

# **NEONATAL REFERRAL PATTERNS WITHIN A REFERRAL SYSTEM IN SOUTHERN GAUTENG, SOUTH AFRICA**

Judy Nicola Rothberg

MBBCh, FCPaed(SA), DipHIV Man

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# DECLARATION

I, Judy Nicola Rothberg, hereby declare that this submission is my own work and to the best of my knowledge it contains no material previously published or written by another person. I also declare that the intellectual content of this report is the product of my own work, although I have received assistance from others which I duly acknowledge.

Signed: .....

Date :.....

Place :.....

# DEDICATION

I would like to dedicate this research project to my father, Prof. Alan Rothberg, without whom its completion would probably not have been possible. I cannot thank him enough for his input and constant encouragement. I have been very fortunate to benefit from his knowledge and experience. And because behind every great man there is a greater woman, I dedicate this to my mother as well; she is another great mind, and a neonatologist by association.

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# ABSTRACT

## Background

The aim of regionalisation of neonatal services is to offer a basic level of care to the majority of the obstetric/neonatal population who are at low risk, with smaller numbers of more specialised hospitals offering higher levels of care to the fewer, higher-risk patients. On review of relevant literature there has long been a shortage of neonatal intensive care unit (NICU) beds in the South African public sector.

This study was an audit within a referral system in the public sector. The aim was to identify the need for NICU beds, establish whether the need was being met, ascertain which patients required referral and which were accepted, and delineate factors that influenced the outcome of acceptance versus refusal.

## Subjects and Methods

Data collection took place between 30 October and 11 December 2006. Seven health facilities in southern Gauteng were included as study sites. These included 2 primary healthcare clinics, 3 district, 1 regional hospital and the tertiary referral facility, Charlotte Maxeke Johannesburg Academic Hospital (CMJAH). The study included all neonates requiring transfer to a NICU, for any reason, during the study period. Data collection relied upon completion of information sheets by doctors requesting or accepting transfer of ill neonates at each of the hospitals involved. The primary outcome was acceptance or refusal at CMJAH NICU. Secondary outcome was survival or death within the study period.

## Results

Forty-seven external requests for NICU beds were recorded at CMJAH and another **22** requests came for births within CMJAH. Only 13 (28%) of external requests were accepted. All internal requests were accommodated. Most requests came from level 2 (district or regional) hospitals, many outside the designated referral system, mainly for infants with respiratory distress. Infants **older than 24 hours of age** (OR 0.16; 95% CI 0.04-0.65), those with **congenital abnormalities**, and those requiring **surgery** (OR 0.11; CI 0.23-0.57) were significantly more likely to be accepted. Greater numbers of staff on duty at CMJAH also correlated with the probability of acceptance into NICU.

## **Conclusion**

Relatively few external requests were accepted. CMJAH provides sub-specialist services including paediatric surgery and therefore *should* accept patients requiring such management. However, there was a high number of patients refused admission for 'simple' neonatal respiratory conditions. Level 2 hospitals *should* be able to manage these. Furthermore, hospitals are not following strict referral protocols.

The findings are indicative of the continued shortage of neonatal intensive care beds, poor adherence to referral guidelines, and a general failure of regionalisation within the sector under consideration.

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# ABBREVIATIONS

CMJAH	Charlotte Maxeke Johannesburg Academic Hospital
NICU	Neonatal intensive care unit
ICU	Intensive care unit
CHBH	Chris Hani Baragwanath Hospital
RMMCH	Rahima Moosa Mother and Child Hospital
LBW	Low birth weight
VLBW	Very low birth weight
ELBW	Extremely low birth weight
CPAP	Continuous positive airway pressure
CI	Confidence interval
OR	Odds ratio

# 1. BACKGROUND

## 1.1 INTRODUCTION

Neonates constitute a relatively high-risk population, with the potential to experience a variety of predicted and unpredicted problems. The neonatal period (birth to twenty-eight days) is a critical time for many, particularly the early neonatal period (birth to seven days). Although the vast majority of newborn babies follow an uneventful course, those who do require medical intervention tend to need urgent, specialised attention by skilled providers in an appropriately-equipped facility. This is essential to maximise the likelihood of a favourable outcome.<sup>1,2</sup>

Worldwide, approximately four million babies die in the first month of life,<sup>3</sup> and the first twenty-four hours are the most critical.<sup>4,5,6</sup> On average, neonatal deaths make up approximately two thirds of the infant mortality (birth to one year),<sup>4</sup> however the ratio of neonatal to post-neonatal mortality varies by country or region according to the nature and stage of development of paediatric care provided.<sup>7</sup>

Most neonatal deaths (more than ninety-eight percent) occur in developing or resource-poor settings,<sup>5,8,9</sup> the latter term applicable to many if not most parts of South Africa. Although global figures show that approximately fifty-four percent of women deliver with skilled care,<sup>10</sup> in South Africa ninety- five percent of women attend antenatal clinics and more than ninety percent deliver with skilled care.<sup>11</sup> Given such statistics, and considering the large proportion born in a health facility, it would be reasonable to expect that most newborns in South Africa have access to specialised care when needed. This should certainly be the case in an urban, developed setting such as the Greater Johannesburg Metropolitan area in southern Gauteng.

## 1.2 REGIONALISATION OF CARE

In the aforementioned area there are three tertiary, academic centres which are affiliated to the University of the Witwatersrand. Thirteen hospitals or clinics within the area provide obstetric services and varying levels of care for neonates.

The latter facilities generally refer ill neonates (or problematic obstetric patients) to the larger, higher-level hospitals for specialised care. However, a few of the regional (level 2) hospitals are supposedly equipped with the human and technical resources to manage a certain number of neonatal conditions themselves, only referring 'upwards' if more specialised care (such as surgery or specialist intervention) is necessary, or if bed occupancy is saturated.

The concept of 'Regionalisation of Care' came about in the 1960's when the American Medical Association Committee on Maternal and Child Care decided that something should, and could be done about the excessive infant mortality.<sup>12</sup> This required reorganisation of maternal and infant services so that the population served received the appropriate care, with high-risk pregnancies in particular having access to obstetric and newborn intensive care.<sup>12</sup>

It is known that infant mortality is related to various social, nutritional, economic and educational factors, as well as the standard of available health care. However it has been found that with neonatal intensive care, neonatal outcomes can be drastically improved regardless of maternal socioeconomic background.<sup>12</sup> Efficient, reliable newborn transport is a crucial requirement for the success of the system so that no matter the location of birth, intensive care can be reached timeously.

### 1.3 **ADVANCES IN NEONATAL CARE**

Regionalisation of care not only ensures access to the most appropriate facility, but also to the highest levels of care. In this regard, neonatal medicine has come a long way in a relatively short time.<sup>13-16</sup> The science and practice of neonatology has become a highly specialised field, with advances constantly developing in terms of drugs, procedures and devices. As a result, conditions which were previously considered to have uniformly poor outcomes are now treated on a daily basis with favourable results. Head and total body cooling to reduce morbidity due to perinatal asphyxia;<sup>17</sup> novel modes of ventilation;<sup>18,19</sup> use of drugs such as sildenafil to treat pulmonary hypertension;<sup>20,21</sup> and improvements in feeding practices with use of pre- and probiotics to prevent necrotising enterocolitis<sup>22,23</sup> are but a few examples. Significant advances in postnatal treatment of neonatal surgical conditions aside, intrauterine procedures are now also possible since the advent of foetal medicine as a specialty.<sup>24</sup>

The numerous advances have not only resulted in major improvements in outcome in neonates who previously had a reasonable chance of survival, but have also facilitated the survival of neonates who were previously considered to be non-viable. As neonatology evolved in the 1970's and 1980's, the ability to salvage premature babies improved, with progressive increases in survival rates in Low Birth Weight (LBW) (less than 2500g), Very Low Birth Weight (VLBW) (less than 1500g) and Extremely Low Birth Weight (ELBW) (less than 1000g) categories. However, there was always an inverse relationship between the birth weight and length of stay, such that an ELBW infant would typically require up to twelve weeks of ventilation in NICU, whereas a VLBW infant would require as little as two to three weeks.<sup>25,26</sup>

This situation of improved 'salvage' plus prolonged length of stay created both logistic and ethical problems for neonatologists. On the one hand, obstetricians who previously would have regarded ELBW infants as unsalvageable were now transferring patients to tertiary hospitals and performing Caesarean sections because neonatologists were able to offer a

reasonable prognosis for what would previously have been regarded as an early spontaneous abortion. This led to NICUs with capacities of only six to eight ventilators having each ventilator occupied for as many as three months. Thus, whereas up to sixteen VLBW infants could have been treated in a three month period, NICUs might only be treating half that number if beds were being utilised for ELBW infants.

#### 1.4 **NEONATOLOGY IN SOUTH AFRICA**

In South Africa, with its history of under-supply of NICU beds, neonatologists were compelled to agree on a minimum 1000 gram threshold for ventilation in an attempt to free up more ventilators for infants who required shorter stays, and in any event had better prognoses in terms of neurodevelopmental, ocular and pulmonary outcomes.

Much changed with the advent of artificial surfactant in the late 1970's and its commercial availability in the early 1980's.<sup>15,16</sup> Survival rates in VLBW and ELBW infants improved dramatically and mortality dropped.<sup>15,16</sup> This obviously had an impact on length of stay in NICUs because duration of ventilation decreased, but infants were still too small to be discharged, and this created a new demand – to increase the number of high care beds in neonatal units.<sup>27</sup>

Having said that neonatology has taken such giant leaps forward in the recent past, the question of the extent to which advanced technology is available in South Africa is an important one. Where funding and intensive care beds are not a limiting factor such as in the private sector in South Africa, babies have for a long time had access to intensive care when needed. However in resource-poor developing countries, or the public sector in South Africa, even though the ability to salvage premature babies exists, there is always the issue of insufficient beds and staff.

Although there are many areas in our country which may be described as ‘third-world’ in terms of socioeconomic conditions, infrastructure, and available healthcare, there are also centres which offer many of the facilities of a ‘first-world’ country. This would include not only advanced equipment, but also appropriately trained, skilled staff. It is necessary to emphasise that South Africa does have such services at its disposal, to make the point that patients in need of specialised care may actually receive it.

## 1.5 REGIONALISATION OF CARE IN THE SOUTH AFRICAN CONTEXT

Pre-democratisation of South Africa in 1994, the government’s emphasis was on secondary and tertiary care, with scant attention given to primary care, particularly in the periurban and rural areas. The country and its health services were fragmented, with multiple health authorities and poor coordination of services.<sup>28</sup>

Even before the elections in 1994 and the first African National Congress government, considerable effort was put into the development of a health policy that would shift the emphasis and the budget, particularly from tertiary to primary care. However, under the apartheid government, even though there was an emphasis on hospital versus outpatient and primary care, there were never enough resources to cope with the loads at specialised hospitals, particularly in evolving disciplines such as neonatology. Work overseas was being carried out to develop norms for neonatal and high care beds per thousand/ten thousand/hundred thousand population, and when applied to South Africa showed great deficiencies.<sup>29</sup>

Whereas the advent of artificial surfactant had a significant effect on admission rates of ELBW infants in countries such as the United States of America, Canada and the United Kingdom, shortage of NICU beds in South Africa, and the inability to provide substantially more high care beds resulted in maintenance of the 1000 gram threshold. In fact, in 1998 this threshold was

adopted by the Department of Health as the prescribed minimum weight for mandatory health insurance cover in the private sector as well.<sup>30</sup>

One alternative to increasing the number of intensive care beds in tertiary hospitals is obviously to upgrade the quality of care in secondary level hospitals, and there have certainly been efforts to do so. For example the Perinatal Education Programme developed by David Woods at the University of Cape Town became the standard for upgrading skills of neonatal nurses.<sup>31</sup> However budgetary, nursing, equipment and maintenance problems at outlying public hospitals have often frustrated attempts to create beds that would 'decompress' tertiary hospitals. These same issues have frustrated efforts to develop skills at many outlying public hospitals to the extent that they could ventilate and provide high care for their own neonates rather than transfer them to tertiary centres.

The advent of Kangaroo Mother Care has certainly introduced an alternative to the establishment of additional high care beds,<sup>32,33,34</sup> but in the public sector even this alternative comes with resource demands including ward space, board and lodging for mothers, and medical, nursing and support staff to monitor the care of the infants. However, on balance, this appears to be an alternative that is creating meaningful capacity.

From the above it may be deduced that regionalisation in the country, certainly in the Gauteng region, is not fully-formalised or functional. Certainly there are 'designated' hospitals and referral pathways, but these are typically 'unidirectional' with little back-referral once patients have recovered to the point of being transferable, and all too often the referring facilities fall short of providing the care their designated level would normally demand.

While there has been correspondence in the South African medical literature<sup>35,36</sup> advocating a change in policy regarding the threshold for ventilation, for example lowering it to 800 grams because the prognosis for an 800 gram neonate was potentially as favourable as that of one weighing 1000 – 1500 grams, the public sector has not yet solved the problems of neonatal



bed shortages in tertiary hospitals, or reliable neonatal service provision in secondary level hospitals.

Nevertheless, in recent years it has become common practice to admit ELBW infants weighing between 750 and 900 grams to High Care or NICUs in the tertiary hospitals in Johannesburg. Some of these neonates avoid full ventilation and ICU admission through the use of early surfactant administration and nasal CPAP. For NICUs in tertiary hospitals, all the above issues translate into a constant demand for ventilators, the demand coming from inpatient obstetric wards (which have often received in-utero transfers of problem cases) and designated (and often undesignated) referring hospitals with inadequate expertise, staff or equipment.

## 1.6 **JUSTIFICATION OF THIS STUDY**

Consultants, registrars and nursing staff receive calls on a daily basis requesting admissions, and it was felt by all that it would be appropriate to review the situation in order to obtain a clearer picture of the following:

- the number of calls received per day/ week/ month requesting admission
- the origin of such calls and level of referring hospital
- the percentage admitted and factors influencing admission
- the percentage refused admission and factors influencing refusal
- the outcome of those admitted
- the outcome of those refused admission

Clearly some of the above questions could only be answered by obtaining fairly detailed information from the referring hospital, so it would be necessary to not only conduct an internal audit, but there would also have to be a component of audit at the referring hospitals. It was anticipated that the above information might assist the NICU staff in the following ways:

- give a clearer idea of what would typically be admitted and under what circumstances, thereby providing some guidelines as to when one could comfortably agree to an admission and when one could refuse
- generate discussions about cases that would typically be admitted but where policy might require review because ultimate prognosis might be less than optimal
- identify conditions that would typically be the reason for peripheral hospitals requesting referrals, but should ideally be managed by those hospitals themselves
- identify hospitals that would benefit from training programmes to upgrade skills

## 2. STUDY DETAILS

### 2.1 SUBJECTS AND METHODS

#### 2.1.1 Study sites

Data collection was planned for the health facilities that have been defined as the referral pool for the Charlotte Maxeke Johannesburg Academic Hospital (CMJAH). The group therefore included Edenvale Hospital, Germiston Hospital, Far East Rand Hospital, South Rand Hospital, Alexandra Health Clinic, and Hillbrow Community Health Centre. These facilities are described in Table 2.1. below.

**Table 2.1: Details of hospitals in CMJAH pool\***

Hospital	Hospital level	Services available (related to Paediatrics)
Charlotte Maxeke Johannesburg Academic Hospital	Level three	All specialties including neurosurgery, cardiothoracic surgery; allied health professionals; comprehensive diagnostic facilities including magnetic resonance imaging.
Far East Rand Hospital	Level two	Consultant paediatrician; intensive care unit (ICU); allied health professionals; limited diagnostic facilities
Edenvale Hospital	Level two	Consultant paediatrician; allied health professionals; limited diagnostic facilities
Germiston Hospital	Level one	Medical officers, allied health professionals
South Rand Hospital	Level one	Medical officers, allied health professionals
Alexandra Health Centre	Primary Healthcare Clinic	Paediatric Outpatient department run by medical officers; midwife-run antenatal clinic and obstetric unit. Doctor in Casualty at night. No facilities for admissions
Hillbrow Community Health Centre	Primary Healthcare Clinic	Midwife-run antenatal clinic and obstetric unit. Doctor in Casualty at night. No facilities for admissions

\*Tambo Memorial Hospital, a secondary level hospital which refers patients to CMJAH, should have been included in the study, however subsequently was not, and therefore is not included in the Table.

Level **one** hospitals are also known as **district hospitals**. Patients are referred here from surrounding clinics. They offer non-specialist care and are staffed by medical generalists. 24-hour in-patient care is available. Level **two** hospitals are **regional hospitals** which should receive referrals from the district hospitals but also serve as level one hospitals for their own catchment areas. They are staffed by general specialists such as surgeons and paediatricians.

However, most of the hospitals in Johannesburg do not function exactly as they should, with district hospitals bypassing regional hospitals and often referring directly to level three hospitals. Furthermore, the level three hospitals have outpatient departments and therefore offer level one services, making strict classification as district, regional and academic hospitals quite difficult, even obsolete. For the purposes of this study, and to facilitate analysis of the data, all hospitals other than the three academic hospitals in the region (CMJAH, Chris Hani Baragwanath and Rahima Moosa Mother and Child Hospitals) and the two primary healthcare clinics (Alexandra Health Centre and Hillbrow Clinic), were classified as **level two hospitals**, although some are district (South Rand and Germiston) and some are regional (Edenvale and Far East Rand).

## 2.1.2 **Structure and functioning of the hospitals in the study**

### 2.1.2.1 **Charlotte Maxeke Johannesburg Academic Hospital (CMJAH)**

This is a level three hospital. In terms of the neonatal unit, there is a neonatal ward where all neonates (inborn or transferred from another hospital) requiring hospital care are admitted. It is composed of a high care section, where the sicker neonates are treated, and a low care section where the babies simply awaiting weight gain stay until ready for discharge.

At the time of the study there was also a transitional unit within the labour ward where the recently-born, ill neonates were managed before being transferred to the neonatal ward. They would usually not stay there for longer than seventy-two hours. When necessary there was

also the capacity to manage babies on nasal continuous positive airway pressure (CPAP) utilising staff adequately trained to care for such patients.

The neonatal unit does not only accept problematic patients from lower-level hospitals, the doctors also make use of the referral system, and transfer patients out (when clinically appropriate) by 'stepping down' to lower levels of care in order to create more bed space for new admissions. Lower level facilities include Edenvale, South Rand, and Germiston Hospitals. Such babies are usually transferred out of the neonatal unit once they are stable and require minimal care other than intravenous fluids, antibiotics, and (most commonly) nasogastric feeds while awaiting weight gain. Obviously the patients must be transferred to hospitals which are easily accessible so that the parents can visit, especially if the mother is breastfeeding.

As long as the system is not forced by circumstances to function beyond capacity it is an excellent example of how a successful regionalised referral system should function.

There is also the NICU, which does not only serve neonates as other paediatric patients requiring intensive care may also be admitted. There are eleven patient stations in the NICU, but usually only enough staff to care for ten patients. Surgical cases requiring intensive care are also admitted (mostly post-surgery, but sometimes pre-surgery as well if necessary). A separate cardiothoracic ICU (located elsewhere in the hospital) admits paediatric patients requiring heart surgery. However lower level interventions such as surgical closure of a patent ductus arteriosus (probably the most common neonatal condition requiring cardiac intervention) are also cared for in the NICU.

Neonates may also be admitted to one of four paediatric wards in the CMJAH and also into the paediatric surgical ward. Admissions to, transfers from, and deaths of neonates occurring in all the above- mentioned wards were captured during the study period.

At the time of the study a Kangaroo Mother Care ward did not yet exist at CMJAH.

There is a labour ward, as mentioned, and an operating theatre for carrying out Caesarean sections.

### Staff

At the time of the study there were three paediatric consultants in the neonatal department. There is always one registrar who is stationed in NICU, and usually two registrars in the neonatal wards. There is a varying number of medical officers (usually three) undergoing training in the neonatal department at any one time. At least four registered nurses are on duty at all times in NICU, at least one in the transitional unit and one in the neonatal ward, and there is usually a number of staff nurses as well.

**Table 2.2: Structure and function of neonatal and paediatric wards at Charlotte Maxeke Johannesburg Academic Hospital**

<b>Subspecialty</b>	<b>Ward</b>	<b>Function</b>
Neonatal unit	NICU	10-11 bed capacity. Consultant-run, registrar based in NICU all hours. Usually 4-5 registered nurses on duty. Manages ventilated patients (neonates and children up to 12 years of age), post-operative cases.
	Neonatal Ward: High care	35 bed capacity. Usually 1-2 registered nurses assisted by varying number of staff nurses. Manages patients requiring oxygen, nasogastric feeds, and intravenous fluids.
	Neonatal Ward: Low care	15 bed capacity. Run by staff nurses. Manages premature babies awaiting weight gain and adequate oral feeding prior to discharge.
	Transitional Unit	8-10 bed capacity, occasionally this is overburdened (>1 baby per warmer). Usually 2 registered nurses, assisted by staff nurses. Manages babies requiring high care, including nasal CPAP, pending transfer to high care ward.
Paediatric wards	Ward 285	General paediatric cases older than 1 year, including a cubicle for isolation of gastroenteritis patients. Also 2 isolation cubicles (contagious cases).
	Ward 286	Oncology ward. Cubicle with 3 bed capacity for neonatal admissions.
	Ward 287	General paediatric patients under 1 year of age. Two cubicles dedicated to renal cases.
Paediatric surgery	Ward 277	Paediatric general surgical cases. May also manage paediatric neurosurgical cases.
	Ward 275	Paediatric patients requiring ear, nose and throat surgery and orthopaedic surgery. May also manage paediatric neurosurgical cases.
Cardiothoracic Surgery	Ward 466	Adult and paediatric patients pre- and post- invasive cardiothoracic procedures.

### 2.1.2.2 Far East Rand Hospital

This level two hospital has an ICU which is a mixed adult and paediatric ICU. A maximum of four babies can be ventilated at any one time. There were three nasal CPAP machines available for use at the time of the study.

There is a neonatal ward with high care and low care sections. There is also a Kangaroo Mother Care ward. Neonates re-admitted from home (i.e. after being discharged following birth) would be admitted into the paediatric ward.

There is a labour ward with an operating theatre for Caesarean sections.

#### Staff

There was one paediatric consultant in charge of the paediatrics department at the time of the study. He was assisted by a senior medical officer and another medical officer with a few years' experience in paediatrics. Two interns were in the paediatric ward, and a Community Service doctor and intern in the neonatal ward. Usually two doctors cover after hours calls for the whole hospital, which includes adult patients. One registered nurse and two to three staff nurses work in ICU.

Of concern was the physical distance between the ICU and the other wards – there is no doctor based in ICU so in the case of an emergency there could be a critical delay in arriving at the patient.

### 2.1.2.3 Edenvale Hospital

This is a level two hospital. However, unlike Far East Rand Hospital, there is no ICU. There is a neonatal ward within the area of the paediatric ward, divided into high care and low care sections. There is also a small ward adjacent to the labour ward where four or five newborns



could stay while awaiting transfer up to the ward. The hospital has a labour ward with an operating theatre, but at night patients are referred to CMJAH for emergency Caesarean sections due to a lack of anaesthetists after hours.

#### Staff

At the time of the study there was one paediatrician at Edenvale Hospital, and three interns/Community Service doctors working in the paediatrics department. At night there is only one doctor on call covering emergencies in the whole hospital, and that doctor may have little experience in paediatrics.

#### **2.1.2.4 Germiston Hospital**

This level one hospital has one paediatric ward and a labour ward. There is no neonatal ward. Ill newborns are managed in a small area/room within the labour ward. There is sufficient space to look after four babies, and capacity to administer oxygen, intravenous fluids and standard antibiotics (penicillin and aminoglycosides).

#### Staff

A chief medical officer and one other medical officer cover paediatrics, including newborns. One doctor covers all emergencies in the hospital after hours.

#### **2.1.2.5 South Rand Hospital**

This is a level one hospital. There is one paediatric ward. There is a room within the labour ward where a few newborns can stay for a maximum of seventy-two hours if they have relatively simple problems such as mild respiratory distress. Most newborns requiring a longer stay or more intervention are referred out for a higher level of care. There is an operating theatre for Caesarean sections, but these are only performed on Mondays, Wednesdays and

Fridays. On other days obstetric patients are referred to Chris Hani Baragwanath Hospital (CHBH) for Caesarean sections. Neonates are referred to CMJAH.

### Staff

At the time of the study a senior medical officer ran the paediatric department assisted by two interns/Community Service doctors.

#### **2.1.2.6 Alexandra Health Centre**

This is a primary healthcare clinic. There is a midwife-run antenatal clinic and labour ward which cater for uncomplicated normal deliveries. There is a paediatric outpatient clinic which is run by two medical officers with experience in paediatrics, and they refer patients to CMJAH if an admission is necessary, whether it be for ICU or simply to the general wards. There is a Casualty department for emergency cases, and such cases would also be transferred as necessary.

There is a relatively good relationship between the clinic and Witwatersrand University, CMJAH, and Rahima Moosa Hospital: medical students pass through the clinic during their training, and the clinic is quite actively involved in the teaching programme. The abovementioned two hospitals are supposed to accept referrals on alternate days (there is a roster dictating which hospital should accept transfers from Alexandra Clinic, depending on the day of the week). The staff has no choice but to refer problem cases onwards, so the process should be made as easy as possible for them. However, clinic staff members have reported on various occasions that they tend to come up against resistance from the (receiving) doctors when it comes to accepting patients.

An important aspect of this referral system is the transport service. The ambulance service from Alexandra Clinic is particularly unreliable, and patients often have to wait for excessively

long periods to be transferred to another hospital. In the case of an ill neonate this delay can be detrimental to the baby's outcome.

#### 2.1.2.7 Hillbrow Community Health Centre

This is the other major primary healthcare clinic in Central Johannesburg, serving the surrounding suburbs. The clinic refers problem cases to CMJAH. There is a midwife-run antenatal clinic and a labour ward for normal deliveries only. Again, as with Alexandra Clinic, any problems must be transferred, even if there is not a need for intensive care.

### 2.2. STUDY POPULATION

The population of interest included all babies **born** at any of the above facilities during the study period, all **neonatal deaths** (up to twenty eight days of age) in any of these facilities during the study period, and all babies **admitted** to any of these facilities within the first twenty eight days of life and their course and progress during the study period.

### 2.3. DATA COLLECTION

In order to collect information pertaining to requests for neonatal beds in the CMJAH ICU, the nursing and medical staff in the unit were asked to assist in the gathering of data by completing an information sheet at the time of each incoming phone call pertaining to transfer of a neonate (Appendix A). For optimal accuracy it was decided that the details of requests *from* referring hospitals should also be recorded. These were recorded on a different form (Appendix B). It was hoped that in this way fewer data would be missing in the event that a request at CMJAH was not adequately recorded.

'Referring hospitals' in this study applies to those hospitals which according to regional plans are officially designated as eligible for referral of problem neonates to the CMJAH (for specialist or sub-specialist care or if there are no available intensive care beds at that hospital). In addition, the referral hospital has policies determining eligibility for admission i.e. there is a triage system in place. As per Table 2.1 these include Edenvale Hospital, Far East Rand Hospital, Tambo Memorial Hospital, and South Rand Hospital. The latter hospital refers problem neonates to CMJAH, while problematic obstetric patients are referred to Chris Hani Baragwanath Hospital. Alexandra Health Centre and Hillbrow Community Health Clinic, because they are inadequately equipped for higher levels of care, are obliged to send any problem cases to CMJAH, even if the patient does not require intensive care. Germiston Hospital's protocol calls for referral to Natalspruit Hospital, but because of chronic inadequacies at the latter facility, doctors often call CMJAH first, and therefore Germiston Hospital was included as a referring hospital.

The Rahima Moosa Mother and Child Hospital has its own intensive care unit and is in many regards a tertiary level hospital; however neonates may be referred to CMJAH for paediatric or cardiothoracic surgery.

Highlighting the deficiencies and lack of a formal regional referral system, requests are frequently received from outside the designated referring area, with calls coming from as far afield as Pretoria, Klerksdorp and private hospitals within and sometimes outside of the province.

While the formal list of referring hospitals has been shown in Table 2.1, there are other facilities that either have an arrangement to transfer to CMJAH (as mentioned above with respect to Rahima Moosa hospital's referral of surgical patients) or bypass their designated referral system and access CMJAH. An extended list that includes examples of 'extra-network' or 'supra-network' facilities is shown in Table 2.3.

**Table 2.3: Examples of hospitals from which CMJAH typically receives requests for NICU beds, including level of care and designated referral hospital for each facility**

<b>Category</b>	<b>Hospitals</b>	<b>Comment</b>	<b>Designated referral hospital</b>
Level three (academic hospitals)	Chris Hani Baragwanath (CHBH)	Refers if own facilities full. Refers cases requiring sub-specialist care (cardiothoracic, paediatric surgery)	Not applicable
	Rahima Moosa Mother and Child Hospital (RMMCH)	Refers if own facilities full. Refers cases requiring sub-specialist care (cardiothoracic, paediatric surgery)	CMJAH/ CHBH (sub-specialist cases)
Level two (regional) hospitals*	Far East Rand Hospital	Refers if own facilities full/ sub-specialist care	CMJAH
	Edenvale Hospital	Refers all patients requiring NICU	CMJAH
	Tambo Memorial Hospital	Refers all patients requiring NICU	CMJAH
	Natalspruit Hospital	Refers if own facilities full/ sub-specialist care	CHBH
	Klerksdorp Hospital	Refers if own facilities full/ sub-specialist care	Outside Gauteng. Usually refers first to CHBH
Level one (district) hospitals*	Germiston Hospital	Refers all patients requiring NICU	Natalspruit, but generally call CMJAH first
	South Rand Hospital	Refers all patients requiring NICU	CMJAH
	Carltonville Hospital	Refers all patients requiring NICU	RMMCH
	Yusuf Dadoo Hospital	Refers all patients requiring NICU	RMMCH
*For the purposes of this study district and regional hospitals were grouped together as Level two hospitals			
Primary healthcare clinics	Alexandra Health Centre	Refers all patients requiring admission to hospital	CMJAH/RMMCH
	Hillbrow Community Health Centre	Refers all patients requiring admission to hospital	CMJAH

Initially it was considered ideal to cover all the hospitals in southern Gauteng as study sites and formally include them in comprehensive data collection in order to gain an overall picture of referral patterns in the area. However, the scale of such a project was considered too large and complex given the time (and human resource) constraints.

#### 2.4. **STUDY CONDUCT**

At the referral site (CMJAH NICU), the paediatric registrar is generally the first person to receive a request for a bed for an ill patient, and all registrars were contacted and asked to participate. The nurses were also made aware of the study so that they could remind doctors (at all hours) to complete the necessary information sheet. Every time a phone call was received requesting a bed for a neonate, the doctor was asked to fill in a simple one-page information sheet (Appendix A), irrespective of whether the patient was accepted or refused. Patient's date of birth, age, gender, birth weight (and current weight where relevant), pathology/diagnosis, reason for request, outcome of request, time of call, referring hospital, and number of nurses on duty were recorded. A box was provided for collection of these information sheets, and it was emptied by the principal investigator once to twice weekly. Regular interaction with the doctors was necessary to encourage their ongoing participation and assistance.

A different information sheet (Appendix B) was to be filled out if the registrar was making a request for a bed elsewhere; as there may occasionally be a need to request a bed elsewhere if there is a bed shortage. This information sheet, which was also available in the neonatal unit, required similar information, however there was also a section to be filled which identified how many, and which hospitals were phoned during the process of finding a bed for a neonate. A separate box was provided for these information sheets.

The information sheets were placed in a conspicuous position in the NICU as well as in the high care nursery, as requests sometimes came through to the doctor working in that ward.

The principal investigator visited the CMJAH once a week to collect all completed information sheets and provide new blank forms if necessary. All admissions to the NICU (which would include all inborn cases as well as neonates who are accepted from elsewhere), are recorded in the neonatal intensive care unit admission book. This was a useful tool to identify referrals in or out of the NICU which had not been captured on an information sheet. If unrecorded referrals (where no information sheet had been completed) were detected in this manner, data were recovered and an information sheet was completed by the principal investigator.

During data collection it emerged that there would be gaps in the recording process in terms of a) how many times a request may have been made before the acceptance and successful referral of a patient and b) unrecorded refusals of transfers since there would be no record of a call having been made.

Admission registers, birth registers and death notification books were also reviewed at each participating facility to document the numbers of neonates admitted to the facility's neonatal intensive care unit or neonatal unit, numbers transferred in and out, and the numbers of births and neonatal deaths at each one. Because neonates are also admitted to the general paediatric wards and paediatric surgical wards in certain facilities, these wards were also visited weekly, and the same information was gleaned there from the aforementioned relevant registers. Information sheets were not left in these wards, however, as participation of the doctors had not been sought.

At Germiston Hospital, Edenvale Hospital, Far East Rand Hospital and South Rand Hospital, the doctors were requested to complete a 'Referral out' information sheet (similar to the one mentioned above for the CMJAH – Appendix B) whenever requesting transfer of an ill neonate to another hospital. This applied even if they were phoning hospitals other than the CMJAH,

because this would still give an idea of how easy/difficult it was to find a bed for a neonate in a higher level hospital. The information sheets were left in the nursery or labour ward at each hospital as well as in the general paediatric wards. Far East Rand Hospital has a neonatal ward and an ICU (for adults and children/neonates), so information sheets were also left in these areas. The principal investigator visited each hospital once a week to collect information sheets and review the aforementioned registers to ascertain numbers of transfers out (and transferred-in, in the case of Far East Rand ICU), births, deaths and admissions.

Because Alexandra Health Centre and Hillbrow Community Health Clinic have a policy of transferring all neonates who are either below a certain weight, or who have problems even if intensive care per se is not necessary, it was not necessary to ask the staff to complete information sheets for every referral from the labour ward. In these cases the relevant information was gathered on a weekly basis from the maternity register which records all births, details such as time of birth, gender, birth weight, and outcome (discharge, stillborn or transferred out) of all babies born there. Death registers and certificates were also reviewed in order to ascertain whether each death was regarded as a stillborn or an early neonatal death, since the former may be considered an obstetric complication and the latter reflects more of a need for specialist neonatal attention. Staff were asked to complete a very brief questionnaire (Appendix C) if there were problems or delays with the transfer of neonates or if the receiving doctor refused to accept a patient. This should never happen as the CMJAH is obliged to accept patients from these clinics, however on the rare occasion the doctor is able to reassure the nurse that a patient does not need to be transferred, depending on the history and circumstances.

Alexandra Health Centre runs a paediatric outpatient department from 08h00 until 16h00 weekdays, and staff there was willing to fill in information sheets if an ill neonate required transfer to CMJAH (or Rahima Moosa Mother and Child Hospital, depending on the day of the week). The Casualty register was also reviewed weekly to try to detect any after-hour



transfers, but few details other than names of patients are recorded, and therefore this source of information was not reliable. It was felt it would be too difficult to get the numerous different Casualty doctors to assist with information sheet completion, so none were left in the Casualty department. However, if a neonate was admitted to the ward or NICU at the CMJAH from Alexandra Health Centre, this information would be found in the admission registers there.

Information regarding requests from outside the designated referral system was limited to that recorded on Appendix A by the doctor receiving the call at CMJAH.

## 2.5. **ETHICAL CLEARANCE**

The collection of data was carried out during the months of November and December 2006. Prior to commencing data collection, approval was sought from the University of the Witwatersrand Committee for Research on Human Subjects (Approval number M060937). Permission was also obtained from the Gauteng Department of Health and the managers/superintendents of the eight proposed study sites. The latter step resulted in considerable delay in the proceedings because certain parties would only grant permission conditional upon that of other parties being granted. Ultimately, approval of the University committee was obtained, and there were no objections from the Department of Health or from the administrative heads of seven of the eight proposed sites. The superintendent of the Tambo Memorial Hospital failed to provide consent and it was decided to omit this hospital from the study.

Formal consent to collect data at a site included permission to gain access to wards of interest, to gain access to files of patients who had either been referred in or out or had demised, to

make use of admission registers, birth registration books and death notification books, and to request involvement of the staff.

Once consent had been given to include facilities as study sites, contact was made with the staff (doctors and nurses) at each site in order to request their participation and assistance in the collection of data.

The information sheets requested that the patient's/mother's initials be included. This was necessary solely as a means of tracking each patient so that outcomes could be ascertained, whilst still maintaining anonymity.

## 2.6. DATA ANALYSIS

At the end of six weeks the data were analysed. Simple/standard descriptive statistics were used to calculate neonatal mortality rates. Primary outcome measures were: whether a patient was accepted or denied a bed in the CMJAH NICU and whether that baby survived or demised. The significance of the relationship between outcome measures and a number of different variables of interest was calculated using the chi square or Fisher exact test (for categorical data) or t-test (for parametric/continuous data) using Smith's Statistical Package (version 2.80, September 26, 2005, by Gary Smith, California). All tests were two-tailed and all results with  $p < 0.05$  were regarded as significant, except in the case of multiple comparisons in which case the Bonferroni correction was used and a lower p-value applied.

### 3. RESULTS

Overall, there were **sixty-nine** requests for NICU admission (**forty-seven external** and **twenty-two internal**). The total number of admissions to CMJAH NICU during the study period was **thirty-five** (**twenty-two internal** and **thirteen external**). **Seventy-two** percent of external requests were not accommodated. For the purposes of this study 'external' refers to requests for admission to CMJAH from **any** other hospital while 'internal' refers to requests from within CMJAH.

Table 3.1. below focuses on the number of requests for admission (internal and external) during the study period, and factors that related to acceptance into CMJAH NICU. Most of the admissions (22/35 i.e. 63%) were actually from within the hospital, and most of the requests for admission from outside were refused (34/47 i.e. 72%).

**Table 3.1: Requests and admissions to CMJAH NICU, Oct – Dec 2006**

		Internal (from within CMJAH)	External (from outside CMJAH)	Total
<b>Requests</b>	<b>Number</b>	22	47	69
	<b>Percentage of all requests (%)</b>	32	68	100
<b>Admissions (accepted) to CMJAH NICU</b>	<b>Number</b>	22	13	<b>35</b>
	<b>Percentage of requests accepted (%)</b>	100	28	51
<b>Proportion of total admissions (total 35)</b>	<b>Number</b>	22/35	13/35	
	<b>Percentage (%)</b>	63	37	
<b>Comment and level of significance (p value, odds ratio and 95% confidence interval)</b>		Internal transfers = 63% of admissions. p value Internal vs. External = <0.0001* OR 54.9 (6.69-450.97)		

\*Bonferroni correction requires p value <0.03 for significance

“100% of internal requests were accommodated” because the attending staff at CMJAH adhere to NICU admission criteria prior to requesting an NICU bed. These criteria are designed to reserve intensive care facilities for neonates with better prognoses, and therefore exclude babies with severe perinatal asphyxia, major congenital abnormalities and extremely low birth weight (less than 900 grams at the time of the study). According to the latter triage criteria 29 babies were not considered for admission and subsequently died, but it is worth noting that in no case was admission refused because a bed was not available and there were no cases in which referral to an outside NICU was attempted.

**Table 3.2: Patients accepted to CMJAH NICU in relation to diagnosis**

Diagnosis (external referrals)	Requests for CMJAH NICU		Admissions (accepted) to CMJAH NICU		Comment and level of significance
	Number	Percentage of all requests (%)	Number	Percentage who were accepted (%)	
Congenital abnormalities (includes cardiac defects, congenital surgical conditions, abnormalities of airway, and 'unspecified' - no exact diagnosis)	6	13	6	100	<b>Most likely to be accepted if diagnosis was congenital abnormality. p value &lt;0.0001* Least likely if 'simple' Hyaline Membrane Disease</b>
Sepsis (includes necrotizing enterocolitis, apnoea associated with sepsis)	11	23	4	36	
Respiratory Distress due to other causes such as congenital pneumonia or meconium aspiration	7	15	2	29	
Respiratory Distress Syndrome (premature infants with Hyaline Membrane Disease)	20	43	1	5	
Perinatal Asphyxia in term infants	3	6	0	0	
<b>Total</b>	47	100	13		

\*Bonferroni correction requires p value <0.03 for significance

It should be noted that the categories of diagnosis were based on previously-accepted classifications (congenital abnormalities, prematurity, asphyxia, and infection).<sup>37,38</sup> However there was a slight problem with assigning a specific diagnosis to each patient in this study in that the details on the information sheets were not always clear and the diagnosis may have been made by less-experienced medical practitioners. As shown in the Table, in this study infants with congenital abnormalities and

infections were most likely to be accepted, while ‘simple’ prematurity with Hyaline Membrane Disease was likely to be refused admission.

Taking into consideration previous comments regarding exclusion criteria for NICU admission, the 3 requests from outside CMJAH for babies with perinatal asphyxia perhaps should not have been included. However assessment by the referring doctor may not always be accurate i.e. they may not have been severe, therefore all requests were included. Furthermore, in those neonates with perinatal asphyxia who were refused admission, the reason for refusal was captured on the investigator’s data sheet and in all cases was on the grounds of capacity rather than failing triage.

**Table 3.3: Patients accepted in relation to reason for referral**

Reason for referral (external referrals)	Requests for CMJAH NICU		Admissions (accepted) to CMJAH NICU		Comment and level of significance. Odds ratio (95% confidence interval)
	Number	Percentage of all requests (%)	Number	Percentage of requests accepted (%)	
Ventilation	38	81	7	18	<b>More likely to be admitted if surgery required. p value 0.014* OR 0.113 (0.226 - 0.565)</b>
Surgery/ Surgery + ventilation	9	19	6	67	
Total	47	100	13		

\*Bonferroni correction requires p value <0.03 for significance

Overall, admissions were more likely if infants required surgery.

**Table 3.4: Patient demographics, hospital level and area of origin of request, in relation to acceptance to CMJAH NICU**

Demographic/ Determinant		Requests for CMJAH NICU		Admissions (accepted) to CMJAH NICU		Comment and level of significance. Odds ratio (95% confidence interval)
		Number	% of all requests	Number	% of requests accepted	
Weight category of infants referred from outside	<1000 grams	1	2	1	100	Tendency to accept larger LBW babies. However comparison of means p value =0.5. Not statistically significant
	1000-1499 grams	18	38	2	11	
	1500-1999 grams	8	17	3	38	
	2000-2499 grams	7	15	4	57	
	>2500 grams	12	26	3	25	
	Total	46*	98*	13		
		*Weight was not recorded for one baby.				
Level of care of referring hospital	Level 2	35	75	8	23	Tendency to accept from level 3 hospitals. p value = 0.42. OR 0.42 (0.10 - 1.67). Not statistically significant
	Level 3	12	25	5	42	
	Total	47	100	13		
Area of origin of request in cases of external referral	Within designated CMJAH referral system	10	21	5	50	Trend towards admission if within system. OR 3.63 (0.84 - 15.70). Difference not significant
	Outside designated CMJAH referral system	37	79	8	22	
	Total	47	100	13		

There was a trend towards admission of infants weighing more at birth but the difference was not significant.

**Table 3.4: (continued)**

Demographic/ Determinant		Requests for CMJAH NICU		Admissions (accepted) to CMJAH NICU		Comment and level of significance
		Number	% of all requests	Number	% of requests accepted	
Age at time of request for admission (external referrals)	≤24 hours	29	62	4	14	p value 0.014* (9 external admissions >1 week old). OR 0.16 (0.04 - 0.65)
	>24 hours	18	38	9	50	
	Total	47	100	13		

\*Bonferroni correction requires p value <0.03 for significance

**Table 3.5: Further determinants of whether patient was accepted or rejected at CMJAH NICU**

Determinant	Accepted	Refused	Comment and level of significance
Mean number (± S.D.) of phonecalls made in cases of external referrals	1.5 ± 2.3	5.9 ± 3.4	Significantly more calls when patient refused. p value 0.02*
Mean nurse: patient ratio in NICU (± S.D.) when requesting referral from outside	0.86:1 ± 0.17	0.70:1 ± 0.13	More likely to be accepted if higher nurse: patient ratio. p value 0.0059*
Mean weight of infants (external referrals)	2065 ± 826g	1880 ± 798g	Comparison of means p value = 0.5. Not statistically significant

\*Bonferroni correction requires p value <0.03 for significance.



From Table 3.5, one can also see that the need for referral is marked by the fact that hospitals persisted in calling in cases that were refused admission, signifying inability to cope and lack of alternatives. Admission from outside was more likely when the nurse: patient ratio was favourable.

**Table 3.6: Time of day requests were made as a determinant of acceptance to CMJAH NICU**

Time of day request for referral made (from outside)	Requests for CMJAH NICU		Admissions (accepted) to CMJAH NICU		Comment and odds ratio (95% confidence interval)
	Number	% of all requests	Number	% of requests accepted	
07h00 - 19h00	37	79	9	24	No significant difference noted. OR 0.48 (0.11 - 2.10)
19h00 - 07h00	10	21	4	40	
Total	47	100	13		

The **outcome** of only thirty-one of the forty-seven requests for admission could be established as it proved to be impossible to ascertain the outcome for all the patients who were refused a bed in the NICU. For example, such outcomes were not likely to be available if patients were accepted into another NICU at a hospital not included in the study. **Outcome** refers to survival to the end of the study period, or death within the study period, and in the case of those who were refused admission was established by means of follow up visits to hospitals within the system, or telephonic contact for the remainder.

**Table 3.7: Outcome (survival) of patients accepted at CMJAH NICU vs that of patients refused a bed at CMJAH**

<b>Outcome of request at CMJAH NICU</b>	<b>Number with known outcome</b>	<b>Number survived</b>	<b>% survived</b>	<b>Comment and level of significance. Odds ratio (95% confidence interval)</b>
Accepted	13	10	77	Trend towards better survival at CMJAH. Not statistically significant. OR 2.67 (0.54 - 13.08)
Refused	18	10	56	

Ten requests came from within the referral system. The 5 patients accepted to CMJAH NICU all survived; 2 were accepted in another NICU, 1 of whom survived, the other demised, 2 patients were not accepted in any NICU; 1 of these is known to have survived without NICU admission, but the outcome of the other patient not accepted and the outcome of one other patient could not be ascertained. The numbers are too small to allow any significant conclusions to be drawn.

## 4. DISCUSSION

The total number of admissions to the NICU during the study period was **thirty-five** (twenty-two internal and thirteen from outside). The **thirteen** accepted from outside represented **twenty-eight** percent of the **forty-seven** documented requests for an NICU bed at CMJAH. During the period of data collection no outgoing requests from CMJAH NICU were documented, implying that during this time, needs for NICU beds within the hospital were met and the capacity of the NICU for additional patients during the study period could be taken as thirteen.

Whether or not the acceptance rate is ideal is difficult to ascertain. Although the numbers are small, what can be seen is that **ten** of the requests came from hospitals within the CMJAH referral system and **thirty-seven** from outside the designated referral system. Therefore, if one were to strictly adhere to referral protocols and only accept the transfer of patients *within* the system, then since there was capacity for **thirteen** beds and only **ten** requests were made, technically more beds were available than were actually necessary. In other words, if capacity was based on official 'regional' needs then the CMJAH NICU had correctly assessed the likely need for beds. However the problem with this argument is that hospitals from outside the referral system were competing for the **thirteen** beds, and in the event only **five** of the **ten** from within the referral system were admitted and **eight** of **thirty-seven** requests from outside were accepted. There was obviously a discrepancy, and technically speaking, too many beds were made available to patients from outside the system and not enough to those within the system. Several comments should also be made in this regard:

- Some calls are for inappropriate referrals. For example, Germiston Hospital tried twice (for two different babies) and Edenvale once, to refer patients with a diagnosis of severe birth asphyxia. These patients were not considered good candidates for acceptance as the clinical history was such that the prognosis was considered to be extremely poor and the beds would rather have been allocated to patients who were more likely to have a more favourable outcome. (While such

‘telephonic triage’ is common, one must acknowledge that it might also result in self-fulfilling prophecies and the denial of care to some infants who would survive intact if given the appropriate care.)

- In practice, being accepted into the NICU is usually not a matter of regionalisation and eligibility, but rather one of timing: if a call comes when a bed and staff are available then it will usually be given to a patient, irrespective of whether or not the call is from within the referral system.
- Given that the CMJAH is a tertiary-quaternary hospital there is always a sense that one or two beds will be required for internal transfers. This often results in denial of requests from outside in order to cater for the internal needs.

To summarise at this point, if one simply looks at the ten requests for admission from hospitals within the referral system, but the capacity to admit thirteen, then one might deduce that there is adequate capacity within the ‘system’, and in fact one might argue that there is even excess capacity. This position, which could be described as naïve and bureaucratic, could be used to argue that regionalisation is potentially working, but the problem is that not all the referring facilities are compliant with regionalisation plans, and CMJAH is being ‘abused’ as a result.

The other view one should consider when reviewing the results is possibly a more realistic one, because looking at the global picture of NICU referrals one sees more in the way of unmet needs and preventable deaths. While CMJAH NICU clearly had demands from within the hospital, the number of requests for beds, number of rejections and nature of referrals and rejections reflect a serious problem. Overall, there were **sixty-nine** calls for NICU admission (**forty-seven** external and **twenty-two** internal). **Seventy-two** percent of external requests were not accommodated, and most of the refusals were for neonates that probably had excellent prognoses (e.g. seventeen refusals weighed >1500grams). The following findings support this view:

- The profile of requests for admission to a neonatal NICU is as expected, i.e.

- respiratory conditions, especially Hyaline Membrane Disease predominated over other conditions
- the majority of referrals required ventilation as the reason for transfer
- most infants requiring referral were younger (<24 hours of age) as opposed to older
- it was mainly lower level hospitals requesting a bed rather than hospitals of equivalent status
- **However**, the profile of admissions/acceptances shows:
  - there were few admissions for 'simple' respiratory problems
  - patients requiring surgery were more likely to be accepted
  - mainly older (>24 hours of age) infants were accepted
  - patients from equivalent level (level 3) hospitals were accepted more often (although not statistically significant)
- **Furthermore**, of importance is that
  - most referral requests (seventy-nine percent) came from *outside* the referral system (however, this did not significantly affect decision to accept or refuse patients)
  - overall there were many refusals (seventy-two percent of all requests were refused)

These facts suggest that the system is not actually working optimally and regionalisation is in fact failing. The results indicate that:

- health facilities are not adhering to the designated referral guidelines or following the proposed pathways/channels.
- there are clearly inadequate numbers of beds (and/or staff) within the system and surrounding systems, which is why requests are received from outside the designated area. The fact that other tertiary hospitals also request beds possibly implies a shortage of beds in neighbouring referral systems.
- repeated calls for those refused a bed is indicative of desperation.

- there is a lack of competence in many level 2 hospitals. Most requests pertain to infants with HMD, and altogether **fifty-eight percent** of requests were for respiratory conditions. **Eighty-one** percent of requests were for ventilation alone. These are relatively easy/straightforward conditions to manage and should ideally be managed in a level 2 hospital (such as Far East Rand Hospital in the instance of this study). Level 2 hospitals with an NICU should not need to refer such patients elsewhere and should in fact also be able to serve other level 1 and level 2 hospitals. As mentioned already, level 1 and 2 hospitals were grouped together in this study. Neither a level 1 (district) hospital nor a level 2 hospital without an ICU would be able to ventilate infants, however a level 2 hospital with an ICU should be able to manage uncomplicated cases of Hyaline Membrane Disease.
- the large number of calls in the first 24 hours of life suggests a lack of capacity to manage immediate problems.
- the 'equivalence' of academic hospitals is not borne out. Rahima Moosa Hospital is regarded as a tertiary hospital in many respects, but still needs to refer certain patients to CMJAH due to a lack of equivalent expertise and/or facilities.
- the definition and functioning of primary, secondary, tertiary and quaternary facilities is not supported, with excessive numbers of admissions of what could be considered 'lower-level' (uncomplicated Hyaline Membrane Disease) cases to higher level facilities. It also appears that district hospitals often bypass regional hospitals when referring, and call tertiary hospitals first.

In recent years, there have been plans to transform CMJAH from a multi-level facility into a dedicated level 3 or even a level 4 or quaternary institution. The implications of this are that only highly specialised/complicated cases should be managed at this hospital. At this level there should be a concentration of subspecialists such as paediatric surgeons and cardiothoracic surgeons, as well as specialised diagnostic facilities. In the context of neonates, the ideal way of receiving the potentially problematic newborns that may need specialised care would be by referral in utero. High risk pregnancies should be identified and the mother transferred prior to delivery. Patients should not be

able to refer themselves or 'walk off the street' into the casualty department – there should be limited direct access for the surrounding community. Only referrals from specialists/other hospitals or clinics should be seen and admitted. The consequence of non-adherence to level-of-care policies is that the hospital ends up admitting patients whose infants might require an NICU bed but at a level that could and should be handled by a level 2 hospital. On the other hand, and overriding all 'grand plans', **one can only restrict access to the higher levels of care if there are adequate numbers of lower level beds and staff to cater for the needs of the community or the community served.**

The Obstetrics Department at CMJAH previously ran a Midwife Obstetric Unit which managed uncomplicated deliveries. This unit closed some years back and the service was taken over by the Hillbrow Community Health Centre. However, despite this move towards managing uncomplicated cases in a primary health centre, the antenatal clinic at CMJAH continues to follow up similar patients as long as they live within the specified drainage area.

As already noted, the creation of a high level tertiary or quaternary hospital would necessitate turning away patients and providing them with an appropriate, alternative health facility. At this stage it is unlikely that the two clinics in the area – Hillbrow Community Health Centre and Alexandra Health Centre, would be able to absorb the additional numbers of patients. Before a referral centre can become dedicated purely to managing only specialised cases the peripheral primary and secondary centres need to be functioning optimally.

Another problem with the system is that while each smaller, peripheral centre should ideally concentrate its services on the population surrounding it, it happens all too often that patients provide false addresses so that they may register at a facility of their choice and burden the facility with numbers for which they were not designed.

Having provided only negative aspects of 'the system' one should also focus on some positive points. The nature of the referrals in this study emphasises the specialised services available at CMJAH, particularly the ability to handle the more complex neonatal problems requiring surgical intervention

and treatment for a variety of congenital abnormalities. This is evidenced by the acceptance of all the referrals with congenital abnormalities. Whether or not all infants with these conditions *should* be accepted into an NICU when capacity is so limited is questionable. Some conditions are correctable, however others have neurological and complex cardiac associations which may carry a poor prognosis. Referring doctors are not always able to give an accurate assessment of the condition and thus occasionally an NICU bed may be given to a patient who is not an appropriate candidate (in a resource-limited setting).

#### Additional points of discussion

**Time of day** when a request came in was not found to make a significant difference to the outcome of whether the patient was accepted or not. On the other hand, more calls were received in the day (**thirty-seven** versus **ten** at night), and it is reassuring to note that admission was as likely at night even though there might be fewer nurses on duty. Further analysis showed that there was in fact a relationship between nurse:patient ratio and acceptance, but this was not related to time of day.

There is generally a fixed number of registered nurses on duty in NICU at night (usually four). unless complex or extra patients require additional staff. During the day there may be between five and seven nurses on duty. In light of the fact that there is always fewer staff on duty in the night than in the day, it is actually reassuring to see that this did not result in a difference in the numbers of patients accepted. This is appropriate given that an NICU is expected to operate on a 24 hour basis. However, it appears that the 'rate limiting' factor is nurse availability, and the lowest number available (at night) determines how many beds are 'open'.

In an article published in the Lancet in September 2009, Chopra et al reviewed the **Millennium Development Goals** for South Africa and lamented the fact that the country appears to be going backwards.<sup>39</sup> The end of apartheid and the change in government 15 years ago brought hope that inequalities in health services would diminish and services would be reorientated towards primary health care. However, health expenditure is still dominated by tertiary-level hospitals. Although these



facilities have important referral and educational roles, health needs throughout the country, especially in more peripheral areas, will not be met by the high-level centralised services. This point is evident in this study, which has shown that a large number of patients originate from the lower-level hospitals and should be managed there.

The previously fragmented public health service has been consolidated to a large extent, however an effective district health system is yet to be established. Decentralisation through strengthening of a district health system is the crux of the National Health Act, but this has not been achieved. As suggested by the authors of the Lancet article, the South African Government needs to re-examine the distribution of resources between the different levels of care. However, improving the quality of lower-level services must not come at the cost of a deterioration in the excellence built up in tertiary hospitals.

## 5. CONCLUSION

This study was essentially an audit. It was carried out with the purpose of ascertaining how well a small component of the public health system is managing to provide neonatal services in a region where first-world health care delivery should be a reasonable expectation. The major objectives were to find out *how great the need* was for neonatal intensive care beds, *which were the patients* requiring intensive care, were the *needs met*, and *if not, why not?*

On balance the findings of this study were:

- There were **sixty-nine** requests for an NICU bed at CMJAH (**forty-seven** external, **twenty-two** internal). A large proportion of the external requests (**seventy-two percent**) were **not** accommodated. Most of those refused were neonates with 'simple' respiratory conditions which generally have favourable expected outcomes.
- Those accepted were more likely to be patients requiring surgery, older infants (>24 hours of age, and those from equivalent level (level 3) hospitals.
- Most referral requests (**seventy-nine percent**) came from *outside* the referral system, which suggests that health facilities are *not* adhering to the designated referral guidelines or following the proposed pathways/channels. This also indicates that there are clearly inadequate numbers of beds (and/or staff) within the system and surrounding systems.
- There appears to be a lack of competence in level 2 hospitals. Most requests came from level 2 hospitals for respiratory conditions which should be managed at that level. Ideally some of these hospitals with their own NICU facilities should be able to serve other level 2 hospitals, rather than overburdening level 3 facilities with relatively simple cases.
- Not all academic hospitals are equally-equipped to behave as tertiary institutions and themselves have to refer certain patients for specialist care they cannot provide.

- Less than a third of all requests were accommodated, and most of these were actually from outside the designated referral area. This means that a disturbingly large number of neonates did not receive the care they required, regionalisation is not working, and the system is not coping with the patient load.

## 6. RECOMMENDATIONS

In order to attain the Millennium Development Goals, South Africa needs to improve its efforts by incorporating priority interventions in a comprehensive primary health-care system which would address the needs of the country given the available resources.<sup>28</sup> The focus of the health care service needs to shift from servicing of immediate medical needs to maintaining community health.<sup>28</sup> In the context of the findings of this study, this philosophy could be interpreted as using available resources to save more infants with conditions with better prognoses rather than ventilating babies under 1000 grams for extended periods. Although such infants *are* salvageable, in a setting where there are clearly limited resources, is the recently- adopted policy of admitting extremely low birthweight babies into NICU really the best decision for the greater community?

Another recommendation from the Lancet's Series on South Africa is enhanced interaction between the Department of Health, regulatory authorities and training institutions to improve the qualification of doctors, nurses and mid-level workers so that an expanded range of services may be offered at district and primary level facilities.<sup>28</sup> There would also have to be greater incentive to work at these hospitals, to try to curb the alarming exodus of health-care workers to the private sector and foreign shores.

This study highlights the large numbers of newborns requiring ventilation in an NICU for respiratory conditions, which ideally should be managed at a level 2 facility. Therefore, in order to try to meet these needs and unburden level 3 hospitals which should be managing more complex conditions, the level 2 hospitals should be improved in terms of skills, confidence and possibly resources.

Those which already have an NICU, such as Far East Rand Hospital in this study, should increase the NICU capacity and competence. Of great concern is the high mortality rate observed at this hospital during the study period (12/769, which is 15.6 per 1000 live births). The mortality rate of neonates admitted to the NICU was 2/6 which is 33.3 percent). It is not an academic centre, so there are no training registrars who are based in NICU 24 hours a day, and only one full-time specialist consultant

who oversees all the paediatric and neonatal wards and clinics. The NICU at Far East Rand is a combined adult and paediatric/neonatal NICU and therefore the staff are unlikely to be specifically trained to deal with neonates who obviously require very specialised care. There is also the added concern of sepsis under such conditions.

Ideally, such hospitals should still be an active part of the academic circuit, receiving regular teaching ward rounds and 'problem rounds' with consultant paediatricians from the tertiary institutions. This would certainly be of benefit to the medical officers, as well as nursing staff. Courses on neonatal resuscitation also need to be carried out and staff knowledge regularly updated. This is something that has been instituted in the Level 1 and 2 hospitals, but of importance is that such educational activities continue on an ongoing basis, and that the outcomes are evaluated so that problems are regularly addressed.

A further move towards up-scaling services at level 2 hospitals could be the creation of NICUs in certain hospitals such as Edenvale Hospital. There was indeed a consultant paediatrician at this hospital and the unit was well-managed, however competent staff would also have to be available **at night** to attend to problems in the NICU.

If the above suggestions are not possible or prove inadequate to meet the needs for NICU beds, then an obvious recommendation is that the NICU capacity at CMJAH be increased in terms of beds, equipment and staff.

Higher level hospitals should also step down patients to lower levels of care whenever possible and feasible in order to free up high care beds for those who need them.

As mentioned, certain congenital abnormalities may be present as part of a syndrome or association. The diagnosis can be difficult and require an expert's opinion. In order to avoid referral of a patient whose condition carries a poor prognosis, it would be ideal, and certainly should be possible with current technology, to send images of such patients to the receiving doctor prior to acceptance of the patient.

Another idea is a central, web-based register of beds available at all NICUs in the region/province, which should be updated twice-daily, so that any hospital requiring a bed would know where vacancy exists. (Such a system does exist in many regions overseas, e.g, California.)

In order to gain a broader perspective, and perhaps a more accurate idea of how referral systems are functioning in Gauteng, a recommendation would be to carry out an expanded study similar to this one, but including referral systems in regions covering both major and intermediate centres e.g. Pretoria and Polokwane, both of which have academic circuits. However it would be important to improve on the present study and also capture as much information as possible from hospitals that are outside of designated referral systems to establish where the bottlenecks and deficiencies are. It would also be useful to regularly review triage policies to ensure that new interventions have not impacted on and improved chances of survival for at least some neonates that are essentially 'condemned to die' because their prognoses are considered too hopeless.

## 7. LIMITATIONS OF THE STUDY

The major limitation of this study is the small number of subjects involved. Ideally the study should have been carried out over a longer period so that more events (in this case requests for beds) could have been recorded, thereby allowing the findings to be reported with greater confidence in terms of statistical significance. However, as a result of time constraints this was not possible. This is largely due to the nature of the Registrar training programme during which there are limited opportunities for research until the small window of opportunity between completion of specialist examinations and expiry of registrar training time. This is typically small, at best six months.

This study showed that the majority of requests for NICU beds came from hospitals outside the referral system. These hospitals were not included in the study i.e. information sheets were not collected at these sites, because this would have required visits to a vast number of hospitals, which was not possible (although obviously desirable) given the time in which the study was to be completed.

In this particular study, another reason for the relatively short period during which data could be collected was the delay in obtaining consent from all the relevant parties. It took several months to receive feedback from the Gauteng Department of Health and the superintendents at the various health facilities. As mentioned previously there were often frustrating delays because consent from one party was said to be dependent on that given by others. The result of these delays had a knock-on effect in terms of final ethics approval, prior to which no data collection could take place.

It is important to consider these factors as the Faculty explores ways in which to increase MMed throughput and completion within the formal registrar training time. It is imperative to devise a successful strategy in order to comply with future HPCSA specialist registration requirements.

The smaller-than-desired numbers was probably also due to the fact that data collection depended on the cooperation and assistance from numerous people whose involvement was not obligatory and

therefore it is likely that some data were not captured. This problem was circumvented as much as possible by reviewing, other records/registers, but this was not always reliable.

Ideally knowledge of the outcomes of all the subjects would have been desirable. However it was not possible to track all the patients who were transferred to a hospital other than CMJAH, nor those where requests originated from a hospital which was not one of the study sites. More complete data would be necessary to demonstrate whether acceptance into CMJAH NICU does indeed result in a statistically significant difference in outcome.



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# APPENDIX A

Referral IN request form to be completed when RECEIVING a request for NICU bed for a NEONATE FROM ANOTHER HOSPITAL	
DATE	____/____/2006
TIME OF REQUEST	____ h ____
REFERRING HOSPITAL	1)Edenvale 2)Far East Rand 3)Pholosong 4)Tambo Memorial 5)Germiston 6)Leratong 7)Carltonville 8)Yusuf Dadoo 9)Natalspruit 10)Sebokeng 11)Kopanong 12)Heidelberg 13)South Rand 14)Coronation 15)Baragwanath 16)Klerksdorp 17)Alex Clinic 18)OTHER _____
PATIENT/MOTHER'S INITIALS	
DIAGNOSIS	
REASON FOR REQUEST	1)Ventilation 2)Inotropic support 3)Surgery 4)High Care monitoring 5)Congenital cardiac lesion 6)Exchange transfusion 7)Seizures 8)Other
DATE OF BIRTH	____/____/2006
WEIGHT OF BABY	_____ g
OUTCOME	1)Accepted 2)Refused
IF DENIED, REASON	1)Poor prognosis 2)Too well - no need for NICU 3)Too small 4)Bed/staff shortage
IF POOR PROGNOSIS, PLEASE SPECIFY	1)Severe acidosis 2)Severe asphyxia 3)Severe deformity 4)Pathology too advanced
IF BED/STAFF SHORTAGE (IN NICU)	1)No. of registered nurses on duty 2)No. of occupied beds 3)No. of intubated patients 4)No. of patients on NCPAP

## APPENDIX B

Referral OUT request form to be completed when REQUESTING an NICU bed for a NEONATE	
Hospital making request	1)Edenvale 2)Far East Rand 3)Germiston 4)South Rand 5)Johannesburg Hospital
DATE	____/____/2006
TIME OF REQUEST	____ h ____
HOSPITAL/S PHONED (Please indicate ALL contacted)	1)Johannesburg General 2)Baragwanath 3)Coronation 4)Natalispruit 5)Leratong 6)Far East Rand 7)Sebokeng 8)Kalafong 9)Garankua 10)One Military 11)Pretoria Academic 12)Klerksdorp 13)Private Hospital _____ 14)Other_____
PATIENT/MOTHER'S INITIALS	
DIAGNOSIS	
REASON FOR REQUEST (choose all relevant)	1)Ventilation 2)Inotropic support 3)Surgery 4)High Care monitoring 5)Congenital cardiac lesion 6)Exchange transfusion 7)Seizures 8)Other
DATE OF BIRTH	____/____/2006
WEIGHT OF BABY	_____ g
OUTCOME	1)Accepted 2)Refused 3)Awaiting response
IF ACCEPTED, TIME OF ACCEPTANCE	____ h ____
IF ACCEPTED, ACCEPTING HOSPITAL	
IF DENIED (BY JHB HOSPITAL), REASON	1)Poor prognosis 2)Too well - no need for NICU yet 3)No beds 4)Weight cutoff - too small

## APPENDIX C

Referral OUT request form to be completed when requesting transfer of a NEONATE to JHB Hospital	
HEALTH FACILITY MAKING REQUEST	1)Alex Clinic      2)Hillbrow Clinic
DATE	____ / ____ /2006
TIME OF REQUEST	____ h ____
PATIENT/MOTHER'S INITIALS	
DATE OF BIRTH	____ / ____ /2006
BIRTHWEIGHT	_____g
REASON/S FOR REFERRAL (DIAGNOSIS)	
IF DENIED, REASON WHY	
IF ACCEPTED, TIME OF ACCEPTANCE	