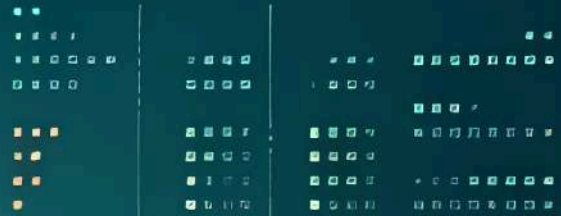


REPORT OF THE MALAYSIAN NATIONAL NEONATAL REGISTRY 2022



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- Farah Inaz Syed Abdullah
- Azanna Ahmad Kamar
- Wong Ann Cheng
- Nor Zubaidah Kadir



Report of the

MALAYSIAN NATIONAL NEONATAL REGISTRY 2022

**A STUDY OF CRITICALLY ILL BABIES
IN NEONATAL INTENSIVE CARE UNITS**

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Chong Chooi Siang

With contributions from:

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Disclaimer

There is a potential that data for previous years printed in this report are different from what were printed in previous reports. This is because analysis for this report is based on latest dataset in the web which may have been updated by SDP.

September 2026

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- Pn. Nur Ain Bt Hamdan, Clinical Registry Manager, MNNR
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Report of the Malaysian National Neonatal Registry (MNNR) 2022

1. Organization of the MNNR

1.1 Objectives

The Malaysian National Neonatal Registry was set up in 2002 to study the outcome of sick babies admitted to Neonatal Intensive Care Units (NICUs) in the country. A minimum data set and a data collection system at a national level are important to monitor mortality and morbidity of babies admitted to NICUs.

The Malaysian NNR aims:

1. To determine the frequency and distribution of critically ill neonates in Malaysia. These are useful measures of the health burden of neonatal critical illnesses and its care in the country.
2. To study the mortality and some morbidity outcomes of babies admitted to NICUs in participating hospitals.
3. To calculate the neonatal mortality rate of inborn babies.
4. To compare the outcomes between various centres.
5. To develop indicators for standard of care in various areas e.g., acceptable sepsis rate in NICUs.
6. To study, in further detail, the outcome of very low birth weight babies.
7. To stimulate and facilitate research on neonatal critical illness and its management.

1.2 Structure

The MNNR consists of a Governance Board, Steering Committee and administrative staff. The Governance Board is to monitor and to direct the functions of MNNR and it meets at least once a year.

The Steering Committee consists of nine elected members. This committee is responsible for the general running and decision-making of the Registry and for approving the use of its data.

1.3 Funding

Funding was provided via Perinatal Society of Malaysia & sponsors from industry.

2. Data Set

2.1 Registration criteria

The MNMR audit of critically ill babies admitted to Neonatal Units (NNUs) in 2021 included

A. All babies admitted to a Neonatal Unit who have any of the following criteria:

1. Had a gestation of <32 weeks i.e. up to 31 weeks + 6 days
2. Had a birth weight of 500-1500 grams
3. Had hypoxic ischaemic encephalopathy (HIE) with or without requirement of ventilatory support

B. All neonatal deaths (i.e. newborn babies (<28days) who died in the NNU, delivery room i.e. operating theatre, labour room, and in other wards)

- Both inborn and outborn babies were included.
- Outborn babies who died before arrival were excluded. Babies who were admitted to the NNU at a corrected gestation of > 44/52 were not considered neonatal cases and hence were omitted from the study.
- The inclusion criteria for MNMR were modified for the years 2021, 2022, and 2023. During this period, the migration of online data entry to a new system resulted in significant limitations that rendered the database unusable. Consequently, the MNMR steering committee opted to revert to the previous online system. To address the considerable backlog in data entry, it was necessary to reduce the inclusion criteria for these three years. Previous criterias that were omitted included those babies that need respiratory support, confirmed sepsis and congenital heart diseases (unless they fulfill the 4 criterias mentioned above).

2.2 Data Collection

The CRF consisted of four sheets (of forms).

- Babies discharged or transferred out to non-paediatric wards (e.g. paediatric surgical wards) in the same hospital or to other hospitals would have only one set of CRF completed and readmission of the same babies into the NNU would require a new set of CRF.
- A baby who was transferred between neonatal and paediatric wards under the same department was considered to be the same admission and the discharge CRF was completed after complete discharge from the hospital. Hardcopy CRFs were used and data from completed CRFs were entered via the MNMR website by the respective SDPs or sent to MNMR secretariat after a defined period for data entry.

2.3 Data Verification

Missing or anomalous data was identified by manual check and then clarified with the respective centre. Further data verification was made on data entry onto the main database. Quantification of errors and the implementation of practices via website data entry to minimize errors are continually refined.

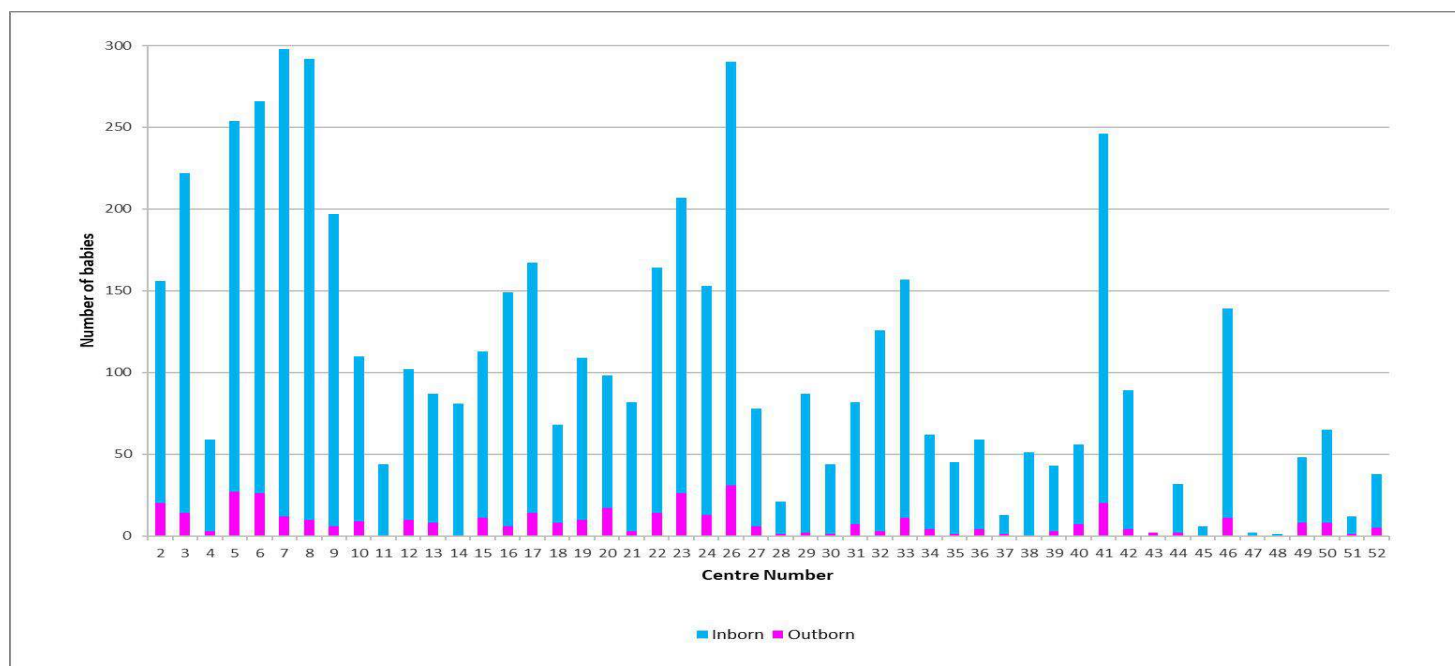
RESULTS

INTRODUCTION

- In the year 2022, the number of participating SDP hospitals increased to 50, with four new hospitals joining the registry during the year. These contributing institutions continue to span the Ministry of Health, university hospitals, and private medical centers across the country.
- The MNNR in 2022 was focused on four core inclusion criterias, capturing all babies (both inborn and outborn) who were delivered at a gestational age of less than 32 completed weeks, presented with a birth weight between 500 grams to 1500 grams, were diagnosed with hypoxic-ischaemic encephalopathy, as well as, all neonatal deaths.
- During the year, the 50 participating hospitals recorded a total of 260,292 livebirths, marking a continued decline from the 290,171 births reported in 2021. Among these livebirths, 28,700 babies (11.0%) were born preterm at less than 37 completed weeks of gestation, while 3,319 (1.3%) were delivered very preterm at less than 32 completed weeks. Furthermore, the monthly census from the SDP centers indicated that 3,787 babies (1.5%) were born with a birthweight between 500 grams and 1500 grams.
- A total of 5,372 babies met the specific registry inclusion criteria for closer clinical analysis. Within this selected cohort, 4,962 cases (92.4%) were inborn, while 410 (7.6%) were outborn transfers (Table 1 and Figure 1). Evaluation of these registry entries shows that 3,193 infants (59.4%) were born below 32 completed weeks of gestational age (Table 2 and Figure 2), and 3,408 infants (63.4%) presented with a birth weight of 1500 grams or below (Table 3 and Figure 3).
- A persistent discrepancy stands between the individual case numbers successfully submitted into the online database and the aggregate figures compiled via the manual monthly census. This variance underscores a volume of missing data fields that could not be retrieved or reconciled during retrospective data entry and cleaning phases.

Figure 1

Number of babies according to place of birth



COMMENT: There were 4962 inborn babies and 410 outborn babies in the MNNR.

Table 1: Number of babies according to place of birth

Hospitals		Place of Birth		Total
		Inborn	Outborn	
2	n	136	20	156
	(%)	(87.2)	(12.8)	(100)
3	n	208	14	222
	(%)	(93.7)	(6.3)	(100)
4	n	56	3	59
	(%)	(94.9)	(5.1)	(100)
5	n	227	27	254
	(%)	(89.4)	(10.6)	(100)
6	n	240	26	266
	(%)	(90.2)	(9.8)	(100)
7	n	286	12	298
	(%)	(96.0)	(4.0)	(100)
8	n	282	10	292
	(%)	(96.6)	(3.4)	(100)
9	n	191	6	197
	(%)	(97.0)	(3.0)	(100)
10	n	101	9	110
	(%)	(91.8)	(8.2)	(100)
11	n	44	0	44
	(%)	(100.0)	0	(100)
12	n	92	10	102
	(%)	(90.2)	(9.8)	(100)
13	n	79	8	87
	(%)	(90.8)	(9.2)	(100)
14	n	81	0	81
	(%)	(100.0)	(0.0)	(100)
15	n	102	11	113
	(%)	(90.3)	(9.7)	(100)
16	n	143	6	149
	(%)	(96.0)	(4.0)	(100)
17	n	153	14	167
	(%)	(91.6)	(8.4)	(100)

Table 1: Number of babies according to place of birth continued

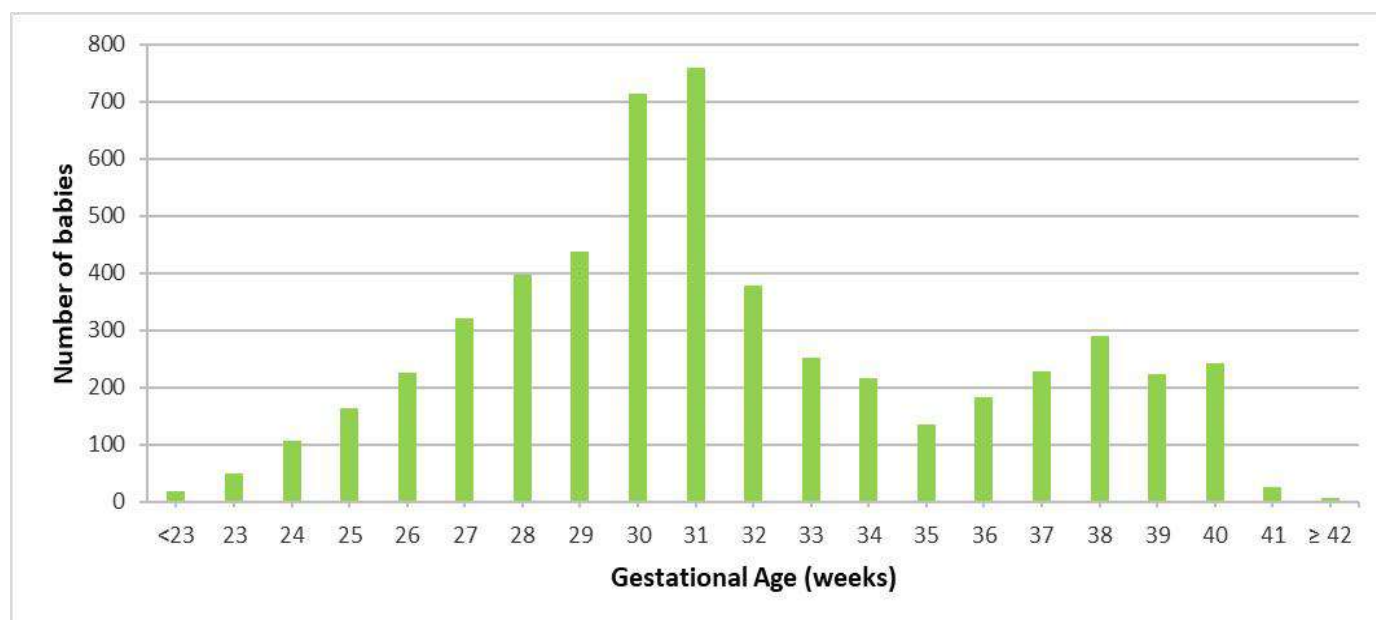
Hospitals		Place of Birth		Total
		Inborn	Outborn	
18	n	60	8	68
	(%)	(88.2)	(11.8)	(100)
19	n	99	10	109
	(%)	(90.8)	(9.2)	(100)
20	n	81	17	98
	(%)	(82.7)	(17.3)	(100)
21	n	79	3	82
	(%)	(96.3)	(3.7)	(100)
22	n	150	14	164
	(%)	(91.5)	(8.5)	(100)
23	n	181	26	207
	(%)	(87.4)	(12.6)	(100)
24	n	140	13	153
	(%)	(91.5)	(8.5)	(100)
26	n	259	31	290
	(%)	(89.3)	(10.7)	(100)
27	n	72	6	78
	(%)	(92.3)	(7.7)	(100)
28	n	20	1	21
	(%)	(95.2)	(4.8)	(100)
29	n	85	2	87
	(%)	(97.7)	(2.3)	(100)
30	n	43	1	44
	(%)	(97.7)	(2.3)	(100)
31	n	75	7	82
	(%)	(91.5)	(8.5)	(100)
32	n	123	3	126
	(%)	(97.6)	(2.4)	(100)
33	n	146	11	157
	(%)	(93.0)	(7.0)	(100)
34	n	58	4	62
	(%)	(93.5)	(6.5)	(100)
35	n	44	1	45
	(%)	(97.8)	(2.2)	(100)

Table 1: Number of babies according to place of birth continued

Hospitals		Place of Birth		Total
		Inborn	Outborn	
36	n	55	4	59
	(%)	(93.2)	(6.8)	(100)
37	n	12	1	13
	(%)	(92.3)	(7.7)	(100)
38	n	51	0	51
	(%)	(100.0)	(0.0)	(100)
39	n	40	3	43
	(%)	(93.0)	(7.0)	(100)
40	n	49	7	56
	(%)	(87.5)	(12.5)	(100)
41	n	226	20	246
	(%)	(91.9)	(8.1)	(100)
42	n	85	4	89
	(%)	(95.5)	(4.5)	(100)
43	n	0	2	2
	(%)	(0.0)	(100)	(100)
44	n	30	2	32
	(%)	(93.8)	(6.3)	(100)
45	n	6	0	6
	(%)	(100.0)	(0.0)	(100)
46	n	128	11	139
	(%)	(92.1)	(7.9)	(100)
47	n	2	0	2
	(%)	(100.0)	(0.0)	(100)
48	n	1	0	1
	(%)	(100.0)	(0.0)	(100)
49	n	40	8	48
	(%)	(83.3)	(16.7)	(100)
50	n	57	8	65
	(%)	(87.7)	(12.3)	(100)
51	n	11	1	12
	(%)	(91.7)	(8.3)	(100)
52	n	33	5	38
	(%)	(86.8)	(13.2)	(100)
TOTAL	n	4962	410	5372
	(%)	(92.4)	(7.6)	(100)

Figure 2

Frequency distribution of all babies in MNRR according to gestational age



COMMENT: For the categories ≥ 32 weeks, the case distribution does not include all livebirths in that respective gestational age group (See inclusion criteria).

Table 2: Frequency distribution of all babies in MNRR according to gestational age

Gestational age in completed weeks at birth	Frequency (n)	Percent (%)
< 23	18	0.3
23	50	0.9
24	107	2.0
25	164	3.1
26	225	4.2
27	321	6.0
28	398	7.4
29	438	8.2
30	713	13.3
31	759	14.1
32	378	7.0
33	251	4.7
34	217	4.0
35	135	2.5
36	182	3.4

Table 2 continued: Frequency distribution of all babies in MNMR according to gestational age

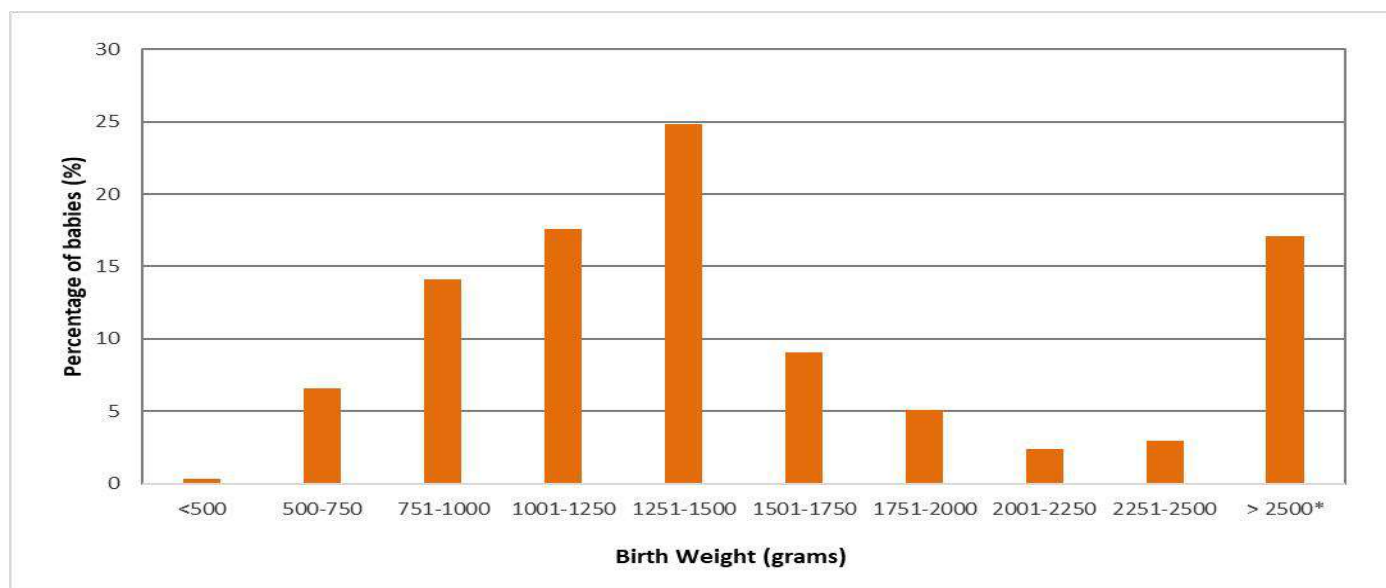
37	229	4.3
38	290	5.4
39	223	4.2
40	242	4.5
41	26	0.5
≥ 42	6	0.1
Total included	5372	100
Total no. of babies with missing gestational age	0	
Total no. of babies	5372	

Table 3: Frequency distribution of all babies in MNRR according to birth weight (BW) categories

Birth weight grams	Frequency (n)	Percent (%)
<500	17	0.3
500-750	353	6.6
751-1000	759	14.1
1001-1250	945	17.6
1251-1500	1334	24.8
1501-1750	487	9.1
1751-2000	274	5.1
2001-2250	130	2.4
2251-2500	157	2.9
> 2500	916	17.1
Total included	5372	100
Total no. of babies with missing birth weight	0	
Total no. of babies	5372	

Figure 3

Frequency distribution of all babies in MNRR according to birth weight categories



*COMMENT: * For the categories > 1500 gram birth weight, the case distribution does not include all live births in the respective categories (see inclusion criteria)*

MATERNAL INTERVENTIONS

- Antenatal corticosteroids for fetal lung maturation were administered to 76.1% of mothers whose babies were born at less than 32 weeks of gestational age. A lower proportion of mothers of outborn infants received this intervention compared to those of inborn infants, with 79.0% of inborns receiving antenatal corticosteroids compared to only 38.8% of outborns. Across the participating MNNR centers, the utilization of antenatal corticosteroids for inborn babies ranged from 20.0% to 100.0%, while the rate for outborn infants varied between 0.0% and 100.0% (Figure 4a & 4b and Table 4).
For infants presenting with a birth weight of 1500 grams or below, antenatal corticosteroids were administered to the mothers of 78.1% of inborn babies and 37.5% of outborn babies (Figures 5a & 5b and Table 5).

Figure 4a

Antenatal corticosteroids for all inborn babies born at < 32 weeks gestational age according to centres

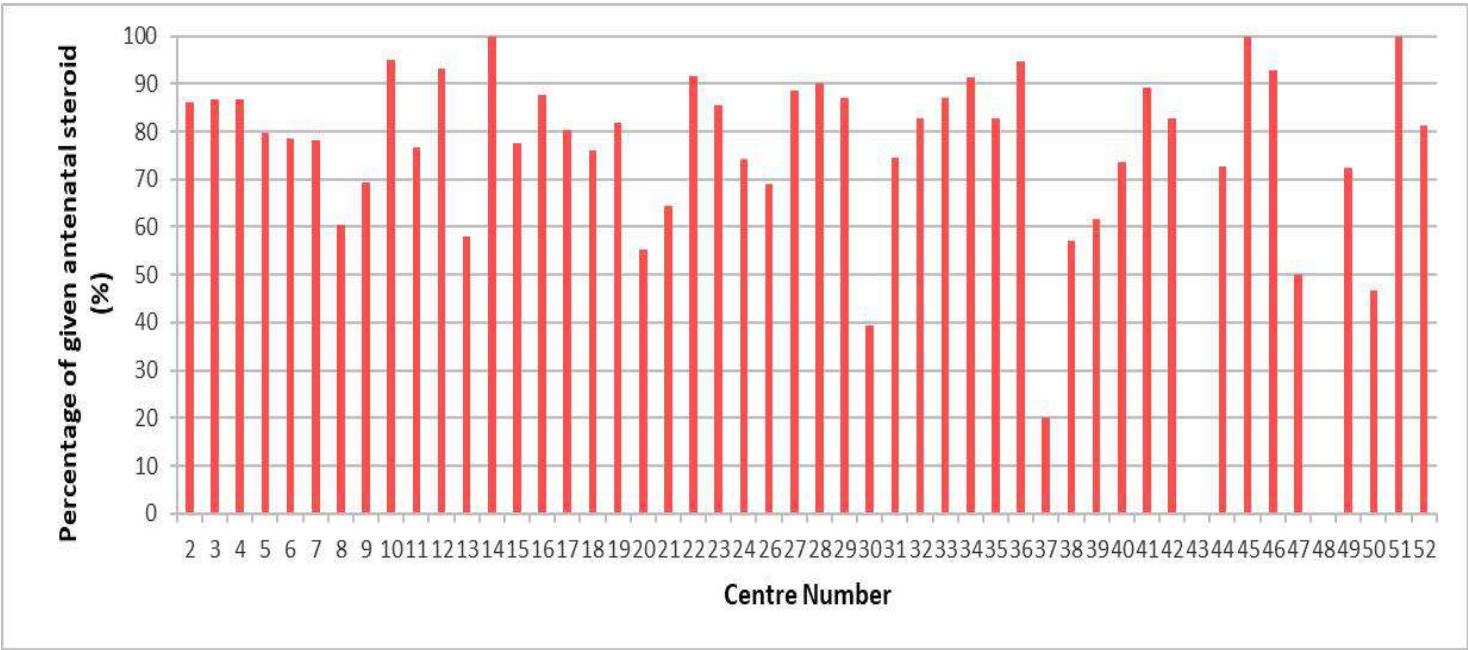


Figure 4b

Antenatal corticosteroids for all outborn babies born at < 32 weeks gestational age according to centres

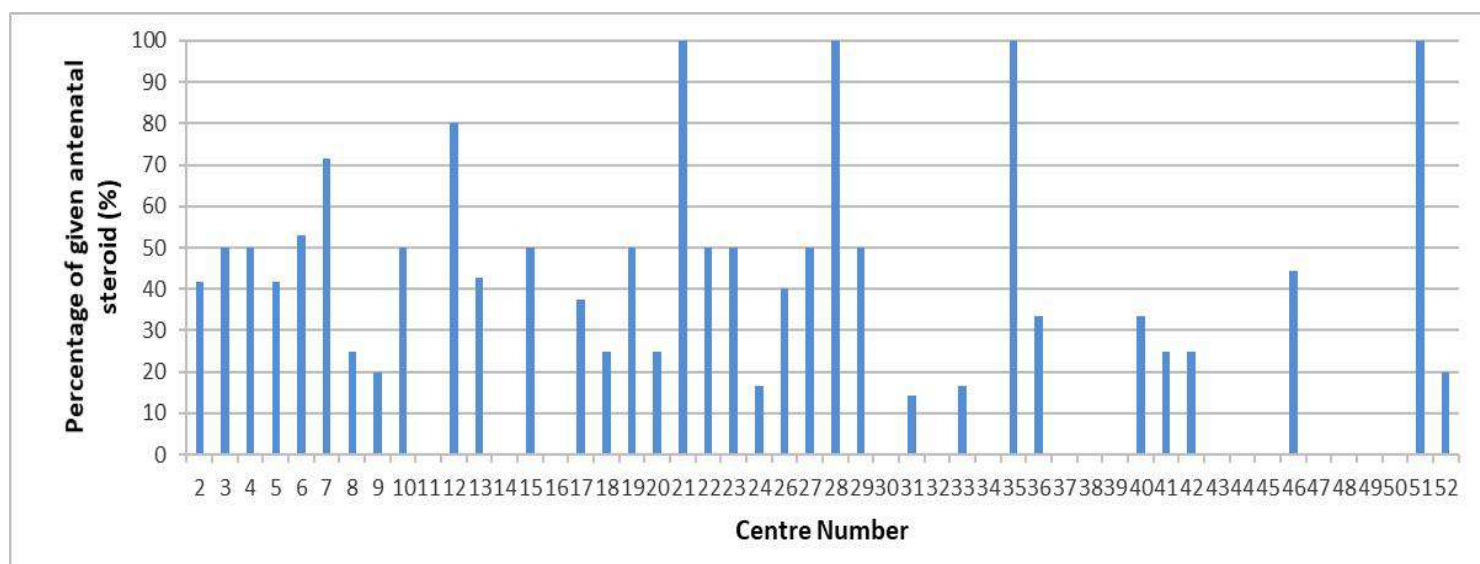


Table 4: Antenatal corticosteroids for all babies born at < 32 weeks gestational age according to centre

Hospitals	Inborn			Outborn		
	Total no of babies	Given Antenatal Steroids		Total No of Babies	Given Antenatal Steroids	
	n	N	%	n	N	%
	2961	2340	79.0	232	90	38.8
2	93	80	86.0	12	5	41.7
3	98	85	86.7	6	3	50.0
4	30	26	86.7	2	1	50.0
5	108	86	79.6	12	5	41.7
6	93	73	78.5	17	9	52.9
7	189	148	78.3	7	5	71.4
8	184	111	60.3	8	2	25.0
9	101	70	69.3	5	1	20.0
10	58	55	94.8	6	3	50.0

Table 4 continued:

Antenatal corticosteroids for all babies born at < 32 weeks gestational age according to centres

Hospitals	Inborn			Outborn		
	Total no of babies	Given Antenatal Steroids		Total No of Babies	Given Antenatal Steroids	
	n	N	%	n	N	%
11	30	23	76.7	0	0	0.0
12	58	54	93.1	5	4	80.0
13	43	25	58.1	7	3	42.9
14	47	47	100.0	0	0	0.0
15	71	55	77.5	4	2	50.0
16	73	64	87.7	4	0	0.0
17	92	74	80.4	8	3	37.5
18	25	19	76.0	4	1	25.0
19	71	58	81.7	8	4	50.0
20	38	21	55.3	8	2	25.0
21	42	27	64.3	1	1	100.0
22	95	87	91.6	6	3	50.0
23	117	100	85.5	14	7	50.0
24	105	78	74.3	6	1	16.7
26	168	116	69.0	15	6	40.0
27	52	46	88.5	6	3	50.0
28	20	18	90.0	1	1	100.0
29	61	53	86.9	2	1	50.0
30	28	11	39.3	1	0	0.0

Table 4 continued:

Antenatal corticosteroids for all babies born at < 32 weeks gestational age according to centres

Hospitals	Inborn			Outborn		
	Total no of babies	Given Antenatal Steroids		Total No of Babies	Given Antenatal Steroids	
	n	N	%	n	N	%
31	63	47	74.6	7	1	14.3
32	70	58	82.9	0	0	0.0
33	92	80	87.0	6	1	16.7
34	34	31	91.2	3	0	0.0
35	23	19	82.6	1	1	100.0
36	19	18	94.7	3	1	33.3
37	5	1	20.0	0	0	0.0
38	21	12	57.1	0	0	0.0
39	26	16	61.5	2	0	0.0
40	19	14	73.7	3	1	33.3
41	139	124	89.2	8	2	25.0
42	69	57	82.6	4	1	25.0
43	0	0	0.0	0	0	0.0
44	22	16	72.7	2	0	0.0
45	4	4	100.0	0	0	0.0
46	97	90	92.8	9	4	44.4
47	2	1	50.0	0	0	0.0
48	0	0	0.0	0	0	0.0

Table 4 continued:

Antenatal corticosteroids for all babies born at < 32 weeks gestational age according to centres

Hospitals	Inborn			Outborn		
	Total no of babies	Given Antenatal Steroids		Total No of Babies	Given Antenatal Steroids	
	n	N	%	n	N	%
49	18	13	72.2	2	0	0.0
50	30	14	46.7	1	0	0.0
51	2	2	100.0	1	1	100.0
52	16	13	81.3	5	1	20.0

Figure 5a

Antenatal corticosteroids for all inborn babies born at $\leq 1500\text{g}$ birth weight according to centres

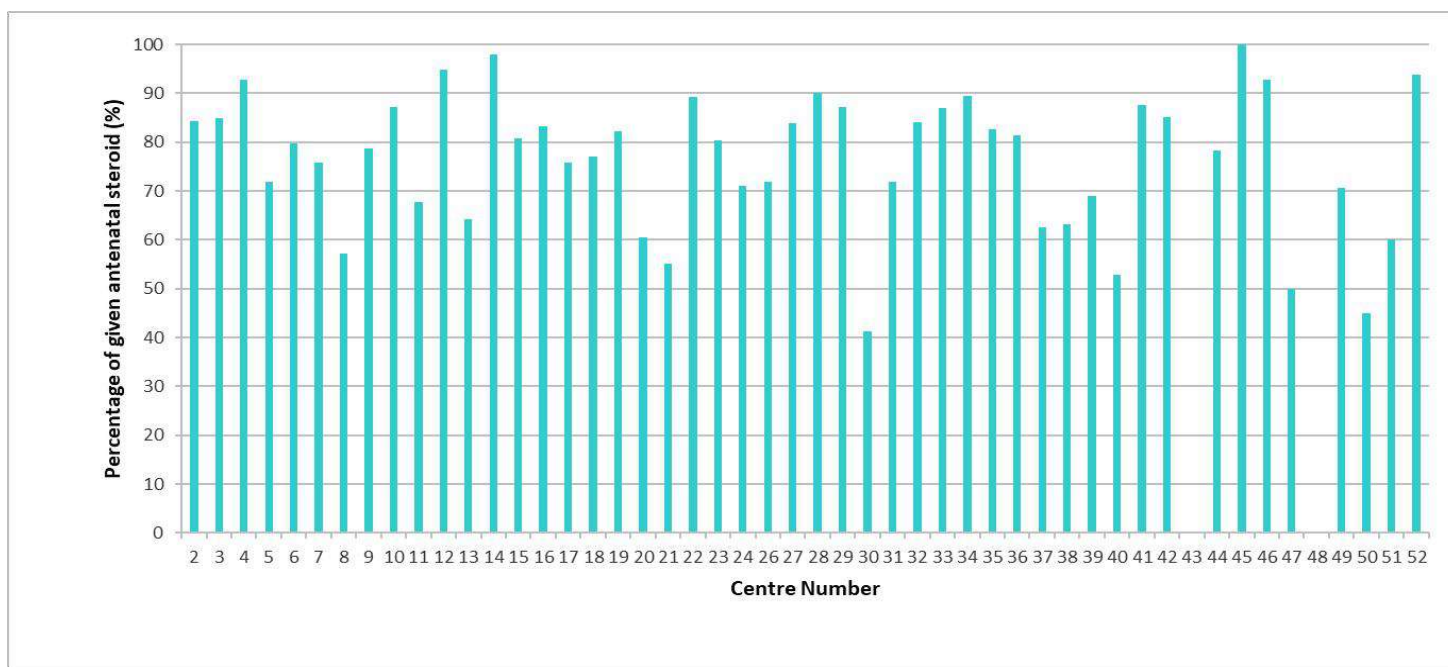


Figure 5b

Antenatal corticosteroids for all outborn babies born at $\leq 1500\text{g}$ birth weight according to centres

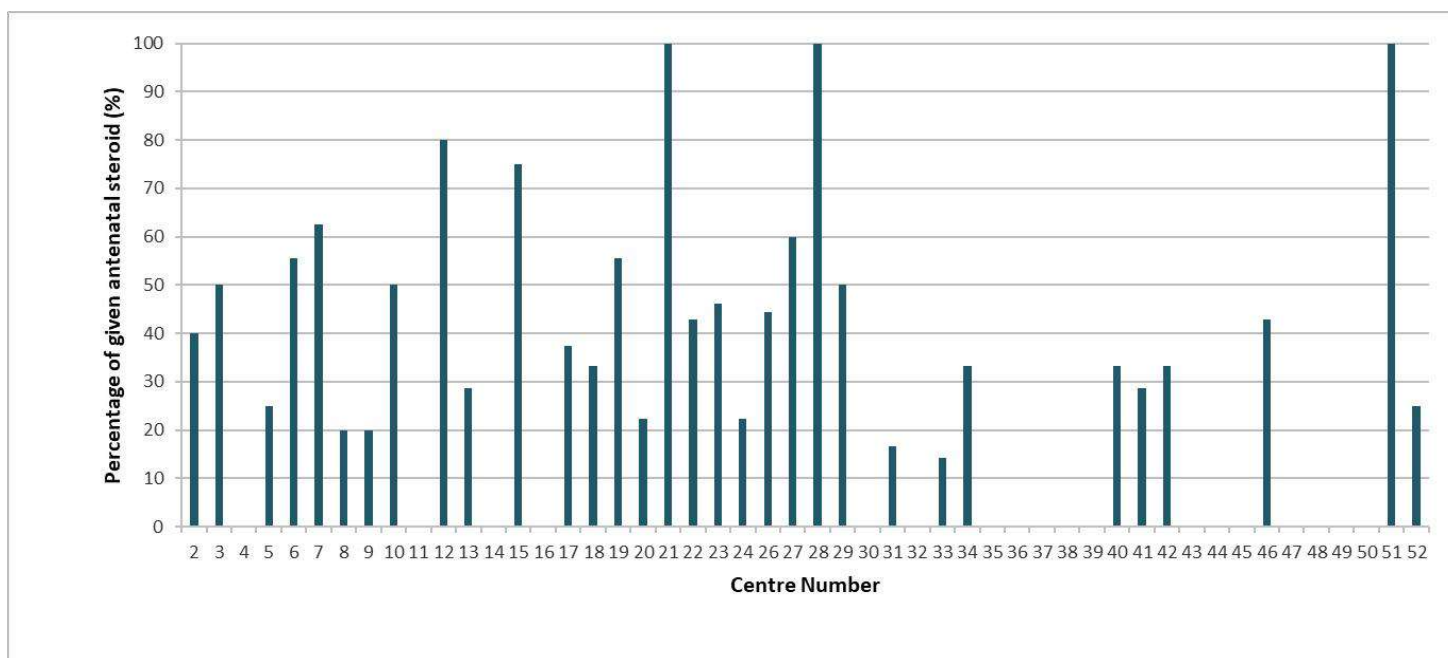


Table 5 :
Antenatal corticosteroids for all babies born at ≤ 1500 grams birth weight according to centres

Hospitals	Inborn			Outborn		
	Total no. of babies	Given antenatal steroids		Total no. of babies	Given antenatal steroids	
	n	N	%	n	N	n
	3,168	2,473	78.1	240	90	37.5
2	76	64	84.2	10	4	40.0
3	119	101	84.9	6	3	50.0
4	28	26	92.9	1	0	0.0
5	128	92	71.9	12	3	25.0
6	104	83	79.8	18	10	55.6
7	203	154	75.9	8	5	62.5
8	189	108	57.1	10	2	20.0
9	127	100	78.7	5	1	20.0
10	70	61	87.1	6	3	50.0
11	31	21	67.7	0	0	0.0
12	58	55	94.8	5	4	80.0
13	42	27	64.3	7	2	28.6
14	49	48	98.0	0	0	0.0
15	68	55	80.9	4	3	75.0
16	90	75	83.3	4	0	0.0
17	103	78	75.7	8	3	37.5
18	35	27	77.1	3	1	33.3
19	73	60	82.2	9	5	55.6

Table 5 continued:

Antenatal corticosteroid for all babies born at ≤ 1500 grams birth weight according to centres

Hospitals	Inborn			Outborn		
	Total no. of babies	Given antenatal steroids		Total no. of babies	Given antenatal steroids	
	n	N	%	n	N	%
20	38	23	60.5	9	2	22.2
21	49	27	55.1	1	1	100.0
22	103	92	89.3	7	3	42.9
23	128	103	80.5	13	6	46.2
24	104	74	71.2	9	2	22.2
26	174	125	71.8	18	8	44.4
27	68	57	83.8	5	3	60.0
28	20	18	90.0	1	1	100.0
29	70	61	87.1	2	1	50.0
30	17	7	41.2	0	0	0.0
31	64	46	71.9	6	1	16.7
32	69	58	84.1	1	0	0.0
33	93	81	87.1	7	1	14.3
34	38	34	89.5	3	1	33.3
35	23	19	82.6	0	0	0.0
36	27	22	81.5	2	0	0.0
37	8	5	62.5	1	0	0.0
38	19	12	63.2	0	0	0.0

Table 5 continued:

Antenatal corticosteroid for all babies born at ≤ 1500 grams birth weight according to centres

Hospitals	Inborn			Outborn		
	Total no. of babies	Given antenatal steroids		Total no. of babies	Given antenatal steroids	
	n	N	%	n	N	%
39	29	20	69.0	1	0	0.0
40	17	9	52.9	3	1	33.3
41	145	127	87.6	14	4	28.6
42	67	57	85.1	3	1	33.3
43	0	0	0.0	0	0	0.0
44	23	18	78.3	2	0	0.0
45	4	4	100.0	0	0	0.0
46	97	90	92.8	7	3	42.9
47	2	1	50.0	0	0	0.0
48	1	0	0.0	0	0	0.0
49	17	12	70.6	3	0	0.0
50	40	18	45.0	1	0	0.0
51	5	3	60.0	1	1	100.0
52	16	15	93.8	4	1	25.0

RESPIRATORY DISEASES AND CHRONIC LUNG DISEASE

Chronic Lung Disease

- **Rates of Chronic Lung Disease (Oxygen Dependency) by Gestational Age:** For all admitted inborn infants less than 32 weeks gestation surviving to the respective timeframes, the rates of oxygen dependency at **day 28 of life** and **36 weeks post-menstrual age** were:
 - **22–24 weeks gestational age:** 81.0% at day 28 and 65.8% at 36 weeks.
 - **25–27 weeks gestational age:** 63.2% at day 28 and 52.6% at 36 weeks.
 - **28–31 weeks gestational age:** 23.1% at day 28 and 17.4% at 36 weeks

(Figure 6 and Table 6).

- **Rates of Chronic Lung Disease (Oxygen Dependency) by Birth Weight:** For all admitted inborn infants with a birth weight < 1500 g surviving to the respective timeframes, the rates of oxygen dependency were:
 - **Birth weight < 750 g:** 71.6% at day 28, 70.1% at 36 weeks (for < 32 weeks gestation), and 0.0% at day 56 (for ≥ 32 weeks gestation).
 - **Birth weight 750–999 g:** 59.0% at day 28, 47.8% at 36 weeks (for < 32 weeks gestation), and 29.0% at day 56 (for ≥ 32 weeks gestation).
 - **Birth weight 1000–1249 g:** 31.5% at day 28, 28.3% at 36 weeks (for < 32 weeks gestation), and 9.5% at day 56 (for ≥ 32 weeks gestation).
 - **Birth weight 1250–1499 g:** 12.0% at day 28, 12.7% at 36 weeks (for < 32 weeks gestation), and 3.7% at day 56 (for ≥ 32 weeks gestation)

(Figure 7 and Table 7).

Figure 6

Incidence of oxygen dependency among admitted inborn babies with gestational age < 32 weeks

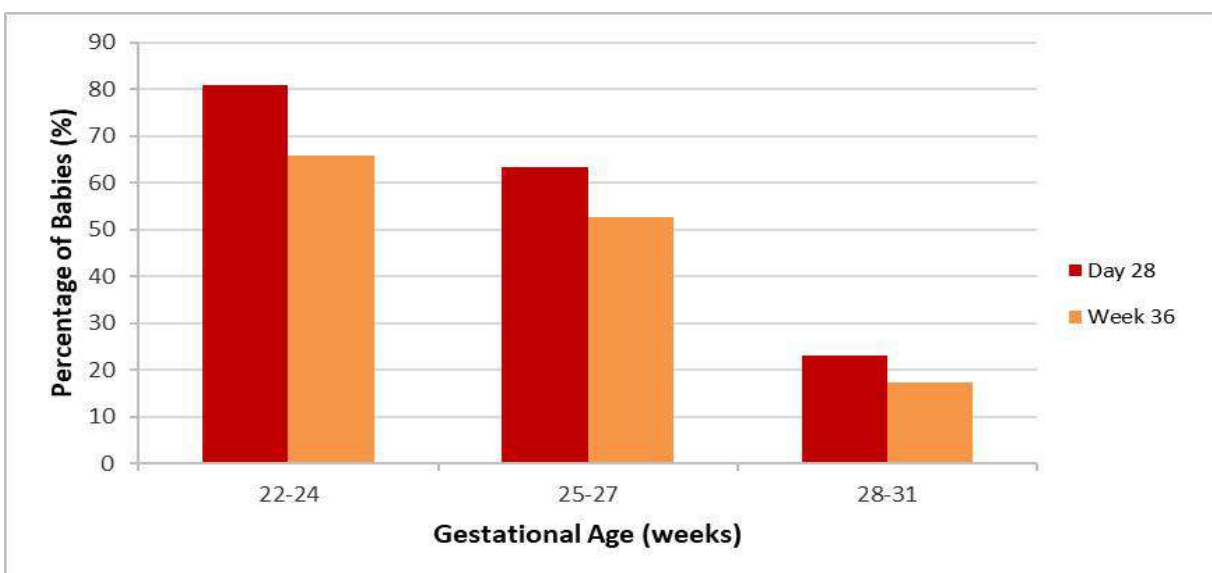


Table 6:

Incidence of oxygen dependency among admitted inborn babies with gestational age < 32 weeks

Gestational age at birth weeks		Total no of admitted inborn babies	Babies alive at day 28	Babies with oxygen dependency at day 28 among survivors	Babies alive at 36 weeks postmenstrual age	Babies with oxygen dependency at 36 weeks among survivors
22-24	<i>n</i>	120	42	34	38	25
	%	4.2	35.0	81.0	31.7	65.8
25-27	<i>n</i>	618	443	280	426	224
	%	21.5	71.7	63.2	68.9	52.6
28-31	<i>n</i>	2138	1983	459	1973	344
	%	74.3	92.8	23.1	92.3	17.4
Total included	<i>n</i>	2876	2468	773	2437	593
	%	100	85.8	31.3	84.7	24.3
Total babies		2876				

Figure 7

Incidence of oxygen dependency among admitted inborn babies with birth weight < 1500 grams

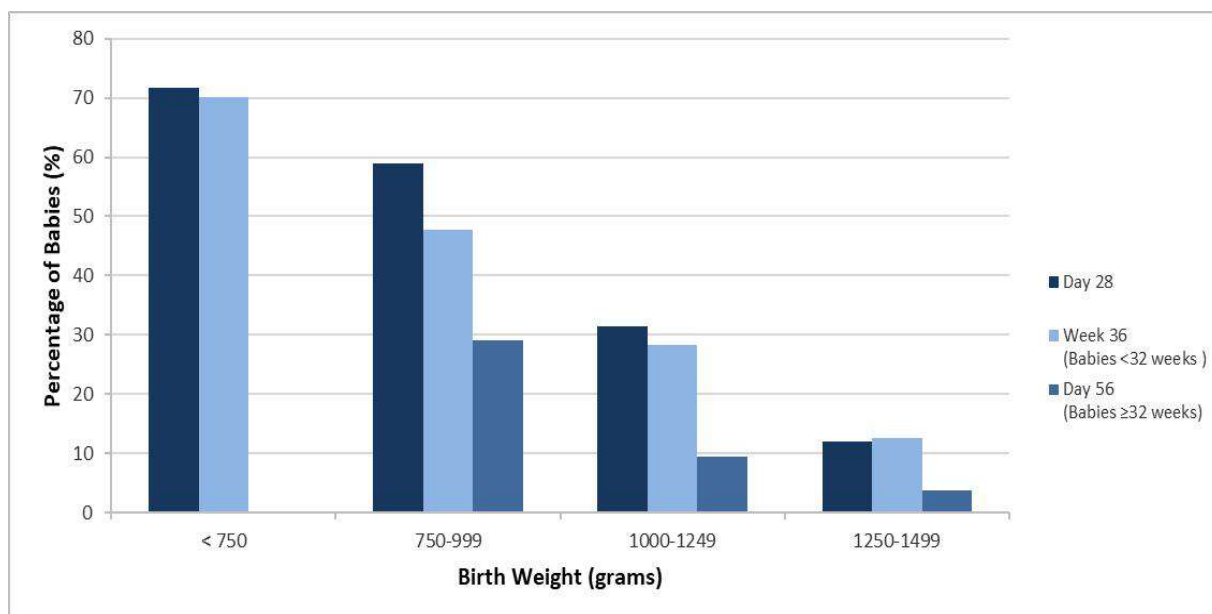


Table 7:**Incidence of oxygen dependency among admitted inborn babies with birth weight < 1500 grams**

Birth Weight grams		Total no of admitted inborn babies	Babies alive at 28	Babies with oxygen dependency at day 28 among survivors	Week 36		Day 56	
					Babies <32 weeks		Babies ≥32 weeks	
					Babies alive at 36 weeks postmenstrual age	Babies with oxygen dependency at 36 weeks among survivors	Babies alive at day 56	Babies with oxygen dependency at day 56 among survivors
< 750	<i>n</i> %	284 9.5	134 47.2	96 71.6	117 42.6	82 70.1	7 63.6	0 0.0
750-999	<i>n</i> %	630 21.0	500 79.4	295 59.0	452 76.5	216 47.8	31 79.5	9 29.0
1000 – 1249	<i>n</i> %	875 29.1	782 89.4	246 31.5	601 88.5	170 28.3	179 91.3	17 9.5
1250 - 1499	<i>n</i> %	1216 40.5	1153 94.8	138 12.0	662 95.9	84 12.7	483 91.8	18 3.7
Total Included	<i>n</i> %	3005 100	2569 85.5	775 30.2	1832 82.0	552 30.1	700 90.7	44 6.3
Total babies		3005						

CARDIOVASCULAR COMPLICATIONS**Patent Ductus Arteriosus**

- Patent ductus arteriosus (PDA) was diagnosed in 1131 (39.3%) inborn babies with gestational age less than 32 weeks admitted to the NICUs. Overall, 97.8% of these diagnosed babies had an echocardiogram to confirm the diagnosis. Indomethacin, ibuprofen, and paracetamol were administered to 1.3%, 13.0%, and 50.7% of these infants respectively, while 1.9% of them underwent PDA ligation (Table 8).
- Analysis of the birth weight cohort reveals that 1121 (37.3%) admitted inborn infants weighing less than 1500 g were diagnosed with a patent ductus arteriosus (PDA). Confirmation via echocardiogram was obtained for 97.8% of these diagnosed cases. Regarding medical management, indomethacin, ibuprofen, and paracetamol were administered to 1.3%, 13.0%, and 50.1% of these infants respectively, whereas surgical PDA ligation was performed in 1.9% of them (Table 9).

Table 8

Treatment of patent ductus arteriosus (PDA) in admitted inborn babies in the MNRR by gestational age categories

Gestation weeks	Total Inborn n	PDA Diagnosed n %		Confirmed by ECHO n %		Treatment							
						Indomethacin		Ibuprofen		Paracetamol		Ligation	
						n	%	n	%	n	%	n	%
22-24	120	46	38.3	43	93.5	1	6.0	8	17.4	26	56.5	6	13.0
25 - 27	618	350	56.6	343	98.0	4	1.7	60	17.1	204	58.3	8	2.3
28 -31	2138	735	34.4	720	98.0	6	0.8	79	10.7	343	46.7	8	1.1
Total	2876	1131	39.3	1106	97.8	11	1.3	147	13.0	573	50.7	22	1.9

Table 9

Treatment of patent ductus arteriosus (PDA) in admitted inborn babies by birth weight categories

Birth Weight grams	Total Inborn n	PDA Diagnosed n %		Confirmed by ECHO n %		Treatment							
						Indomethacin		Ibuprofen		Paracetamol		Ligation	
						n	%	n	%	n	%	n	%
< 750	284	119	41.9	113	95.0	2	2.9	20	16.8	66	55.5	4	3.4
750 - 999	630	338	53.7	332	98.2	5	1.1	57	16.9	180	53.3	10	3.0
1000- 1249	875	347	39.7	338	97.4	3	1.7	41	11.8	176	50.7	5	1.4
1250 - 1499	1216	317	26.1	313	98.7	2	0.3	28	8.8	140	44.2	2	0.6
Total	3005	1121	37.3	1096	97.8	12	1.3	146	13.0	562	50.1	21	1.9

RETINOPATHY OF PREMATURITY

Outcomes by Gestational Age

Screening for retinopathy of prematurity (ROP) before discharge was completed for **2,032 (83.0%)** inborn infants born at less than 32 weeks gestation who survived to 6 weeks of age. Within this examined cohort, the staging distribution was as follows:

- **No ROP:** 1,712 infants (84.3%)
- **Stage 1 or 2 ROP:** 277 infants (13.6%)
- **Stage 3 ROP:** 32 infants (1.6%)
- **Stage 4 or 5 ROP:** 3 infants (0.1%)
- **Aggressive Posterior ROP (APROP):** 8 infants (0.4%)

The incidence of severe ROP (defined as stage 3, 4, 5, or APROP) demonstrated a clear downward trend as gestational maturity increased. Severe ROP affected **16.7%** of babies born at 22–24 weeks (6/36), **5.8%** at 25–27 weeks (24/414), and dropped significantly to **0.8%** at 28–31 weeks gestational age (13/1,582) (*Table 10a and Figure 10*).

Ophthalmic Interventions by Gestational Age

Therapeutic management for these infants included laser therapy for 29 babies and anti-vascular endothelial growth factor (anti-VEGF) injections for 7 babies. No infants required cryotherapy or vitrectomy surgery. Evaluated by maturity category, interventions consisted of:

- **22–24 weeks cohort:** 5 babies received laser therapy; none required anti-VEGF.
- **25–27 weeks cohort:** 16 babies received laser therapy; 4 received anti-VEGF injections.
- **28–31 weeks cohort:** 8 babies underwent laser therapy; 3 received anti-VEGF injections.

(*Table 10b*)

Outcomes by Birth Weight

A total of **2,105 (82.7%)** inborn infants weighing less than 1500 g who survived to 6 weeks of age successfully underwent ROP screening prior to discharge. Within this birth weight cohort, outcomes included:

- **No ROP:** 1,790 infants (85.0%)
- **Stage 1 or 2 ROP:** 274 infants (13.0%)
- **Stage 3 ROP:** 31 infants (1.5%)
- **Stage 4 or 5 ROP:** 3 infants (0.1%)
- **Aggressive Posterior ROP (APROP):** 7 infants (0.3%)

Severe ROP scaled inversely with birth weight, affecting **9.8%** of babies weighing <750 g (12/122), **4.9%** of those weighing 750–999 g (23/465), **0.7%** of those weighing 1000–1249 g (5/678), and only **0.1%** of those weighing 1250–1499 g (1/840) (*Table 11a and Figure 11*).

Ophthalmic Interventions by Birth Weight

Ophthalmic therapeutic management for these very low birth weight infants involved laser therapy for 28 babies and anti-VEGF injections for 6 babies, with no infants requiring cryotherapy or vitrectomy surgery. Looking at specific weight categories, interventions consisted of:

- **<750 g group:** 11 babies received laser therapy; 3 received anti-VEGF injections.
- **750–999 g group:** 15 babies received laser therapy; 1 received an anti-VEGF injection.
- **1000–1249 g group:** 1 baby underwent laser therapy; 2 received anti-VEGF injections.
- **1250–1499 g group:** A single baby required laser therapy; none received anti-VEGF treatment.

(Table 11b)

Figure 10

Incidence of retinopathy of prematurity ROP in admitted inborn babies by gestational age categories

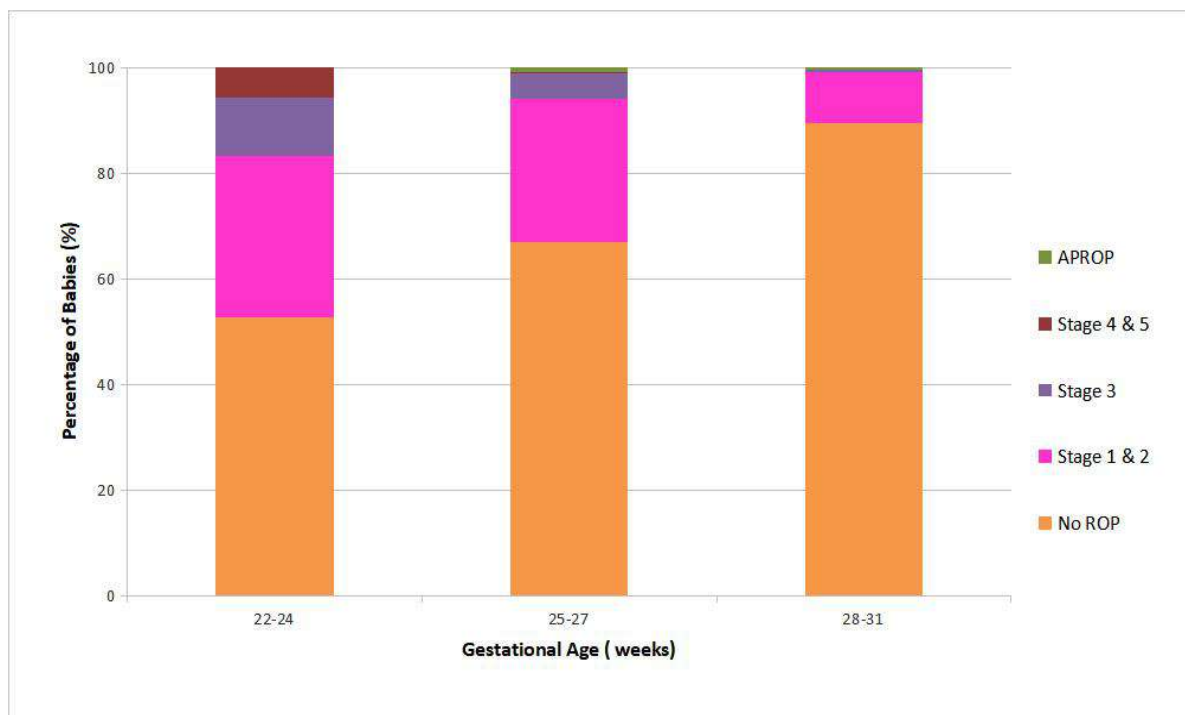


Table 10a:**Incidence of retinopathy of prematurity ROP in admitted inborn babies in the MNNR by gestational age categories**

Gestational age at birth weeks	Total number of admitted inborn babies	No. of babies alive at 6 weeks	No. of babies with eye examination		Retinopathy of prematurity									
					No ROP		ROP Stage 1 or 2		ROP Stage 3		ROP Stage 4 or 5		APROP	
					<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
22-24	120	41	36	87.8	19	52.8	11	30.6	4	11.1	2	5.6	0	0.0
25-27	618	432	414	95.8	277	66.9	113	27.3	20	4.8	1	0.2	3	0.7
28-31	2138	1975	1582	80.1	1416	89.5	153	9.7	8	0.5	0	0.0	5	0.3
Total Included	2876	2448	2032	83.0	1712	84.3	277	13.6	32	1.6	3	0.1	8	0.4

Table 10b:**Ophthalmic interventions for retinopathy of prematurity (ROP) in admitted inborn babies by gestational age categories**

Gestational age at birth weeks	Therapy			
	Laser	Cryotherapy	Anti-VEGF	Vitrectomy
22-24	5	0	0	0
25-27	16	0	4	0
28-31	8	0	3	0
Total Included	29	0	7	0

Comment: "Number of babies with eye examination" refers to those screened during the ward admission

Figure 11

Incidence of retinopathy of prematurity (ROP) in admitted inborn babies by birth weight categories

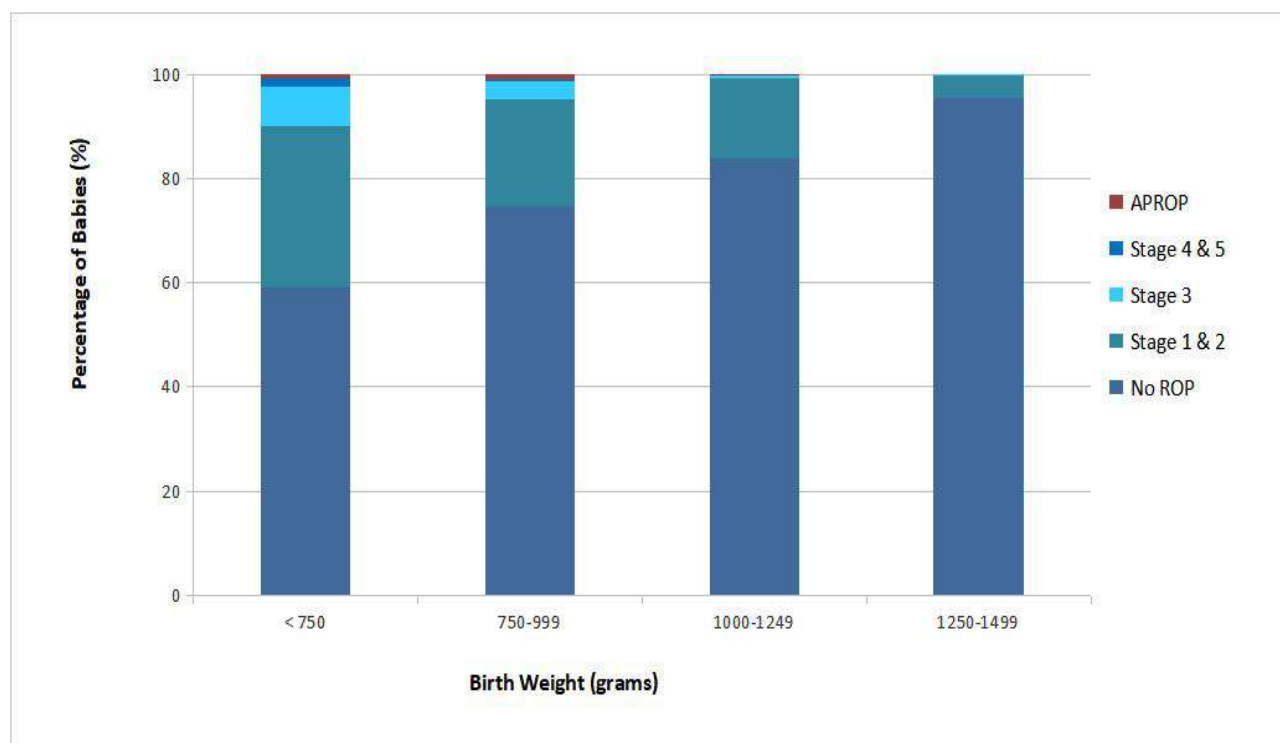


Table 11a :

Incidence of retinopathy of prematurity (ROP) in admitted inborn babies in the MNNR by birth weight categories

Birth weight grams	Total no of admitted inborn babies	No. of babies alive at 6 weeks	No. of babies with eye examination		Retinopathy of prematurity									
					No ROP		ROP Stage 1 or 2		ROP Stage 3		ROP Stage 4 or 5		APROP	
	<i>n</i>	<i>n</i>	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
< 750	284	130	122	93.8	72	59.0	38	31.1	9	7.4	2	1.6	1	0.8
750-999	630	487	465	95.5	347	74.6	95	20.4	17	3.7	1	0.2	5	1.1
1000-1249	875	780	678	86.9	569	83.9	104	15.3	4	0.6	0	0.0	1	0.1
1250-1499	1216	1148	840	73.2	802	95.5	37	4.4	1	0.1	0	0.0	0	0.0
Total included	3005	2545	2105	82.7	1790	85.0	274	13.0	31	1.5	3	0.1	7	0.3

Table 11b :

Ophthalmic interventions for retinopathy of prematurity (ROP) in admitted inborn babies by birth weight categories

Gestational age at birth weeks	Therapy			
	Laser	Cryotherapy	Anti-VEGF	Vitreectomy
< 750	11	0	3	0
750 - 999	15	0	1	0
1000- 1249	1	0	2	0
1250 - 1499	1	0	0	0
Total included	28	0	6	0

Comment: “Number of babies with eye examination” refers to those screened during the ward admission

INTRAVENTRICULAR HAEMORRHAGE

Outcomes by Gestational Age

Cranial ultrasound examinations for intraventricular haemorrhage (IVH) were completed for **2,766 (96.2%)** admitted inborn babies born at less than 32 weeks gestation. Within this screened group, the staging distribution was as follows:

- **No IVH:** 1,670 infants (60.4%)
- **Grade 1 or 2 IVH:** 885 infants (32.0%)
- **Grade 3 IVH:** 124 infants (4.5%)
- **Grade 4 IVH:** 87 infants (3.1%)

The combined incidence of severe IVH (defined as Grade 3 or 4) demonstrated a sharp downward trend as gestational maturity advanced. Severe IVH affected **24.4%** of babies born at 22–24 weeks (21/86), **18.6%** at 25–27 weeks (108/582), and dropped to **3.9%** at 28–31 weeks gestational age (82/2,098) (Figure 12 and Table 12).

Outcomes by Birth Weight

A total of **2,883 (95.9%)** admitted inborn infants weighing less than 1500 g underwent a cranial ultrasound scan prior to discharge. Within this birth weight cohort, outcomes included:

- **No IVH:** 1,765 infants (61.2%)
- **Grade 1 or 2 IVH:** 909 infants (31.5%)
- **Grade 3 IVH:** 123 infants (4.3%)
- **Grade 4 IVH:** 86 infants (3.0%)

Severe IVH scaled inversely with birth weight, affecting **20.0%** of babies weighing <750 g (47/235), **14.5%** of those weighing 750–999 g (88/606), **5.6%** of those weighing 1000–1249 g (48/861), and dropping to **2.2%** among those weighing 1250–1499 g (26/1,181) (Figure 13 and Table 13).

Figure 12

Incidence of intraventricular haemorrhage (IVH) in admitted inborn babies < 32 weeks gestational age

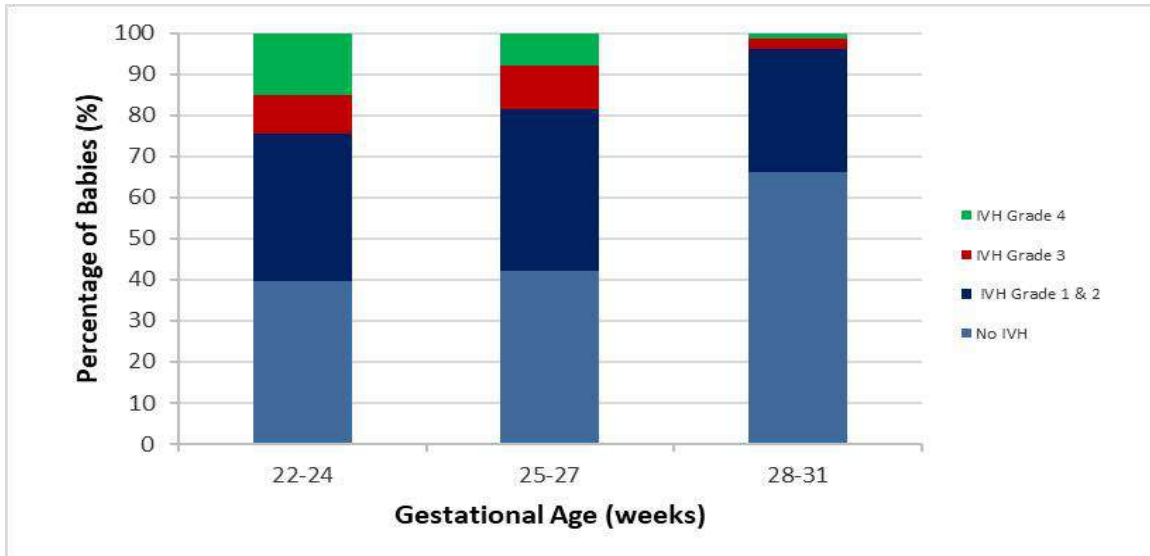


Table 12 :

Incidence of intraventricular haemorrhage (IVH) in admitted inborn babies < 32 weeks gestational age

Gestational age completed weeks		Total no. of admitted inborn babies	Babies with cranial US	NO IVH	IVH Grade 1 or Grade 2	IVH Grade 3	IVH Grade 4
22-24	N	120	86	34	31	8	13
	%	4.2	71.7	39.5	36.0	9.3	15.1
25-27	n	618	582	245	229	62	46
	%	21.5	94.2	42.1	39.3	10.7	7.9
28-31	N	2138	2098	1391	625	54	28
	%	74.3	98.1	66.3	29.8	2.6	1.3
Total included	N	2876	2766	1670	885	124	87
	%	100	96.2	60.4	32.0	4.5	3.1
Total babies		2876					

Figure 13

Incidence of intraventricular haemorrhage (IVH) in admitted inborn babies < 1500 grams birth weight

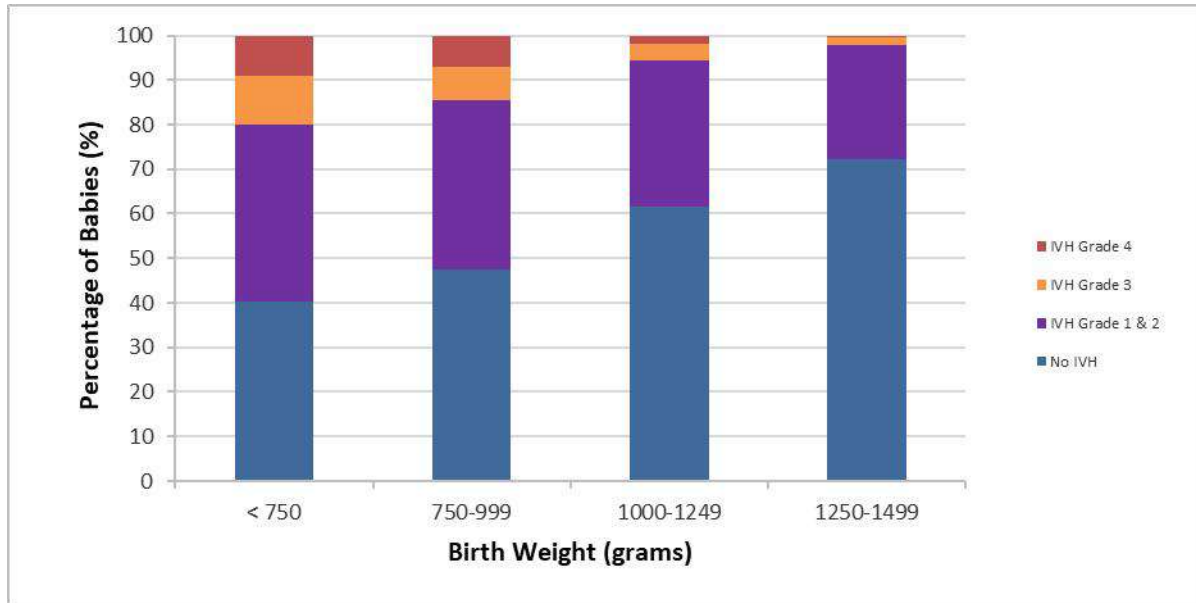


Table 13 :

Incidence of intraventricular haemorrhage (IVH) in admitted inborn babies <1500 grams birth weight

Birth weight grams		Total no. of admitted inborn babies	Babies with Cranial US	NO IVH	IVH Grade 1 or Grade 2	IVH Grade 3	IVH Grade 4
< 750	n	284	235	95	93	26	21
	%	9.5	82.7	40.4	39.6	11.1	8.9
750-999	n	630	606	288	230	45	43
	%	21.0	96.2	47.5	38.0	7.4	7.1
1000-1249	n	875	861	530	283	32	16
	%	29.1	98.4	61.6	32.9	3.7	1.9
1250-1499	n	1216	1181	852	303	20	6
	%	40.5	97.1	72.1	25.7	1.7	0.5
Total included	n	3005	2883	1765	909	123	86
	%	100	95.9	61.2	31.5	4.3	3.0
Total babies		3005					

NECROTIZING ENTEROCOLITIS

Outcomes by Gestational Age

A diagnosis of necrotizing enterocolitis (NEC)—defined as Stage 2 or above using modified Bell’s criteria—was documented in **153 (5.3%)** admitted inborn infants born at less than 32 weeks gestation.

- **Surgical Intervention:** Within this affected group, surgical management was required for **67 (43.8%)** of the babies.
- **Incidence by Gestational Age:** The occurrence of NEC varied across maturity categories, affecting:
 - **22–24 weeks:** 2.5% (3/120)
 - **25–27 weeks:** 6.1% (38/618)
 - **28–31 weeks:** 5.2% (112/2,138)

(Figure 14 and Table 14)

Outcomes by Birth Weight

Among the cohort weighing less than 1500 g at birth, **166 (5.5%)** inborn babies developed NEC of Stage 2 or higher.

- **Surgical Intervention:** Surgical management was required for **76 (45.8%)** of these cases.
- **Incidence by Birth Weight Brackets:** Disease frequency scaled progressively downward as birth weight increased:
 - **<750 g:** 9.2% (26/284)
 - **750–999 g:** 7.0% (44/630)
 - **1000–1249 g:** 5.1% (45/875)
 - **1250–1499 g:** 4.2% (51/1,216)

(Figure 15 and Table 15)

Figure 14

Incidence of necrotizing enterocolitis (NEC) in admitted inborn babies according to gestational age categories

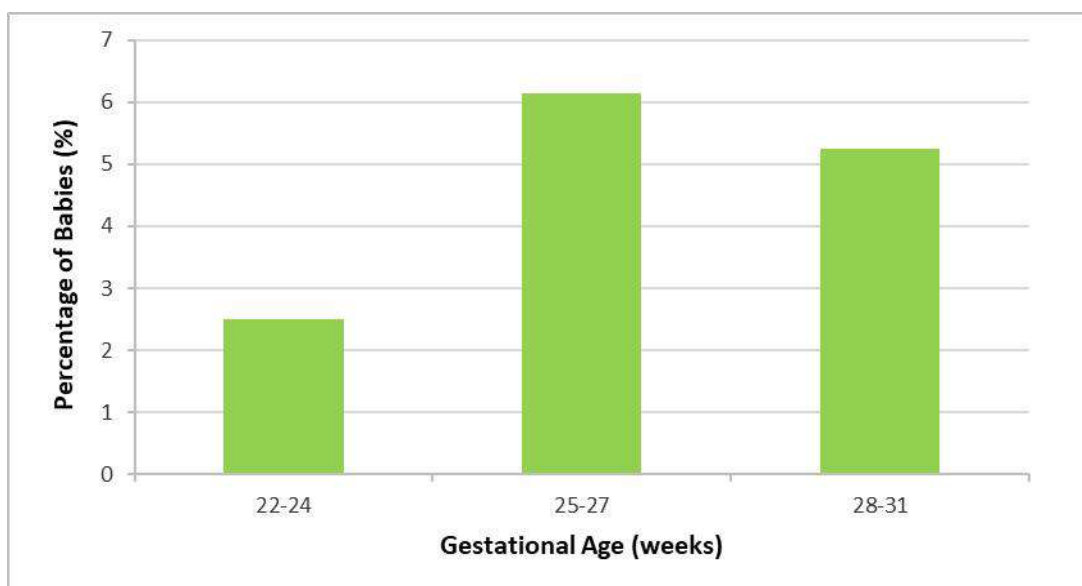


Table 14 :

Incidence and treatment of necrotizing enterocolitis (NE)C in admitted inborn babies according to gestational age categories

Gestational age weeks	Total number of admitted inborn babies	Babies with NEC		With Surgical treatment	
		<i>n</i>	%	<i>n</i>	%
22-24	120	3	2.5	1	33.3
25-27	618	38	6.1	19	50.0
28-31	2138	112	5.2	47	42.0
Total Included	2876	153	5.3	67	43.8
Total no. of missing GA	0				
Overall Total babies	2876				

Comment: NEC refers to those with at least Stage 2 modified Bell's criteria

Figure 15

Incidence of necrotizing enterocolitis (NEC) in admitted inborn babies according to birth weight categories

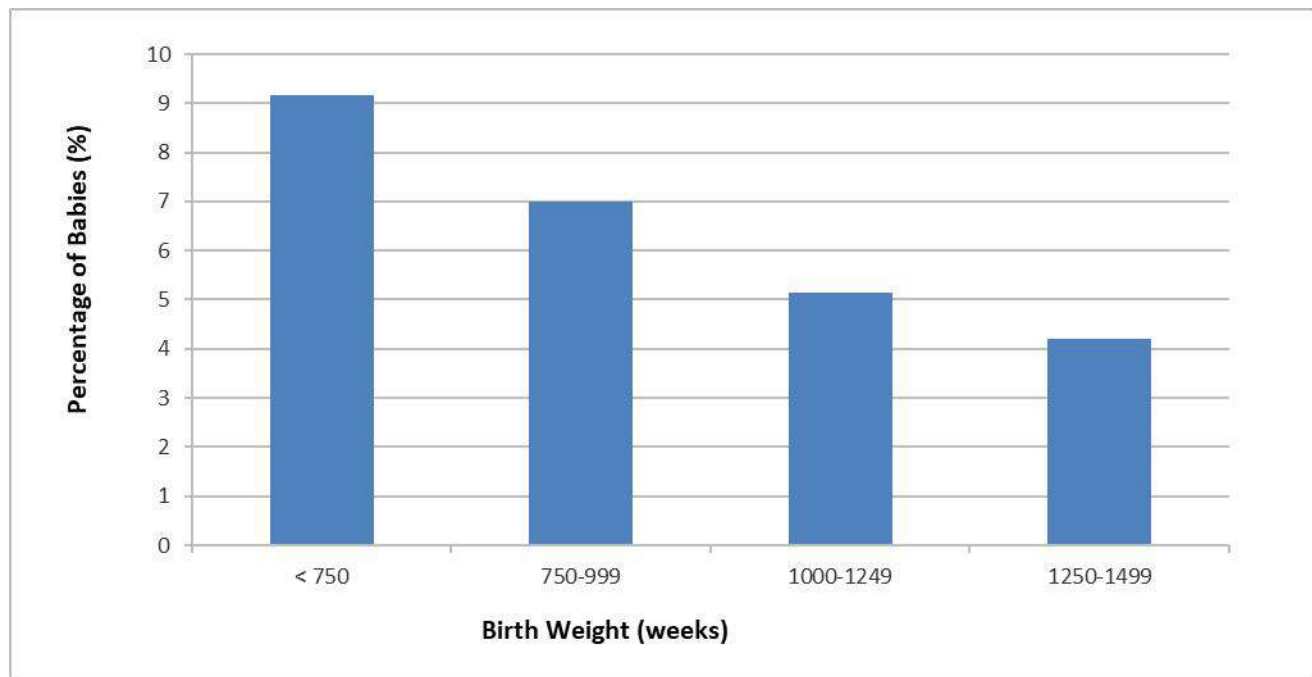


Table 15 :

Incidence and treatment of necrotizing enterocolitis (NEC) in admitted inborn babies according to birth weight categories

Birth weight grams	Total number admitted of inborn babies	Babies with NEC		With Surgical treatment	
		<i>n</i>	%	<i>n</i>	%
< 750	284	26	9.2	10	38.5
750-999	630	44	7.0	24	54.5
1000-1249	875	45	5.1	19	42.2
1250 – 1499	1216	51	4.2	23	45.1
Total included	3005	166	5.5	76	45.8
Total no. of missing BW	0				
Overall total babies	3005				

Comment: NEC refers to those with at least Stage 2 modified Bell's criteria

NEONATAL SEPSIS

Blood Culture-Positive Early-Onset Sepsis (EOS)

An evaluation of blood culture-positive early-onset sepsis among admitted inborn babies born at less than 32 weeks gestation revealed an overall incidence rate of **1.6% (46/2,876)**.

- **Incidence by Gestational Age:** Stratification by maturity category showed:
 - **22–24 weeks:** 1.7% (2/120)
 - **25–27 weeks:** 2.8% (17/618)
 - **28–31 weeks:** 1.3% (27/2,138)

(Figure 16 and Table 16)

Blood Culture-Positive Late-Onset Sepsis (LOS)

Outcomes by Gestational Age

Among inborn infants born at less than 32 weeks gestation who survived beyond 3 days, **225 (8.6% of 2,625)** experienced at least one episode of confirmed blood culture-positive infection.

The risk of developing late-onset sepsis correlated strongly with lower gestational maturity, demonstrating a sharp decline in older cohorts:

- **22–24 weeks:** 26.2% (16/61)
- **25–27 weeks:** 17.8% (91/510)
- **28–31 weeks:** 5.7% (118/2,054)

(Figure 17 and Table 17)

Outcomes by Birth Weight

Among the cohort weighing less than 1,500 g at birth who survived past 3 days, **231 (8.4% of 2,745)** developed one or more confirmed blood culture-positive episodes.

The incidence of late-onset sepsis scaled progressively downward as birth weight increased:

- **<750 g:** 22.7% (41/181)
- **750–999 g:** 15.3% (85/557)
- **1000–1249 g:** 7.3% (60/820)
- **1250–1499 g:** 3.8% (45/1,187)

(Figure 18 and Table 18)

Figure 16

Incidence of blood culture positive early onset sepsis in admitted inborn babies by gestational age categories

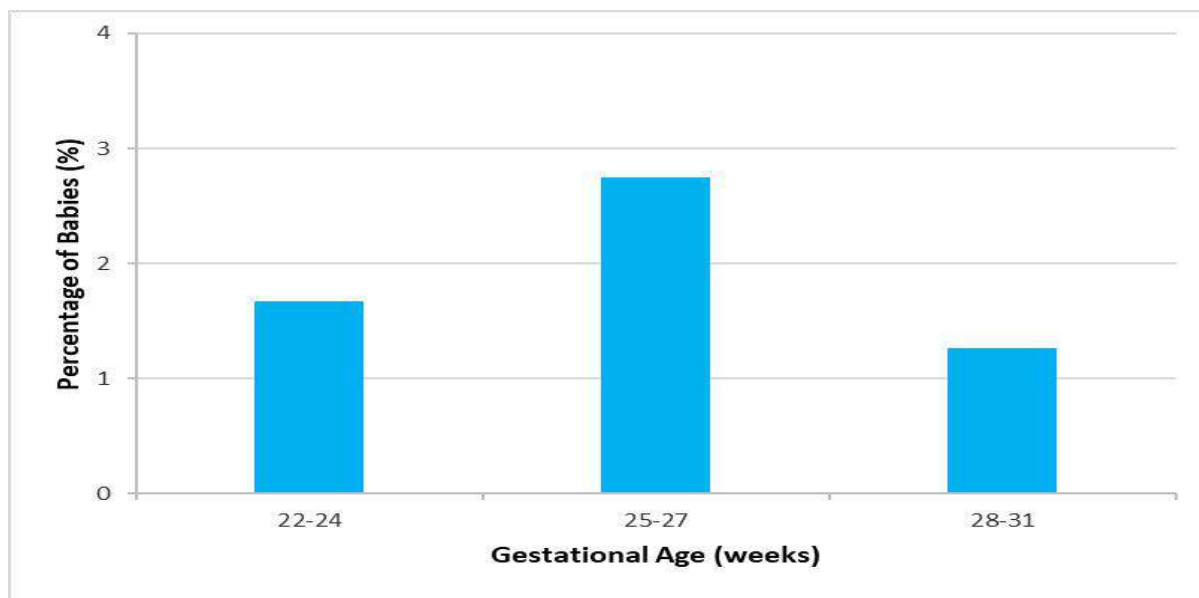


Table 16 :

Incidence of blood culture positive early onset sepsis in admitted inborn babies by gestational age categories

Gestational age at birth (completed) weeks	Total number of admitted inborn babies	No. of babies with early infection	
	<i>n</i>	<i>n</i>	%
22-24	120	2	1.7
25-27	618	17	2.8
28-31	2138	27	1.3
Total included	2876	46	1.6
Total no. of missing GA	0		
Total babies	2876		

Figure 17

Incidence of blood culture positive late onset sepsis in admitted inborn babies by gestational age categories

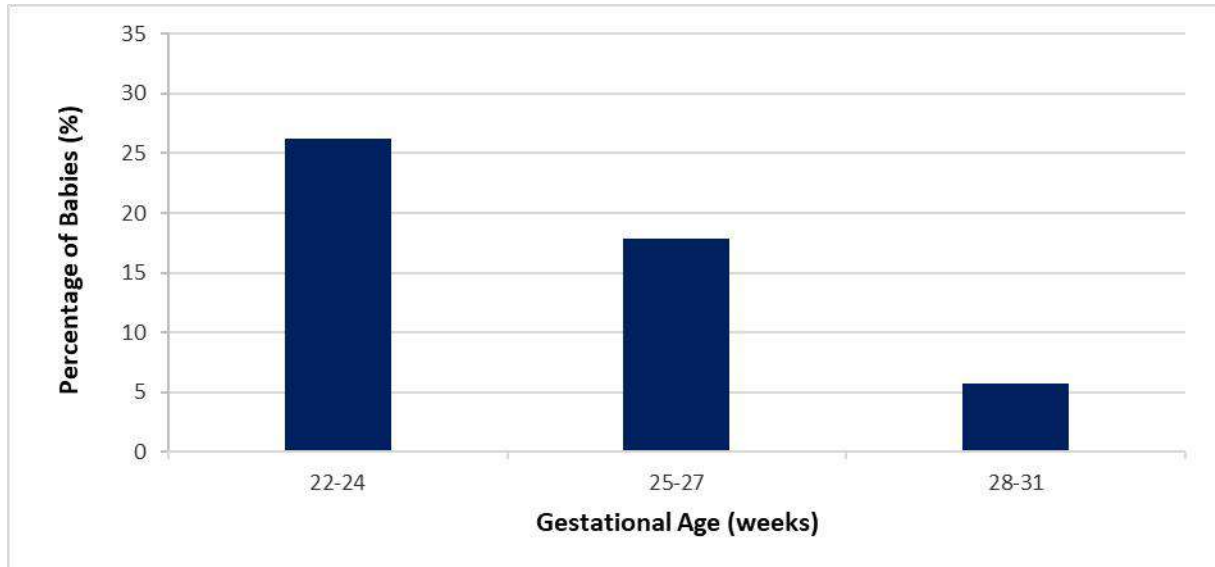


Table 17:

Incidence of blood culture positive late onset sepsis in admitted inborn babies by gestational age categories

Gestational age weeks	Total number of admitted inborn babies	No. of babies who survived beyond day 3 after birth	No. of babies (survived more than 3 days) with at least one episode of late onset sepsis	
	<i>n</i>	<i>n</i>	<i>n</i>	%
22-24	120	61	16	26.2
25-27	618	510	91	17.8
28-31	2138	2054	118	5.7
Total included	2876	2625	225	8.6
Total no. of missing GA	0			
Total babies	2876			

Figure 18

Incidence of blood culture positive late onset sepsis in admitted inborn babies by birth weight categories

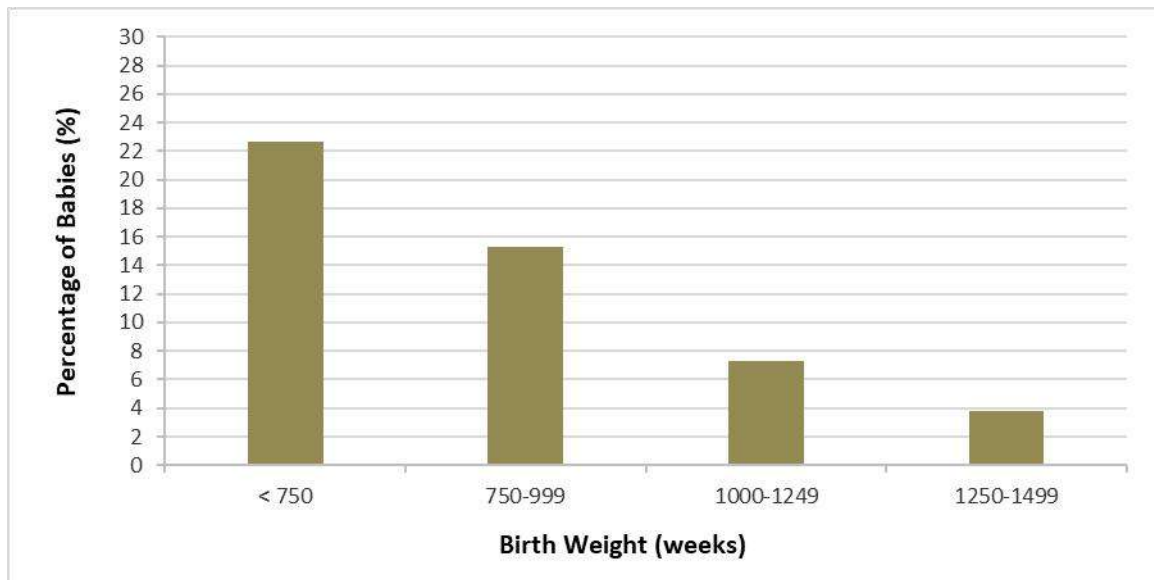


Table 18 :

Incidence of blood culture positive late onset sepsis in admitted inborn babies by birth weight categories

Birth weight grams	Total number of admitted inborn babies	No. of babies who survived beyond day 3 after birth	No. of babies (survived more than 3 days) with at least one episode of late onset sepsis	
	<i>n</i>	<i>n</i>	<i>n</i>	%
< 750	284	181	41	22.7
750-999	630	557	85	15.3
1000-1249	875	820	60	7.3
1250 - 1499	1216	1187	45	3.8
Total included	3005	2745	231	8.4
Total no. of missing BW	0			
Overall total babies	3005			

SURVIVAL AND MORBIDITIES FOR PRETERM BABIES (<32 WEEKS OR BIRTH WEIGHT 500 GRAMS TO 1500 GRAMS)

Survival to Discharge by Gestational Age

Survival rates for very preterm infants (both inborn and outborn) registered in the MNRR demonstrated a clear, incremental increase aligned with advancing gestational age. Survival was lowest at the limit of viability, starting at **12.0%** at 23 weeks and **29.0%** at 24 weeks, before climbing steadily:

- **25 weeks:** 51.2%
- **26 weeks:** 59.1%
- **27 weeks:** 76.6%
- **28 weeks:** 82.9%
- **29 weeks:** 88.1%
- **30 weeks:** 94.1%
- **31 weeks:** 92.1%

(Figure 19 and Table 19)

Survival to Discharge by Birth Weight

Survival outcomes scaled strongly with birth weight categories. While survival was only **5.9%** for extremely low birth weight infants weighing <500 grams, rates improved significantly across heavier weight cohorts:

- **500–750 grams:** 37.1%
- **751–1000 grams:** 73.9%
- **1001–1250 grams:** 87.4%
- **1251–1500 grams:** 93.3%

(Figure 20 and Table 20)

Analysis of Major Neonatal Morbidities among Inborn Survivors

To evaluate the clinical burden of prematurity, we assessed the cumulative presence of six major neonatal morbidities prior to hospital discharge among inborn survivors:

1. **Patent Ductus Arteriosus (PDA)** requiring surgical ligation.
2. **Retinopathy of Prematurity (ROP)** Stage 3, 4, or 5, or Aggressive Posterior ROP (APROP).
3. **Oxygen Dependency** at 36 weeks post-conceptual age (bronchopulmonary dysplasia).
4. **Sepsis** confirmed by positive blood culture.
5. **Necrotizing Enterocolitis (NEC)** Stage 2 or greater based on modified Bell's criteria.
6. **Intraventricular Haemorrhage (IVH)** Grade 3 or 4.

Morbidity Burden by Gestational Age

The overall morbidity burden among survivors decreased significantly as gestational age increased:

- **22–24 Weeks:** Only **30.5%** survived without any of the six major morbidities. Conversely, **27.8%** developed one morbidity, **13.9%** had two, **25.0%** had three, and **2.8%** suffered from four morbidities. No infants in this cohort experienced five or more morbidities.

- **25–27 Weeks:** Over one-third (**35.7%**) of survivors escaped major morbidities. Of the remaining infants, **41.7%** had one morbidity, **17.6%** had two, **4.3%** had three, and **0.7%** had four morbidities. None had five or more.
- **28–31 Weeks:** The vast majority (**75.8%**) of survivors in this group discharged free of any major morbidities. For those who did experience complications, **18.6%** had one morbidity, **4.6%** had two, **0.9%** had three, and **0.1%** had four.

(Table 21a)

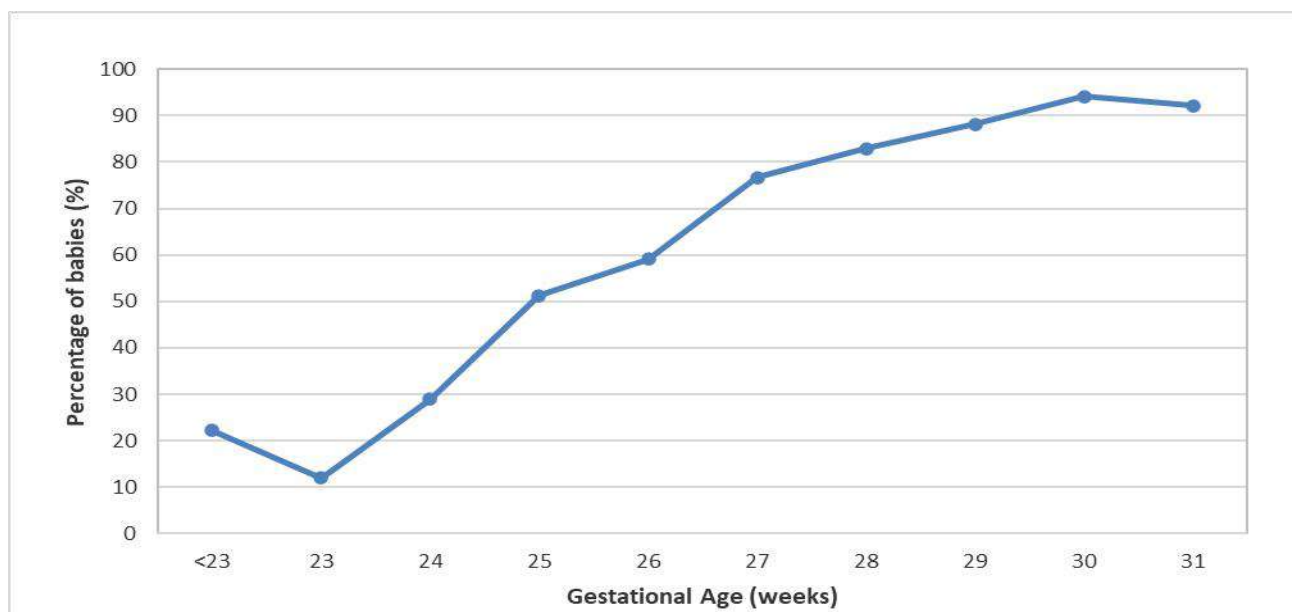
Morbidity Burden by Birth Weight

Lighter infants carried a substantially higher multi-morbidity burden compared to their heavier counterparts:

- **<750 grams:** Nearly a quarter (**23.9%**) survived without any major morbidities. However, **41.0%** developed one morbidity, **20.5%** experienced two, and **14.6%** suffered from three morbidities.
- **750–999 grams:** Free of major morbidities in **43.6%** of cases. The remaining survivors experienced one (**38.1%**), two (**14.9%**), three (**2.7%**), or four (**0.7%**) morbidities.
- **1000–1249 grams:** Survival without any of the six morbidities rose to **71.3%**. Single morbidity occurred in **21.2%**, two in **5.8%**, three in **1.6%**, and four in **0.3%**.
- **1250–1499 grams:** The vast majority (**85.7%**) of infants discharged with no morbidities. Morbidity was largely limited to a single complication (**12.1%**), with **2.1%** experiencing two morbidities, and only **0.1%** experiencing three.

Figure 19

Survival to discharge of all live births admitted to MNNR hospitals according to gestational age



*COMMENT: * For the category ≥ 32 weeks gestation, calculated survival rate does not include all live births in that category (see inclusion criteria).*

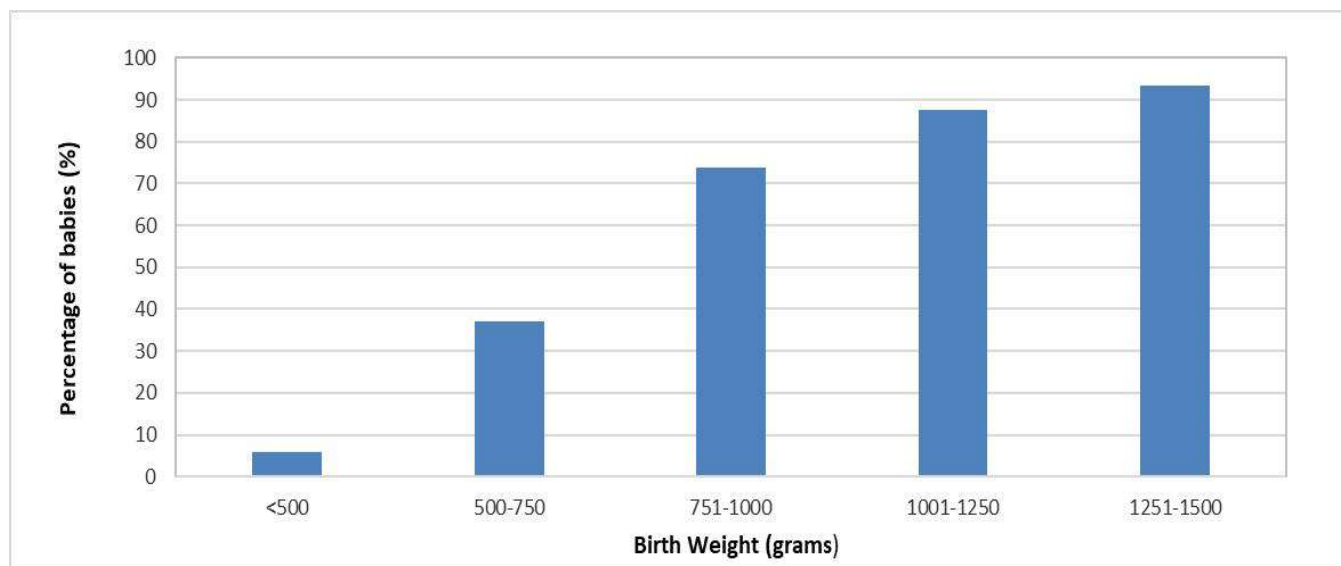
Table 19 :

Survival to discharge of all live births admitted to MNNR hospitals according to gestational age

Gestational age completed weeks	Total number of inborn & outborn babies	Number of survivors	% survival
<23	18	4	22.2
23	50	6	12.0
24	107	31	29.0
25	164	84	51.2
26	225	133	59.1
27	321	246	76.6
28	398	330	82.9
29	438	386	88.1
30	713	671	94.1
31	759	699	92.1
Total included	3193	2590	81.1
Total no. of missing GA	0		
Total babies	3193		

Figure 20

Survival to discharge of all babies admitted to MNHR hospitals according to birth weight categories



*COMMENT: * For the category > 1500 gram birth weight, calculated survival rate does not include all live births in that category (see inclusion criteria).*

Table 20 :

Survival to discharge of all babies admitted to MNHR hospitals according to birth weight categories

Birth weight grams	Total number of inborn & outborn babies	Number of survivors	% survival
<500	17	1	5.9
500-750	353	131	37.1
751-1000	759	561	73.9
1001-1250	945	826	87.4
1251-1500	1334	1244	93.3
Total included	3408	2763	81.1
Total no. of missing BW	0		
Overall Total babies	3408		

*COMMENT: * For the category > 1500 gram birth weight, calculated survival rate does not include all live births in that category (see inclusion criteria).*

Table 21a
Gestational age specific survival with significant morbidity(ies) in admitted inborn babies

Gestaional age at birth		Total no. of babies	Survived	No. with any one morbidity prior to discharge	No. with any two morbidities prior to discharge	No. with any three morbidities prior to discharge	No. with any four morbidities prior to discharge	No. with any five morbidities prior to discharge	No. with six morbidities prior to discharge	No. with no morbidity prior to discharge
(completed weeks)		N %	n %	n %	n %	n %	n %	n %	n %	n %
22-24	n %	120 4.2	36 30.0	10 27.8	5 13.9	9 25.0	1 2.8	0 0	0 0	11 30.5
25-27	n %	618 21.5	420 68.0	175 41.7	74 17.6	18 4.3	3 0.7	0 0	0 0	150 35.7
28-31	n %	2138 74.3	1950 91.2	364 18.6	90 4.6	17 0.9	1 0.1	0 0	0 0	1479 75.8
Total babies <32 weeks included	N %	2876 100	2406 83.7	549 22.8	169 7.0	44 1.8	5 0.2	0 0	0 0	1640 68.2

Morbidities

- | | |
|---|---|
| i. Patent ductus arteriosus (PDA) requiring surgery | iv. Oxygen dependency at 36 weeks |
| ii. Stage 3, 4 or 5 retinopathy of prematurity (ROP) or APROP | v. Blood culture positive sepsis |
| iii. Necrotising enterocolitis (NEC) | vi. Intraventricular haemorrhage (IVH) stage 3 or 4 |

Table 21b

Birth weight specific survival with significant morbidity(ies) in admitted inborn babies

Birth weight		Total no. of babies	Survived	No. with any one morbidity prior to discharge	No. with any two morbidities prior to discharge	No. with any three morbidities prior to discharge	No. with any four morbidities prior to discharge	No. with any five morbidities prior to discharge	No. with six morbidities prior to discharge	No. with no morbidity prior to discharge
(grams)		N %	n %	n %	n %	n %	n %	n %	n %	n %
< 750	n	284	117	48	24	17	0	0	0	28
	%	9.5	41.2	41.0	20.5	14.6	0	0	0	23.9
750-999	n	630	475	181	71	13	3	0	0	207
	%	21.0	75.4	38.1	14.9	2.7	0.7	0	0	43.6
1000-1249	n	875	766	162	44	12	2	0	0	546
	%	29.1	87.5	21.2	5.8	1.6	0.3	0	0	71.3
1250-1499	n	1216	1142	138	24	1	0	0	0	979
	%	40.5	93.9	12.1	2.1	0.1	0	0	0	85.7
Total babies < 1500 grams included	N	3005	2500	529	163	41	5	0	0	1761
	%	100	83.2	21.2	6.5	1.7	0.2	0	0	70.4

Morbidity

- Patent ductus arteriosus (PDA) requiring surgery
- Stage 3, 4 or 5 retinopathy of prematurity (ROP) or APROP
- Necrotizing enterocolitis (NEC)

- Oxygen dependency at 36 weeks
- Blood culture positive sepsis
- Intraventricular haemorrhage (IVH) stage 3 or 4

THERAPEUTIC HYPOTHERMIA

A total of 758 infants born at ≥ 35 weeks gestational age were diagnosed with hypoxic-ischaemic encephalopathy (HIE), comprising 688 inborn and 70 outborn admissions.

- By clinical severity, 360 infants were diagnosed with mild HIE, 253 with moderate HIE, and 145 with severe HIE.
- Therapeutic hypothermia was initiated for 494 infants within the HIE cohort.
- In-hospital mortality rates for infants with moderate and severe HIE were 2.8% (7/253) and 51.7% (75/145), respectively.

APPENDICES

(Adapted from Paediatric Services Operational Policy, Ministry of Health Malaysia, 2024, pg 44-45)

Level I (Neonatal care in the postnatal wards)

Provide care for the following infants placed together with their mothers and regarded as inpatients:

- a. Stable term newborn infants
- b. Infants born 35-37 weeks' gestation who remain physiologically stable
- c. Infants receiving phototherapy for mild neonatal jaundice, on glucose monitoring, for completion of antibiotics

Level II (Special care nursery)

Provide care for the following infants:

- a. Born at > 32 weeks' gestation and weight > 1500g who have physiologic immaturity.
- b. Moderately ill infants with problems that are expected to resolve rapidly and are not anticipated to need subspecialty services on an urgent basis.
- c. Infants with mild to moderate respiratory illness on non-invasive ventilation (CPAP or HFNC). Conventional ventilation may be provided for a brief duration until transfer to a NICU.
- d. Infants with management of common neonatal conditions e.g. neonatal jaundice, Infants with risk of sepsis.
- e. Post intensive care convalescing infants
- f. Infants with chronic NIV or oxygen dependency.
- g. Infants needing surgical nursing.

Level II facilities and capabilities should take into consideration geographical constraints.

Level III (NICU)

Provide sustained life support for the following infants:

- a. Born before 32 weeks gestation and weight less than 1500g
- b. Infants born at all gestational ages and birth weights with critical illness requiring sustained life support, such as:
 - i. Respiratory support including invasive ventilation (conventional and high-frequency ventilation), non-invasive ventilation (CPAP, HFNC), inhaled nitric oxide
 - ii. Therapeutic hypothermia for neonatal encephalopathy
- c. Infants require access to paediatric medical subspecialists, paediatric surgeons, paediatric anaesthesiologists, paediatric ophthalmologists, etc.

Level IV (Regional NICU)

Level III capabilities plus:

- a. Located within an institution with the capability to provide on-site surgical repair of complex congenital or acquired conditions.
- b. Has a range of paediatric medical subspecialists, paediatric surgical subspecialists, and paediatric anaesthesiologists at the site.

DATA DEFINITIONS AND CRITERIA

Centre Name*: Name of participating hospital

Date of Admission (dd/mm/yy): Date of first admission to the participating site

State if it is a new case, or a readmission and to specify the referring centre (*Referral from :*) if relevant.

Case Status:

'New case': First time admission to the NNU concerned will be considered as a new case.

'Readmission': Subsequent admission of the same baby to the same NNU within 44 weeks postconceptional age.

'Previously admitted to another SDP': Case transferred from SDP hospital to another SDP hospital for first time.

State if it is admitted to neonatal ward/ admitted to neonatal ward as an abandoned baby.

SECTION 1: Patient Particulars

1. **Name of mother:** Name as in hospital record
2. **Name of baby (optional):** Name as in hospital record, if relevant
3. **RN of baby:** Registration Number at participating hospital. If the baby dies in Labour room and has no RN, then use the mother's RN.
4. **a) Mother's I/C Number:** MyKad number or Other ID document no. If "Other" please specify type of document.
b) Baby's MyKid number: add number if available
5. **a) Date of Birth:** dd/mm/yy **b) Time of Birth:** To state 24-hour format (mandatory for death cases) Estimate time of death if patient died at home and time accurately not known as in home delivery
6. **Ethnic group:** Malay / Chinese / Indian / Orang Asli / Bumiputra Sabah / Bumiputra Sarawak / Other Malaysian (e.g. Punjabi, Eurasian or Serani) / Non-citizen (specific country). If Bumiputra Sabah or Bumiputra Sarawak, please specify the indigenous group.
7. **Maternal Age:** Age in completed years.
8. **GPA:** Gravida, Para, Abortion (of current pregnancy before delivery of this child). To state number of ectopic pregnancies (Ectopic pregnancy also considered as an abortion).
9. **Maternal Diabetes:** State 'yes' or 'no' if mother had diabetes (regardless of whether it is gestational or pre-gestational) State 'unknown' if so
10. **Maternal Hypertension:** State 'yes' or 'no' if mother had hypertension (regardless of whether it is chronic or pregnancy induced) State 'unknown' if so

- 11. Maternal Chorioamnionitis:** State 'yes' or 'no' if mother had chorioamnionitis. State 'unknown' if so.
- 12. Maternal Eclampsia:** State 'yes' or 'no'. State 'unknown' if so.
- 13. Maternal Anaemia:** State 'yes', 'no' or 'unknown'. Mother's Hb level < 11 g/dL or noted to have anaemia of pregnancy by O&G.
- 14. Maternal abruptio placenta:** State 'yes' or 'no'.
- 15. Maternal bleeding placenta praevia:** State 'yes' or 'no'.
- 16. Cord prolapse:** State 'yes' or 'no'.
- 17. Maternal obesity** - BMI > 30 at booking weight during 1st trimester. State 'yes' or 'no'.
- 18. Other current maternal illness** – State 'yes' or 'no'. Examples of other current illness are SLE, renal disease, cancer, epilepsy, cardiovascular disease, mental disorder, etc.

SECTION 2: Birth History

- 19. Antenatal steroids:** Corticosteroids given antenatal via any route to the mother at a time likely to enhance fetal lung maturation. Excludes steroids given for other reasons. State 'yes' if this has been given (regardless of number of doses or when it was given) or 'no' if this has not been given. If yes, state whether ONE or TWO doses given. State 'unknown' if so
- 20. Antenatal magnesium sulphate:** Antenatal magnesium sulphate given to mother prior to preterm birth for fetal neuroprotection.
- 21. Intrapartum antibiotics:** Antibiotic treatment is provided to the mother within the period mother is in labour, with the intent of preventing infection of the fetus. This includes the prophylactic use of parenteral penicillin or ampicillin. State 'Yes' if systematic antibiotics (enteral or parenteral) were given to mothers in the 24 hours prior to delivery. State 'unknown' if so
- 22. Birth weight (grams):** The weight of the baby immediately following delivery recorded in grams to the nearest gram and measured within the first hour of life.
- 23. a) Gestation (weeks):** Best estimate of gestational age at birth given in full weeks. Preferences among estimates should be:
 - 1) obstetric estimate according to delivering obstetrician. (Ultrasound date selected if done earlier than 25 weeks and there is a discrepancy with the Last Menstrual Period (LMP) dates. Otherwise, use LMP dates.
 - 2) New expanded Ballard scoring. If there is no definite estimate but baby referred to as term baby, enter 40. Preferably insert the exact gestation for term infants – i.e. ranging from 37-41 weeks
 - 3) LMP, Ultrasound, Ballard score or unknown. Choose only one – the option on which you based the baby's gestational age.

24. Growth status: based on Intrauterine Growth Curves (Composite Male / Female) chart in page 4 of the CRF. (SGA<10th centile; AGA 10-90th centile; LGA >90th centile). (Autoplot planned but presently still use the growth charts to plot)

25. Gender: Indicate Male, Female or Ambiguous/Indeterminate.

26. Place of birth:

Inborn – born in the same hospital as the participating site. If born within the wards of participating hospital also considered as inborn. (unless in ambulance – born before arrival BBA as outborn)

Outborn – Born in another place (includes BBA) and transferred after birth to NNU of the participating site. Includes those born in hospital compound but not wards.

- Home
- Health Clinic
- Government Hospital with specialist – General/District
- Government Hospital without specialist
- University Hospital
- Private Hospital/maternity home<50 beds with/without specialist
- Private Hospital/maternity home>50 beds
- Alternative Birthing Centre (ABC) – Urban/Rural
- Enroute / During transport (including delivery in ambulance within own hospital grounds)
- Others __ (please specify)
- Unknown

27. Multiplicity: To indicate as singleton, twins, triplets or others i.e. quadruplets, etc. If the baby is other than singleton, specify birth order e.g. if baby is twin 1 – fill in “01”. For triplet three, fill “03”. This together with mother’s IC no. will act as unique identifier.

28. Final Mode of Delivery: Tick as relevant. All caesarians are considered as such without differentiation into upper or lower segment. For breech presentation in caesarian sections, tick Caesarian only.

Tick as ‘emergency’ if there is a reason for the Caesarian section that has an emergency indication, not whether it is listed as ‘semi emergency’ or ‘emergency’ in the OT list.

29. Apgar Score at 1 min and 5 min: A numerical score of the condition of newborn at 1 min and 5 min after birth based on heart rate, colour, respiratory effort, muscle tone and reflex irritability. Enter the Apgar score at 1 min & at 5 min as noted in the labour and delivery record. Please score even if the baby was intubated by 5 minutes of life. Only tick ‘unknown’ if truly so and not because it was not scored once baby intubated. Apgar score can be ‘0’ at 1 minute and 5 minutes.

30. Initial Resuscitation (for inborn babies only): Tick ‘Yes’ for all intervention that apply at birth for inborn cases only

- a) Oxygen
- b) Early CPAP
- c) Bag-mask ventilation

- d) Endotracheal Tube Ventilation
- e) Cardiac Compression
- f) Adrenaline

31. a) Plastic wrap at birth: Yes /No (for < 1500 gm)

b) If yes: was baby wrapped without drying at birth: Yes /No

c) Admission Temperature: Indicate the first temperature (axillary) on admission to one decimal point in degree Celsius. Mandatory field for admission to Neonatal Ward. Does not include babies who die in delivery room.

SECTION 3: Neonatal Events

32. Respiratory support: Tick 'Yes' if any respiratory support was given

- a) CPAP – Continuous Positive Airway Pressure.
- b) High flow nasal cannula (HFNC)
- c) Conventional Ventilation – intermittent positive pressure ventilation through an endotracheal tube a conventional ventilator (IMV rate < 240/min) at any time after leaving the delivery room.
- d) HFJV/ HFOV – High frequency ventilation
- e) Nitric oxide – delivered as a gas via a ventilator at any time after leaving the delivery room.

33. Surfactant: A dose of any type of exogenous surfactant was used to treat the baby. Indicate whether exogenous surfactant given or not. If 'yes' indicate whether given at < 1 hour, 1 -2 hours or > 2 hours postnatal age.

34. Parenteral Nutrition: Intravenous infusion of a nutrient solution consisting of a minimum of dextrose and protein but generally providing a complete nutrient infusion including electrolytes, calcium, phosphorus, zinc, trace elements, vitamins and fat. Nutrition given intravenously. Parenteral nutrition must include amino acids with or without fats, hence plain dextrose saline infusion is not parenteral nutrition.

SECTION 4: Problems / Diagnoses

Mandatory fields are included for some diagnoses/procedures that are very important in the care of VLBW and sick infants. Definitions of these conditions are as shown below (AFTER SECTION 5). Other diagnoses or problems not given in the list can be referred to 'WHO 1992 ICD-10; Volume 1 document' and to be written in the space provided under 'Others'.

NA in the CRF means data is not applicable or not available. There should not be too many 'Not available' data

SECTION 5: Outcome

49a. Date of discharge/transfer/death: Enter the exact date

49b. Time of death: State as 24-hour format – used to auto calculate age at discharge. Mandatory for death cases – give best-estimated time if of death if exact time not known.

50. Weight (grams) and growth status on discharge/ death:

- a) Weight in grams. For weight on death is the last weight taken when the baby was alive
- b) Indicate growth status as per Intrauterine Growth Curves (Composite Male / Female)

51. Total Duration of hospital stay (Neonatal/Paeds Care): State to next complete day i.e. < 24 hours is 1 day and 10 days 6 hours is 11 days.

52. Home oxygen therapy: State if baby discharged home with oxygen. Also Includes non-invasive ventilation e.g. CPAP/HFNC

53. Outcome: Alive or Dead – Alive at discharge or died before discharge.

If child alive, state Place of discharge to: Home, Other Non-Paeds Ward, Social Welfare home 'Still hospitalised as of 1st birthday' or 'Transferred to other hospitals'. If transferred to other hospitals, specify the name of hospital transferred to.

If a case is transferred to another hospital in the MNNR network, complete the CRF up to current status and send photocopy of the form with the baby to assist the referral hospital in obtaining the patient particulars and birth history. The referring hospital still need to key in the original form into the system. The referral centre will open and complete a new CRF and this will be analysed together with the CRF of the referring hospital.

Post- transfer disposition: If the case is transferred to another hospital out of the NNR network, the referring unit **must get the final 'outcome' of the baby** from the unit that the case was referred to. Click "still in the ward" if patient is still hospitalized in the non-NNR hospital at close out. **ROP findings after discharge can also be updated in the ROP section.**

If child died, tick 'Yes' or 'No' whether the infant died within 12 hours or less from the time of admission to the NICU.

Place of Death: Labour Room/OT, In Transit Neonatal Unit or others, specify.

SUPPLEMENTARY FORM

Filled whenever there is neonatal death in accordance to the Modified Wigglesworth Classification of Perinatal Mortality:

An additional data to that collected in the main CRF for neonatal deaths.

1. **Centre' Name:** State name of reporting hospitals
2. **Name:** State mother's name
3. **RN of baby:** RN at participating hospital. If the baby dies in Labour Room and has no RN, use mother's RN.
4. **Mother's new IC number or passport:** whichever applicable

Immediate Cause of Death (Modified Wigglesworth):

(Adapted from Garis panduan Penggunaan Format PNM 1/97 (Pindaan 2000) bagi Melapor Kematian Perinatal, Jun 2000, Bahagian Pembangunan Kesihatan Keluarga, Kementerian Kesihatan Malaysia)

a. Lethal Congenital Malformation (LCM)/defect

Severe or lethal malformation that contribute to death. If 'Yes', tick specifically the cause of death.

b. If no LCM, is Gestation < 37 weeks?

- c. Gestation < 37 weeks (Preterm death without LCM) due to:** This includes only livebirths less than 37 weeks gestation after excluding LCM. Tick the immediate secondary cause of death e.g. severe IVH, pulmonary haemorrhage, acute intrapartum event ("asphyxia"). Tick "extreme prematurity" in the subcategory only for babies less than 28 weeks only who died and no immediate secondary cause of death eg. as in palliative care

Gestation ≥ 37 weeks (did the baby had an was there an Asphyxial condition? All term babies who die from birth asphyxia or meconium aspiration syndrome or PPHN.

d. If term and no asphyxia conditions, was there Infection?

This refers to term babies (> 37 weeks gestation) whose primary cause of death is an infection. Some examples include meningitis, group B streptococcal infection, intrauterine infections etc.

e. If term and infection present, tick organism

f. If term and infection absent, are they any other specific causes of death?

Specify any other cause of death not included in the above classification. This includes kernicterus, haemorrhagic shock /inborn error of metabolism/pneumothorax/ pulmonary haemorrhage. Use ICD 10 code

g. Unknown

Where cause of death is not known.

DEFINITIONS OF CERTAIN SPECIFIED DIAGNOSES

(Modified from ICD 10)

Diagnosis	Definition
Respiratory	
Meconium aspiration syndrome	Tick 'yes' if all 5 criteria are satisfied: - Presence of meconium-stained amniotic fluid at birth - Respiratory distress onset within 1 hour of birth. Respiratory distress defined as presence of one of the following signs: tachypnoea, grunting, nasal flaring, or intercostal retraction. $\text{PaO}_2 < 50$ mmHg in room air, central cyanosis in room air or requirement for supplemental O_2 to maintain a $\text{PaO}_2 > 50$ mmHg - Abnormal CXR compatible with meconium aspiration: Findings may include coarse irregular or nodular pulmonary densities, areas of diminished aeration or consolidation alternating with area of hyperinflation, or generalized hyperinflation. - Absence of culture proven early onset bacterial sepsis or pneumonia (i.e. negative blood culture within 72 hours of birth).
Pulmonary haemorrhage	Originating in the perinatal period (as diagnosed clinically by pink or red frothy liquid draining from mouth or arising from the trachea between the vocal cord or suctioned through the endotracheal tube. (Diagnosis may also be made on autopsy finding of haemorrhage in the lungs).
Congenital Pneumonia	Infection of the lungs acquired prepartum, intrapartum, at birth or after birth. (Diagnosed with / without cultures). Diagnosis made clinically and supported by CXR findings.
Nosocomial pneumonia	Infection of the lungs acquired after admission to the ward.
Community acquired pneumonia	Infection of the lungs acquired after discharge home
Transient Tachypnoea of Newborn	Benign disease of near-term, term or large premature infants with respiratory distress shortly after delivery resolving within 3 days.

Pulmonary Interstitial Emphysema	Dissection of air into the perivascular tissues of lung from alveolar overdistention or overdistention of smaller airways evident on CXR as linear or cast like lucencies with a history of requiring increasing ventilatory support
Respiratory distress syndrome (RDS).	Defined as: within the first 24 hours of life, A. $\text{PaO}_2 < 50\text{mmHg}$ in room air, central cyanosis in room air, or a requirement for supplemental O_2 to maintain a $\text{PaO}_2 > 50\text{mmHg}$ AND B. A chest radiograph consistent with RDS (low lung volumes and reticulogranular appearance to lung fields, with or without air bronchograms)
Pneumothorax	Presence of extrapleural air diagnosed by chest radiograph or needle aspiration (thoracocentesis). For infants who had thoracic surgery and a chest tube placed at the time of surgery OR if free air was only present on a CXR taken immediately after thoracic surgery and was not treated with a chest tube, tick 'No'. For infants who had thoracic surgery and then later developed extra pleural air diagnosed by CXR or needle thoracocentesis, tick 'Yes'. Indicate whether pneumothorax developed during CPAP, Conventional ventilation or HFV.
Supplemental oxygen & BPD Tick "yes" if the baby received continuous oxygen concentration $> 21\%$ for at least 28 continuous days (note not "till 28 days of life"). Otherwise tick "no". For babies < 32 weeks – state if O_2 / any form of CPAP or ventilatory support required at 36 weeks corrected gestation. For babies ≥ 32 weeks - state if O_2 / any form of CPAP or ventilatory support required at Day 56.	Receipt of continuous enriched oxygen concentration $> 21\%$ by oxyhood, nasal cannula, nasal catheter, facemask or still requiring nCPAP or other forms of respiratory support by Day 28 and 36 weeks or day 56. 'Continuous' means that the patient is receiving oxygen throughout the time period and not just in brief episodes as needed i.e. during feeds. 'Blow-by' oxygen dose not counted unless it is the mode of oxygen administration used in a transport situation. Do not score oxygen given as part of a hyperoxia test.
Cardiovascular a. Persistent Pulmonary Hypertension (PPHN)	Definitive diagnosis of PPHN is made by echocardiography. In the absence of echo confirmation, pre and postductal pulse oxymetry difference of $> 10\%$ can be used. Preductal pulse oxymetry done on the right hand and post ductal

b. Heart failure	pulse oxymetry done on lower limbs. Failure of the heart to pump characterized by tachypnea, tachycardia, feeding difficulties, hepatic enlargement, and cardiomegaly.
Patent ductus arteriosus (PDA) Only applies for pre term < 37 weeks GA only	Clinical evidence of left to right PDA shunt documented by continuous murmur, hyperdynamic precordium, bounding pulses, wide pulse pressure congestive heart failure, increased pulmonary vasculature or cardiomegaly by CXR, and/or increased O₂ requirement or ECHO evidence of PDA with documentation of left to right ductal shunting. If ticked 'Yes', indicate whether ECHO was done and whether pharmacological closure (indomethacine/ibuprofen/paracetamol) or ligation was given or not.
Necrotising enterocolitis (NEC) (Stage 2 and above) If 'yes' and managed surgically, tick 'Surgical Treatment' NEC present before admission to your centre? (applies to outborn babies)	Definition for NEC stage 2 and above : 1 Diagnosis at surgery or post mortem, or 2 Radiological diagnosis, a clinical history plus • pneumatosis intestinalis, or • portal vein gas, 3 Clinical diagnosis, a clinical history plus abdominal wall cellulitis and palpable abdominal mass. NEC according to Bell's criteria stage 2 or higher Stage 1: Suspect (History of perinatal stress, systemic signs of ill health i.e. temperature instability, lethargy, apnoea, GIT manifestations i.e. poor feeding, increased volume of gastric aspirate, vomiting, mild abdominal distension, faecal occult blood with no anal fissure). Stage 2: Confirmed (Any features of stage 1 plus persistent occult or gastrointestinal bleeding, marked abdominal distension, abdominal radiograph, intestinal distension, bowel wall oedema, unchanging bowel loops, pneumatosis intestinalis, portal vein gas). Stage 3: Advanced (Any features of stages 1 or 2 plus: deterioration in vital signs, evidence of shock or severe sepsis, or marked gastrointestinal haemorrhage, or abdominal radiograph shows any features of stage 2 plus pneumoperitoneum).
Retinopathy of prematurity (ROP)	Criteria for screening for ROP are for babies with birth weight < or equal 1500 grams OR gestational <

Maximum stage of ROP in left/right eye as defined by the International Committee on ROP (ICROP). Score according to the grade of ROP assigned on an eye exam done by an ophthalmologist (e.g. threshold). If there is no explicit grade listed, then score according to the descriptions given by the ICROP. (e.g. threshold). Tick 'Yes' if a retinal exam was done. State exact date of first screening and post conceptional age at screening. Specify only the worst stage. Also tick if PLUS disease present State if laser, cryotherapy, intravitreal anti VEGF or vitrectomy was done. If screening was not done, state 'No' and indicates whether an appointment for retinal examination was given, if applicable. State "date of appointment" or "date of first screening" section and postconceptional age will be autocalculated ROP present prior to admission? (applies to outborn babies) To trace back the outcome of ROP screening on first screening if done after Tick "Not applicable" if does not fulfill criteria	32 weeks, as well as all preterm babies whose clinical course places them at increased risk for ROP as determined by the attending doctor. If an indirect ophthalmologic examination was performed at any time, enter the worst stage documented: No ROP : No Evidence of ROP Stage 1 : Demarcation Line Prethreshold ROP ("Prethresh") Threshold ROP ("Thresh") Stage 4 : Partial Retinal Detachment Stage 5 : Total retinal detachment PLUS disease : dilated veins and tortuous arteries, papillary rigidity (must also include stages other than No ROP)
Intraventricular haemorrhage (IVH) Tick 'Yes' if IVH is seen and enter the worst grade before or on 28 days of life. State if VP shunt/reservoir was inserted Tick 'No; if no IVH before or day 28 Tick 'Not Applicable' for term infant Tick "Ultrasound not done" if it was not done.	If ultrasound of brain done, enter the worst grade: Grade 1: Subependymal germinal matrix (GM) haemorrhage only Grade 2: IVH without ventricular dilation Grade 3: IVH with ventricular dilation Grade 4: IVH with parenchymal involvement

Central venous line a. Central line - yes or no Date of insertion Date of removal (autocalculate) b. CLABSI	If more than one central line, use data of the central line with the longest duration Central line defined as: (1) Umbilical catheters. (2) Percutaneously inserted central catheters. (3) Surgically placed Broviac catheter that terminates at or close to the heart or in one of the great vessels. Aorta, superior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, inferior vena cava, external iliac veins and common femoral veins are considered great vessels for this study. CLABSI defined as clinical sepsis with positive blood culture in patient with ALL of the following: a. central line in place for at least 48 hours, or within 48 hours after removal b. no other apparent source of infection c. two positive cultures of the same organism from different sites if the organism is a common skin organism (to differentiate from skin contaminant)
Confirmed sepsis Tick 'Yes' if there is evidence of <u>confirmed</u> sepsis. Do not include presumed or clinical sepsis. State whether the onset of first confirmed sepsis was On or before 72 hours of life OR after 72 hours of life. State the organism cultured: • Group B streptococcus • MRSA • CONS (see definition) • Staphylococcus aureus • Klebsiella • Pseudomonas • Acinetobacter • Fungal (see definition) • Others, specify • ESBL organisms	Confirmed sepsis Clinical evidence of sepsis plus blood culture-proven infection. <u>For CONS:</u> Place a tick if the infant has ALL 3 of the following: 1. CONS is recovered from a blood culture obtained from either a central line, or a peripheral blood sample AND 2. Signs of generalized infection (such as apnoea, temperature instability, feeding intolerance, worsening respiratory distress or haemodynamic instability) AND 3. Treatment with 5 or more days of IV antibiotics after the above cultures were obtained. If the patient died, was discharged, or transferred prior to completion of 5 days or more of IV antibiotics, this condition would still be met if the intention were to treat for 5 or more days. Do not place a tick if any or all of the above are not true.

	For FUNGAL infection: Place a tick only if a fungus recovered from a blood culture obtained from either a central line or peripheral blood sample after day 3 of life.
Neonatal meningitis Tick 'yes' (if CSF biochem or cytology suggestive even if CSF C&S is negative) or 'no' If yes, State if CSF Culture positive - Yes / No State the organism cultured: • Group B streptococcus • MRSA • CONS (see definition) • Staphylococcus aureus • Klebsiella • Pseudomonas • Acinetobacter • Fungal (see definition) • Others, specify • ESBL organisms	Signs of clinical sepsis and evidence of meningeal infection as shown in cerebrospinal fluid findings (i.e. cytology, biochemistry or microbiologic findings).
Hypoxic ischaemic encephalopathy (HIE) Applies only to gestation $\geq$ 35 weeks	HIE requires the presence of all 3 of the following criteria: 1. Presence of a clinically recognized encephalopathy within 72 hours of birth. Encephalopathy is defined as the presence of 3 or more of the following findings within 72 hours after birth: a. Abnormal level of consciousness: hyperalertness, lethargy, stupor or coma b. Abnormal muscle tone: hypertonia, hypotonia or flaccidity c. Abnormal deep tendon reflexes: increased, depressed or absent d. Seizures: subtle, multifocal or focal clonic e. Abnormal Moro reflex: exaggerated, incomplete or absent

HIE severity If the infants diagnosed with HIE, record the worst stage observed during the first 7 days following birth based on the infant's level of consciousness and response to arousal maneuvers such as persistent gentle shaking, pinching,	f. Abnormal suck: weak or absent g. Abnormal respiratory pattern: periodic, ataxic or apnoeic h. Oculomotor or papillary abnormalities: skew deviation, absent or reduced Doll's eye or fixed unreactive pupils AND 2. Three or more supporting findings from the following list: a. Arterial cord pH<7.00 b. Apgar score at 5 minutes of 5 or less c. Evidence of multi-organ system dysfunction – dysfunction of one or more of the following systems within 72 hours of birth d. Evidence of foetal distress on antepartum monitoring: persistent late decelerations, reversal of end-diastolic flow on Doppler flow studies of the umbilical artery or a biophysical profile of 2 or less e. Evidence of CT, MRI, technetium or ultrasound brain scan performed within 7 days of birth of diffuse or multifocal ischaemia or of cerebral oedema. f. Abnormal EEG: low amplitude and frequency, periodic, paroxysmal or isoelectric. AND 3. The absence of an infectious cause, a congenital malformation of the brain or an inborn error of metabolism, which could explain the encephalopathy. HIE severity a. Mild (normal or hyperalert) – infants in this category are alert or hyperalert with either a normal or exaggerated response to arousal. No seizures (Sarnat Stage 1) b. Moderate (lethargic or stupor) – infants in this category are arousable but have a
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shining a light or ringing of a bell: Tick “none” if there is no HIE Tick “Mild, Moderate, Severe ” according to the definition Tick “none” if there is no HIE Tick “Mild, Moderate, Severe ” according to the definition Highest Thompson Score before 6 hours of life Cooling therapy Seizures in HIE cases	diminished response to arousal maneuvers. Such babies frequently have seizures (Sarnat Stage 2) c. Severe (deep stupor or coma) – infants in this category are not arousable in response to arousal maneuvers. (Sarnat Stage 3) Insert highest score Yes/ No if yes , completed 72 hours yes no If yes : cooling blanket or cap / passive cooling plus or minus gel pack / both Yes / No
Major Congenital Abnormalities Tick ‘Yes ‘ if major congenital anomaly is present even if it is an isolated one (i.e. only one abnormality) If Yes, state: 1. ‘Known Syndrome’, 2. ‘Not a Recognised Syndrome’ 3. ‘Isolated major abnormality’ If the syndrome is known, tick the specify syndromes or specify it. Types of Abnormalities: Tick all major abnormalities found for recognisable syndrome, non-recognisable ones or isolated major congenital abnormality	A major congenital abnormality is defined as any abnormality of prenatal origin that if uncorrected or uncorrectable, significantly impairs normal physical or social function or reduce normal life expectancy Any abnormalities of prenatal origin that are present at birth, and do not have surgical, medical or cosmetic importance at the time of examination during the newborn period is a minor congenital abnormality and NOT included in this registry. Examples include isolated findings such as ‘low-set ears’, sacral dimple or single transverse palmar crease”. For congenital heart disease, Type Operation yes or no Age of operation ____ (days)

Appendix 3 Census Forms

Malaysian National Neonatal Registry

Unit G-10-D8,
Dataran Emerald,
Jalan PS11 Prima Selayang,
68100, Batu Caves,
Selangor

Tel/Fax: 03-61281100

i. Hospital:												
ii. Month:					iii. Year:							
iv. Total Births:					v. Live Births:							

SECTION 1: DELIVERIES VERSUS BIRTH WEIGHT

Birth Weight (grams)	No. of Still Births	No. of Live Births	No. Admitted to Neonatal Unit	No. who died in delivery room
< 500				
500				
501 - 600				
601 - 700				
701 - 800				
801 - 900				
901 - 999				
1000				
1001 - 1250				
1251 - 1499				
1500				
1501 - 2000				
2001 - 2500				
> 2500				
TOTAL				

SECTION 2: BIRTH VERSUS GESTATION WEEKS

Gestation (weeks)	No. of Still Births	No. of Live Births	No. Admitted to Neonatal Unit	No. who died in delivery room
<22				
22-24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37-40				
> 40				
TOTAL				

SECTION 3: BIRTH VERSUS MODE OF DELIVERY

Mode of Delivery	No. of Still Births	No. of Live Births	No. Admitted to Neonatal Unit	No. who died in delivery room
SVD				
Breech				
Forceps				
Ventouse				
LSCS Elective				
LSCS Emergency				
TOTAL :				

SECTION 4: BIRTHS VERSUS ETHNIC GROUP

Ethnic Group	No. of Still Births	No. of Live Births	No. Admitted to Neonatal Unit	No. who died in delivery room
Malay				
Chinese				
Indian				
Orang Asli				
Bumiputera Sabah specify ethnic group: _____				
Bumiputera Sarawak specify ethnic group: _____				
Foreigner				
Other Malaysian: _____				
TOTAL :				

1. Remarks:	
2. Name of Site Coordinator:	
3. Chap:	
4. Date:	/ /

i. Birth census should be sent together with the tracking forms and the completed GRFs of discharges for the month by the end of the following month.

ii. Sample of tracking form are as follows

Appendix 4 Case Report Form CRF

MALAYSIAN NATIONAL NEONATAL REGISTRY (CRF 2022)			
Centre Name:	☐ New Case ☐ Readmission ☐ Transfer from another SDP Hospital or IJN:	MNMR No (Office use):	/
Date of Admission: (dd/mm/yy)		Centre:	
Admitted to neonatal ward: ☐ Yes → (Proceed to complete ALL sections in this CRF) ☐ No → (Proceed to complete Section 1, 2 [without No.30], 4[No.47 only] and 5)			
☐ Abandoned baby → (if this box is ticked, item No.1, No.3a & 3b, No.5 to No.20 are not mandatory)			
Instruction: Where check boxes ☐ are provided, ticked (✓) one or more boxes. Where radio buttons ☐ are provided, ticked (✓) one box only.			
* RN of baby:			
SECTION 1 : PATIENT PARTICULARS & MATERNAL HISTORY			
* 1. Name of mother:			
* 2. Name of baby (Optional):			
* 3a. Mother's I/C number:	MyKad: - - Other ID document No: Specify document: ☐ Passport ☐ Armed Force ID ☐ Driver's License ☐ Old IC ☐ Hospital RN type (if others): ☐ Father's I/C ☐ Work Permit Number ☐ Police ID Card ☐ Immigration Permit ☐ Other, specify:		
* 3b. Baby's MyKid number:	- -		
* 4a. Date of birth of baby: (dd/mm/yy)	4b. Time of birth: (24 hour format. Enter the best estimated time of birth if the exact time unknown)		
* 5. Ethnic group of Mother:	☐ Malay ☐ Indian ☐ Bumiputra Sabah, specify: ☐ Other, Malaysian ☐ Chinese ☐ Orang Asli ☐ Bumiputra Sarawak, specify: ☐ Non-citizen, specify country:		
* 6. Maternal age:			
* 7. GPA: (current pregnancy before delivery of this child)	* Gravida:		* Parity:
			* Abortion:
* 8. Maternal diabetes (including gestational diabetes):	☐ Yes ☐ No ☐ Unknown		
* 9. Maternal hypertension, chronic pregnancy included:	☐ Yes ☐ No ☐ Unknown		
* 10. Maternal Eclampsia:	☐ Yes ☐ No ☐ Unknown		
* 11. Maternal Chorioamnionitis:	☐ Yes ☐ No ☐ Unknown		
* 12. Maternal Anaemia: (<11g/dL)	☐ Yes ☐ No ☐ Unknown		
* 13. Maternal abruption placenta:	☐ Yes ☐ No ☐ Unknown		
* 14. Maternal bleeding placenta praevia:	☐ Yes ☐ No ☐ Unknown		
* 15. Cord prolapse:	☐ Yes ☐ No ☐ Unknown		
* 16. Maternal obesity:	☐ Yes ☐ No ☐ Unknown		
* 17. Other current maternal illness:	☐ Yes If yes, specify : ☐ No		
SECTION 2 : BIRTH HISTORY			
* 18. Antenatal steroid:	☐ Yes → ☐ 1 dose ☐ 2 doses ☐ No ☐ Unknown		
* 19. Antenatal magnesium sulphate:	☐ Yes ☐ No ☐ Unknown		
* 20. Intrapartum antibiotic:	☐ Yes ☐ No ☐ Unknown		
* 21. Birth weight:	(gram)		
* 22. Gestation:	(weeks)		
* 23. Growth status:	☐ SGA ☐ AGA ☐ LGA		
* 24. Gender:	☐ Male ☐ Female ☐ Ambiguous / Indeterminate		
* 25. Place of birth:	☐ Inborn ☐ Outborn → ☐ Home ☐ Health Clinic ☐ Private Hospital ☐ Government hospital with specialist ☐ District ☐ General ☐ Government hospital without specialist ☐ University hospital ☐ Enroute / during transport ☐ Maternity home with specialist ☐ Maternity home without specialist ☐ Alternative Birthing centre (ABC) ☐ Urban ☐ Rural ☐ Others / specify: ☐ Unknown		
* 26. Multiplicity:	☐ Singleton ☐ Twin ☐ Triplet ☐ Other, specify: Specify birth order if not a singleton:		
* 27. Final Mode of delivery:	☐ Vaginal delivery → ☐ SVD ☐ Breech ☐ Caesarean section → ☐ Elective ☐ Emergency ☐ Instrumental → ☐ Vacuum ☐ Forceps ☐ Others, specify: ☐ Unknown		

SECTION 4: PROBLEMS/ DIAGNOSES (continue)

* 42a. IVH: < 37 weeks - option 'Not Applicable' will be auto blocked	☐ Yes If yes, worst grade: → ☐ Grade 1 ☐ Grade 2 ☐ Grade 3 ☐ Grade 4 ☐ No ☐ Not applicable (term infant) ☐ Ultrasound not done ☐ VP shunt/reservoir insertion
* 42b. Cystic Periventricular Leukomalacia	☐ Yes ☐ No
* 43a. Central Venous Line (applies to the catheter in situ for the longest duration)	i. ☐ Yes ☐ No ii. Date of insertion: / / Date of removal: / / Duration of central line (autocalculate) : _____ days
* 43b. CLABSI	☐ Yes ☐ No
* 44. Confirmed sepsis: (Blood culture positive only)	☐ Yes ☐ No ☐ ≤ 72 hours of life i) Type of organism (can tick more than one) ☐ Group B Streptococcus ☐ Staphylococcus aureus ☐ Acinetobacter ☐ ESBL organisms ☐ MRSA ☐ Klebsiella ☐ Fungal ☐ E. Coli ☐ CONS ☐ Pseudomonas ☐ Serratia ☐ Others, specify: ☐ > 72 hours of life ii) Type of organism (can tick more than one) ☐ Group B Streptococcus ☐ Staphylococcus aureus ☐ Acinetobacter ☐ ESBL organisms ☐ MRSA ☐ Klebsiella ☐ Fungal ☐ E. Coli ☐ CONS ☐ Pseudomonas ☐ Serratia ☐ Others, specify:
* 45. Neonatal meningitis:	☐ Yes ☐ No CSF Culture positive : ☐ Yes ☐ No i) If Yes, type of organism: (can tick more than one) ☐ Group B Streptococcus ☐ Staphylococcus aureus ☐ Acinetobacter ☐ ESBL organisms ☐ MRSA ☐ Klebsiella ☐ Fungal ☐ E. Coli ☐ CONS ☐ Pseudomonas ☐ Others, specify:
* 46. HIE: (Only for ≥ 35 weeks GA) If None option chosen leave b, c and d blank	a) HIE severity ☐ None ☐ Mild ☐ Moderate ☐ Severe b) Highest Thompson c) Cooling therapy : ☐ Yes ☐ No If yes, then to choose ☐ Cooling blanket or cap ☐ Passive cooling ± gel pack ☐ Both d) Seizures in HIE cases: ☐ Yes ☐ No
* 47. Congenital anomalies:	
* 47a. Major congenital anomalies : ☐ Yes ☐ No ☐ Syndrome (known) ☐ Down ☐ Edward ☐ Patau ☐ Others, specify (Refer to ICD 10): ☐ Not a recognized syndrome ☐ Isolated major abnormality	*47b. Types of abnormalities (check all that are present. Applies to all including 'known syndromes', 'not a recognized syndrome' or isolated major abnormality) ☐ CNS → ☐ Hydrocephalus ☐ Hydrancephaly ☐ Holoprosencephaly ☐ Others (Refer to ICD 10) : _____ ☐ Neural Tube Defect → ☐ Myelomeningocele ☐ Anencephaly ☐ Encephalocele ☐ Others (Refer to ICD 10) : _____ ☐ CVS → Please see (page 4) ☐ Skeletal dysplasia ☐ Respiratory ☐ CDH ☐ GIT ☐ Hydrops ☐ Renal ☐ Others, specify (Refer ICD10): ☐ None of the above

SECTION 4: PROBLEMS/ DIAGNOSES (continue)

* 47c. ☐ CVS
Tick all present

☐ Duct dependent lesion →

- ☐ TGA
- ☐ TOF or PA with VSD
- ☐ Pulmonary atresia (PA) with Intact ventricular septum
- ☐ Complex cyanotic heart with PA
- ☐ Critical PS
- ☐ Hypoplastic left heart syndrome
- ☐ Interrupted aortic arch
- ☐ Coarctation of aorta
- ☐ Critical AS
- ☐ Tricuspid atresia
- ☐ Others, specify:

☐ Non duct dependent lesion →

- ☐ TAPVD
- ☐ ASD
- ☐ VSD
- ☐ AVSD
- ☐ PDA (for term infant)
- ☐ Others, specify:

Date of echo diagnosis: Date done: ____/____/____ auto calculate age (days)

Intervention →

- ☐ Nil done
- ☐ Surgery
- ☐ Catheterization
- ☐ Died before operation
- ☐ Palliative
- ☐ For review later

Date done: ____/____/____ auto calculate age (days)
Date done: ____/____/____ auto calculate age (days)

Name of procedure: _____

SECTION 5: OUTCOME

*48a. Date of discharge / transfer / death: (dd/mm/yy)		*48b. Time of Death: (24 hour format) (mandatory for death cases)	
* 49. Weight and growth status on discharge:	a) Weight: (grams)		
	b) Growth status: ☐ SGA ☐ AGA ☐ LGA		
* 50. Total duration of hospital stay (neonatal/ paed care):	(in completed days) (auto calculate)		
* 51. Home oxygen therapy:	☐ Yes ☐ No		
* 52. Outcome:			

☐ Alive →

Place discharged to:

- ☐ Home
- ☐ Social welfare home
- ☐ Other wards within hospital
- ☐ Still hospitalized as of 1st birthday
- ☐ Transfer to other hospitals →

a) Name of hospital:			
b) Reason for transfer:	☐ Growth/ stepdown care ☐ Lack of NICU bed ☐ Chronic/ Palliative care	☐ Acute medical/ diagnostic services ☐ Surgery	☐ Social/Logistic reason ☐ Other, specify:
c) Post transfer disposition: (Please fill this section if place transferred is not part of the NNR Network)	☐ Home ☐ Death ☐ Transferred again to another hospital ☐ Readmitted to your hospital ☐ Still in ward		

☐ Dead →

Place of death:

☐ Labour room/OT
☐ In transit

☐ Neonatal unit
☐ Others, specify:

Name : _____ Signature: _____

Date: (dd/mm/yy)

MALAYSIAN NATIONAL NEONATAL REGISTRY

Supplementary Form

Instruction:

- 1) For term babies please fill in according to the most pertinent underlying cause of death.
2) For preterm babies please fill in according to the most immediate cause of death.

1. Centre Name:		3. RN:		Office use:	
2. Name:		Passport:		Centre:	
4. Mother's I/C Number:	New IC:				

Immediate cause of death (Modified Wigglesworth):

Tick relevant button to reach correct classification

NEONATAL DEATH
 (Is there any LCM?)

Note: LCM = Lethal Congenital Malformation

☐ LCM present

a) Lethal congenital malformation/defect, specify:

☐ Neural tube defects

☐ Anencephaly
☐ Encephalocele
☐ Others, specify _____
 (Refer to ICD 10):

☐ CVS

☐ Complex Heart Disease
☐ Acyanotic

☐ CNS

☐ Hydrancephaly
☐ Holoprosencephaly
☐ Others, specify _____
 (Refer to ICD 10):

☐ Recognisable syndrome

☐ Edward
☐ Patau
☐ Others, specify _____
 (Refer to ICD 10):

☐ Not recognisable syndrome

☐ Skeletal dysplasia

☐ Respiratory (eg. lung hypoplasia)

☐ GIT

☐ Hydrops foetalis

☐ Renal

☐ Others, specify: _____

☐ LCM absent

b) (Is gestation <37 weeks?)

☐ Yes

c) Gestation <37 weeks
(Preterm Death without LCM) due to:

☐ IVH
☐ Septicaemia
☐ PDA in failure
☐ Pulmonary hemorrhage
☐ NEC
☐ Pneumonia
☐ PIE / BPD
☐ Pneumothorax
☐ Extreme prematurity
☐ Acute intrapartum event
☐ Severe RDS
☐ Others (specify) _____

☐ No

Gestation ≥37 weeks
(Did the baby have an asphyxial condition?)

☐ d) Asphyxial condition absent
(Did the baby die from infection?)

☐ e) If term and infection present

☐ Group B streptococcal septicaemia
☐ Meningitis
☐ Congenital pneumonia
☐ Congenital Infection
☐ Others, specify _____

☐ Asphyxial condition present

☐ f) Other specific causes of death:

☐ Kernicterus / severe neonatal jaundice
☐ Haemorrhagic disease of newborn / Vitamin K deficiency
☐ Intracranial bleed / SAH
☐ Pneumothorax
☐ Pulmonary hemorrhage
☐ IEM
☐ MAS
☐ Surgical, specify: _____
☐ Others, specify: _____

☐ Unknown cause

Name : _____ Signature: _____

Date: / / (dd/mm/yy)

