS)*
3.15 Urinary tract infection not responding to first line treatment

3.16 Vaginal discharge not responding to first line treatment
3.17 Abnormal PAP smear
3.18 Known or suspected mental health problem
3.19 Substance abuse other than heroin/opiate addition (e.g. Tik, Cocaine, Mandrax, Dagga)
3.20 Unsure gestational age

4. REFERRAL TO APPROPRIATE REFERRAL HOSPITAL AT 36 WEEKS AND SUBSEQUENT DELIVERY

4.1 Breech presentation or other malpresentation→ referral hospital
4.2 Previous Caesarean Section → referral hospital *(NB: Must have USS at booking)*
4.3 Parity > 4 *(can be referred at 38 weeks)*
4.4 Patients with known epilepsy on treatment *(can be referred at 38 weeks)*
4.5 Patients with chronic asthma on treatment *(can be referred at 38 weeks)*
4.6 Previous inverted uterus *(can be referred at 38 weeks)*
4.7 Previous PPH *(can be referred at 38 weeks)*

5. IMMEDIATE REFERRAL TO REFERRAL HOSPITAL FOR ANTENATAL ADMISSION WITH ANTENATAL COMPLICATION

Discuss with registrar at referral hospital who will liaise with B Side registrar if patient needs urgent referral to GSH.

5.1 Eclampsia (Flying Squad) → GSH
5.2 Symptoms of imminent eclampsia with hypertension and proteinuria (Flying Squad) → referral hospital or GSH
5.3 Systolic BP > 165 mmHg or Diastolic BP > 100 mmHg on repeated examination 10 minutes apart → referral hospital
5.4 Hypertension plus any proteinuria → referral hospital
5.5 Gestational diabetes for spreads in confirmed gestational diabetes in current pregnancy → GSH ANC for outpatient spreads call 021 4046004*(GTT fasting glucose > 8.0mmol/l, 2 hrs glucose > 11.0mmol/l)*
5.6 Proteinuria 3+ or more, regardless of the blood pressure → referral hospital
5.7 Antepartum haemorrhage (Flying Squad) → referral hospital or GSH
5.8 Prelabour Rupture of membranes < 36 weeks GA → referral hospital
5.9 Prelabour rupture of membranes in HIV positive patient → referral hospital *(all gestations)*
5.10 Prelabour rupture of membranes after 36 weeks GA, HIV negative, if contractions have not commenced after 12 hours → referral hospital
5.11 Pyrexial illness → referral hospital or GSH
5.12 Decreased fetal movements (for CTG) → referral hospital
5.13 Intra uterine demise, if not in labour → referral hospital
5.14 Suspected lower respiratory tract infection/pneumonia → referral hospital or GSH
5.15 Respiratory compromise → GSH
5.16 Severe vomiting → referral hospital
5.17 Jaundice → GSH
5.18 Suspected pyelonephritis → referral hospital

6. TRANSFER TO REFERRAL HOSPITAL IN LABOUR

6.1 Any of criteria mentioned under sections 2, 4, 5, 6 *(NB: tertiary patients to GSH)*
6.2 Diastolic BP 90 mmHg or more on two or more occasions
6.3 Prolonged latent phase > 12 hours
6.4 Failure to progress in active labour (crossed transfer line)
6.5 Preterm labour > 30 weeks or EFW >1200g: referral hospital. **If 26-30 weeks or EFW 700-1200g : GSH**
6.6 Malpresentation
6.7 Obesity : BMI>50 : GSH / BMI> 40: referral hospital
6.8 Antepartum haemorrhage
6.9 Worsening asthma/respiratory distress
6.10 Convulsions
6.11 Cord prolapse
6.12 Meconium stained liquor
6.13 Fetal distress: FH < 120, >160 bpm, or any decelerations
6.14 Prolonged second stage of labour > 45 mins in para 0 and > 30 mins in multiparous patient
6.15 Twins in labour
6.16 Suspected uterine rupture
6.17 Preterm &Prelabour ROM, any duration, if HIV (+)

7. POSTPARTUM REFERRALS

Discuss with registrar at referral hospital who will liaise with B side registrar if patient needs referral to GS

7.1 Postpartum haemorrhage (Flying Squad) → referral hospital or GSH
7.2 Retained placenta (Flying Squad) → referral hospital or GSH
7.3 Extensive secondary or third degree tear → referral hospital
7.4 Uterine inversion (Flying Squad) → referral hospital or GSH
7.5 Postpartum pyrexia → referral hospital
7.6 Postpartum hypertension → referral hospital
7.7 Postpartum eclampsia (Flying Squad) → GSH

8. MOU SUPPORT

- Perinatal Mortality Meetings for each MOU take place on Fridays at 08:00am and are attended by:

  - Community MO's: all MOU's
  - Prof Fawcus: Mitchell's Plain
  - MOU
  - Dr Allie: Gugulethu MOU
  - Dr Horak: Retreat MOU
  - Prof Anthony: False Bay Hospital

- Perinatal training days take place on Fridays, all day, yearly for each MOU, as per schedule.
- Monthly perinatal updates are provided by MMH Clinic Education Department as per schedule.