

## NEONATOLOGY IN SINGAPORE

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## ABSTRACT

A short account of the history of Neonatology in Singapore is given. Current practice and results of management of neonates are highlighted and future directions for neonatology in Singapore outlined. Brief mention is made of 2 common controversies in neonatal practice.

**Keywords:** Neonatology, Singapore

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## INTRODUCTION

Neonatology in Singapore can be said to have started with the establishment of the Kandang Kerbau Maternity Hospital in 1924. This institution grew to be arguably the largest maternity hospital in the world, having a delivery total of about 40,000 a year in the mid 60s.

In 1969, an obstetric unit was opened in Toa Payoh Hospital with some 5,000 deliveries a year. This was followed 2 years later with the opening of the Unit in Alexandra Hospital, again with 5,000 deliveries a year. In the early years, basic neonatal care was the norm and very few neonates were ventilated or survived assisted ventilation.

Two other neonatal units make up the complement of Government established institutions and these were the Neonatal Units at the National University Hospital and the Singapore General Hospital, established in 1985 and 1986 respectively.

There are 5 major private hospitals with maternity beds but none with any comprehensive neonatal unit.

To understand the work that is being done in the neonatal units in Singapore, it is worthwhile looking at the important advances in neonatal intensive care through the years (Table I) (1). This list is not exhaustive but gives an indication of the efficacy of certain preventive or therapeutic interventions on neonatal outcome.

It is true to say that there is a lag phase in the development of neonatology in Singapore by some 5 to 10 years compared to Australia for instance, but most of the major Government neonatal units are currently able to provide nearly all of the services listed, although they vary greatly in their development.

A look at Fig 1 gives an indication of the results of improving perinatal care in Singapore over the years. It is generally accepted that neonatal intensive care as we know it today was first started in 1978. The graph shows the following:

1. A progressive decline in the Perinatal Mortality rate from 14.9 in 1979 (prior to this the Perinatal Mortality rate ranged from 15.2 in 1978 to 21.5 in 1970) to 7.3 in 1988.
2. A steady decline in the Still Birth rate suggesting improved obstetric care but an even more noticeable decline in the first week deaths.
3. This together with the observation that there has been no reduction in the Very Low Birth Weight rate (in fact there was an increase in very low birth weight babies in two units sampled - Fig 2) suggests that the improved Perinatal Mortality has been largely due to improved standards of neonatal care, and in particular neonatal intensive care.

The weight-specific survival rates give an idea of the current standard of care in a unit and Table II shows the results in two such units in Singapore. It is useful to note that a baby that is over 1000 grams has a better than 90% chance of survival and one that is below 1000 grams but above 750 grams a 58% chance of survival. This compares with figures of over 89% and 65% respectively in an established Unit in Australia in 1987 (2).

The causes of neonatal deaths in the same units in Singapore give an idea of the clinical challenges ahead. Over the years the 4 main causes of neonatal death have been Hyaline Membrane Disease, Congenital Malformations, Severe Prematurity and Birth Asphyxia. This pattern is seen in all the major neonatal units in Singapore.

The next graph (Fig 3) shows a 10-year trend (1979 to 1988) in chief causes of neonatal deaths in the two units in Singapore.

There is a marked improvement in survival from Hyaline Membrane Disease but continued prevalence of severe prematurity, congenital malformations and birth asphyxia.

It would be logical at this time to begin to look at quality of survival. In this regard, it must be admitted that there is a dearth of neonatal follow-up studies in all the institutions in Singapore. The only study reported to date was one in 1984, where the early growth and development of very low birth weight babies in Alexandra Hospital was reported (3). Out of the cohort of 210 babies studied over a 5-year period born between 1978 and 1982, the overall rate of major handicap was 3% (Table III). This is very low compared to a world prevalence rate

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Table I  
**IMPORTANT ADVANCES IN NEONATAL INTENSIVE CARE**

- 1950s:
- Avoidance of oxygen over-exposure
  - Exchange transfusion for hyperbilirubinaemia
  - Objective evaluation (Apgar) of birth condition
  - Maintenance of thermoneutral environment
- 1960s:
- Intravenous glucose and alkali for RDS
  - Early enteral feeding in preterm infants
  - Mechanical ventilation for respiratory failure
  - Establishment of regional NICUs.
  - Phototherapy for hyperbilirubinaemia
  - Continuous distending airway pressure for RDS
- 1970s:
- Transpyloric enteral feeding
  - Echocardiography for cardiac investigations
  - Total parenteral nutrition
  - Promotion of maternal contact
  - Xanthine therapy for recurrent apnoea
  - Tolazoline therapy for pulmonary hypertension
  - Transcutaneous measurement of PO<sub>2</sub> and PCO<sub>2</sub>
  - Indomethacin therapy for patent ductus arteriosus
  - Chest physiotherapy
  - Specialized neonatal transport service
  - Correlation of staffing level and neonatal mortality
  - Computer-assisted neonatal intensive care
  - Real-time cerebral ultrasonography
  - Effectiveness of perinatal outreach education
- 1980s:
- Transcutaneous bilirubinometry
  - Artificial surfactant for RDS\*
  - High frequency ventilation\*
  - Extracorporeal membrane oxygenation (ECMO)\*
  - Neonatal follow up programmes\*
  - Establishment of regional perinatal centres\*
  - Pulse oximetry
- Assessed by randomized controlled clinical trials
- \* Services not yet available in Singapore

FIG 1

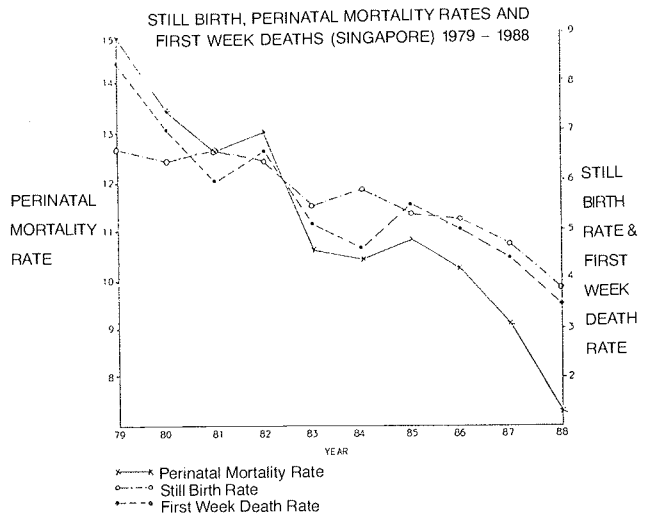


FIG 2

VERY LOW BIRTH WEIGHT (PER 100 LIVE BIRTHS) IN ALEXANDRA HOSPITAL AND TOA PAYOH HOSPITAL

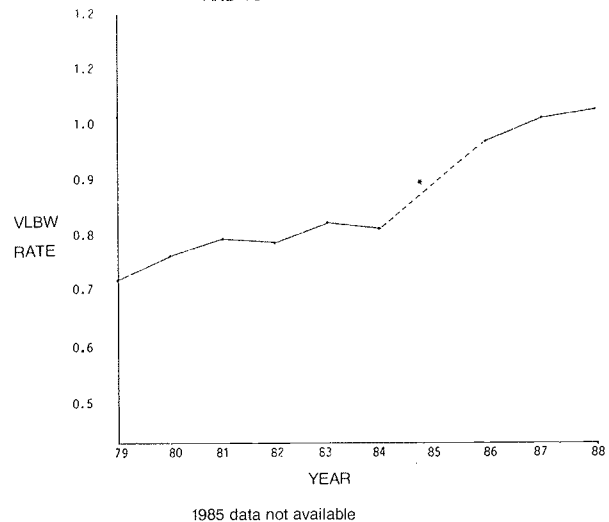


Table II  
**WEIGHT SPECIFIC SURVIVAL RATES OF NEONATES IN ALEXANDRA HOSPITAL AND TOA PAYOH HOSPITAL 1988**

Wt Groups (gms)	No. of Births	No. of Deaths	Wt Specific Survival Rate (%)
≤ 500	1	1	0
501 - 750	5	4	20
751 - 1000	12	5	58.3
≤ 1000	18	10	44.4
1001 - 1250	20	4	80
1251 - 1500	30	2	93.3
1001 - 1500	50	6	92
1501 - 2000	98	5	95
2001 - 2275	89	4	95.5

Table III  
**EARLY DEVELOPMENTAL OUTCOME OF 210 VERY LOW BIRTHWEIGHT INFANTS OVER A FIVE-YEAR PERIOD (1987-1982)**

Birthweight (gm)	Died (%)	Handicapped (%)	Lost of F/U (%)	Healthy Survivors (%)
501-1000 (n = 56)	86	—	—	14
1001-1500 (n = 154)	31	4	12	53
Overall (n = 210)	46	3	9	42

FIG 3  
 CAUSES OF NEONATAL MORTALITY IN ALEXANDRA HOSPITAL AND TOA PAYOH HOSPITAL (1977 - 1988)

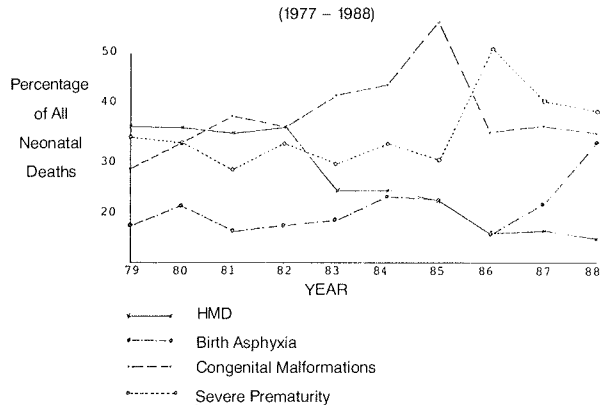


Table IV  
**FUTURE DIRECTIONS FOR NEONATOLOGY IN SINGAPORE**

1. Upgrading of NICUs
2. Ethical/Moral issues in neonatal intensive care
3. Neonatal follow up programmes
4. Perinatal audit
5. Regionalization of perinatal care
6. Specialized neonatal emergency transport service (NETS)
7. Continuing education in neonatology
8. Assisted Reproduction Programmes — impact on perinatal services?

Table V  
**NEONATAL CARE AT NATIONAL LEVEL**

**Definitions**

**Level I Facilities**

Level I facilities are those designed primarily for the care of mothers and babies who have no complications.

**Level II Facilities (Special Care)**

Level II Facilities are those hospitals which have larger maternity and newborn services. In addition to Level I care, they will provide services for some patients with complications. The range of these complications will depend on the resources available but do not as a rule include assisted ventilation.

**Level III Facilities (Intensive Care)**

The NICU needs to have a full range of services for the neonate including assisted ventilation.

**Definitions Level I Facilities**

**Level II Facilities (Special Care)**

**Level III Facilities (Intensive Care)**

- 1) staff for Singapore as a whole.
- 2) Ethical/Moral issues in NICU  
 Such ethical dilemmas as the sanctity of human life versus the quality of human life debate is ever present in all nurseries and there is a general feeling

of 6-8%. In addition to the low morbidity, it was noted that there was not a single case of blindness from Retinopathy of Prematurity and the incidence of Necrotizing Enterocolitis was also very low. Nevertheless, I feel this study requires further expansion and follow-up as it was only a study of early outcome.

The future directions for Neonatology in Singapore are - (Table IV) :

- 1) upgrading of neonatal intensive care units;
- 2) ethical and moral issues in neonatal intensive care;
- 3) neonatal follow-up programmes;
- 4) perinatal audit;
- 5) regionalization of perinatal care;
- 6) specialised neonatal emergency transport service (NETS);
- 7) continuing neonatal education;
- 8) assisted reproduction programmes - impact on neonatal services?

1) Upgrading of NICU's (Neonatal Intensive Care Units)  
 The concept of levels of patient care is a primary aspect of planning in neonatology. Table V shows the 3 levels of care. The level indicates not the quality of care which should be optimum, whatever the degree of care given, but rather the degree of complexity of patient care pertaining to the unit. The next table (Table VI) gives an indication of bed and staff allocation in the major neonatal units in Singapore. Data from private hospitals confirm that there are no Level 3 neonatal intensive care units in any of the private hospitals. There is a discrepancy between estimated and actual numbers of beds and

Table VI  
**BED AND STAFF REQUIREMENTS FOR NEONATAL INTENSIVE CARE AT  
 NATIONAL LEVEL — CURRENT AND EXPECTED**

Hospital	Level 1 Beds	Level 2 Beds	Level 3 Beds	Doctors		Nurses for L3 beds	
				Neonato- logists	Others	Staff Nurses	Others
TPH	20	5	1	4	7	4	
KKMH	34	6	2	8	10	10	
AH	25	6	1	5	11	7	
SGH	19	6	1	6	8	7	
NUH	15	5	2	3	23	5	
							(L2 and L3)
5 major private hospitals		20	3	No dedicated Level III Neonatal Intensive Care Unit			
Total		133	31	7	26	59	33
Total Expected (based on 40,000 deliveries per year)	280	40					

among neonatologists that guidelines will eventually be required for withholding or withdrawing treatment from some of these babies.

3) Neonatal follow-up programmes

The dearth of neonatal follow-up studies in Singapore has been mentioned. Advances in Neonatal Intensive Care have resulted not only in a significant and progressive reduction in mortality but also an improvement in long-term morbidity. Nevertheless, those who survive with neonatal intensive care remain at higher risk for growth and developmental problems compared with children who do not experience perinatal complications. Therefore, in addition to routine medical care, those at risk require serial and systematic examinations to identify possible physical, neurological, visual, auditory developmental or behavioural disability. These specialised programmes are recognised as an integral part of a regional perinatal service as they provide a basis for outcome surveillance, evaluation and early intervention.

4) Perinatal Audit

An effective monitoring system for perinatal mortality and morbidity is a pre-requisite to ensure that optimal obstetric and neonatal care is provided to those in need. Evaluation requires uniform perinatal definitions, terminology and statistical reporting in all hospitals.

It has been found in one Australian study in 1982 that avoidable factors were present in nearly one quarter of all stillbirths with deficiencies identified in both the antenatal period and in the management of labour (4). Furthermore, one in 10 neonatal deaths had one or more avoidable factors.

Perhaps the time has come to establish a proper and comprehensive national perinatal mortality review committee.

5) Regionalization of Perinatal Care

It is probably better to have no neonatal care than to have neonatal care badly done, or done too late. Neonatal intensive care should really be given in the place the infant is born, which implies regionalization of perinatal care. Neither money nor professional staff members are available to provide maximum sophistication of care at every hospital with a delivery service. A regionalized network would allow for high-risk pregnancies to be transferred to referral centres before delivery. Regionalization implies the development, within a geographical area, of a health care system in which by co-ordination between hospitals and physicians based on population needs, the degree of complexity of perinatal care each hospital is required to provide is determined (Table VII). For regionalization to work, it must be emphasized again that the grading refers not to the quality, but to the intensity of care to be provided. A look at the next graph (Fig 4) will show the increasing numbers of deliveries that are being handled at private hospitals. Neonatal intensive care is not available in these hospitals. It would be ideal if the regionalization system could be established in Singapore.

6) Specialised Neonatal Emergency Transport Service (NETS)

An efficient and effective newborn emergency transport service (NETS) is an integral part of neonatal intensive care in a regionalized system. Recommendations for management of newborns during transport were first formulated in 1966 and these have since been expanded in Canada, USA and Australia. It has been shown conclusively that specialized newborn transport systems significantly lessen mortality and morbidity (5).

The need for such a service is undoubtedly present in Singapore as those working in neonatal units can testify.

TABLE VII

REGIONALIZATION OF PERINATAL CARE

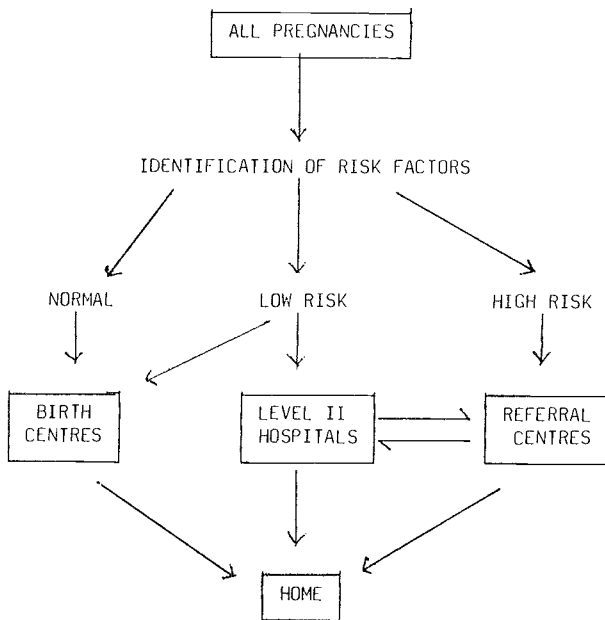
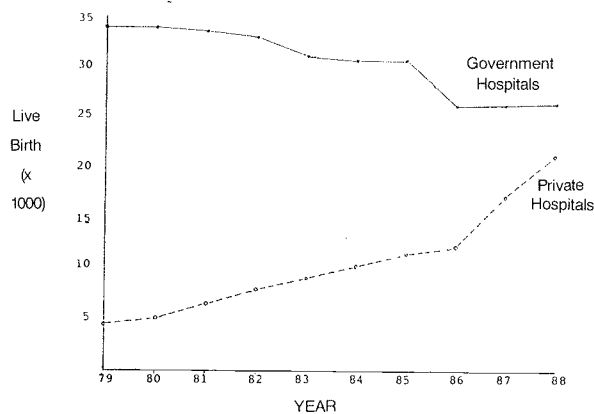


FIG 4

LIVE BIRTHS BY PLACE OF OCCURRENCE (SINGAPORE) 1979 - 1988



- 7) Continuing Neonatal Education  
The critical factor in providing a high quality service is not electronic equipment and spacious facilities. The critical factor is personnel, trained and experienced in neonatal care. In Singapore, the HMDP programme is instrumental in ensuring subspecialization in neonatology for doctors. Lately nurses have been included in the scheme. There is also a post-basic course in Paediatric and Neonatal nursing. However, this could be improved with a separate post-basic course in neonatal intensive care nursing. In addition each unit has its own continuing education programme.
- 8) Assisted Reproduction Programmes  
Currently several hospitals have established such programmes and these are in both the public and private sectors. It is well known that the products of such conceptions may lead to premature births (7 to 15%) and multiple pregnancies (22%) (6). The im-

fact on neonatal services remains to be seen. It is not possible to end by omitting to mention two emotive issues in neonatal intensive care and these are :

- a) Cost of neonatal intensive care;
- b) Outcome in survivors in neonatal intensive care.

COST OF NEONATAL INTENSIVE CARE

Neonatal intensive care is expensive, but it would be unrealistic not to compare its cost with that of other health programmes. In one study the costs per quality-adjusted life-year in 1983 was determined in US dollars. These were:

Cost	Programme
US \$ 1,220	Antepartum anti-D therapy (7)
US \$ 4,550	Neonatal intensive care in infants weighing 1 to 1.5 kg at birth (8)
US \$ 6,300	Thyroid screening (9)
US \$ 9,400	Treatment of severe hypertension (10)
US \$27,000	Oestrogen therapy in women after-menopause (11)
US \$31,800	Neonatal intensive care in infants weighing 0.5 to 1 kg at birth (8)
US \$36,300	Coronary artery bypass surgery (12)
US \$37,000	School tuberculin-testing programme (13)
US \$47,000	Continuous ambulatory peritoneal dialysis (14)
US \$54,000	Hospital haemodialysis (14)

Clearly, neonatal intensive care of infants weighing 1 to 1.5 kg at birth is placed very favourably in relation to the cost-utility of other health programmes, although for those weighing under 1 kg at birth, the cost of neonatal intensive care is less encouraging but by no means the least rewarding. Criticisms concerning the cost of neonatal intensive care are unjustified when we are able to make comparisons with other health care programmes. Furthermore, comparable costings of newer high-cost programmes like transplants, geriatric programmes and spinal units have not been reported.

OUTCOME IN SURVIVORS OF NEONATAL INTENSIVE CARE

It is a popular belief even amongst Paediatricians that neonatology and neonatal intensive care have resulted in an increase in the handicap rate in the community. No study has been done in Singapore but in a review of outcome for infants of very lowbirth weights surveyed in the world literature (15), Stewart et al found that, in general, mortality rates and the prevalence of major handicaps in survivors were high until 1960. The sixties was the period when neonatal care began to advance world-wide and since then, "the chances of healthy survival have trebled, whereas the handicap rate has remained stable and relatively low at 6-8% of very low birth weight births."

In absolute terms, this is a small increase in the number of handicapped children entering the community as a result of neonatal intensive care. It is important,

therefore, to know the proportionate contribution that these children make to the total number of children handicapped from all causes. The main reasons for severe handicap are appropriately grown full-term infants, many of whom show no signs of asphyxia at birth(16). Another very common cause of severe handicap is congenital abnormalities, including conditions such as Down's syndrome; very low birth weight survivors account for less than 2% of seriously handicapped children. I would therefore like to emphasize that the main result of the advances in neonatology is not an increase in the handicap rate amongst survivors but rather **an increased survival of normal children.**

Finally, what of the future of Neonatology in Singapore? Much more needs to be done but I believe the development of the subspecialty should be rational and

realistic, for it must be admitted that neonatal intensive care is expensive. But it must also be realized, especially in Singapore, that the most valuable resource that this nation has is its young and we cannot afford either financially or in terms of human suffering, the cost of failing to give each future generation the safest possible start in life.

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