



MOH/K/ASA/119.22(RR)



UNDER-5 MORTALITY REVIEW 2016:

LOOKING INTO THE PREVENTABLE DEATHS

FAMILY HEALTH DEVELOPMENT DIVISION
MINISTRY OF HEALTH
2022

September 2022

Under-5 Mortality Review 2016: Looking into The Preventable Deaths

MOH/K/ASA/119.22(RR)

Published by:

Bahagian Pembangunan Kesihatan Keluarga (Family Health Development Division)

Jabatan Kesihatan Awam (Public Health Department)

Kementerian Kesihatan Malaysia (Ministry of Health)

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UNDER-5 MORTALITY REVIEW 2016: LOOKING INTO THE PREVENTABLE DEATHS

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FOREWORD BY MINISTER OF HEALTH

Under-5 mortality measures child survival. It also reflects the social, economic, and environmental conditions in which children (and others in the society) live. Children and newborns have greater chances of surviving today than they did three decades ago. According to the Child Mortality Report 2020 by United Nation Inter-Agency Group for Child Mortality Estimation (UN-IGME), globally, the number of under-5 deaths dropped from 12.5 million in 1990 to 5.2 million in 2019.



On average, 14,000 children died before age five every day in 2019 compared to 34,000 in 1990. Almost half of these under-5 deaths were newborns whose deaths could have been prevented by several basic healthcare methods like reaching a higher coverage of quality antenatal care, prevention of premature births, skilled care at birth, postnatal care for both mother and baby, and care of small and sick newborns.

In 2016, Malaysia achieved a low under-5 mortality rate of 8.1 per 1000 live births. However, this review reports that 46% of the deaths were preventable. The report also revealed that 99% of deaths due to injury, 91% due to infection, and 75% from respiratory diseases were preventable. Moving forward, in accordance with the Sustainable Development Goals 2030 - to improve child survival, we must focus on reducing preventable deaths among the newborns and children less than five years old. To achieve this, it is important that we have strong inter-agency collaboration, as well as involvement of non-governmental agencies to ensure all children, especially the vulnerable populations, have access to basic health care such as immunisation and nutrition, treatment of infection and illness, and injury prevention. Parenting education, health literacy and empowerment are also key elements to tackle this matter.

It is my hope that this report will be utilised to develop evidence-based interventions to reduce and subsequently end under-5 preventable deaths. Together, let's work to create a better future for all children here at home.

KHAIRY JAMALUDDIN ABU BAKAR
MINISTER OF HEALTH, MALAYSIA

FOREWORD BY DIRECTOR GENERAL OF HEALTH MALAYSIA

The under-5 mortality is often utilised as a proxy indicator of the nation's progress in general social and economic development. It is one of the most critical indicators in achieving Sustainable Development Goals (SDG) 2030. Beyond development indicators lies the overall aspect of child survival, growth, and development. A high mortality rate suggests a combination of systemic failures, including poor nutrition, low immunisation rates, and poor maternal health and education. Despite Malaysia achieving the SDG's target of below 25 under-5 deaths per 1000 live births, the nation's under-5 rate has been stagnant for the past ten years, signifying the need for improvement, which may hinder the nation from achieving the status of a developed country.



Malaysia will need to intensify strategies for reducing preventable deaths among newborns, infants, and toddlers, mainly by preventing premature births, early detection of infection and home injury prevention. Correspondingly, improving maternal health care is vital in reducing preventable deaths related to the perinatal period, particularly deaths due to prematurity. Hence, to further improve data collection on stillbirths and under-5 deaths, the Ministry of Health has developed the Stillbirth and Under-5 Mortality Reporting System (SU5MR). The ultimate aim is to determine aspects to improve healthcare services and formulate interventions to reduce deaths among children less than five years old.

Unique population demography and culture in Malaysia purports unique issues and problems that cause under-5 mortalities within the states and communities. Hence, various programmes were developed and implemented at the grass-root level to improve children's overall health and reduce mortality. These programmes include Approach to Unwell Children Under-5 (ATUCU5), the inclusion of pneumococcal vaccination in the National Immunization Program (NIP), and Guidelines for the Prevention and Management of Children Under-5 at Risk of Malnutrition, among others.

The Ministry of Health will continue its strategic direction to strengthen healthcare delivery with innovative, multiple, and tailored approaches to improve access, coverage, and quality of child health services. However, multisectoral efforts are needed to overcome the inequalities and the social determinants of health to allow Malaysia to achieve its optimal potential.

TAN SRI DATO' SERI DR NOOR HISHAM BIN ABDULLAH
DIRECTOR-GENERAL OF HEALTH, MALAYSIA

EXECUTIVE SUMMARY

The focus of this review was to determine the proportion of the preventable deaths among children less than five years old in Malaysia for the year 2016, to identify the contributory and risk factors and to propose remedial measures. This is part of the roadmap to achieve the Sustainable Development Goals (Goal 3) to end all preventable deaths in this age group.

There were 5005 under-5 mortalities reported in 2016, in which 4938 were audited. Sixty-seven deaths were excluded due to the unavailability of the under-5 mortality reporting forms. There were 2274 preventable deaths (46.1% of the total deaths) found in the audit. The most common preventable underlying cause of deaths were conditions originating in the perinatal period (735; 32.3%), followed by congenital malformations, deformations, and chromosomal abnormalities (436; 19.2%), injury, poisoning and certain other consequences of external causes (305; 13.4%), certain infectious and parasitic disease (242; 10.6%) and diseases of the respiratory system (210; 9.2%).

Looking closer within the main underlying causes of deaths, 99% of the under-5 mortalities from the injury, poisoning and external causes of deaths were preventable, with 90.6% of the deaths due to certain infectious and parasitic disease, 75.2% from diseases from respiratory system, 40.6% from conditions originating in the perinatal period and 30.1% from the congenital malformation group.

Non-Malaysians, Orang Asli and Bumiputera Sarawak had higher risk of under-5 mortalities. Under-5 deaths were more common in households with income less than RM3000 a month.

Comorbidities were present in 49.5% of the deaths. The most common comorbidities were events related to perinatal period, cardiac disease, underlying syndromes, surgical related events, and malnutrition. Malnutrition was mainly related to deaths in the certain infectious and parasitic disease, and disease of the respiratory system.

Contributing factors of the preventable under-5 deaths were divided into medical and non-medical factors. The most common medical contributing factor was a shortfall in quality of care and the non-medical contributing factor was delay in seeking treatment. Other medical factors were lack of critical care beds, resuscitation equipment, ambulance service and retrieval system. Non-medical factors that need to be addressed were injury and birth defect prevention, poverty, malnutrition, and teenage pregnancy. Important family contributing factors were failure to appreciate the severity of the child's illness and non-compliance to medical advice.

In conditions originating in the perinatal period, the preventable deaths mainly occurred in infants with the birth weight 1500 g and less; and premature at less than 32 weeks. Term babies contributed to 33.5% of the preventable deaths. Majority of the preventable deaths in the prematurity group were due to nosocomial infection and respiratory distress syndrome.

Fifty percent of deaths from congenital malformations of the cardiovascular system could have been prevented through early detection, either antenatally or postnatally; and timely cardiac surgery after cardiac consultation. Neural tube defects contributed to 50% of the deaths from congenital malformations of the central nervous system and are potentially preventable by folate fortification. Biliary atresia was the commonest preventable cause of death in the surgically related congenital malformation. Majority of the deaths had undergone Kasai operation beyond the recommended age of 60 days of life.

Motor vehicle accident was the most common cause of the preventable deaths in the injury, poisoning and certain other consequences of external causes group at 34.7%. This was followed by drowning (22.1%), assault or non-accidental injury (15.3%) and asphyxia (13.6%). About half of these deaths occurred in the home vicinity and two-thirds was below 2 years of age. Safety measures were only documented in 20.0% of deaths due to motor vehicle accidents and 32.3% of deaths due to drowning. Eighty-one percent of deaths due to asphyxia was caused by milk aspiration and most of the children were less than 6 months of age.

Pneumonia was the main underlying cause of preventable deaths in the diseases of the respiratory system. Aetiological agents were identified in 15.4% of all pneumonia deaths. Majority were due to viruses. Almost 43% of all the preventable deaths in this group occurred in a non-hospital setting in which majority were brought-in-dead. Mothers with no formal education were found to be a risk factor for mortality in this group. Nineteen percent of these children did not complete their immunization as per schedule. Main contributing medical factors of mortality in this group were shortfall in quality of care and lack of retrieval system.

Sepsis and acute gastroenteritis contributed to the majority of the preventable deaths due to certain infection and parasitic disease. One third of the parents of children who died in this group did not receive any formal education, and almost 60% of them were from households with income less than RM3000 a month. In contrast, one third of the vaccine preventable deaths occurred in children from households with higher total income and parents who were professionals, associated professionals, and technicians.

To reduce and subsequently end preventable under-5 deaths, we would like to make the following recommendations: -

1. Strengthen existing and prioritize future programmes for vulnerable children at risk of under-5 deaths in particularly those with malnutrition and from low socio-economic groups.
2. Improve the current national immunization programme by introducing an application-based immunization record and alert for parents. Ensure all children residing in Malaysia regardless of citizenship are immunized. Address vaccine hesitancy and expand immunization coverage for common childhood infections such as rotavirus, varicella zoster, influenza, and respiratory syncytial virus for high-risk groups.
3. Strengthen early detection programmes such as detailed foetal ultrasound detection of various congenital malformations, pulse oximetry detection of critical cardiac defects in postnatal babies and rapid detection of pathogenic organisms using polymerase chain reaction panel for respiratory infections.
4. Improve the quality of care in neonatal and paediatric services by strengthening the existing programmes such as neonatal resuscitation programme, paediatric life support, advanced paediatric life support and Approach to Unwell Child Under 5 Years (ATUCU5) programme training.
5. Develop a clinical practice guideline to optimize management of paediatric sepsis.
6. Introduce programmes to reduce teenage pregnancies and single motherhood. Empower girls and women with comprehensive sexuality education and advocate for a legal reform to end child marriage.
7. Review and revise the current child health record book. It may also serve as an educational tool for parents.
8. Educate parents to ensure a safe home environment especially for infants and toddlers. Introduce or strengthen childhood safety programmes to prevent deaths from motor vehicle accidents, drowning, non-accidental injuries and milk aspiration. This may include providing child safety allowance to lower income households to purchase child restraint system for vehicles, monitoring and evaluation of childcare facilities and provision of child minder service at the workplace.
9. Implement mandatory folic acid fortification. This would involve public consultation, legislative change, and interagency collaboration.
10. Strengthen or establish registries related to programmes focused on prevention of under-5 mortalities.

This report has provided a comprehensive and in-depth analysis of the preventable causes to under-5 deaths in the year of 2016 for Malaysia. A close inter-agency collaboration within the Ministry of Health and with other relevant ministries is imperative to ensure the successful implementation of the above recommendations.

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CHAPTER 1: INTRODUCTION

In accordance to achieving Millennium Development Goals, Malaysia has improved its surveillance of under-5 mortalities where all under-5 deaths must be registered, reported, and investigated. The purpose of the surveillance was to investigate the under-5 mortality and identify areas for intervention at national, state and district levels¹.

The mortality rate recorded for Malaysia has reduced from 16.8 per 1000 live births in 1990 to 8.9 per 1000 live births in the year 2000. Since then, the under-5 mortality rates have plateaued ranging from 7.6–8.6 per 1000 live births, with the rate of 8.1 per 1000 live births in 2017². Hence, to reduce the under-5 mortalities and to achieve goals set in the Sustainable Development Goals, the under-5 deaths were analysed further to determine factors that can potentially lead to reduction of the mortality rates.

Analysis of the reported under-5 mortality data has shown discrepancies in the cause of death. Deaths were classified differently in each region especially in identifying preventable and non-preventable deaths. The rate for preventable deaths varied between 5% to 30% in different regions³. Review of the data by the Family Health Division has shown lack of universal understanding of the term preventable and non-preventable deaths. A preliminary audit on preventable deaths among children under the age of 5 in 2015 showed that preventable deaths were under reported, with the percentage raised to 48.7% post audit⁴. Therefore, a guideline was put in place to ensure uniformity in reporting⁵.

This audit investigated the accuracy of the data reported in the common underlying causes of death (UCOD) which were⁶:

- Conditions originating in the perinatal period
- Congenital malformations, deformations and chromosomal abnormalities
- Diseases of the respiratory system
- Injury, poisoning and certain other consequences of external causes
- Certain infectious and parasitic diseases

The definition of the ICD10 classification of the five main UCOD are elaborated in [Appendix 1](#).

Preventable causes in these groups of conditions were analysed and risk factors for individual cause of death identified to evaluate necessary actions in reducing the mortality rate. Demographic data which included race, maternal age, maternal education, marital status, household income in comparison to the basic income in Malaysia were also reviewed to identify vulnerable population of children under-5 years of age.

OBJECTIVES

PRIMARY OBJECTIVES

- To determine the proportion of preventable deaths among children less than 5 years old.
- To identify the associated and contributing factors to the preventable deaths among children less than 5 years old.

SECONDARY OBJECTIVES

- To evaluate the quality of the data collection of under-5 mortality forms and consolidation reports.
- To identify areas for improvement.
- To formulate measures to reduce preventable deaths.

CHAPTER 2: METHODOLOGY

Study Design

This is a cross-sectional study using data from the 'Stillbirth and Under-5 Mortality Form SU5MR-1/2012' reporting form coordinated and collected nationwide by the Family Health Development Division (FHDD), Ministry of Health, Malaysia.

Process of Data Collection

All deaths under-5 years of age were reported and investigated as per the process outlined in the Study for Under 5 Deaths in Malaysia in the Year 2016⁶.

The SU5MR -1/2012 forms were then grouped according to the ICD 10 classification⁷ and according to the respective states in Malaysia. The forms and accompanying consolidation reports were audited, and the information were recorded onto the clinical research forms (CRF) and analysed by the investigators. The list of investigators and their credentials are listed at the end of this document.

Any discrepancies of information that were detected leading to a disagreement of the UCOD or preventability of death by an investigator were discussed with two other investigators. A consensus was reached. If all three investigators were in agreement, then the UCOD or the preventability of death were rectified.

Sample

All deaths which met the criteria of under-5 deaths in the year 2016 were included in this study. However, any deaths in which the birth weight was less than 500g or less than 22 completed weeks of gestation, were excluded in the reporting. Deaths of non-citizens who have been residing in Malaysia for less than 6 months were also excluded in the notification and investigation⁸.

There were 5005 deaths recorded in this age group for the year 2016. Sixty-seven deaths were excluded due to missing SU5MR forms. In total, 4938 deaths were evaluated.

Inclusion Criteria

All under-5 deaths for the year 2016 with available SU5MR -1/2012 forms were included

Exclusion Criteria

1. Intrauterine death, fresh and macerated stillbirths.
2. Any deaths in which the birth weight was less than 500g or less than 22 completed weeks of gestation.
3. Deaths of non-citizens who have been residing in Malaysia for less than 6 months.
4. Non- available SU5MR -1/2012 forms.

Key data source

SU5MR -1/2012 forms and accompanying consolidation reports.

Variables collected include:

- i. State, District,
- ii. Demographic data such as gender, ethnicity, date of birth, age, immunization status, household income, parental occupation
- iii. Date and time of death, place of death
- iv. Preventable risk factors- medical and non- medical
- v. Underlying cause of death (UCOD) by ICD-10 classification
- vi. Comorbid conditions
- vii. Death preventable, non-preventable or of undetermined preventability
- viii. Specific risk factors for the major UCOD
- ix. Quality of consolidation report. The consolidation report was deemed adequate subjectively when the investigators could agree or derive the underlying causes of death and preventability of death from the information stated in the report.

Data Management and Data Quality Assurance

Data entry and cleaning

Ethical approval for this study was obtained from the Medical Research and Ethics Committee, MOH Malaysia, approval number NMRR-18-3528-43962.

All the SU5MR forms available that fulfilled the inclusion and exclusion criteria were audited and data was transferred to the clinical research forms (CRF). The data was entered, verified, and cleaned by six researchers into a database in SPSS version 26.

Data Quality Assurance⁹

It was decided that 2% of CRFs were re-audited for consistency. A total of 99 CRFs were re-audited for ID, State, Diagnosis and Preventability. All the CRFs had the correct ID and State. For diagnosis, 95 out of 99 forms had correct entries whereas 98 out of 99 forms had correct preventability stated. Two out of 99 CRF had both diagnosis and preventability disagreement. Hence, the overall inter-observer agreement was at 92.9% (overall agreement for 92 out of 99 forms).

Two percent of the data (100 CRFs) entered into the database were randomly checked for ID, State, Diagnosis, ICD10 Classification and Preventability to ensure that the data entered were the same as the hard copy. All the data checked were correct except for 1 out of 100 for ICD10 Classification (99%).

Data analysis was done using SPSS version 26.

Statistical Methods

The sample size for this study was not pre-determined prior to the study. All children who died and were reported to the FHDD MOH using Stillbirth and Under-5 Mortality Form SU5MR-1/2012 in the year 2016 and satisfied the inclusion and exclusion criteria were included.

All data obtained were used for analysis. Descriptive and univariate analyses were performed to determine the frequency and to estimate the risks associated with the 5 most common causes of death according to the sociodemographic factors. Mortality rates were calculated based on the year 2016 population figures as denominator retrieved from the Department of Statistics Malaysia (DOSM)².

The UCODs were classified according to the Classification of Diseases and Related Health Problems 10th Revision, ICD-10 2016 by the investigators and were analysed. The 5 leading causes of death were further sub-classified. Group comparison by odds ratio (OR) was also performed to identify ethnic group differences.

Comparison between reported data as published in A Study of Under-5 Deaths in Malaysia in The Year 2016⁶ and reclassified underlying causes of death and the preventability of death in this study was done using kappa statistic.

Factors related to preventability of death were classified according to medical and non-medical factors. The medical factors were further sub-classified according to quality of care, healthcare transport system and health facilities and equipment, whilst sub-classification of non-medical factors include patient/family factors, health systems factors and social factors.

Each of these sub-classifications of the 5 major underlying causes of death were studied in more detail.

CHAPTER 3: OVERALL RESULTS, DISCUSSION & RECOMMENDATIONS

Overall Result

There were 5005 deaths among children under the age of 5 in Malaysia in the year 2016, in which 4938 deaths were included in the study. There were 67 missing SU5MR forms, and these deaths were excluded from the study.

Proportion of Preventable Deaths

After the process of auditing and reclassifying the underlying causes of death according to ICD10 classification and the preventability of death in accordance with the guidelines of preventable deaths in Malaysia, the proportion of preventable deaths increased to 46.1% with a total of 2274 preventable deaths. The 5 main underlying causes of death (UCOD) remain unchanged after reclassification.

Table 3.1: The Number and Percentage of Preventable, Not Preventable and Undetermined Preventability Reclassified Under-5 Underlying Causes of Deaths, Malaysia, 2016

ICD 10 Classification	Preventable	Not preventable	Undetermined	Total
	n (%)	n (%)	n (%)	n (%)
Certain conditions originating in the perinatal period	735 (32.3)	812 (38.1)	262 (49.0)	1809 (36.6)
Congenital malformations, deformations and chromosomal abnormalities	436 (19.2)	975 (45.8)	36 (6.7)	1447 (29.3)
Injuries, poisoning and external causes	305 (13.4)	0 (0)	3 (0.6)	308 (6.2)
Diseases of the respiratory system	210 (9.2)	55 (2.6)	14 (2.6)	279 (5.7)
Certain infectious & parasitic diseases	242 (10.6)	15 (0.7)	10 (1.9)	267 (5.4)
Diseases of nervous system	74 (3.3)	83 (3.9)	18 (3.4)	175 (3.5)
Neoplasms	40 (1.8)	67 (3.1)	6 (1.1)	113 (2.3)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	50 (2.2)	13 (0.6)	21 (3.9)	84 (1.7)
Endocrine, nutritional and metabolic diseases	30 (1.3)	22 (1.0)	12 (2.2)	64 (1.3)
Diseases of the digestive system	29 (1.3)	11 (0.5)	8 (1.5)	48 (1.0)
Diseases of the circulatory system	15 (0.7)	29 (1.4)	2 (0.4)	46 (0.9)
Diseases of blood & blood-forming organs & certain disorders involving the immune mechanism	9 (0.4)	11 (0.5)	1 (0.2)	21 (0.4)
Diseases of the genitourinary system	8 (0.4)	7 (0.3)	1 (0.2)	16 (0.3)
Others	5 (0.2)	1 (0)	0 (0)	6 (0.1)
Unknown	86 (3.8)	28 (1.3)	141 (26.4)	255 (5.2)
Total	2274 (100)	2129 (100)	535 (100)	4938 (100)

Certain condition originating in the perinatal period contributed to 32.3% of all preventable deaths, followed by 19.2% from congenital malformation group, 13.4% from the injuries, poisoning and external causes, 10.6% from certain infectious and parasitic diseases and 9.2% from diseases of the respiratory system.

Unknown underlying cause of death contributed to the sixth most common cause of death at 3.8%. Deaths with insufficient clinical information or unclear information to arrive at a proper diagnosis had to be classified as unknown cause of death.

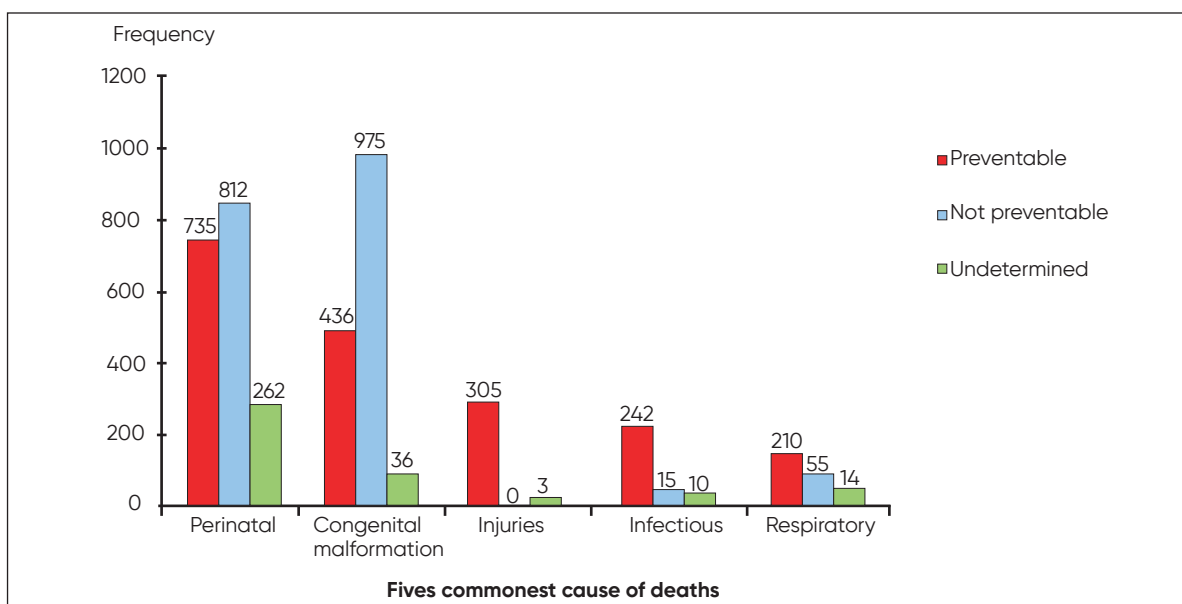


Figure 3.1: Frequency of Preventable, Non-preventable Deaths and Deaths of Undetermined Preventability Under-5 UCOD among the 5 Main UCOD, Malaysia, 2016

Looking at the individual ICD10 groups of underlying causes of deaths, 99.0% (305/308) of deaths due to injuries, poisoning and external causes of death were preventable. There were 90.6% (242/267) preventable deaths occurring in certain infectious and parasitic diseases. Diseases from the respiratory system had 75.2% (210/279) preventable deaths. Out of 1809 deaths from the perinatal period, 40.6% were preventable. There were 30.1% (436/1447) preventable deaths in the congenital malformation group.

Table 3.2: Frequency and Percentage of Preventable and Non-Preventable Deaths and Deaths of Undetermined Preventability Under-5 UCOD by States, Malaysia, 2016

State	Preventable	Not preventable	Undetermined	Total
	n (%)	n (%)	n (%)	n (%)
Selangor	436 (44.2)	442 (44.8)	109 (11.0)	987 (100)
Sabah	360 (49.7)	270 (37.3)	94 (13.0)	724 (100)
Johor	236 (42.1)	256 (45.7)	68 (12.1)	560 (100)
Sarawak	184 (52.4)	125 (35.6)	42 (12.0)	351 (100)
Perak	166 (48.3)	146 (42.4)	32 (9.3)	344 (100)
Kedah	119 (36.6)	179 (55.1)	27 (8.3)	325 (100)
Kelantan	162 (52.1)	119 (38.3)	30 (9.6)	311 (100)
Pahang	146 (52.3)	105 (37.6)	28 (10.0)	279 (100)
WP Kuala Lumpur	100 (40.7)	120 (48.8)	26 (10.6)	246 (100)
Terengganu	114 (46.9)	106 (43.6)	23 (9.5)	243 (100)
Pulau Pinang	100 (49.5)	94 (46.5)	8 (4.0)	202 (100)
Negeri Sembilan	65 (43.3)	64 (42.7)	21 (14.0)	150 (100)
Melaka	40 (32.8)	68 (55.7)	14 (11.5)	122 (100)
WP Labuan	21 (61.8)	9 (26.5)	4 (11.8)	34 (100)
Perlis	15 (50.0)	7 (23.3)	8 (26.7)	30 (100)
WP Putrajaya	10 (33.3)	19 (63.3)	1 (3.3)	30 (100)
Total	2274 (46.1)	2129 (43.1)	535 (10.8)	4938 (100)

Looking at the percentage of preventable deaths by state, the preventable deaths were at the range of 32.8% to 61.8%. Melaka, WP Putrajaya and Kedah recorded the lowest percentage of preventable deaths. The states with the highest percentage of preventable deaths were WP Labuan, Sarawak and Pahang.

Further details in regard to the relationship of the preventable UCOD and the individual states are in [Appendix 2](#).

Table 3.3: Place of Preventable Under-5 Deaths According to States, Malaysia, 2016

State	Hospital death	Non-hospital death	Total
	n (%)	n (%)	n (%)
Selangor	341 (78.2)	95 (21.8)	436 (100)
Sabah	312 (86.7)	48 (13.3)	360 (100)
Johor	188 (79.7)	48 (20.3)	236 (100)
Sarawak	139 (75.5)	45 (24.5)	184 (100)
Perak	116 (69.9)	50 (30.1)	166 (100)
Kelantan	125 (77.2)	37 (22.8)	162 (100)
Pahang	103 (70.5)	43 (29.5)	146 (100)
Kedah	89 (74.8)	30 (25.2)	119 (100)
Terengganu	92 (80.7)	22 (19.3)	114 (100)
WP Kuala Lumpur	73 (73.0)	27 (27.0)	100 (100)
Pulau Pinang	73 (73.0)	27 (27.0)	100 (100)
Negeri Sembilan	49 (75.4)	16 (24.6)	65 (100)
Melaka	28 (70.0)	12 (30.0)	40 (100)
WP Labuan	20 (95.2)	1 (4.8)	21 (100)
Perlis	11 (73.3)	4 (26.7)	15 (100)
WP Putrajaya	6 (60.0)	4 (40.0)	10 (100)
Total	1765 (77.6)	509 (22.4)	2274 (100)

Table 3.4: Frequency and Percentage of Preventable and Non-Preventable Deaths and Deaths of Undetermined Preventability Under-5 UCOD by Place of Death, Malaysia, 2016

Place of death	Preventable	Not preventable	Undetermined	Total
	n (%)	n (%)	n (%)	n (%)
Hospital death				
State hospital	924 (40.6)	1097 (51.5)	228 (42.6)	2249 (45.5)
District hospital with specialist	562 (24.7)	613 (28.8)	106 (19.8)	1281 (25.9)
District hospital without specialist	117 (5.1)	59 (2.8)	21 (3.9)	197 (4.0)
University hospital	74 (3.3)	95 (4.5)	13 (2.4)	182 (3.7)
Private hospital/maternity home < 50 beds with specialist	30 (1.3)	35 (1.6)	4 (0.7)	69 (1.4)
Private hospital/maternity home > 50 beds	27 (1.2)	16 (0.8)	3 (0.6)	46 (0.9)
Private hospital/maternity home < 50 beds without specialist	3 (0.1)	0 (0)	1 (0.2)	4 (0.1)
Military hospital	1 (0)	1 (0)	1 (0.2)	3 (0.1)
Others	27 (1.2)	13 (0.6)	7 (1.3)	47 (1)
Non-hospital death				
Home	235 (10.3)	128 (6.0)	94 (17.6)	457 (9.3)
En route / during transport	87 (3.8)	27 (1.3)	26 (4.9)	140 (2.8)
At the scene	44 (1.9)	1 (0)	0 (0)	45 (0.9)
Health clinic	40 (1.8)	9 (0.4)	7 (1.3)	56 (1.1)
Caretaker's house	20 (0.9)	5 (0.2)	7 (1.3)	32 (0.6)
Private clinic	5 (0.2)	0 (0)	0 (0)	5 (0.1)
Nursery	3 (0.1)	2 (0.1)	2 (0.4)	7 (0.1)
University clinic	1 (0)	0 (0)	0 (0)	1 (0)
Alternative birthing centre	1 (0)	1 (0)	0 (0)	2 (0)
Others	48 (2.1)	14 (0.7)	13 (2.4)	75 (1.5)
Unknown	25 (1.1)	13 (0.6)	2 (0.4)	40 (0.8)
Total	2274 (100)	2129 (100)	535 (100)	4938 (100)

Majority of the deaths occurred in the hospital setting. Looking at preventable deaths, 40.6% of the deaths occurred in the state hospitals, with another 24.7% in district hospitals with specialists. During the period of audit, a number of children arrived at the hospital in critical condition where death was imminent despite the medical care given.

As for non-hospital preventable deaths, 10.3% of the deaths occurred at home and 3.8% occurred en route or during transportation to a health facility.

Comparison between the reported and reclassified deaths

This study investigated the difference between the reported data in Under-5 Deaths in Malaysia Year 2016⁶ study to the audited data in which the deaths were reclassified according to the underlying cause of death and their preventability.

Table 3.5: Kappa Agreement of ICD 10 Classification between Reclassified and Reported Under-5 UCOD, Malaysia, 2016

	Kappa	Std error	95%CI Kappa		p-value
			lower	upper	
Overall (N=4938)	0.75	0.01	0.74	0.77	<0.001
State					
Perlis (n=30)	0.90	0.07	0.77	1.00	<0.001
Melaka (n=122)	0.83	0.04	0.75	0.90	<0.001
Negeri Sembilan (n=150)	0.84	0.03	0.77	0.90	<0.001
Pulau Pinang (n=202)	0.82	0.03	0.75	0.88	<0.001
Kedah (n=325)	0.81	0.03	0.77	0.86	<0.001
Kelantan(n=311)	0.81	0.03	0.77	0.86	<0.001
Pahang (n=279)	0.81	0.03	0.76	0.86	<0.001
WP Labuan (n=34)	0.81	0.08	0.65	0.96	<0.001
Terengganu (n=243)	0.77	0.03	0.71	0.82	<0.001
Selangor (n=987)	0.75	0.02	0.72	0.78	<0.001
Perak (n=344)	0.75	0.03	0.70	0.80	<0.001
Johor (n=560)	0.74	0.02	0.69	0.78	<0.001
Sarawak (n=351)	0.73	0.03	0.67	0.78	<0.001
WP Kuala Lumpur (n=246)	0.71	0.03	0.64	0.77	<0.001
Sabah (n=724)	0.66	0.02	0.62	0.70	<0.001
WP Putrajaya (n=30)	0.46	0.10	0.27	0.65	<0.001
Hospital death					
Private hospital/maternity home > 50 beds (n=46)	0.83	0.06	0.71	0.95	<0.001
University hospital (n=182)	0.82	0.03	0.76	0.89	<0.001
Private hospital/maternity home < 50 beds with specialist (n=69)	0.81	0.06	0.69	0.92	<0.001
District hospital with specialist (n=1281)	0.77	0.01	0.75	0.80	<0.001
State hospital (n=2249)	0.77	0.01	0.75	0.79	<0.001
Government hospital without specialist (n=197)	0.74	0.03	0.67	0.81	<0.001
Private hospital/maternity home < 50 beds without specialist (n=4)	0.43	0.07	0.29	0.57	0.046
Military hospital (n=3)	1.00	0.00	1.00	1.00	0.014
Others (n=47)	0.52	0.08	0.36	0.69	<0.001

Overall, there was substantial kappa agreement (Landis and Coch, 1977) between the investigators of this audit and the reported data in the Under-5 Deaths in Malaysia Year 2016⁶ study.

Majority of the states in Malaysia had substantial to perfect kappa agreement for the UCOD. WP Putrajaya had moderate kappa agreement for the UCOD.

Looking at hospital deaths, all sites had substantial kappa agreement for the UCOD except for private maternity homes without specialists.

Details of the findings are in [Appendix 3](#), [Appendix 4](#), [Appendix 5](#), [Appendix 6](#) and [Appendix 7](#).

Table 3.6: Kappa Agreement of Preventability Classification between Reclassified and Reported Under-5 UCOD, Malaysia, 2016

	Kappa	Standard error	95%CI Kappa		p-value
			Lower	Upper	
Overall (N=4938)	0.43	0.01	0.41	0.45	<0.001
State					
WP Labuan (n=34)	0.83	0.08	0.67	1.00	<0.001
Sarawak (n=351)	0.57	0.04	0.49	0.64	<0.001
WP Kuala Lumpur (n=246)	0.49	0.05	0.40	0.58	<0.001
Pahang (n=279)	0.47	0.04	0.39	0.55	<0.001
Selangor (n=987)	0.45	0.02	0.40	0.49	<0.001
Johor (n=560)	0.45	0.03	0.39	0.51	<0.001
Perak (n=344)	0.45	0.04	0.37	0.52	<0.001
Kedah (n=325)	0.44	0.04	0.35	0.52	<0.001
Pulau Pinang (n=202)	0.44	0.06	0.33	0.54	<0.001
Kelantan(n=311)	0.43	0.04	0.35	0.51	<0.001
Melaka (n=122)	0.43	0.07	0.29	0.57	<0.001
Terengganu (n=243)	0.41	0.05	0.32	0.50	<0.001
Negeri Sembilan (n=150)	0.36	0.06	0.25	0.48	<0.001
Sabah (n=724)	0.29	0.03	0.24	0.34	<0.001
Perlis (n=30)	0.28	0.10	0.09	0.46	0.009
WP Putrajaya (n=30)	0.26	0.13	0.01	0.52	0.019
Hospital death					
University hospital (n=182)	0.46	0.06	0.35	0.56	<0.001
District hospital with specialist (n=1281)	0.44	0.02	0.40	0.48	<0.001
Private hospital/maternity home < 50 beds with specialist (n=69)	0.42	0.08	0.25	0.58	<0.001
State hospital (n=2249)	0.41	0.02	0.38	0.44	<0.001
Government hospital without specialist (n=197)	0.38	0.05	0.28	0.48	<0.001
Private hospital/maternity home > 50 beds (n=46)	0.37	0.10	0.18	0.56	0.001
Private hospital/maternity home < 50 beds without specialist (n=4)	-0.23	0.16	-0.55	0.09	0.046
Military hospital (n=3)	0.00	0.24	-0.46	0.46	>0.999
Others (n=47)	0.42	0.10	0.23	0.62	<0.001

However, when comparing preventability between reported and reclassified deaths, there was fair to moderate kappa agreement between the reported and reclassified deaths in almost all states and all hospital deaths, except for WP Labuan which displayed perfect agreement for preventability.

Comparison for preventability between military hospitals and private maternity hospital < 50 beds without specialist were not significant.

Further details are in [Appendix 8](#), [Appendix 9](#), and [Appendix 10](#).

Contributory and Risk Factors of Preventable Underlying Cause of Death

Socio-demographic factors

Table 3.7: Preventable Under-5 deaths according to Age of Death, Gender, Nationality and Ethnicity, Malaysia, 2016

Socio-demography	Preventable death		Live birth*	Mortality rate per thousand
	n	%		
<u>Overall</u>	2274		508,203	4.47
<u>Age group (Year)</u>				
< 1 Year	1707	75.1		3.36
Neonatal Death	890	52.1		1.75
<i>Early Neonatal Death</i>	631	70.9		1.24
<i>Late Neonatal Death</i>	259	29.1		0.51
28 Days - < 1 Year	817	47.9		1.61
1 Year	246	10.8		0.48
2 Years	120	5.3		0.24
3 Years	104	4.6		0.20
4 Years	97	4.3		0.19
<u>Gender</u>				
Male	1247	54.8	262,755	4.75
Female	998	43.9	245,448	4.06
Indeterminate	4	0.2		
Unknown	25	1.1		
<u>Nationality</u>				
Malaysian	1997	87.8	483,243	4.13
Non-Malaysian	254	11.2	24,960	10.18
Unknown	23	1.0		
<u>Ethnicity (Malaysian)</u>				
Malay	1338	58.8	331,637	4.03
Orang Asli	86	3.8	4,613	18.64
Bumiputera Sabah	189	8.3	37,953	4.98
Bumiputera Sarawak	115	5.1	21,411	5.37
Chinese	125	5.5	65,574	1.91
Indian	79	3.5	22,055	3.58
Other ethnicity	65	2.9	7,721	8.42
Unknown	23	1.0		

*Data source: Department of Statistics, 2016

Table 3.7 depicts the socio-demographic distribution of the under-5 mortalities in 2016. The overall under-5 mortality rate for the preventable deaths was 4.47 per 1000 live births. Seventy-five percent of the deaths occurred below 1 year of age, with the deaths occurring almost equally in the neonatal period and from 28 days until less than 1 year of age.

The gender-specific mortality rates for the preventable deaths were 4.74 in males and 4.07 in females.

Non-Malaysians had a higher mortality rate compared to Malaysians, 10.1 to 4.13 per 1000 live births. As for Malaysians, the highest mortality rate was recorded in the Orang Asli at 18.64 followed by other ethnicities at 8.42 and Bumiputera Sarawak at 5.37 per 1000 live births.

Table 3.8: Preventable Under-5 deaths according to Age of Death, Gender, Nationality and Ethnicity, Malaysia, 2016

Nationality	OR	95% CI		P-value
		Lower	Upper	
Nationality				
Malaysian	1			
Non-Malaysian	2.24	1.78	2.81	<0.001
Ethnicity (Malaysian only)				
Malay	1			
Chinese	0.71	0.56	0.91	0.006
Indian	0.83	0.61	1.13	0.242
Orang Asli	2.84	1.87	4.31	<0.001
Bumiputera Sabah	0.99	0.80	1.23	0.934
Bumiputera Sarawak	1.53	1.13	2.06	0.005
Other ethnicity	1.15	0.80	1.65	0.461

The results derived from univariate logistic regression test

Non-Malaysians have a significantly higher estimated risk of preventable deaths compared to Malaysian (OR 2.24).

For Malaysians, Malays had the highest number of deaths, which was expected, as Malays had the highest population for children under-5 years of age.

Orang Asli and Bumiputera Sarawak had significantly higher estimated risk of preventable deaths when compared to Malay with the OR of 2.84 and 1.53 respectively. In contrast, Chinese had significantly lower risk of under-5 preventable deaths in 2016 when compared to the Malays.

Table 3.9: Relationship between Age of Death against Place of Death for the Reclassified Preventable Under-5 Deaths, Malaysia, 2016

Age group (Year)	Hospital	Non-hospital	Total
	n (%)	n (%)	n
< 1 Year	1390 (81.4)	317 (18.6)	1707
<i>Early Neonatal</i>	574 (91.0)	57 (9.0)	631
<i>Late Neonatal</i>	225 (86.9)	34 (13.1)	259
<i>28 Days - < 1 Year</i>	591 (72.3)	226 (27.7)	817
1 Year	171 (69.5)	75 (30.5)	246
2 Years	75 (62.5)	45 (37.5)	120
3 Years	61 (58.7)	43 (41.3)	104
4 Years	68 (70.1)	29 (29.9)	97
Total	1765 (77.6)	509 (22.4)	2274

Looking closer at the relationship between age and place of death, around a third of children beyond the neonatal age died in the non-hospital setting.

Almost half of the under-5 deaths among Orang Asli occurred at a non-hospital setting. In contrast, only 10-30% of the under-5 deaths for other Malaysians and non-Malaysians occurred in a non-hospital setting. ([Appendix 11](#))

In regards to the relationship between the UCOD and the age of death, deaths occurring between 1-4 years were mainly due to injuries, poisoning and other consequences of external causes (ranged between 28.5-38.3%) followed by certain infections and parasitic diseases (12.5-18.7%) and disease of the respiratory system. (ranging from 9.3 to 18.3%). ([Appendix 12](#))

Socioeconomic Factors among the Preventable Under-5 Deaths ([Appendix 13](#) and [Appendix 14](#))

Majority of the parents received secondary and tertiary education, with the overall percentage of 72.1%. Both maternal and paternal highest education received were at secondary level, with 47.6% and 45.8% respectively.

The most common maternal occupation was housewife at 54.4% followed by professionals at 12.5%. However, the most common paternal occupation was elementary occupations with 17.5% and technicians and associated professionals at 13.2%. Only 1.2% of the fathers were unemployed.

More than half of the families of this group of children had monthly household income less than RM3000 (51.9%), with another 0.4% receiving social welfare support and 2.2% with no income.

There was 1.9% of mothers less than 18 years of age. Majority were between the ages of 26-35 years of age. Eighty-eight percent of the mothers were married. Only 5.9% were unmarried.

Comorbidities

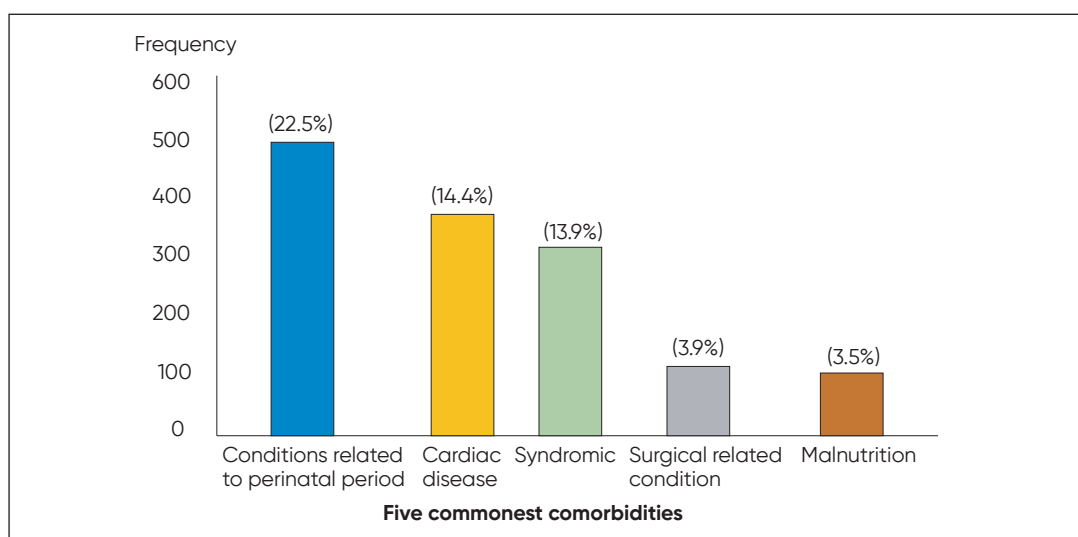


Figure 3.2: Five Commonest Comorbidities Reported in the Preventable Under-5 Deaths, Malaysia, 2016

Conditions related to the perinatal period was the commonest comorbidity reported at 22.5%. This is followed by cardiac disease (14.4 %), underlying syndromes at 13.9%, surgical related conditions at 3.9% and malnutrition at 3.5%.

Looking closer to the individual comorbidities reported ([Appendix 15](#)), conditions related to the perinatal period was commonly reported in ICD10 UCOD of conditions originating from the perinatal period (378/488; 76.2%). Other UCOD that had relationship with conditions related to perinatal period were congenital malformation, deformations and chromosomal abnormalities (32/488; 6.6%), diseases from the respiratory system (30/488; 6.1%) and certain infectious and parasitic diseases (23/488; 4.7%).

As for cardiac diseases, it was reported commonly in the UCOD of congenital malformations, deformations and chromosomal abnormalities at 234/312 deaths (75.0%). Cardiac disease was also reported as a comorbidity in disease of the respiratory system (22/312; 7.1%) and certain infectious and parasitic diseases (15/312; 4.8%).

Underlying syndromes was expectedly the commonest comorbidity reported in congenital malformations, deformations and chromosomal abnormalities (236/300; 78.7%) It was also reported in disease from respiratory period (17/300; 5.7%), conditions originating from the perinatal period (16/300; 5.3%) and certain infectious and parasitic diseases (15/300; 5.0%).

Surgical related conditions were reported as a common comorbidity in congenital malformations, deformations and chromosomal abnormalities (56/84; 66.7%) and conditions related to the perinatal period (15/84; 17.9%).

Malnutrition was a commonly reported comorbidity related to certain infectious and parasitic diseases (19/76; 25.0%) and disease from the respiratory system (16/76; 21.1%). It was also reported in diseases from the central nervous system at 14.5% (11/76).

Table 3.10: Presence of Comorbidities in Relation to Preventable Under-5 Deaths, Malaysia, 2016

ICD 10 classification	Present	Absent	Not applicable	Unknown	Total
	n (%)	n (%)	n (%)	n (%)	n (%)
Certain condition originating in the perinatal period	409 (55.6)	297 (40.4)	26 (3.5)	3 (0.4)	735 (100)
Congenital malformation, deformations and chromosomal abnormalities	418 (95.9)	13 (3.0)	0 (0)	5 (1.1)	436 (100)
Injuries, poisoning and external causes	19 (6.2)	285 (93.4)	1 (0.3)	0 (0)	305 (100)
Certain infectious & parasitic diseases	77 (31.8)	161 (66.5)	1 (0.4)	3 (1.2)	242 (100)
Diseases of the respiratory system	96 (45.7)	111 (52.9)	2 (1.0)	1 (0.5)	210 (100)
Diseases of nervous system	32 (43.2)	28 (37.8)	0 (0)	14 (18.9)	74 (100)
Symptoms, signs & abnormal clinical & laboratory findings, NEC	9 (18.0)	31 (62)	0 (0)	10 (20.0)	50 (100)
Neoplasms	7 (17.5)	29 (72.5)	0 (0)	4 (10.0)	40 (100)
Endocrine, nutritional and metabolic diseases	13 (43.3)	4 (13.3)	0 (0)	13 (43.3)	30 (100)
Diseases of the digestive system	9 (31.0)	15 (51.7)	0 (0)	5 (17.2)	29 (100)
Diseases of the circulatory system	8 (53.3)	5 (33.3)	0 (0)	2 (13.3)	15 (100)
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	3 (33.3)	5 (55.6)	0 (0)	1 (11.1)	9 (100)
Diseases of the genitourinary system	1 (12.5)	6 (75.0)	0 (0)	1 (12.5)	8 (100)
Others	3 (60.0)	2 (40.0)	0 (0)	0 (0)	5 (100)
Unknown	22 (25.6)	37 (43.0)	2 (2.3)	25 (29.1)	86 (100)
Total	1126 (49.5)	1029 (45.3)	32 (1.4)	87 (3.8)	2274 (100)

Comorbidities were present in 49.5% of the preventable deaths. Looking at the respective preventable underlying causes of deaths, co-morbidities were present in 95.8% of all deaths due to congenital malformation, 55.6% in conditions originating in the perinatal period and 53.3% in diseases of the circulatory system. Forty-five percent of the deaths from diseases of the respiratory system had comorbidities.

As for certain infectious and parasitic diseases, 31.8% of the preventable deaths had comorbidities. Only 6.2% of the deaths in the injury, poisoning and external causes UCOD had comorbidities.

Comorbidities that were not applicable to the mortalities referred mainly to deaths which occurred in the neonatal period. There were 87 deaths (3.8%) where comorbidities were not stated, hence recorded as unknown.

There may be one or more comorbidities present for one death.

Contributing risk factors

Table 3.11: Number and Percentage of Medical and Non-Medical Risk Factors Related to Preventable Under-5 deaths, Malaysia, 2016

Risk factor	N (%)
Medical	
Quality of care	1054 (46.9)
Facility	79 (3.5)
Equipment	59 (2.6)
Transport	27 (1.2)
Non-medical	
Socio-political	
Injury prevention	240 (10.6)
Poverty/ Malnutrition	175 (7.7)
Transport infrastructure	88 (3.9)
Inaccessibility	79 (3.5)
Poor living condition	74 (3.3)
Teenage pregnancies	54 (2.4)
Untrained/ unlicensed child minder	26 (1.2)
Substance abuse	11 (0.5)
Birth Defect Prevention	105 (7.3)
Patient & family	
Delay in seeking treatment	717 (31.5)
Lack of awareness of severity of illness	352 (15.6)
Noncompliance to advice	267 (11.8)
Noncompliance/ refusal of therapy/ immunization	176 (7.8)
Noncompliance / refuse admission	96 (4.2)
Health philosophy (alternative treatment/ culture belief)	64 (2.8)
Others	41 (14.0)

Shortfall in quality of medical care was the most common medical risk factor noted whereas delay in seeking treatment was the most common risk factor in the non-medical or public health risk factor (Table 3.11).

In medical risk factors, shortfall in quality of care contributed to 46.9% of the preventable deaths. Under quality of care, failure to recognise the severity of the child's condition was the most common contributing factor leading to the under-5 deaths. Other contributing factors were 'inadequate treatment', 'failure to diagnose correctly', 'inappropriate level of expertise' and 'health-care associated infection'. Details are in [Appendix 16](#).

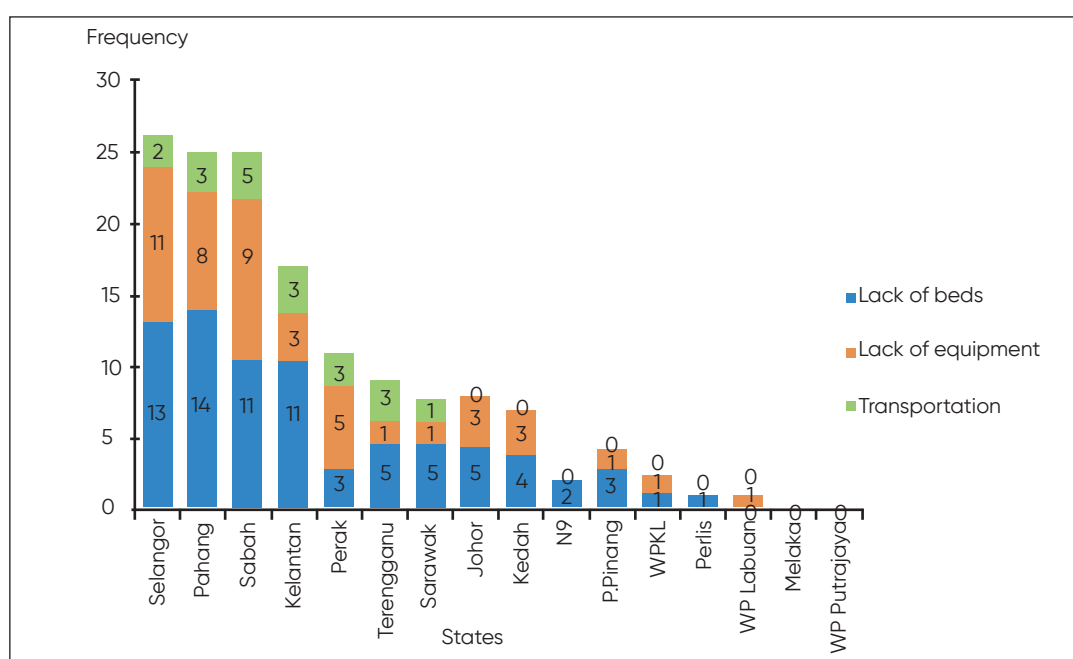


Figure 3.3: Medical Risk Factors (excluding quality of care) contributing to Preventable Under-5 deaths According to States, Malaysia, 2016

Looking at the relationship between the medical risk factors, excluding shortfall in quality of care, to the states in Malaysia, Selangor reported the most responses followed by Pahang, Sabah, Kelantan and Perak. Lack of beds was the most common factor reported in almost all states except Perak. This was followed by lack of equipment and transportation issues such as retrieval systems and lack of ambulances in most states. Further details are in [Appendix 17](#).

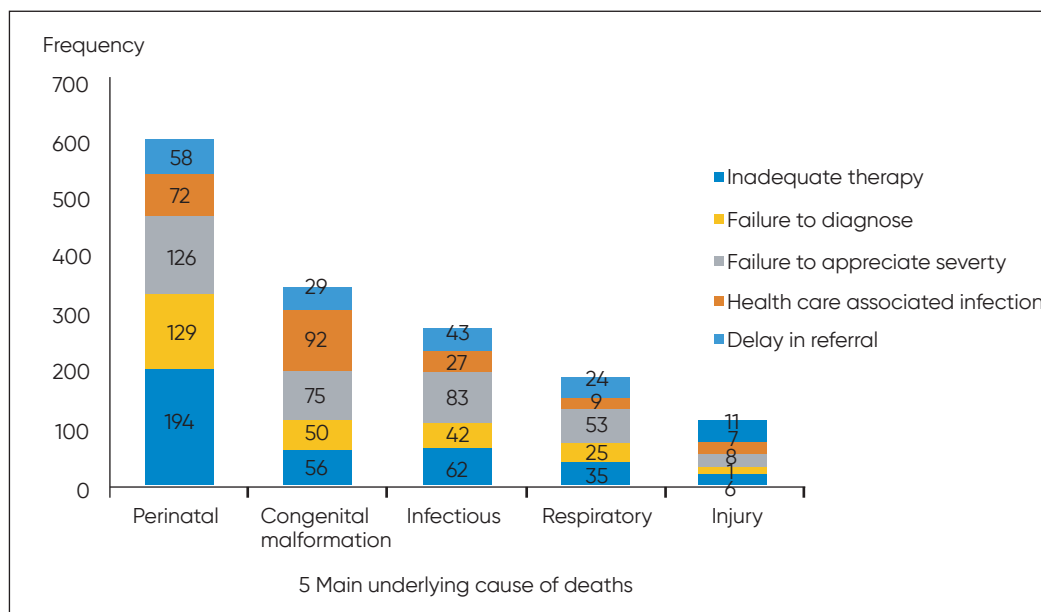


Figure 3.4: Types of Shortfalls in Quality of Care Leading to Preventable Deaths in the 5 Main Underlying Causes of Deaths, Malaysia, 2016

Shortfall in quality of care contributed to almost half of the reported medical risk factors. For the perinatal group, the most common factor cited was inadequate therapy. Nosocomial infection was the commonest factor recorded in congenital malformation. For both certain infectious diseases and diseases from the respiratory system, failure to appreciate severity was the most common factor cited.

In non-medical risk factors, patient and family factors contributed to most of the risk factors reported. Almost one third of the preventable deaths (32.0%) were reported to have delay in seeking treatment. Another 15.6% were reported to have lack of awareness of severity of illness with 11.8% were reported to be non-compliant to advice. Non-compliance or refusal to therapy and/or immunization contributed to 7.8% of the reported risk factors.

As for the socio-political aspect of the non-medical risk factor, lack of injury prevention was the commonest factor recorded. Poverty and malnutrition were reported in 7.7% of the responses, and 7.3% was due to lack of birth defect prevention. Transport infrastructure, inaccessibility and poor living conditions were reported at 3.9%, 3.5% and 3.3% respectively. Teenage pregnancy was also cited as risk factors in 2.4% of the responses.

Ill-defined and unknown underlying cause of death

After reclassifying the deaths, a total of 255 deaths (5.2%) had unknown UCOD. Out of the 255 deaths, 55.3% (141/255) had undetermined preventability, 33.7% (86/255) were preventable and 11% not preventable (28/255). Despite the UCOD classified under ill-defined or unknown cause of death, the preventability of the death was determined by the presence of risk factors (medical and non-medical) which could have prevented the circumstances of the death.

A total of 150 deaths (58.8%) from this group occurred in the non-hospital setting in which 69.3% (104/150) were brought-in-dead (BID).

There was a total of 53 (20.9%) deaths in this group where post-mortem examination was performed and the UCOD remained unknown. However, only 19 (35.8%) of the post-mortem reports were available. Majority (80.2%) of the preventable deaths in this group did not have post-mortem examination done. Only 19.6% of all the unknown UCOD had adequate clinical information.

Table 3.12: Unknown Underlying Cause of Under-5 Deaths, Malaysia, 2016

ICD 10 of Unknown	Preventable	Not preventable	Indeterminate	Total
	n (%)	n (%)	n (%)	n (%)
Underlying cause of death				
Unknown	86 (100)	28 (100)	141 (100)	255 (100)
Place of Death				
Non-hospital	50 (58.1)	15 (53.6)	85 (60.3)	150 (58.8)
Hospital	36 (41.9)	13 (46.4)	56 (39.7)	105 (41.2)
Type of death				
BID	28 (32.6)	14 (50.0)	62 (44.0)	104 (40.8)
Hospital	36 (41.9)	13 (46.4)	56 (39.7)	105 (41.2)
Non-hospital (non-BID)	22 (25.6)	1 (3.6)	23 (16.3)	46 (18.0)
Post-mortem done				
Yes	9 (10.5)	14 (50.0)	30 (21.3)	53 (20.8)
No	69 (80.2)	14 (50.0)	96 (68.1)	179 (70.2)
Not stated	8 (9.3)	0 (0)	15 (10.6)	23 (9.0)
Adequacy of clinical information				
Yes	13 (15.1)	11 (39.3)	26 (18.4)	50 (19.6)
No	73 (84.9)	17 (60.7)	115 (81.6)	205 (80.4)

Discussion

For this study, preventable death is classified under the assumption that all children in Malaysia should receive the highest level of care equally for all states. In reality, all states in Malaysia differ in geography, economy, infrastructure and manpower, which may affect the accessibility of healthcare provided to these children. Wilayah Persekutuan Putrajaya, Kuala Lumpur and Labuan were analysed separately despite being governed by the federal government, due to difference of geography, socio-demography, socio-economy and infrastructure background.

In 2016, Malaysia achieved the targets set by the Sustainable Development Goals with the neonatal mortality rate of 4.2/1000 live births and under-5 mortality rates of 8.4/1000 live births¹⁰. In Malaysia, the under-5 mortality rates have plateaued since 2013. Through the SU5MR reporting system, Family Health Development Division (FHDD) reported an increased figure of 9.78 in 2016. The data reported as national figures were from the registered deaths captured through the Department of Statistics, Malaysia, whereas FHDD derive the data through reporting using the SU5MR forms from the Health Departments. The discrepancy of the data has been explained in the FHDD annual report 2019¹⁰. Data streamlining efforts between the two agencies are ongoing.

As noted earlier in the technical report 2016⁶, there were no major impacts noted despite the implementation of the remedial measures since 2006. Hence, there was a need to investigate the preventable deaths to reduce and subsequently end all preventable deaths and reduce the under-5 mortalities.

The lower percentage of the preventable deaths reported in the technical report was likely due to the unfamiliarity of the health personnel in identifying the non-medical and public health issues despite having an established guideline as early as 2015, before the official publication⁵.

This study affirmed the need to reinforce the understanding of preventable deaths especially from the non-medical or public health aspect. The percentage of preventable deaths in this study was similar to the finding in 2006 at 44%⁹.

Place of death is used as an indicator whether medical care has been sought and provided. Although 77.6% of the preventable deaths died in the hospital, there were deaths that occurred in the hospital setting where the children had arrived in the hospital in a compromised state and death was imminent.

For non-hospital deaths, the majority of the preventable deaths died at home or in caretakers' houses, contributing to 12.2% of all the non-hospital deaths. There were another 4.2% of children who died en-route to the healthcare facility, indicating there may be a delay in seeking treatment. There is a need to address this proportion of deaths and with the upcoming *Guidelines for Management of Under-five Children Brought in Dead (BID) to Ministry of Health Facilities* due to be published soon, a similar approach can be used to investigate these deaths before a strategy can be put in place to prevent these deaths.

Looking at ethnicity as a contributing risk factor, Orang Asli remained the main ethnic group with the highest estimated risk of under-5 mortalities. Similar findings were noted from 2006. Programmes have been in place to rectify the situation as described in the Malaysian Millennium Development Goals Report 2015¹¹. However, there is a need to oversee and evaluate the programme to enhance their uptake, acceptance, and accessibility.

Socioeconomic factors contributing to the preventable deaths are important aspects to consider while preparing remedial measures to ensure reduction of preventable deaths. Education and public health intervention programmes can be tailored to target the lower socioeconomic population be it in the rural or urban areas.

Malnutrition is a well-known contributing factor to childhood mortality. In the National Health Morbidity Survey 2016, the prevalence of stunting as an indicator of chronic malnutrition was highest in children aged 24-35 months, and in other ethnicities (29.5%) and other bumiputera (24.9%)¹². As per global reports, undernutrition contributes up to 44% risk in pneumonia deaths and as high as 73% risk in diarrhoea as a cause of death¹³. Hence, reinforcing existing programmes to overcome malnutrition¹⁴ especially for the vulnerable under-5 population such as Orang Asli, Bumiputera Sarawak, non-Malaysian children and the lower income group families should be prioritized.

Bridging the gap between the different geographical areas in Malaysia would be important in reducing the contributing medical risk factors such as lack of critical care beds, lack of equipment and transportation. The presence of a retrieval system via land, air and water would allow access to critical care management even for the rural children. At present, due to the limited accessibility to suitable ambulance services and critical care beds, referral of a critically ill neonate or child to the nearest hospital could be a challenge. Some rural areas are only accessible through rivers and seas, or makeshift roads. Air transportation are mainly via commercial airplanes, with critically ill children transported via air medical evacuation services¹⁵ or Royal Malaysian Air Force whereas transportation through river and sea is done mainly using commercial ferries, with very few water ambulances.

Land ambulance retrieval system are only available in Sabah and Perak since 2001¹⁶. However, there is limitation to the available service due to the geography, manpower and infrastructure. For instance, in Sabah, retrieval by land may take as long as 4-6 hours to make it back to the tertiary hospital and air retrieval is limited by weather and visibility (Fong SM, personal communication, August 23, 2021). Better retrieval system especially in the interior of Malaysia may help to overcome not only the issue of transportation, but also quality of care in managing critically ill children.

With regards to shortfalls in quality of care, many programmes are already in place to train the health care workers in recognizing danger signs in an unwell child. The Integrated Management of Childhood Illness as well as Approach to Unwell Children Under 5 years¹⁷ programmes are ongoing. Neonatal resuscitation program, basic life support and paediatric life support training are offered regularly. However, due to high turnover of staff working in the health facilities, it remains a challenge to cope with training while maintaining the continuity of service.

Patient and family risk factors contributing to the deaths are more challenging to address as it involves behavioural change. Changing beliefs, educating parents and caregivers should be a continuous process that should be undertaken by all health staff. It is a slow and difficult process especially when the treatment offered is against the families' cultural or perceived religious beliefs.

Unknown cause of deaths is the sixth most common cause of deaths. To reduce the UCOD in this category, full investigation including post-mortem should be undertaken and the guidelines for under-5 mortality BID should be implemented as soon as possible.

Key Findings

- There were 46.1% preventable under-5 mortalities after the audit. The overall preventable mortality rate per 1000 live births was 4.47. For majority of states, UCOD were in substantial kappa agreement pre and post audit. However, preventability was fair to moderate kappa agreement pre and post audit.
- Certain condition originating from the perinatal period contributed to 32.3%, followed by 19.2% from congenital malformation group, 13.4% from the injuries, poisoning and external causes, 10.6% from certain infectious and parasitic diseases and 9.2% from diseases of the respiratory system. Unknown cause of death contributed to 3.8%, making it the sixth most common cause of preventable death.
- Looking within the UCOD, 99.0% of mortalities in injuries, poisoning and external causes of death, 90.6% of deaths in certain infectious and parasitic disease, 75.2% of deaths in diseases of respiratory system, 40.0% of deaths in conditions originating from perinatal period and 30.1% from congenital malformation group were preventable.
- Majority of the preventable deaths occurred in hospital setting. For non-hospital deaths, 10.3% occurred at home with 3.8% occurred en route or during transportation to a health facility.
- Risk factors identified were age less than 1 year (75% of deaths), non-Malaysian (mortality rate of 10.1/ 1000 live births), ethnicity of Orang Asli (mortality rate of 18.64/ 1000 live births), other Malaysian (mortality rate of 8.42/ 1000 live births) and Bumiputera Sarawak (mortality rate of 5.37/ 1000 livebirths).
- 72.1% of parents received secondary and tertiary education. The most common maternal occupation was housewife (54.4%) followed by professionals (12.5%) whereas elementary occupation (17.5%) and technicians and associated professionals (13.2%) were the commonest paternal education. More than half of the families with under-5 mortality had monthly household income of less than RM3000 per month. Majority of the mothers were between 26 to 35 years of age, with 1.9% of mothers aged less than 18 years and 5.9% unmarried.
- Comorbidities were present in 49.5% of the deaths. There were events related to perinatal period (22.5%), cardiac disease (14.4%), underlying syndromes (13.9%), surgical related events (3.9%), and malnutrition (3.5%). Malnutrition was mainly related to deaths in the certain infectious and parasitic disease (25.0%), and disease of the respiratory system (21.1%).
- Contributing factors of the preventable under-5 deaths were divided into medical and non-medical factors. The most common medical contributing factor was a shortfall in quality of care (46.9%) and the non-medical contributing factor was delay in seeking treatment (31.5%). Other medical factors were lack of critical care beds, resuscitation equipment, ambulance service and retrieval system. Non-medical factors that need to be addressed were injury and birth defect prevention, poverty, malnutrition, and teenage pregnancy. Important family contributing factors were failure to appreciate the severity of the child's illness and non-compliance to medical advice.
- Ill-defined and unknown preventable underlying cause of death contributed to 33.7% of the deaths in which majority occurred in non-hospital setting. From this group, 69.3% were brought-in-dead.

Recommendations

- Paediatricians and family medicine specialists together with the district medical officer of health should lead the under-5 mortality discussion in the respective districts and guide the medical officers, and nurses in the investigation and underlying cause of deaths. Paediatricians should also play an active role as a representative to the state technical committee to determine the underlying cause of deaths and preventability of the deaths. Decisions on preventability need to take account of non-medical contributing risk factors as well.
- Current and future health programmes should focus on high risk under-5 children which were from the lower socioeconomic group, Orang Asli and Bumiputera Sarawak ethnicities and non-Malaysian.
- Malnutrition remains an important comorbidity that needs to be addressed. Existing programmes that address the problem of malnutrition should be strengthened and accessible to all children.
- Lack of critical care beds, equipment and transportation for health care facilities located in the interior of Malaysia should be addressed. Safe transportation should be strategized and planned to ensure safety of transportation of sick children. Targeted approaches by the individual states to address issues of facilities, equipment and transportation to suit their individual needs could also be made earlier.
- Availability of retrieval systems may be able to overcome issues of transportation and quality of care by sending teams who are trained in stabilization and transporting sick children to where the patient is managed.
- Shortfall in quality of care was a major contributing factor to preventable deaths across all states in Malaysia. Improving quality of care by hands-on training on CPGs, guidelines, existing programs such as IMCI¹⁸, ATUCU 5 with scheduled practical sessions should be widely available. Training for neonatal resuscitation programme, paediatric life support and advanced paediatric life support should be reinforced to maintain the quality of care.
- Standard operating procedures on communication between medical officer to specialist, also communication between private and government healthcare facilities can be strengthened.
- Having an integrated digital health record in the health clinics would be helpful in improving communication between health care providers of the health clinics and hospitals. Accessibility to patients' health records can reduce the time required to get the medical records especially when attending to health emergencies.
- Socio-political factors especially in injury prevention and birth defect prevention will require inter-agency collaboration and legislative changes and will be detailed in the following sections. Prevention of teenage pregnancies should also be addressed^{19,20}. Advocating for a legal reform to increase the marital age to 18 years must be a priority.
- Patient and family factors are more difficult to address. Improving the behaviour and knowledge of the family and caregivers on danger signs in unwell children and compliance to medical advice and treatment offered will be important and can begin with the services provided at the maternal and child health clinic. Staff can be trained in communication skills to overcome parental beliefs that may endanger the child through programmes available by UNICEF and universities²¹.
- Unknown cause of death should be investigated thoroughly including post-mortem examination by a forensic pathologist or histopathologist.

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CHAPTER 4: CERTAIN CONDITIONS ORIGINATING IN THE PERINATAL PERIOD

Introduction

Reporting of deaths of certain conditions originating in the perinatal period were based on the Modified Wigglesworth Classification ([Appendix 18](#)). The cause of death was based on ICD 10 classification. In this group however lethal congenital malformation is not included as these deaths would be described in detail within the congenital malformation section.

Overall mortality

In 2016, there were 1809 deaths due to certain conditions arising from the perinatal period. It was the highest leading cause of death in children under-5 years of age. Out of these, 40.6%, (735/1809) were preventable deaths (Figure 4.1).

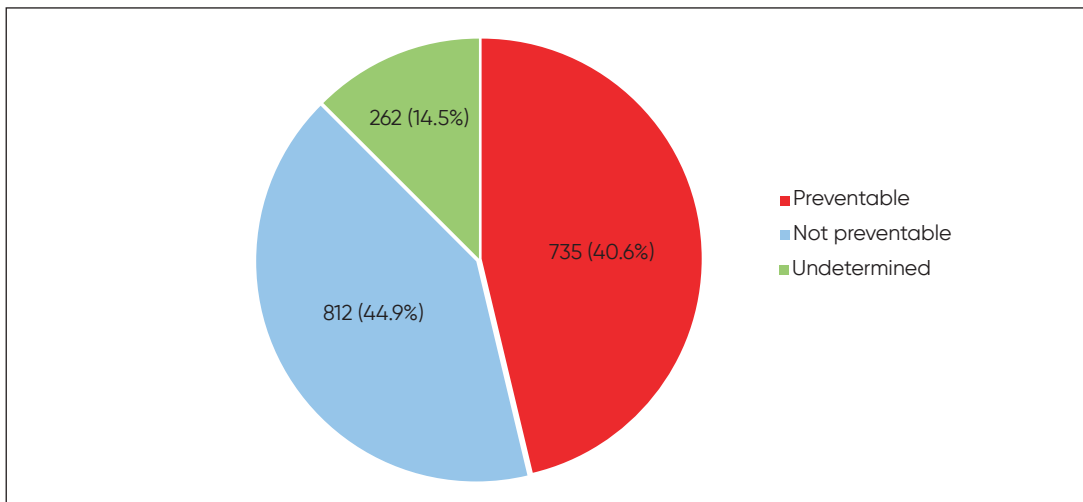


Figure 4.1: Preventable deaths in Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

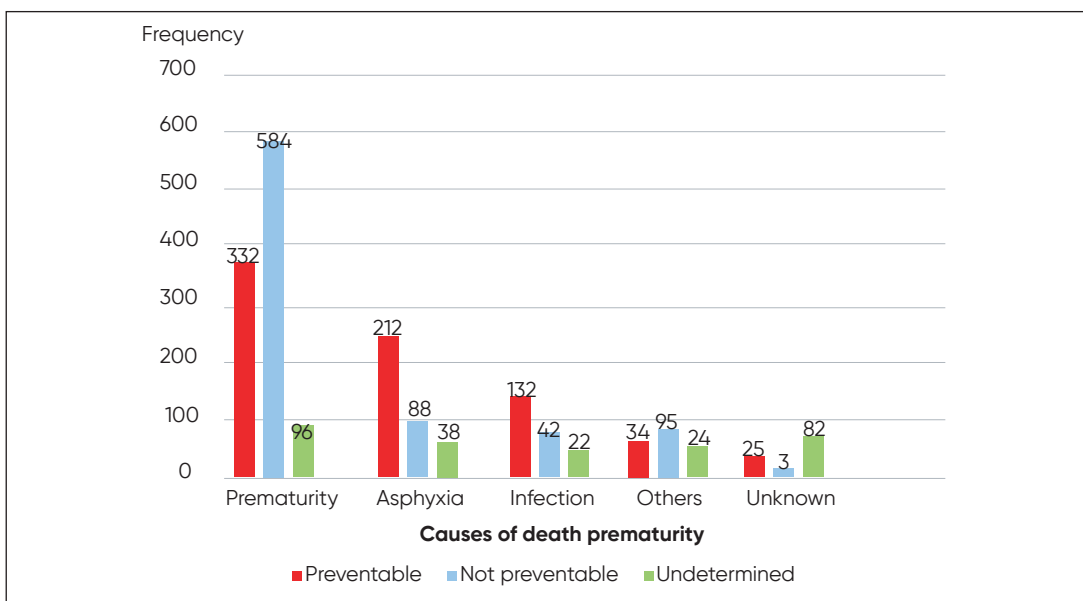


Figure 4.2: Overall Deaths in Category Certain Conditions Originating in the Perinatal Period According to Modified Wigglesworth Classification, Malaysia, 2016

Overall, the leading causes of preventable death by Modified Wigglesworth classification were prematurity 332 (45.2%), followed by asphyxia, 212 (28.8%), and infection 132 (17.9%). There were 34 (4.6%) deaths classified as others and 25 (3.4%) as unknown.

Relationship between birth weight, gestation, and preventable death

Table 4.1: The Number and Percentage of Preventable Deaths According to Birth Weight for Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

Birth weight	Preventable	Not preventable	Undetermined	Total
	n (%)	n (%)	n (%)	n (%)
500 and less	22 (3.0)	35 (4.3)	2 (0.8)	59 (3.3)
501 to 1000	204 (27.8)	465 (57.2)	69 (26.3)	738 (40.8)
1001 to 1500	98 (13.3)	87 (10.7)	40 (15.3)	225 (12.4)
1501 to 2500	140 (19.0)	89 (11.0)	54 (20.6)	283 (15.7)
2501 and above	253 (34.4)	121 (14.9)	77 (29.4)	451 (24.9)
Unknown	18 (2.4)	15 (1.8)	20 (7.6)	53 (2.9)
Total	735 (100)	812 (100)	262 (100)	1809 (100)

Table 4.2: Number and percentage of Preventable Deaths According to Gestation for Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

Gestation	Preventable	Not preventable	Undetermined	Total
	n (%)	n (%)	n (%)	n (%)
Extremely preterm <28w	181 (24.6)	481 (59.3)	58 (22.1)	720 (39.8)
Very preterm 28w to 31w	127 (17.3)	100 (12.3)	51 (19.5)	278 (15.4)
Mod preterm 32w to 33w	37 (5.0)	27 (3.2)	24 (9.2)	88 (4.8)
Late preterm 34w to 36w	75 (10.2)	35 (4.3)	27 (10.3)	137 (7.6)
Term 37w to 40w	189 (25.7)	66 (8.1)	71 (27.1)	326 (18)
>40w	57 (7.8)	16 (2.0)	10 (3.8)	83 (4.6)
Unknown	69 (9.4)	87 (10.7)	21 (8.0)	177 (9.8)
Total	735 (100)	812 (100)	262 (100)	1809 (100)

Majority of preventable deaths occurred in the birth category 1500 grams and less; (324/735; 44.1%), followed by babies with birth weight category above 2500g, (253/735; 34.4%). (Table 4.1)

Similar findings were noted in the category of gestation whereby a total of 308 deaths occurred in premature babies of less than 32 weeks' gestation (41.9%) followed by term babies (246/735; 33.5%). (Table 4.2).

There were 9.4% (69/735) deaths classified as unknown gestation and 2.4% (18/735) with unknown birth weight.

Preventable death by age

Majority of deaths occurred within the first week of life (492/735; 66.9%), followed by late neonatal death (177/735; 24.1%) and death after 28 days until less than 1 year old (66/735; 9.0%) (Figure 4.3).

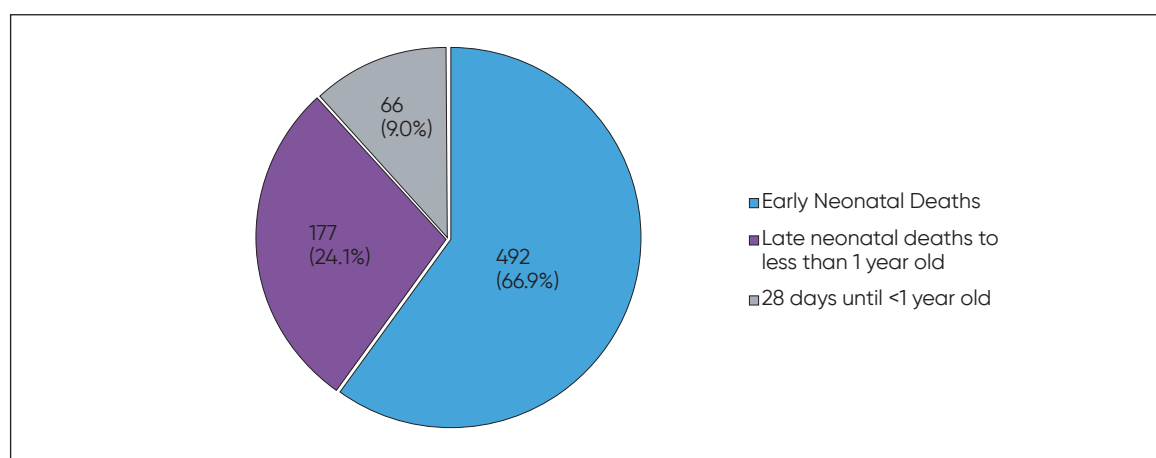


Figure 4.3: Number and Percentage of Preventable Deaths by Age of Death for Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

Association between preventable deaths with socio-demographic factors

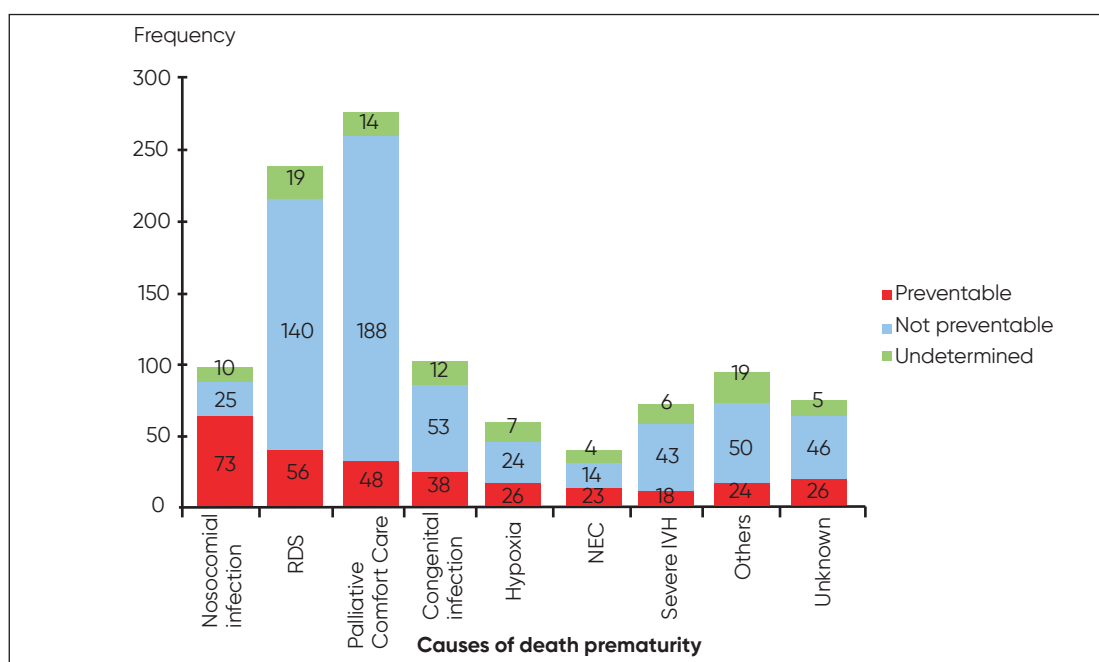
The socio-demographic factors that were observed in this group of deaths were similar to the overall findings. Looking into the levels of parental education, majority of the deaths occurred in families where the parents had secondary or tertiary education. Majority of the preventable deaths occurred in families with household monthly income less than RM3000, in all categories of causes of death.

The most common occupation of mothers was recorded as housewife followed by professionals whereas for the fathers' occupation, majority were unknown, elementary occupation, and technician and associated professionals. The most common maternal age in these families was between 26–35 years of age.

The findings are detailed in [Appendix 19](#).

Causes of Death in Prematurity

Overall Causes of Death in Prematurity



* Palliative comfort care refers to "no active care" was given to the premature babies.

Figure 4.4: Preventable Deaths in Prematurity for Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

The immediate cause of death secondary to prematurity was nosocomial infection at 22.0% (73/332) followed by respiratory distress syndrome, 16.9% (56/332), palliative comfort care group, 14.6% (48/332), and congenital infection, 11.4% (38/332). (Table 4.3)

Most deaths due to nosocomial infection occurred in premature babies of 31 weeks or less (84.9%, 62/73), and birth weight category of 1500 grams or less at 78.1% (57/73).

Majority of deaths in palliative comfort care group occurred in smaller babies 1000 grams and less; and at extreme gestation of less than 28 weeks.

Relationship between birth weight, gestation and causes of death in prematurity

Table 4.3: Relationship between Birth Weight, Gestation and Preventable Deaths for Deaths due to Prematurity in Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

	Nosocomial Infection		RDS	Comfort care		Congenital infection	Hypoxia		NEC	IVH	Others	Unknown	Total
	n (%)	n (%)		n (%)	n (%)		n (%)	n (%)					
Birth weight													
500 and less	2 (2.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3.8)	1 (4.3)	1 (5.6)	0 (0)	0 (0)	3 (9.5)	8 (3.9)
501 to 1000	31 (42.5)	33 (58.9)	33 (58.9)	41 (85.4)	18 (47.4)	18 (47.4)	15 (57.7)	12 (52.2)	9 (50)	11 (45.8)	13 (50.0)	178 (53.6)	
1001 to 1500	24 (32.9)	11 (19.6)	11 (19.6)	5 (10.4)	9 (19.0)	9 (19.0)	3 (11.5)	6 (26.1)	5 (27.8)	5 (20.8)	8 (30.8)	76 (22.9)	
1501 to 2500	10 (13.7)	10 (17.9)	10 (17.9)	0 (0)	10 (26.3)	10 (26.3)	6 (23.1)	2 (8.7)	2 (11.1)	8 (33.3)	2 (7.7)	50 (14.3)	
2501 and above	0 (0)	1 (1.8)	1 (1.8)	0 (0)	1 (2.6)	1 (2.6)	1 (3.8)	0 (0)	0 (0)	0 (0)	1 (3.8)	4 (1.5)	
Unknown	6 (8.2)	0 (0)	0 (0)	2 (4.2)	0 (0)	0 (0)	0 (0)	2 (8.7)	1 (5.6)	0 (0)	0 (0)	11 (6.9)	
Gestation													
Extremely preterm <28w	31 (42.5)	27 (48.2)	27 (48.2)	43 (89.6)	15 (39.5)	15 (39.5)	14 (53.8)	9 (39.1)	13 (72.2)	4 (16.7)	8 (30.8)	164 (49.4)	
Very preterm 28w to 31w	31 (42.5)	22 (39.3)	22 (39.3)	3 (6.2)	10 (26.3)	10 (26.3)	5 (19.2)	11 (47.8)	3 (16.7)	9 (37.5)	6 (23.1)	100 (30.1)	
Mod preterm 32w to 33w	5 (6.8)	1 (1.8)	1 (1.8)	0 (0)	8 (21.1)	8 (21.1)	2 (7.7)	3 (13.0)	2 (11.1)	4 (16.7)	0 (0)	25 (7.5)	
Late preterm 34w to 36w	6 (8.2)	2 (3.6)	2 (3.6)	0 (0)	5 (13.2)	5 (13.2)	5 (19.2)	0 (0)	0 (0)	2 (8.3)	0 (0)	20 (4.2)	
Term 37w to 40w	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3.8)	1 (0.3)	
Unknown	0 (0)	4 (7.1)	4 (7.1)	2 (4.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (20.8)	11 (42.3)	21 (8.4)	
Total	73 (100)	56 (100)	56 (100)	48 (100)	38 (100)	38 (100)	26 (100)	23 (100)	18 (100)	24 (100)	26 (100)	332 (100)	

Number and percentage of antenatal corticosteroid and surfactant received

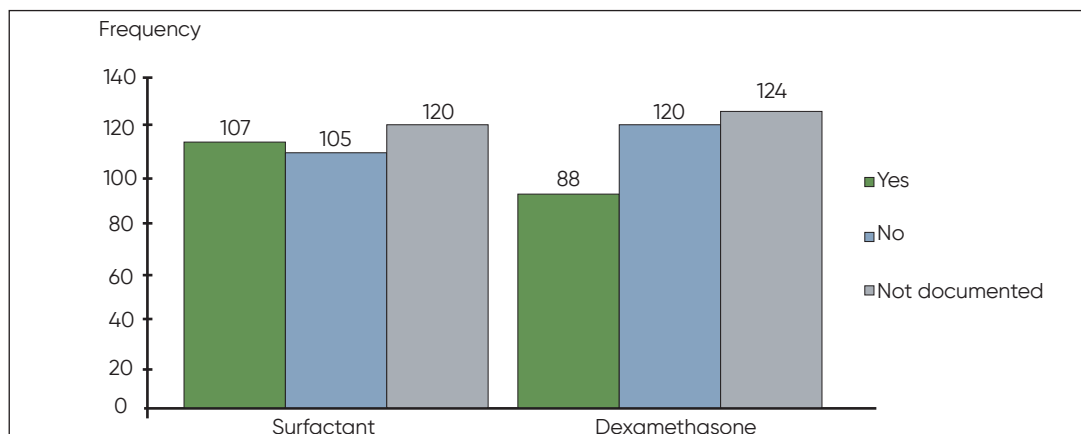


Figure 4.5: Surfactant and Corticosteroid Therapy in Preventable Deaths due to Prematurity in Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

Only 26.5% (88/332) antenatal mothers in the preventable death category were documented to have received corticosteroid therapy. Similarly, only 32.2% (107/332) of the premature babies were documented to have received surfactant therapy (Figure 4.5).

A total of 37.3% (124/332) of the preventable deaths due to prematurity did not have documentation if maternal dexamethasone was administered, and 36.1% (120/332) did not document if babies received surfactant therapy.

Preventable deaths in term babies

There was a total of 409 deaths with gestation of 37 weeks and above. Out of this number, 246 deaths were preventable.

Looking at the overall deaths in term babies, more than half (212/409, 51.8%) died of asphyxia and 132 (32.3%) deaths due to infection.

Asphyxia as cause of preventable deaths

Table 4.4: Relationship between Gestation, Birth Weight, and Preventable Deaths due to Asphyxia in Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

	Asphyxia		Total, n (%)
	Yes, n (%)	No, n (%)	
Gestation			
Term 37w to 40w	109 (57.7)	80 (42.3)	189 (100)
>40w	43 (75.4)	14 (24.6)	57 (100)
Unknown	60 (38.2)	97 (61.8)	157 (100)
Birth weight			
2500 to 4499	159 (61.2)	101 (38.8)	260 (100)
4500 and more	2 (40.0)	3 (60.0)	5 (100)
Unknown	51 (37.0)	87 (63.0)	138 (100)

Looking closer at babies with known gestational age, 152 (61.8%) died due to asphyxia.

As for birth weight, there were 265 deaths who had a birth weight of 2500 g and above. From this group, 161 (60.8%) deaths were due to asphyxia. Out of the 138 mortalities with unknown birth weight, 37% died of asphyxia.

Looking at all the mortalities due to asphyxia, 60.8% (129/212) of these babies died due to Hypoxic Ischaemic Encephalopathy (HIE), followed by Meconium Aspiration Syndrome, 31.6% (67/212). (Figure 4.6)

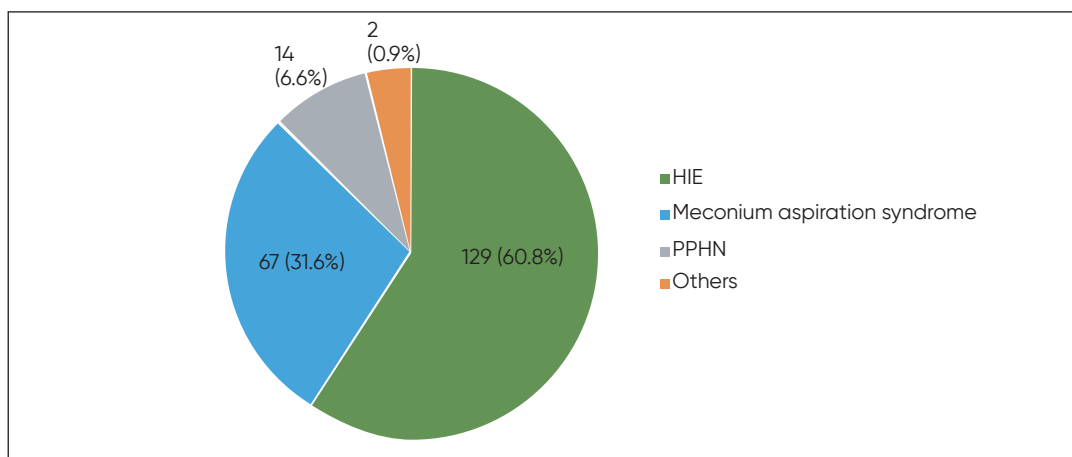


Figure 4.6: Causes of Asphyxia Amongst the Preventable Deaths in Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

Infection as the cause of preventable deaths

Amongst those with known gestational age or birth weight, more than a quarter died of infection at 68/246 (27.6%) and 70/265 (26.4%) respectively. (Table 4.5)

Table 4.5: Preventable Deaths due to Infection in Term Neonates for Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

	Infection		Total, n (%)
	Yes, n (%)	No, n (%)	
Gestation			
Term 37w to 40w	55 (29.1)	134 (70.9)	189 (100)
> 40w	13 (22.8)	44 (77.2)	57 (100)
Unknown	64 (40.8)	93 (59.2)	157 (100)
Birth weight			
2500 to 4499	69 (26.5)	191 (73.5)	260 (100)
4500 grams and more	1 (20.0)	4 (80.0)	5 (100)
Unknown	62 (44.9)	76 (55.1)	138 (100)

The three common infections were sepsis, 77.3%, followed by congenital pneumonia, 15.2%, and necrotizing enterocolitis, 7.6%. (Figure 4.7).

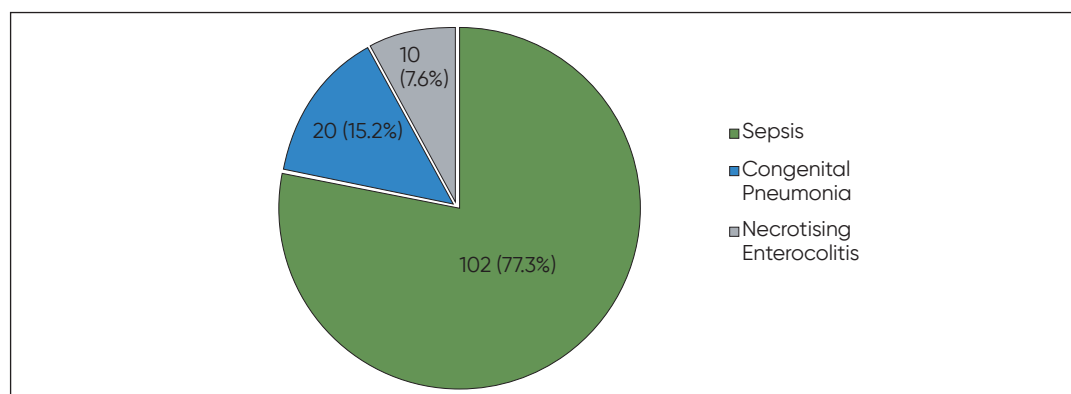


Figure 4.7: Specific Causes of Infection for Preventable Deaths in Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

Other causes of preventable deaths in term babies

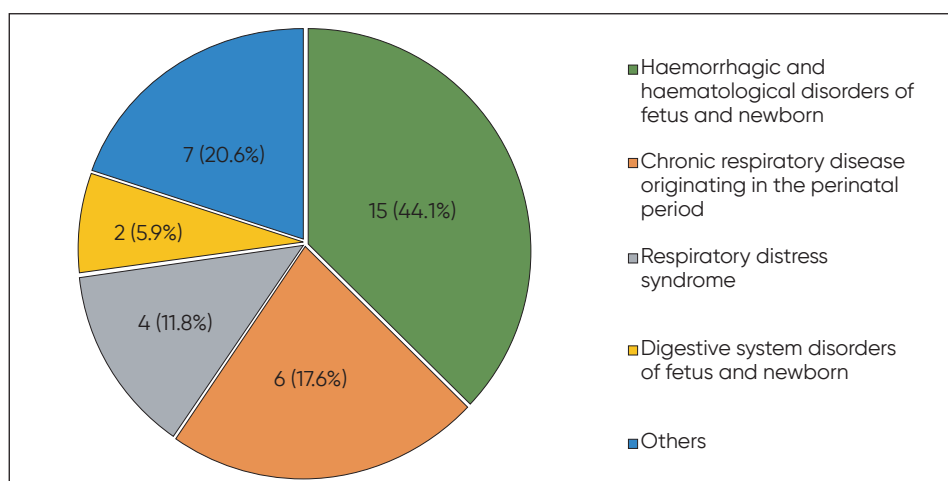


Figure 4.8: Other causes of preventable deaths in term babies, Malaysia, 2016

For other causes of preventable death in term babies, the main UCOD were haemorrhagic and haematological disorders of foetus and newborn, 44.1% (15/34), in which majority of deaths in this group was due to haemorrhagic disease of newborn (HDN), followed by chronic respiratory disease originating in the perinatal period, 17.6% (6/34).

Medical and Non-Medical Risk Factors for Preventable Deaths in Certain Conditions Originating in the Perinatal Period

Maternal medical and non-medical risk factors

Table 4.6: Association of Maternal Risk Factors with Preventable Deaths in Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

Medical/ non-medical factor	Yes	No	Not documented	Total
	n (%)	n (%)	n (%)	n (%)
Maternal medical/ obstetric	429 (58.4)	236 (32.1)	70 (9.5)	735 (100)
Shortfall Antenatal care	286 (38.9)	391 (53.2)	58 (7.9)	735 (100)
Shortfall neonatal care	238 (32.4)	418 (56.9)	79 (10.7)	735 (100)
Shortfall intrapartum	204 (27.8)	410 (55.8)	121 (16.5)	735 (100)

Maternal medical and obstetric risk factors were found in more than half, 58.4% (429/735) in the preventable deaths group.

About one third of all deaths had some shortfall in patient's management during antenatal, intrapartum, and/or neonatal care.

The main maternal or obstetrics risk factors identified were diabetes mellitus (11.2%), hypertension (7.6%), unbooked and/or unmarried mother (7.5%), preterm labour (7.2%), anaemia (6.3%), and obesity (3.9%).

There were 67.7% of mothers who had one risk factor, and 20.5% were in the category of low-risk pregnancy with no risk factor. (Table 4.8)

Table 4.7: Association of Maternal Obstetric Risk Factors and Preventable Deaths in Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

Maternal obstetric risk factor	Frequency (n)	Percent (%)
Risk Factor		
Diabetes mellitus	82	11.2
Hypertension	56	7.6
Unbooked/ unmarried	55	7.5
Preterm labour	53	7.2
Anaemia	46	6.3
PPROM	38	5.2
Obesity	29	3.9
Teenage pregnancy	22	3.0
UTI	10	1.4
Multi-pregnancy	10	1.4
Number of maternal risk factor for each death		
None	151	20.5
1 risk factor	499	67.9
2 risk factors	72	9.8
3 risk factors	13	1.8
Total	735	100

Table 4.8: Relationship between Medical and Non-Medical Risk Factor and Underlying Causes of Deaths for Certain Conditions Originating in the Perinatal Period, Malaysia, 2016

Risk factor	Prematurity	Asphyxia	Infection	Others	Unknown	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Medical						
Quality of care	170 (51.2)	145 (68.7)	80 (61.1)	17 (51.5)	6 (24.0)	418 (57.1)
Equipment	13 (3.9)	13 (6.2)	9 (6.9)	4 (12.1)	0 (0)	39 (5.3)
Facility	14 (4.2)	6 (2.8)	5 (3.8)	0 (0)	0 (0)	25 (3.4)
Transportation	6 (1.8)	4 (1.9)	1 (0.8)	1 (3.0)	0 (0)	12 (1.6)
Non-medical						
Socio-politic						
Teenage pregnancy	29 (8.7)	5 (2.4)	2 (1.5)	0 (0)	2 (8.0)	38 (5.2)
Malnutrition	22 (6.6)	9 (4.3)	5 (3.8)	0 (0)	1 (4.0)	37 (5.0)
Poor living condition	10 (3.0)	5 (2.4)	3 (2.3)	0 (0)	0 (0)	18 (2.5)
Transport	7 (2.1)	5 (2.4)	2 (1.5)	0 (0)	2 (8.0)	16 (2.2)
Inaccessibility	3 (0.9)	2 (0.9)	4 (3.0)	0 (0)	1 (4.0)	10 (1.4)
Substance abused	3 (0.9)	1 (0.5)	0 (0)	1 (3.0)	0 (0)	5 (0.7)
Injury prevention	3 (0.9)	1 (0.5)	0 (0)	0 (0)	1 (4.0)	5 (0.7)
Untrained child minder	0 (0)	0 (0)	1 (0.8)	0 (0)	0 (0)	1 (0.1)
Family & patient						
Delay seeking treatment	115 (34.6)	57 (27.0)	35 (26.5)	11 (33.3)	19 (76.0)	237 (32.3)
Non-compliance advice	53 (16.0)	31 (14.7)	15 (11.4)	2 (6.1)	3 (12.0)	104 (14.2)
Lack of awareness	18 (5.4)	7 (3.3)	16 (12.1)	3 (9.1)	4 (16.0)	48 (6.5)
Non-compliance to immunization	24 (7.2)	9 (4.3)	4 (3.0)	1 (3.0)	2 (8.0)	40 (5.5)
Non-compliance to admission	12 (3.6)	11 (5.2)	4 (3.0)	1 (3.0)	0 (0)	28 (3.8)
Health philosophy	6 (1.8)	2 (0.9)	3 (2.3)	2 (6.1)	2 (8.0)	15 (2.0)

Shortfall in the quality of medical care was the most common medical risk factor that contributed to more than 50% of deaths seen in all categories of underlying cause of death.

On the other hand, delay in seeking treatment (32.3%) and non-compliance to advice (14.2%) were the commonest risk factors from family and patient risk factors. Teenage pregnancy (5.2%) and malnutrition (5.0%) were the most common risk factors in the socio-political category.

Discussion

Preventable deaths secondary to prematurity

In 2016, certain conditions originating in the perinatal period were the leading cause of death by ICD-10 classification in under-5 deaths in Malaysia. World Health Organization (WHO) reported 2.9 million annual neonatal deaths worldwide are attributable to three main causes: preterm birth complications (1.0 million), intrapartum conditions (0.7 million), and infections (0.6 million)^{22,23}.

Perinatal mortality was two times more likely among preterm newborns compared with term newborns. This study showed more than half of the deaths, 55.9% (1011/1809) were in the prematurity group. Most of the deaths were not preventable, 67.2% (679/1011). Mortality was higher in the smaller babies with birth weight less than 1000 g and with extreme prematurity. Almost a quarter of deaths were in the palliative comfort care category. Palliative comfort care involves providing "comfort care," in understanding that when it is offered, any interventions that might once have been considered "lifesaving" would not change the ultimate outcome in favour of survival²⁴. Generally, it is provided to extreme prematurity less than 25 weeks' gestation, however it also depends on availability of neonatal skill personnel and resources of the managing hospital. Comfort care consists of providing warmth, enteral nutrition (if desired by parents), pain medication, and simple intervention such as nasal cannula oxygen.

This study also showed several preventable deaths occurred in this group were probably due to no clinical intervention being offered due to limited resources in certain hospitals. Therefore, reducing births of premature babies may help to reduce overall mortality in this group and children under five years of age.

This study also showed that 54.5% (181/332) extremely premature < 28 weeks, 38.2% (127/332) between (28 - 31 weeks) and 7.2% (24/332) between (32 - 36 weeks) had preventable death. The more premature the babies, the higher the risk of preventable death. In view of preventability potential in this group, factors affecting premature birth and care should be identified for preventive measures to be taken.

A course of antenatal corticosteroid is one of antenatal interventions that has been shown to improve post-delivery neonatal outcome. A Cochrane review shows substantial benefit of antenatal steroid therapy on the reduction of preterm neonatal mortality (31%) and morbidity outcomes (34% reduction in respiratory distress syndrome (RDS)). Meta-analysis of four RCTs from middle-income countries, suggests an even larger effect: halving of deaths due to complications of preterm birth (53% reduction with a CI of 36-65%)²⁵.

Early selective surfactant administration given to infants with RDS requiring assisted ventilation leads to a decreased risk of acute pulmonary injury such as pneumothorax and pulmonary interstitial emphysema and subsequently decreased risk of neonatal mortality and chronic lung disease²⁶.

This study showed low numbers of dexamethasone and surfactant recipients probably due to poor report documentation. Malaysian Neonatal Registry (NNR) 2016 reported 74.5% of mothers who were less than 32 weeks' gestation received antenatal corticosteroids. Similarly, 61% of the premature babies below 32 weeks gestation, and 24% between 32 and 36 weeks had surfactant therapy²⁷. This could be improved further.

Amongst the preventable cause of deaths in prematurity, nosocomial infection was the leading cause and occurred mainly in babies weighing 1500 grams and less. This is due to a longer period of hospitalization in this group of patients. Severe premature babies usually would stay for weeks to months before they could be discharged.

Prematurity itself is the most important risk factor for nosocomial infection. Common nosocomial infection in NICUs are bloodstream infections, catheter-related (central line associated bloodstream infection, CLABSI), Ventilator associated pneumonias (VAP), surgical site infections and less frequently catheter associated urinary tract infections, and ventricular shunt infections. Skin and soft tissue infections may also be hospital acquired in newborn infants. Hand hygiene before and after patient contact is the most important measure to prevent nosocomial infection. Maternal breast milk is another inexpensive and simple measure to reduce infection rate²⁸.

Strict adherence to standard procedures to prevent hospital acquired infection is of utmost importance. This can be a challenge when most NICUs in the country are overcrowded with relatively lack of resources. Strategies to help improve this situation should be our priority.

Preventable deaths in term babies

The two leading causes of death in term babies were asphyxia and infection. This study showed asphyxia contributed to more than half of total death in term babies. Under asphyxia, Hypoxic Ischaemic Encephalopathy (HIE) and Meconium Aspiration Syndrome (MAS) were the main causes of preventable deaths in our Malaysian NICU.

The first day and especially the first hour is critical to newborn survival. Majority of neonatal deaths, (75%) occur during first week of life, with 1 million newborns die within the first 24 hours²⁹. Preterm birth, intrapartum-related complications (such as intrapartum asphyxia, hypertensive disorder and spontaneous preterm labour), infections and birth defects account to most neonatal deaths in 2017²⁹. Birth asphyxia, assumed to be related to intrapartum hypoxia-ischemia, accounts anywhere from 30 to 35% of neonatal deaths³⁰. Studies have shown that skilled maternal and immediate neonatal care may avoid 30–45% of deaths with asphyxia, while adequate neonatal resuscitation accounts for 5–20% of the reduction³⁰.

Cooling therapy is found to be beneficial for HIE babies, and this procedure has been adopted by many NICU. A number of cooling trials have shown that cooling therapy improved survival without disability in newborns with moderate or severe Hypoxic-Ischaemic Encephalopathy (HIE)³¹. In addition, a trial on mild HIE reported that therapeutic hypothermia may have neuroprotective effects in babies with mild HIE³².

Use of proper cooling equipment was associated with significantly higher survival in neonates with moderate and severe HIE³¹. However, since the year 2016 until now, many of our NICUs throughout the country do not have proper facilities for cooling therapy, therefore we should ensure this facility be made available to all NICUs.

The quality of care received during antenatal, intrapartum, and neonatal periods are very important to prevent death. Collaboration efforts with obstetric and public health counterparts are needed.

Risk factors

There were several risk factors associated with preventable deaths shown in this study. The main risk factors identified were maternal medical and obstetric illness, delay in seeking treatment, and quality of care received are paramount important in order to reduce preventable deaths.

In our study, under maternal illness, risks identified were Diabetes Mellitus, hypertension, unbooked and/or unmarried mother, preterm labour, and anaemia, and maternal obesity. World Health Organization Multi-Country Survey on Maternal and Newborn Health had shown that any hypertensive disorder is the most common maternal illness that was associated with early neonatal death (44.5%)²².

The prevalence of pre-gestational diabetes is increasing and is associated with an elevated risk of congenital malformations, macrosomia, preeclampsia, and preterm delivery. The incidence of perinatal mortality in pre-existing diabetes mellitus ranges considerably, with congenital abnormalities and preterm labour the main factors contributing to the higher rate. The risk is higher if they require insulin in their pregnancy. Poorer glycaemic control may result in more frequent unhealthy foetuses, and consequently more death³³.

A meta-analysis on maternal obesity and infant mortality showed maternal obesity with BMI \geq 30 had higher odds of infant death³⁴.

On the other hand, shortfall in the quality of medical care was the most common medical risk factor identified in this study and contributed to more than 50% of deaths. It was seen in all categories of underlying cause of death.

Under quality of care, failure to recognize the severity of the babies' condition was the most common contributing factor leading to the under-5 deaths. Other contributing factors were 'inadequate

treatment', 'failure to diagnose correctly', 'inappropriate level of expertise' and 'health-care associated infection'. On the other hand, delay in seeking treatment together with problems of teenage pregnancy and malnutrition were the most common risk factors in the non-medical or public health category.

World health statistics (WHO) 2019 stated that children who die within the first 28 days of birth suffer from conditions and diseases associated with lack of quality care at birth, or skilled care and treatment immediately after birth and in the first days of life²⁹.

Key Findings

- Out of 1809 deaths in certain conditions originating in the perinatal period, 735 (40.6%) were preventable.
- The leading causes of death were prematurity at 45.2%, asphyxia at 28.8% and infection at 17.9%.
- The preventable under-5 mortality mainly occurred in infants with birth weight 1500g and less (44.1%); and premature less than 32 weeks (41.9%). Birth weight above 2500g contributed to 34.4% of the preventable deaths and term babies at 33.5%.
- 66.9% death occurred in the first week of life, 24.1% were late neonatal death and 9.0% died after 28 days of life until less than 1 year old.
- Preventable deaths due to prematurity were contributed by nosocomial infection (22.0%), respiratory distress syndrome (16.9%), palliative comfort care group (14.6%) and congenital infection (11.4%). Nosocomial infection mainly in premature babies of 31 weeks or less (84.9%) and birthweight of 1500grams or less (78.1%). Majority of deaths in palliative comfort care group occurred in smaller babies 1000 grams and less; and at extreme gestation of less than 28 weeks.
- As for term babies, 61.8% died of asphyxia with Hypoxic Ischaemic encephalopathy and Meconium Aspiration Syndrome as the leading causes. Infection contributed to 27.6% of deaths. Among the types of infection documented were sepsis (77.3%), congenital pneumonia (15.2%) and necrotizing enterocolitis (7.6%).
- Maternal risk factors were identified in 58.4% of the preventable deaths. Diabetes mellitus (11.2%), hypertension (7.6%), unbooked and/ or unmarried mother (7.5%), preterm labour (7.2%), anaemia (6.3%) and maternal obesity (3.9%) were identified.
- Shortfall in antenatal care (38.9%), intrapartum care (27.8%) and neonatal care (32.4%) were identified.
- Shortfall in the quality of care was the most common medical risk factor identified. In the non-medical risk factors, delay in seeking treatment, non-compliance to advice, teenage pregnancy and malnutrition were identified.

Recommendations

Our recommendations are as follows:

- Future study to be carried out in collaboration with obstetrics and public health division to look closely into factors associated with premature births, for preventive measures to be taken to reduce death due to prematurity.
- Addressing the issue of improving overcrowding and the relative lack of resources in most Neonatal Intensive Care Unit (NICU) throughout the country is imperative. These two factors are of utmost importance related to quality of care and nosocomial infections.
- Asphyxia, in particular Hypoxic Ischaemic Encephalopathy (HIE) is the main cause of death in Malaysian Neonatal Intensive Care Unit (NICU), hence future study should be also carried out to look at significant factors affecting especially on part of quality of care provided so that remedial measures could be taken to reduce number of deaths.
- Cooling therapy facility to be made available in all Neonatal Intensive Care Unit (NICU) in the country.

CHAPTER 5: CONGENITAL MALFORMATIONS, DEFORMATIONS AND CHROMOSOMAL ABNORMALITIES

Overview

Of the 1447 under-5 mortality due to congenital malformations, deformations and chromosomal abnormalities (CM) reviewed in 2016, abnormalities of the cardiovascular system constituted 30.4% (440/1447), followed by the central nervous system 14.5% (210/1447), and congenital malformations requiring surgical intervention 9.8% (142/1447). Other congenital malformations included syndromes such as Edward syndrome, Patau syndrome, Potter syndrome, Down syndrome without cardiovascular involvement, lethal skeletal dysplasias and multiple congenital malformations not elsewhere classified amounted to 45.3% of deaths from the congenital malformation group. The 126 mortalities classified under others included polycystic kidneys, CHARGE syndrome, campomelic dysplasia, Harlequin ichthyosis, tracheal atresia, undetermined skeletal dysplasia, and VACTERAL association. (Table 5.1)

Table 5.1: Overview of Under-5 Mortality due to Congenital Malformations, Deformations and Chromosomal Abnormalities, Malaysia, 2016

Congenital Malformation	Total (%)
CM-CVS	440 (30.4)
CM-CNS	210 (14.5)
Surgical related CM	142 (9.8)
Other CM	655 (45.3)
Edward Syndrome	171 (11.8)
Patau Syndrome	78 (5.4)
Potter syndrome	52 (3.6)
Down syndrome with other malformation excluding CVS	36 (2.5)
Lethal skeletal dysplasias	58 (4.0)
Multiple/ lethal congenital malformations not elsewhere classified	134(9.3)
Others	126 (8.7)
TOTAL	1447 (100.0)

Excluding syndromes, the findings in the 3 most common congenital malformations are discussed in the following sections.

5.1 CONGENITAL MALFORMATION OF THE CARDIOVASCULAR SYSTEM (CM-CVS)

Overall result

Of all the reclassified under-5 deaths due to congenital malformations, deformations and chromosomal abnormalities, 440 (30.4%) were due to cardiovascular malformations (CM-CVS), constituting 8.9% (440/4938) of all under-5 deaths reviewed in Malaysia in year 2016. (Table 5.1)

Almost all (435/440, 98.9%) under-5 deaths due to CM-CVS had their diagnosis made in infancy or younger; with 75.2% (331/440) in the neonatal period, 10.9% at >28 days to 1 year, while 12.7% were detected antenatally. The main presentations at diagnosis were cyanosis (45.7%), heart murmur 16.3%, heart failure (8.6%) and 7.3 % presented in collapsed state. Less than 1% (4/440) were detected by pulse oximetry newborn screening for CCHD. (Table 5.2)

Majority (81.8%) of the patients had paediatric cardiologist consultation. This included either seen personally or consulted via any other methods. Most (86.6%) died in hospital. Majority (376/440, 85.5%) died in infancy, with 162/440 (36.8%) died in the neonatal period. (Table 5.2)

Classification of Congenital Heart Disease

The diagnosis of congenital heart disease in this study was based on the diagnosis documented in the consolidation reports. Documentation of 'complex CHD' was classified as 'complex cyanotic heart disease' if cyanosis was documented at diagnosis. Complex cyanotic heart disease also included single ventricle with or without ductal dependent circulation, heterotaxias, congenitally corrected transposition of great arteries with Ebsteinoid tricuspid valve, double outlet right ventricle and many lesions that were literally documented as complex cyanotic heart disease.

Complex congenital heart disease in this description included Shone complex, and mitral abnormalities in addition to those documented as complex CHD but no cyanosis was documented at presentation.

Pulmonary ductal dependent lesions describe lesions with mainly right ventricular outflow tract obstruction including pulmonary atresia intact ventricular septum (PAIVS), pulmonary atresia with VSD, Tetralogy of Fallot with pulmonary atresia, critical pulmonary stenosis and hypoplastic pulmonary artery branches.

Systemic ductal dependent lesions describe lesions with left ventricular (LV) outflow tract obstruction with good LV size including severe aortic valve stenosis, coarctation of aorta and interrupted aortic arch with or without VSD.

Uncommon CM-CVS UCODs were grouped under others, which were aortopulmonary window (1), cor triatriatum sinister (1), coronary abnormality (1) and vascular ring (2).

Table 5.2: Demographic, Clinical Parameters, Management and Outcome Data for CM-CVS Under-5 Mortality, Malaysia, 2016

	VSD	ASD secundum	AVSD	PDA	TGA Variants	Pulmonary ductal dependent lesions	Complex cyanotic heart disease	Tetralogy of Fallot	HLHS	Systemic Ductal Dependent	Complex Congenital	Ebstein anomaly	TAPVD	Truncus arteriosus	Others	Total
	n=40	n=7	n=31	n=13	n=102	n=18	n=68	n=26	n=43	n=24	n=10	n=13	n=31	n=9	n=5	N=440
AGE AT DIAGNOSIS																
Antenatal	4 (10.0)	0 (0)	2 (6.5)	1 (7.7)	19 (18.6)	10 (55.6)	12 (17.6)	0 (0)	3 (7.0)	0 (0)	1 (10.0)	3 (23.1)	1 (3.2)	0 (0)	0 (0)	56 (12.7)
Neonatal	25 (62.5)	6 (85.7)	25 (80.6)	9 (69.2)	73 (71.6)	8 (44.4)	54 (79.4)	19 (73.1)	33 (76.7)	20 (83.3)	7 (70.0)	10 (76.9)	29 (93.5)	9 (100)	4 (80.0)	331 (75.2)
>28 days to 1 year	10 (25.0)	1 (14.3)	3 (9.7)	3 (23.1)	10 (9.8)	0 (0)	2 (2.9)	7 (26.9)	6 (14.0)	4 (16.7)	1 (10.0)	0 (0)	1 (3.2)	0 (0)	0 (0)	48 (10.9)
>1year to 5 years	1 (2.5)	0 (0)	1 (3.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2.3)	0 (0)	1 (10.0)	0 (0)	0 (0)	0 (0)	1 (20.0)	5 (1.1)
PRESENTATION AT FIRST DIAGNOSIS																
Abnormal Pulse Oximetry	0 (0)	0 (0)	1 (3.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (4.7)	0 (0)	0 (0)	0 (0)	1 (3.2)	0 (0)	0 (0)	4 (0.9)
Collapsed State	0 (0)	0 (0)	0 (0)	1 (7.7)	7 (6.9)	0 (0)	11 (16.2)	1 (3.8)	2 (4.7)	3 (12.5)	2 (20.0)	1 (7.7)	2 (6.5)	0 (0)	2 (40.0)	32 (7.3)
Heart Failure	11 (27.5)	0 (0)	3 (9.7)	5 (38.5)	2 (2.0)	0 (0)	0 (0)	9 (34.6)	1 (2.3)	3 (12.5)	2 (20.0)	0 (0)	1 (3.2)	0 (0)	1 (20.0)	38 (8.6)
Elective Screening for Other Reasons e.g. syndromic	8 (20.0)	5 (71.4)	15 (48.4)	1 (7.7)	1 (1.0)	1 (5.6)	2 (2.9)	8 (30.8)	2 (4.7)	1 (4.1)	0 (0)	1 (7.7)	0 (0)	0 (0)	1 (20.0)	46 (10.5)

Antenatal Detection	4 (10.0)	0 (0)	2 (6.5)	1 (7.7)	19 (18.6)	10 (55.6)	12 (17.6)	0 (0)	3 (7.0)	0 (0)	1 (10.0)	3 (23.1)	1 (3.2)	0 (0)	0 (0)	56 (12.7)
Cardiac murmur	16 (40.0)	1 (14.3)	9 (29.0)	4 (30.7)	1 (1.0)	2 (11.1)	3 (4.4)	7 (26.9)	3 (7.0)	13 (54.2)	1 (10.0)	0 (0)	1 (3.2)	1 (11.1)	1 (20.0)	63 (14.3)
Cyanosis	1 (2.5)	1 (14.3)	1 (3.2)	1 (7.7)	72 (70.6)	5 (27.8)	40 (58.8)	1 (3.8)	30 (69.8)	4 (16.7)	4 (40.0)	8 (61.5)	25 (80.6)	8 (89.9)	0 (0)	201 (45.7)
MATERNAL DIABETES																
Present	10 (25.0)	2 (28.6)	3 (9.7)	2 (15.3)	25 (24.5)	4 (22.2)	14 (20.6)	10 (38.5)	8 (18.6)	4 (16.7)	3 (30.0)	3 (23.1)	5 (16.1)	0 (0)	1 (20.0)	94 (21.4)
No	18 (45.0)	3 (42.8)	16 (51.6)	5 (38.5)	44 (43.1)	10 (55.6)	41 (60.3)	11 (42.3)	20 (46.5)	17 (70.8)	5 (50.0)	4 (30.7)	21 (67.8)	9 (100)	0 (0)	224 (50.9)
Unknown	12 (30.0)	2 (28.6)	12 (38.7)	6 (46.2)	33 (32.4)	4 (22.2)	13 (19.1)	5 (19.2)	15 (34.9)	3 (12.5)	2 (20.0)	6 (46.2)	5 (16.1)	0 (0)	4 (80.0)	122 (27.7)

ASD-atrial septal defect, AVSD-atrioventricular septal defect, HLHS-hypoplastic left heart syndrome, PDA-patent ductus arteriosus, TAPVD-total anomalous pulmonary venous drainage, TGA – transposition of the great arteries, VSD-ventricular septal defect

Most (341/440, 77.5%) deaths occurred before or without intervention, 47/440 (10.7%) had successful procedures, and 52/440 (11.8%) died from the procedures. The commonest CM-CVS UCOD was TGA variants with 102 deaths, constituting 7.0% (102/440) of all under-5 deaths due to CM-CVS. Most (73/102, 71.6%) were diagnosed during neonatal period, and 90.3% had paediatric cardiology consult. Approximately three quarter (78/102, 76.5%) died before any cardiac procedures, 9.8% (10/102) died from cardiac procedures, and 13.7% (14/102) died after successful procedure.

Shunt lesions that consist of cardiac septal defects and PDA constituted 91/440 (20.7%) of all under-5 deaths due to CM-CVS. In this cohort, 74 /91 (81.3%) died while waiting for surgery or not referred, and 10/91 died from procedures. Most (59/91, 64.8%) died in infancy. VSD is a common cardiac lesion with good surgical outcome. Out of the 40 deaths due to VSD, 29/40 (72.5%) were diagnosed during infancy, 32/40 (80.0%) died without surgery; 2/40 (5.0%) died after a successful procedure and 5/40 (15.0%) died from procedure itself. (Table 5.3)

Cardiac procedures were indicated in 254/440 patients (57.7%). Conservative management were applied in 40.9% of the patients, in which 20 patients (4.5%) were because of parental refusal for further management. More than half (244/440, 55.5%) were not referred for catheter intervention or surgery. Of those considered to require interventions, 33.9% (86/254) were not referred or died before referral. (Figure 5.1).

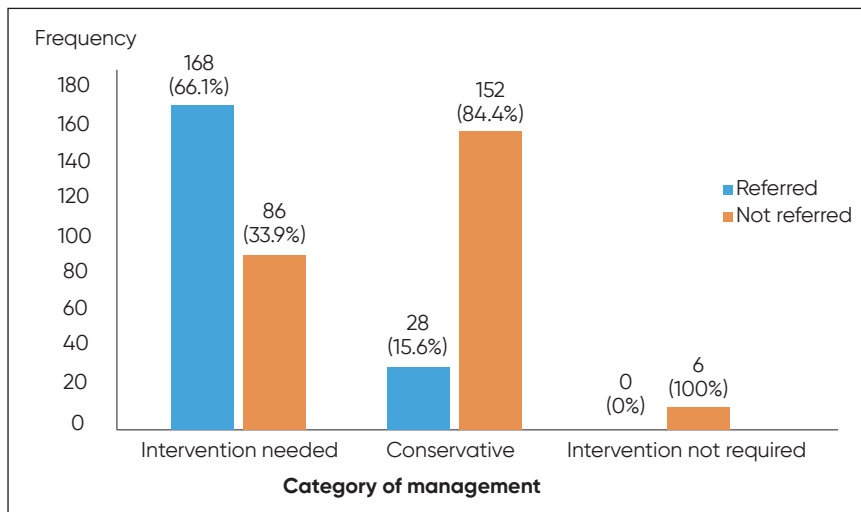


Figure 5.1: Number of under-5 deaths due to CM-CVS referred for cardiac intervention, Malaysia, 2016

Preventability of CM-CVS death

Table 5.3 described cardiac diagnosis in relation to preventability of deaths. Half of 221/440, 50.2% under-5 deaths due to CM-CVS were preventable, 206 (46.8%) were not preventable and 13 (3.0%) were of undetermined preventability. It constituted half (221/436, 50.7%) of total preventable deaths due to congenital malformations, deformations and chromosomal abnormalities. It must be highlighted that preventable deaths were high in common lesions that were amendable to surgery and catheter intervention. These lesions were PDA, VSD, AVSD, transposition of great arteries, pulmonary and systemic ductal dependent lesions.

Table 5.3: Preventability by CM-CVS Diagnosis and Age Groups in Under-5 Mortality, Malaysia, 2016

	VSD	ASD secundum	AVSD	PDA	TGA Variants	Pulmonary ductal dependent lesions	Complex cyanotic heart disease	Tetralogy of Fallot	HLHS	Systemic Ductal Dependent	Complex Congenital	Ebstein anomaly	TAPVD	Truncus arteriosus	Others	Total
	n=40	n=7	n=31	n=13	n=102	n=18	n=68	n=26	n=43	n=24	n=10	n=13	n=31	n=9	n=5	N=440
CONSULTED CARDIOLOGIST																
Yes	32 (80.0)	5 (71.4)	25 (90.6)	11 (84.6)	93 (91.2)	15 (83.3)	46 (67.6)	17 (65.4)	39 (90.7)	19 (79.2)	8 (80.0)	10 (76.9)	28 (90.3)	9 (100)	3 (60.0)	360 (81.8)
No	8 (20.0)	2 (28.6)	6 (19.4)	2 (15.4)	9 (8.8)	3 (16.7)	22 (33.4)	9 (34.6)	4 (9.3)	5 (20.8)	2 (20.0)	3 (23.1)	3 (9.7)	0 (0)	2 (40.0)	80 (18.2)
PLACE OF DEATH																
Hospital death	37 (92.5)	6 (85.7)	25 (90.6)	11 (84.6)	87 (85.3)	16 (88.9)	58 (85.3)	23 (88.5)	34 (79.1)	22 (91.7)	10 (100)	10 (76.9)	31 (100)	8 (89.9)	3 (60.0)	381 (86.6)
Non-hospital death	3 (7.5)	1 (14.3)	6 (19.4)	2 (15.4)	15 (14.7)	2 (11.1)	10 (14.7)	3 (11.5)	9 (20.9)	2 (8.3)	0 (0)	3 (23.1)	0 (0)	1 (11.1)	2 (40.0)	59 (13.4)
CARDIAC PROCEDURE																
Death while waiting/Not referred	32 (80.0)	7 (100)	24 (77.4)	11 (84.6)	78 (76.5)	18 (100)	67 (98.5)	21 (80.8)	22 (51.2)	19 (79.2)	6 (60.0)	8 (61.5)	17 (54.8)	6 (66.7)	5 (100)	341 (77.5)
Successful procedure	2 (5.0)	0 (0)	4 (12.9)	1 (7.7)	14 (13.7)	0 (0)	0 (0)	3 (11.3)	13 (30.2)	3 (12.5)	2 (20.0)	3 (23.1)	1 (3.2)	1 (11.1)	0 (0)	47 (10.7)
Death from procedure	6 (15.0)	0 (0)	3 (9.7)	1 (7.7)	10 (9.8)	0 (0)	1 (1.5)	2 (7.7)	8 (18.6)	2 (8.3)	2 (20.0)	2 (15.4)	13 (41.9)	2 (22.2)	0 (0)	52 (11.8)
Preventability																
Early neonatal death																
Preventable	1 (2.5)	0 (0)	1 (3.2)	0 (0)	4 (3.8)	0 (0)	0 (0)	2 (7.7)	0 (0)	3 (12.5)	2 (20)	0 (0)	1 (3.2)	0 (0)	0 (0)	14 (3.2)
Not preventable	1 (2.5)	0 (0)	0 (0)	1 (9.1)	15 (14.4)	9 (50)	28 (41.2)	1 (3.8)	3 (7)	0 (0)	1 (10)	1 (7.7)	2 (6.5)	2 (22.2)	1 (20)	65 (14.8)
Undetermined	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3.2)	0 (0)	0 (0)	2 (0.5)

Late Neonatal death															
Preventable	2 (5)	1 (14.3)	1 (3.2)	0 (0)	4 (3.8)	0 (0)	0 (0)	4 (15.4)	3 (7)	3 (12.5)	2 (20)	5 (16.1)	1 (11.1)	0 (0)	26 (5.9)
Not preventable	1 (2.5)	1 (14.3)	0 (0)	0 (0)	14 (13.5)	4 (22.2)	26 (38.2)	0 (0)	2 (4.7)	2 (8.3)	0 (0)	1 (3.2)	3 (33.3)	0 (0)	54 (12.3)
Undetermined	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.2)
> 28 days to 1 year															
Preventable	26 (65)	3 (42.9)	15 (48.4)	6 (54.5)	23 (22.1)	0 (0)	0 (0)	12 (46.2)	19 (44.2)	12 (50)	3 (30)	7 (53.8)	14 (45.2)	1 (11.1)	144 (32.7)
Not preventable	3 (7.5)	0 (0)	3 (9.7)	0 (0)	21 (20.2)	3 (16.7)	13 (19.1)	2 (7.7)	5 (11.6)	4 (16.7)	0 (0)	1 (7.7)	5 (16.1)	2 (22.2)	62 (14.1)
Undetermined	1 (2.5)	1 (14.3)	1 (3.2)	0 (0)	3 (2.9)	1 (5.6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3.2)	0 (0)	8 (1.8)
1 year to 5 years															
Preventable	4 (10)	0 (0)	7 (22.6)	2 (18.2)	8 (7.7)	0 (0)	0 (0)	5 (19.2)	8 (18.6)	0 (0)	2 (20)	1 (7.7)	0 (0)	0 (0)	37 (8.4)
Not preventable	1 (2.5)	1 (14.3)	3 (9.7)	2 (18.2)	9 (8.7)	1 (5.6)	1 (1.5)	0 (0)	3 (7)	0 (0)	0 (0)	2 (15.4)	1 (3.2)	0 (0)	25 (5.7)
Undetermined	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (7.7)	0 (0)	0 (0)	2 (0.5)

ASD-atrial septal defect, AVSD-atrioventricular septal defect, HLHS-hypoplastic left heart syndrome, PDA-patent ductus arteriosus, TAPVD-total anomalous pulmonary venous drainage, TGA – Transposition of the Great Arteries, VSD-ventricular septal defect

Table 5.4: Distribution of Under-5 Deaths due to CM-CVS by State in Malaysia, 2016

State	VSD		ASD		ASD secundum		AVSD		PDA		TGA		Pulmonary ductal dependent		Complex cyanotic heart disease		Tetralogy of Fallot		HLHS		Systemic ductal dependent		Congenital Ebstein anomaly		TAPVD		Truncus arteriosus		Others		Total		Mortality Rate per 1,000 Live births
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)		
Selangor	4 (4.5)	1 (1.1)	12 (13.5)	3 (3.4)	18 (20.2)	3 (3.4)	11 (12.4)	5 (5.6)	15 (16.9)	5 (5.6)	0 (0)	1 (1.1)	10 (11.2)	1 (1.1)	0 (0)	1 (1.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	89 (100)	0.85	
Sabah	4 (7.7)	1 (1.9)	4 (7.7)	1 (1.9)	9 (17.3)	4 (7.7)	5 (9.6)	7 (13.5)	5 (9.6)	3 (5.8)	1 (1.9)	4 (7.7)	2 (3.8)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	1 (1.9)	52 (100)	1.00		
Kedah	1 (2.3)	1 (2.3)	2 (4.5)	1 (2.3)	16 (36.4)	4 (9.1)	10 (22.7)	2 (4.5)	3 (6.8)	3 (6.8)	0 (0)	1 (2.3)	1 (2.3)	1 (2.3)	0 (0)	1 (2.3)	0 (0)	1 (2.3)	1 (2.3)	1 (2.3)	1 (2.3)	1 (2.3)	1 (2.3)	1 (2.3)	1 (2.3)	1 (2.3)	1 (2.3)	1 (2.3)	1 (2.3)	44 (100)	1.22		
Johor	6 (15)	0 (0)	1 (2.5)	1 (2.5)	10 (25)	0 (0)	7 (17.5)	2 (5)	2 (5)	2 (5)	4 (10)	2 (5)	0 (0)	2 (5)	0 (0)	2 (5)	3 (7.5)	0 (0)	3 (7.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	40 (100)	0.67		
Terengganu	5 (13.5)	2 (5.4)	4 (10.8)	0 (0)	11 (29.7)	2 (5.4)	4 (10.8)	1 (2.7)	4 (10.8)	0 (0)	0 (0)	1 (2.7)	3 (8.1)	1 (2.7)	0 (0)	0 (0)	1 (2.7)	0 (0)	3 (8.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	37 (100)	1.34		
Pahang	2 (6.5)	0 (0)	2 (6.5)	2 (6.5)	6 (19.4)	3 (9.7)	2 (6.5)	0 (0)	3 (9.7)	5 (16.1)	0 (0)	1 (3.2)	4 (12.9)	1 (3.2)	0 (0)	0 (0)	1 (3.2)	0 (0)	4 (12.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	31 (100)	1.12		
Kelantan	3 (10.3)	0 (0)	1 (3.4)	0 (0)	5 (17.2)	0 (0)	5 (17.2)	2 (6.9)	3 (10.3)	1 (3.4)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	0 (0)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	2 (6.9)	29 (100)	0.75		
Perak	2 (8)	0 (0)	1 (4)	1 (4)	6 (24)	1 (4)	5 (20)	0 (0)	1 (4)	2 (8)	2 (8)	2 (8)	2 (8)	2 (8)	0 (0)	2 (8)	0 (0)	2 (8)	0 (0)	1 (4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	25 (100)	0.70		
Pulau Pinang	4 (17.4)	1 (4.3)	2 (8.7)	1 (4.3)	4 (17.4)	1 (4.3)	4 (17.4)	1 (4.3)	0 (0)	3 (13)	1 (4.3)	1 (4.3)	1 (4.3)	1 (4.3)	0 (0)	1 (4.3)	0 (0)	1 (4.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	23 (100)	1.06		
Sarawak	5 (21.7)	0 (0)	0 (0)	0 (0)	5 (21.7)	0 (0)	6 (26.1)	3 (13)	2 (8.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	23 (100)	0.61		
WP Kuala Lumpur	1 (6.3)	0 (0)	1 (6.3)	0 (0)	4 (25)	0 (0)	4 (25)	0 (0)	3 (18.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	16 (100)	0.62		
Negeri Sembilan	2 (13.3)	0 (0)	1 (6.7)	0 (0)	3 (20)	0 (0)	1 (6.7)	1 (6.7)	1 (6.7)	0 (0)	1 (6.7)	0 (0)	0 (0)	0 (0)	0 (0)	1 (6.7)	0 (0)	1 (6.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	15 (100)	0.83		
Melaka	1 (9.1)	1 (9.1)	0 (0)	0 (0)	3 (27.3)	0 (0)	3 (27.3)	2 (18.2)	0 (0)	1 (9.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	11 (100)	0.76		
Perlis	0 (0)	0 (0)	0 (0)	0 (0)	2 (50)	0 (0)	0 (0)	0 (0)	1 (25)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (100)	0.91		
WP Putrajaya	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0.39		
WP Labuan	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0.00		
Total	40 (9.1)	7 (1.6)	31 (7)	13 (3)	102 (23.2)	18 (4.1)	68 (15.5)	26 (5.9)	43 (9.8)	24 (5.5)	10 (2.3)	13 (3)	31 (7)	13 (3)	24 (5.5)	68 (15.5)	26 (5.9)	43 (9.8)	24 (5.5)	43 (9.8)	24 (5.5)	10 (2.3)	13 (3)	31 (7)	9 (2)	5 (1.1)	440 (100)	0.87					

The state of Selangor contributed the highest number (89/440, 20.2%) of under-5 deaths due to CM-CVS, followed by Sabah (52) and Kedah (44). However, the mortality rate per 1000 live birth was highest for the state of Terengganu at 1.34 deaths per 1000 live births, followed by Kedah 1.22, and Pahang 1.12. (Table 5.4)

Potential Remedial Factors Contributing to CMCVS Death in 2016

Antenatal diagnosis

Table 5.2 and 5.5 showed that the number of under-5 deaths due to CM-CVS detected antenatally was low (56/440, 12.7%) and more likely (73.2% in table 5.5) not preventable compared to those diagnosed after birth (43.8% in table 5.5). Majority (189/221, 85.5%) of the preventable deaths were not diagnosed during antenatal period.

Table 5.5: Antenatal diagnosis in CM-CVS Under-5 Deaths, Malaysia, 2016

Antenatal Diagnosis	Preventable	Not preventable	Undetermined	Total
	N (%)	N (%)	N (%)	N (%)
No antenatal diagnosis	191 (52.9)	158 (43.8)	12 (3.3)	369 (100)
Antenatal diagnosis	15 (26.8)	41 (73.2)	0 (0)	56 (100)
Unknown	15 (65.2)	7 (30.4)	1 (4.3)	24 (100)
Total	221 (50.2)	206 (46.8)	13 (3.0)	440 (100)

Referral for intervention or surgery and waiting time

Waiting time was defined as the duration from the date of referral to the end point of death or cardiac procedure performed. This study showed that the number of preventable deaths was higher with increased waiting time (Table 5.6). Concomitant infection and presence of other congenital anomalies had significant influence in causing longer waiting time for catheter intervention or surgery. (Table 5.7). Correctable lesions such as PDA, VSD and AVSD had high waiting time (1 month or more) and most of the lesions were not referred for cardiac procedures. (Table 5.8). Figure 5.2 showed that the percentage of concomitant infection was high in these groups.

Table 5.6: Preventability and Waiting Time for Intervention or Surgery in CM-CVS Under-5 Mortality, Malaysia, 2016

Waiting time	Preventable	Not preventable	Undetermined	Total
	n (%)	n (%)	n (%)	n (%)
Less than 1 week	10(4.5)	4(1.9)	1(7.7)	15(3.4)
1-2 weeks	10(4.5)	5(2.4)	0(0)	15(3.4)
2-3 weeks	8(3.6)	8(3.9)	1(7.7)	17(3.9)
3-4 weeks	4(1.8)	3(1.5)	0(0)	7(1.6)
1-2 months	18(8.1)	5(2.4)	0(0)	23(5.2)
2-3 months	22(9.9)	5(2.4)	2(15.4)	29(6.6)
>3 months	49(22.2)	10(4.9)	2(15.4)	61(13.9)
Not Documented/Not referred	100(45.2)	166(80.6)	7(53.8)	273(62.0)
Total	221(100)	206(100)	13(100)	440(100)

Table 5.7: Association Between Waiting Time and Risk Factors for Preventable CM-CVS Under-5 Deaths, Malaysia, 2016

	Waiting Time								p-value
	Less 1 week	1-2 weeks	2-3 weeks	3-4 weeks	1-2 months	2-3 months	>3 months	Not referred	
	n	n	n	n	n	n	n	n	
Pulmonary Hypertension	0	1	1	1	1	6	7	33	0.543
Concomitant Congenital Anomaly	0	0	5	2	10	7	20	81	0.009
Dysmorphism	1	0	4	0	5	10	18	77	0.050
Concomitant Infection	6	9	7	3	13	15	45	80	<0.001
Insufficient Weight	0	2	5	2	5	7	6	26	0.037

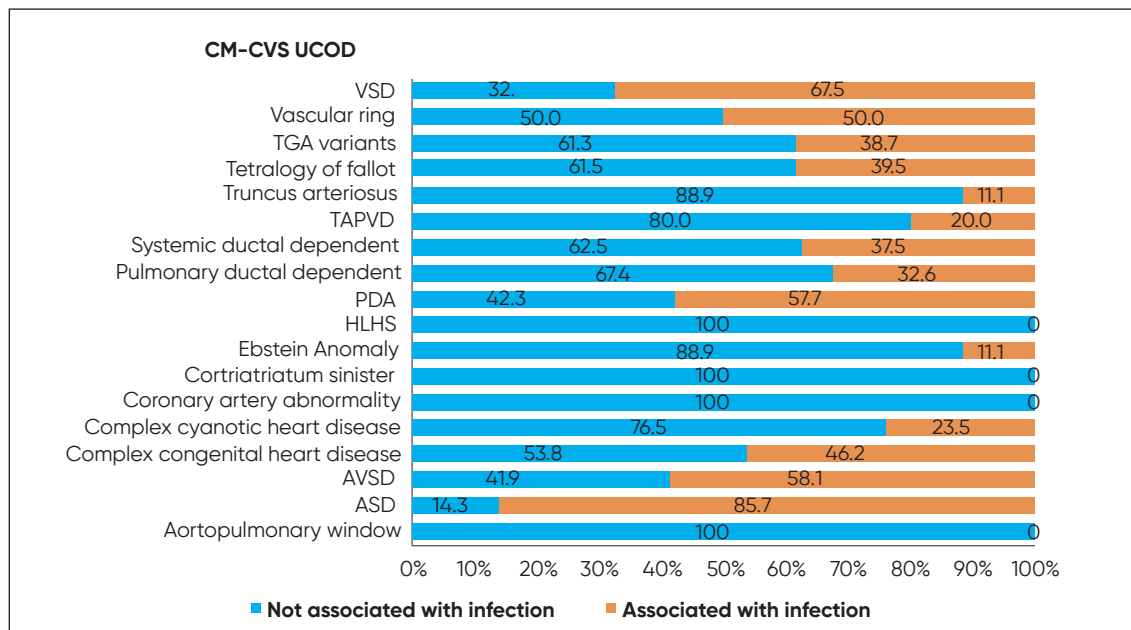


Figure 5.2: Percentage of CMCVS Under-5 Deaths and Associated Infection, Malaysia, 2016

Table 5.8: Waiting Time for Interventions in Different Types of Cardiac Disease in CM-CVS Under-5 Mortality, Malaysia, 2016

Waiting time	VSD	ASD secundum	AVSD	PDA	TGA Variants	Pulmonary ductal dependent lesions	Complex cyanotic heart disease	Tetralogy of Fallot	HLHS	Systemic Ductal Dependent	Complex congenital	Ebstein anomaly	TAPVD	Truncus arteriosus	Others	Total
Less 1 week	1 (6.7)	0 (0)	0 (0)	0 (0)	2 (13.3)	1 (6.7)	0 (0)	0 (0)	2 (13.3)	3 (20.0)	2 (13.3)	1 (6.7)	3 (20.0)	0 (0)	0 (0)	15 (100)
1-2 weeks	0 (0)	0 (0)	0 (0)	0 (0)	5 (33.3)	0 (0)	0 (0)	0 (0)	3 (20.0)	2 (13.3)	1 (6.7)	0 (0)	3 (20.0)	1 (6.7)	0 (0)	15 (100)
2-3 weeks	1 (5.9)	0 (0)	0 (0)	0 (0)	6 (3.5)	0 (0)	0 (0)	0 (0)	4 (23.5)	1 (5.9)	1 (5.9)	1 (5.9)	2 (11.8)	1 (5.9)	0 (0)	17 (100)
3-4 weeks	1 (14.3)	0 (0)	0 (0)	0 (0)	2 (28.6)	0 (0)	0 (0)	0 (0)	1 (14.3)	0 (0)	0 (0)	0 (0)	3 (42.9)	0 (0)	0 (0)	7 (100)
1-2 months	1 (4.3)	0 (0)	2 (8.7)	0 (0)	2 (8.7)	0 (0)	0 (0)	3 (13)	3 (13.0)	1 (4.3)	2 (8.7)	0 (0)	7 (30.4)	1 (4.3)	1 (4.3)	23 (100)
2-3 months	1 (3.4)	0 (0)	7 (24.1)	1 (3.4)	3 (10.3)	0 (0)	0 (0)	1 (3.4)	6 (20.7)	3 (10.3)	1 (3.4)	1 (3.4)	4 (13.8)	1 (3.4)	0 (0)	29 (100)
>3 months	12 (19.7)	1 (1.6)	8 (13.1)	3 (4.9)	13 (21.3)	0 (0)	0 (0)	3 (4.9)	10 (16.4)	2 (3.3)	0 (0)	4 (6.6)	4 (6.6)	0 (0)	1 (1.6)	61 (100)
Not referred	23 (8.4)	6 (2.2)	14 (5.1)	9 (3.3)	69 (25.3)	17 (6.2)	68 (24.9)	19 (3.3)	14 (5.1)	12 (4.4)	3 (1.1)	6 (2.2)	5 (1.8)	5 (1.8)	3 (1.1)	273 (100)
Total	40 (9.09)	7 (1.59)	31 (7.05)	13 (2.95)	102 (23.18)	18 (4.09)	68 (14.45)	26 (5.9)	43 (9.77)	24 (5.45)	10 (2.27)	13 (2.95)	31 (7.05)	9 (2.05)	5 (1.1)	440 (100)

ASD-atrial septal defect, AVSD-atrioventricular septal defect, HLHS-hypoplastic left heart syndrome, PDA-patent ductus arteriosus, TAPVD-total anomalous pulmonary venous drainage, VSD-ventricular septal defect

Discussion

Half of (221/440, 50.2%) under-5 deaths due to CM-CVS were preventable, which was higher than the overall preventable under-5 death at 46.1% in year 2016. These preventable deaths were lesions that were amendable to surgery and catheter intervention such as VSD, PDA, and TGA variants.

Most CM-CVS under-5 deaths occurred during infancy at >28 days to 1 year old. MNM Bah et al reported an overall mortality rate of 34.8% in infants with critical congenital heart disease (CCHD) in Johor, Malaysia from 2006 to 2015. The median age at death was 2.7 months³⁵.

In our study, long waiting time was associated with increased CM-CVS under-5 mortalities. Concomitant infection and presence of other congenital anomalies were associated with longer waiting time for catheter intervention or surgery. A retrospective review in 3 major hospitals in Thailand in 2005 published a median waiting time of 195 days¹¹. A study of waiting time in Saudi Arabia showed infection as one of the factors contributing to prolonged waiting time. Independent risk factors for poor survival by MNM Bah et al are weight at diagnosis of less than 2 kg, syndromic infants, poor pre-operative condition, and non-ductal dependent CCHD. These factors were also factors that contribute to longer waiting time.

Optimisation of clinical care may be able to reduce waiting time and improve survival rate. Efforts to increase and optimise early detection during antenatal and neonatal period may help to reduce waiting time and allow clinicians to offer better care prior to any cardiac procedures.

Antenatal diagnosis of cardiac lesions in Malaysia is still low in comparison to countries like Norway and United Kingdom^{37,38}. Cardiac focus scan in second semester scan in Norway enabled to detect major and minor heart defects at incidences 3.3/1000 and 11.3/1000 respectively³⁵. A study on infant mortality in between 1985-1990 in Northern Region of United Kingdom, infant death from congenital heart disease accounted for 43% of all infant deaths due to congenital malformation. Majority were diagnosed antenatally. Thirty percent of congenital heart disease was not diagnosed before birth³⁹.

Neonatal care plays important role in improvement in CM-CVS mortality as majority of patients presented during neonatal period and inadequacy of neonatal care may delay management and expose to hospital-acquired infections. Efforts in strengthening neonatal cardiac detection and care is essential. 2 major remedial methods include optimise newborn pulse oximetry screening program and to introduce neonatologist-performed echocardiography (NPE).

Newborn pulse oximetry screening is proven to improve detection rate of CCHD up to 92%^{40,41}. Outcome from USA data following implementation of this screening showed significant reduction in infant cardiac deaths in states that made the policy a mandatory. Death reductions were in between 28.4% to 30.7% in relative to the baseline⁴².

Neonatologist-performed echocardiography (NPE) has been organised in Europe, United Kingdom, United State and North America⁴³. A retrospective review of 4 years' experience in Canada showed that NPE contributed in a change in management 40% and improved pre-intervention plan in an additional 20% of cases⁴⁴. There is no current guideline or governance structure or policy for neonatal focus cardiac management and echocardiography evaluation in Malaysia.

Key Findings

- More than half of CM-CVS under-5 deaths were preventable.
- 77.5% CM-CVS under-5 deaths occurred while waiting for cardiac interventions or not referred.
- 30.4% of under-5 mortalities due to congenital malformation were cardiovascular malformation.
- 75.2% had confirmed diagnosis in the neonatal period while 12.7 % was detected antenatally.
- 81.8% had paediatric cardiology consultation.
- 86.6% died in the hospital, majority died in infancy with a third dying in the neonatal period.
- Commonest lesion was TGA variant. Shunt lesions contributed to 20.7% of deaths.

- The mortality rates per 1000 live births according to states were highest in Terengganu (1.34), Kedah (1.22), Pahang (1.12) and Pulau Pinang (1.06).
- 22.2% had waiting time of more than 3 months for intervention or surgery. Concomitant infection and presence of other congenital anomalies were significant contributing factors.

Recommendations

- **Foetal cardiac screening view implementation in routine ultrasound**

- Additional cardiac-focus 4 chamber and outflow tract view in the routine checklist during antenatal ultrasound in health centres and Obstetric clinics. Calvalho et al in their study recommended routine antenatal assessment of the four chambers and great vessels between 18 and 23 weeks as effective method in the prenatal detection of major CHD⁴⁵.
- To allow sustainability of this idea, education on foetal cardiac screening, protocol of referral and training the trainer to Family Medicine Specialist (FMS) and Obstetricians.

- **Strengthening pulse oximetry screening in Ministry of Health facilities**

- Well performed and documented pulse oximetry screening may increase detection of CCHD in asymptomatic neonates.
- To allow sustainability of this test, compulsory ruling to document pulse oximetry screening in neonatal book maybe an option.
- To reemphasis on refresher in education on pulse oximetry screening and training the trainer in Ministry of Health facilities.

- **Education, training, and accreditation of neonatologist-performed echocardiography**

- To improve detection and early management of CCHD.
- To allow sustainability of this idea, a structural syllabus on neonatal focus echocardiography and cardiac management should be implemented as a part of neonatal subspecialty training.
- Training the trainers among neonatology paternity.

- **To improve facilities and medical staffing in tertiary referral centre to cater for more paediatric cardiac surgery and intervention**

- Ratio of paediatric cardiac surgeons and interventional paediatric cardiologist to population still low. It is essential to look into ways to increase number of trainees in these field.
- To date, Hospital Serdang is the only government-based hospital that offered complex congenital cardiac surgery in the whole Malaysia. The main catheter interventions and congenital cardiac surgeries for the country is at National Heart Institute.
- A plan should be in place to allow at least one interventional paediatric cardiologist in each region and to develop at least 2 government-based hospitals for complex congenital cardiac surgery in Malaysia.

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5.2 CONGENITAL MALFORMATION OF THE CENTRAL NERVOUS SYSTEM (CM-CNS)

Underlying Cause of Death by Types of CM-CNS

Of the total deaths due to congenital malformation, 210/1447 (14.5%) were congenital malformations of the central nervous system (CM-CNS). The frequencies of the various types of CM-CNS leading to under-5 mortality in 2016 are shown in Table 5.9.

Table 5.9: Frequencies of Various Types of CM-CNS Leading to Under-5 Mortalities, Malaysia, 2016

Types of CM-CNS	n	%
Anencephaly	83	39.5
Holoprosencephaly	32	15.2
Congenital Hydrocephalus	31	14.8
Hydranencephaly	19	9.0
Encephalocele	10	4.8
Spina Bifida	12	5.7
Others	23	11.0
Total	210	100

Categories of CM-CNS (NTDs vs non-NTDs) leading to Under-5 Mortality

Congenital malformations of the central nervous system can be further sub-classified into neural tube defects (NTDs) and non-NTDs which consisted of 50% respectively. Common NTDs leading to under-5 mortality were anencephaly, encephalocele and spina bifida. Holoprosencephaly, congenital hydrocephalus and hydranencephaly were the common non-NTDs CM-CNS deaths. ([Appendix 20](#))

It is important to note that 50% of CM-CNS deaths were neural tube defects that were potentially preventable by mandatory folic acid fortification of flour as shown in various countries^{46,47}.

Association between Categories of CM-CNS with Sociodemographic and Maternal Risk Factors

When we compare the associated sociodemographic factors between NTDs and non-NTDs, it was found that NTDs were significantly more common among mothers aged less than 26 years old (OR=2.92, 95% CI 1.26, 6.78, p-value=0.013) (Table 5.10).

However, the common maternal risk factors such as hypertensive disorders of pregnancy, diabetes mellitus, persistent anaemia and maternal obesity did not show any significant association with the categories of CM-CNS as a whole.

Table 5.10: Association between Categories of CM-CNS with Sociodemographic Factors, Malaysia, 2016

Sociodemographic factors	NTD	Non- NTD	OR	95% CI		P-Value*
				Lower	Upper	
Gender						
Male	65	55	1.00			
Female	38	49	0.62	0.35	1.09	0.094
Indeterminate	1	1	0.80	0.05	13.10	0.876
Unknown	1	0	-			
Ethnicity						
Malay	69	67	1.00			
Chinese	4	5	0.75	0.19	2.93	0.683
Indian	3	7	0.40	0.10	1.63	0.202
Orang Asli	2	4	0.47	0.08	2.66	0.394
Bumiputera Sabah	11	12	0.94	0.38	2.32	0.897
Bumiputera Sarawak	8	4	1.88	0.54	6.56	0.319
Non-citizen	8	6	1.26	0.41	3.82	0.688
State						
Peninsular Malaysia	78	80	1.00			
Sarawak	12	7	1.71	0.64	4.58	0.283
Sabah	15	18	0.88	0.41	1.89	0.747
Maternal age						
< 26 years	36	22	2.92	1.26	6.78	0.013
26 to 35 years	53	53	1.82	0.85	3.88	0.121
>35 years	14	27	1.00			
Unknown	2	3	1.19	0.18	8.00	0.858
Mother education						
College/ University	25	24	1.00			
Secondary	65	58	1.08	0.55	2.09	0.829
Primary	5	11	0.60	0.17	2.09	0.423
No formal education	7	6	1.12	0.33	3.82	0.856
Others	0	2				
Unknown	3	4	0.72	0.15	3.56	0.687
Household income						
1000 and below	20	19	1.00			
1001-3000	41	34	1.12	0.51	2.45	0.780
3001-5000	14	18	0.74	0.29	1.92	0.537
5001-7000	4	11	0.33	0.09	1.21	0.095
7001 and above	5	2	2.25	0.39	13.07	0.366
No income	3	3	0.90	0.16	5.04	0.905
Unknown	18	18	0.90	0.36	2.24	0.821

*Univariable Binary Logistic Regression

Anencephaly and Holoprosencephaly

Birth Prevalence of Anencephaly

The birth prevalence of anencephaly in Malaysia in 2016 was 1.6 per 10,000 livebirths (Table 5.11). This birth prevalence was slightly lower compared to a study in 2009 using Malaysian National Neonatal Registry which showed a birth prevalence of 1.9 per 10,000 live births⁴⁸.

The exact birth prevalence of spina bifida could not be determined in this study because most infants with spina bifida survived in Malaysia but with significant long-term disability⁴⁸. However, using birth prevalence of anencephaly as a surrogate indicator and the ratio of spina bifida/anencephaly as 1.00–1.33 according to WHO⁴⁹, the estimated birth prevalence of spina bifida would be in between 1.6 to 2.1 per 10,000 livebirths.

The top three states with highest birth prevalence of anencephaly in 2016 were Sarawak, WP Kuala Lumpur and Terengganu (Table 5.11). The similar finding was also found in earlier study of Boo et al⁴⁸ that the neural tube defects birth prevalence was highest among the Sarawak indigenous people.

Table 5.11: Prevalence of Anencephaly by States, Malaysia, 2016

States	Livebirths in 2016*	Number of Anencephaly	Prevalence (per 10,000 livebirths)
Sarawak	37,985	11	2.9
WP Kuala Lumpur	25,739	6	2.3
Terengganu	27,521	6	2.1
Sabah	52,071	10	1.9
Pahang	27,626	5	1.8
Kedah	35,967	6	1.7
Kelantan	38,455	6	1.6
Johor	59,561	9	1.5
Perak	35,685	5	1.4
Pulau Pinang	21,781	3	1.4
Melaka	14,402	2	1.4
Selangor	104,661	13	1.2
Negeri Sembilan	18,036	1	0.5
Perlis	4,392	0	0
WP Putrajaya	2,569	0	0
WP Labuan	1,752	0	0
TOTAL	508,203	83	1.6

*Source: Department of Statistics, Malaysia

Maternal Risk Factors for Anencephaly

Majority (41/74, 55%) of the anencephalies did not have any maternal risk factors. Only a minority had diabetes mellitus (14/74, 19%) or persistent anaemia (13/74, 18%). However, the findings were not statistically significant.

Maternal Risk Factors for Holoprosencephaly

The number of holoprosencephaly with some of the common maternal risk factors is shown in Figure 5.3. Common maternal risk factors noted were diabetes mellitus (11/25, 44%) and maternal obesity (6/25, 24%). The above associations were statistically significant with odd ratio of 3.32 (95% CI 1.36, 8.11, p value =0.009) for diabetes mellitus and odd ratio of 3.13 (95% CI 1.06, 9.23, p value=0.038) for maternal obesity.

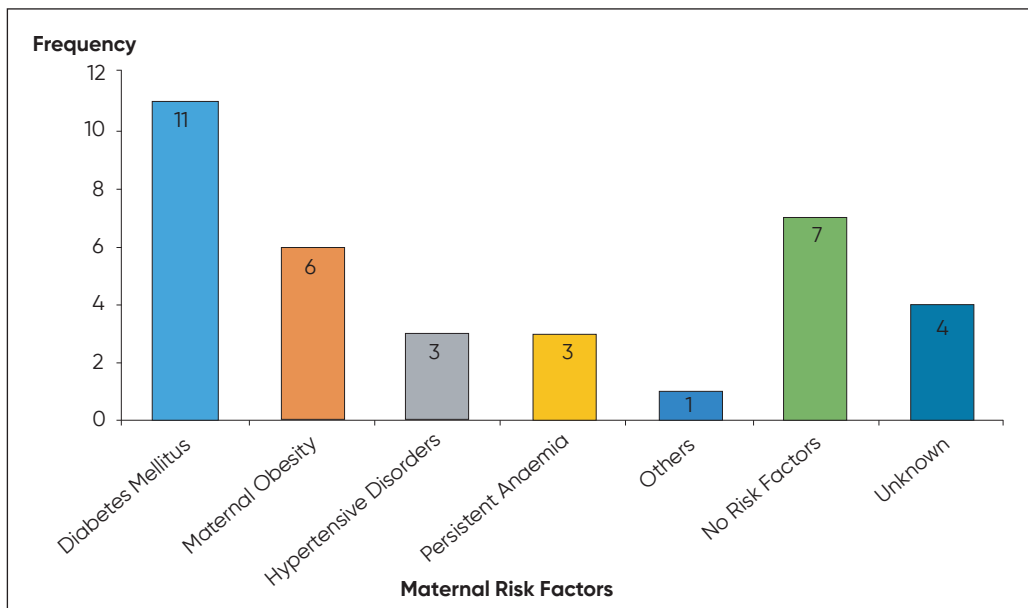


Figure 5.3: Presence of Maternal Risk Factors in Infants with Holoprosencephaly (n=25), Malaysia, 2016

Discussion

This study showed that 50% of CM-CNS deaths in Malaysia were NTDs and hence has high preventability potential.

NTDs are established very early in the embryonic development. They have a major impact on the health and quality of life of affected children and their families. Mandatory food fortification with folic acid has proven to be cost-effective in reducing the number of children affected by NTDs^{46,47,49}.

Several countries in the Americas have implemented mandatory folic acid flour fortification, including Costa Rica, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru, Chile, Argentina, Canada and the USA⁴⁶. Pre- and post-fortification comparisons in Argentina, Brazil, Chile, Costa Rica, Puerto Rico and Mexico had shown an aggregate percentage decline in NTDs prevalence ranged from 33% to 59%⁴⁷. The largest reduction in NTDs after food fortification was observed in Costa Rica; where not only it fortifies wheat flour but also maize flour, cow's milk and rice⁴⁶. ([Appendix 21](#))

From worldwide data, the decrease in NTDs also varies by geographic region and socio-demographic characteristics. Fortification has particularly benefited mothers with lower incomes and in regions or countries with a higher prevalence of NTDs prior to intervention⁴⁶.

Based on the assumption that mandatory fortification of folic acid could reduce 50% of the NTDs, this will confer a significant drop of 1% to under-5 mortality rates of Malaysia once this program starts.

The birth prevalence of anencephaly among countries varies widely, in between 0.8 to 16 per 10,000 livebirths. The prevalence is higher among those countries without mandated folic acid fortification of foods, lower income level and lower elective termination of pregnancy rate⁴⁹.

The birth prevalence of anencephaly in Malaysia as shown in this study was still high and most of them were without any maternal risk factors. Certain states like Sarawak, WP Kuala Lumpur and Terengganu seemed to have higher birth prevalence of anencephaly and that warrants further research looking into the genetic risk factors, dietary preference, and folate intake of women of reproductive age group.

In this study, holoprosencephaly, which was the second commonest CM-CNS; was found to have significant association with diabetes mellitus and obesity during pregnancy. The association of holoprosencephaly with maternal diabetes was also found with few other studies^{50,51}. Other non-genetic causes identified in the published literature include twinning, higher alcohol consumption and exposure to consumer products such as aerosols or sprays.

Key Findings

- Congenital malformation of the central nervous system contributed to 14.5% of deaths in the congenital malformation group.
- 50% of the deaths were due to neural tube defects such as anencephaly, encephalocele and spina bifida.
- 50% of the neural tube defects were potentially preventable by mandatory folic acid fortification.
- Neural tube defects were more common in mothers aged less than 26 years.
- The birth prevalence of anencephaly in 2016 was 1.6/ 10 000 live births. Highest birth prevalence was in Sarawak, WP Kuala Lumpur and Terengganu. There were no significant maternal risk factors.
- As for holoprosencephaly, diabetes mellitus and maternal obesity were significant maternal risk factors identified.

Recommendations

- Implementation of mandatory folic acid fortification by the Ministry of Health should be top priority. This preventive measure has been shown to be cost-effective and will reduce our birth prevalence of neural tube defects by approximately 50% and the overall under-5 mortality rate by 1%.
- It is important to establish a national birth defects registry or neural tube defects registry when the mandatory folic acid fortification program is implemented so that the effectiveness of this program could be properly evaluated and if necessary, adjusted according to the outcome of this program.
- Further research should be carried out to determine the association between holoprosencephaly and maternal risk factors such as diabetes mellitus and obesity and whether any preventive measures could be taken to reduce the incidence of holoprosencephaly which is the second most common congenital malformation of central nervous system leading to under-5 deaths in Malaysia.

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5.3 SURGICAL-RELATED CONGENITAL MALFORMATION

Surgically related congenital malformations constituted 9.8% (142/1447) of all under-5 deaths due to congenital malformations. The distribution according to the ICD 10 UCOD were tabulated in Table 5.12.

Table 5.12: Preventable and Non-Preventable Deaths of Surgical Related Congenital Malformation According to ICD10 Classification UCOD, Malaysia, 2016

Classification ICD 10 UCOD	Preventable		Not preventable		Undetermined		Total	
	n	%	n	%	n	%	n	%
Musculoskeletal system abnormalities	8	15.1	56	75.7	6	42.9	70	49.6
Congenital malformations of the digestive system	43	81.1	14	18.9	7	50.0	64	45.4
Respiratory system malformations	2	3.8	4	5.4	1	7.1	7	5.0
Total	53	100	74	100	14	100	141	100

Congenital malformations of the digestive system have been reported as the commonest cause of preventable death (n=43 41), in which half of them (51.2%) were cases of Biliary Atresia (Figure 5.4).

As for the non-preventable cases, the highest number of deaths was from the musculoskeletal system abnormalities (n=56), mostly contributed by the cases of congenital diaphragmatic hernia (n=52; 92.9%) (Figure 5.5).

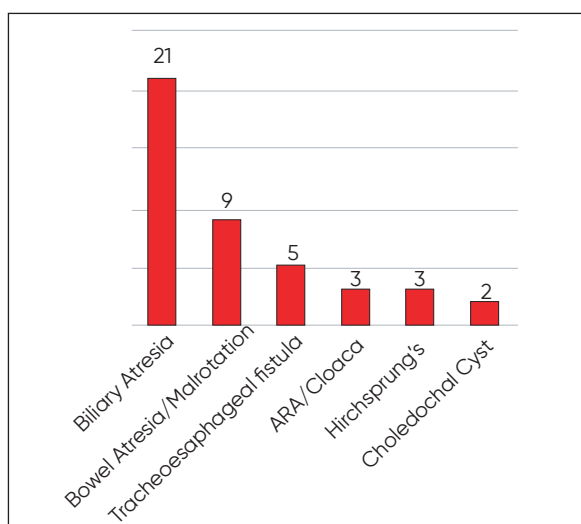


Figure 5.4: Distribution of preventable mortality cases from the congenital malformations of the digestive system (n=43), Malaysia, 2016

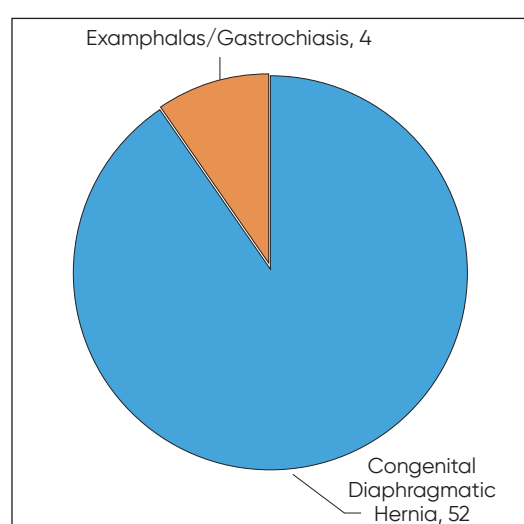


Figure 5.5: Distribution of non-preventable mortality cases from the musculoskeletal system abnormalities (n=56), Malaysia, 2016

Biliary Atresia

In our report, 21 cases of biliary atresia have been reported to die in 2016. Except for one case of unknown status of surgery, 16 of them underwent Kasai portoenterostomy and unfortunately 4 cases were not operated due to parent refusal (died at 6, 7, 8 and 10 months old).

Kasai procedure is proposed to be done within 60 days of life to ensure higher percentage of jaundice clearance, which was reported to be up to 75%⁵². Otherwise, those who had delayed surgery likely to have persistent jaundice, disease progression and died while waiting for transplant. Among those 16 mortality cases who underwent Kasai procedure, majority (14/16; 87.5%) of them were operated beyond the age of 60 days old (Table 5.13). The mean age at Kasai operation was 96 days with median age of 84 days (range 50-168) days. Majority of them died within 2 years of life (Table 5.14), with mean age of 16 months old and median of 14 months old (range 3- 41). Only two cases were specifically mentioned died while waiting for the liver transplant.

Table 5.13: Distribution of Cases According to the Age at Kasai Operation, Malaysia, 2016

Age (days)	Number of Kasai Operation
<60	1
60-90	7
90-120	5
>120	2
Not stated	1
Total	16

Table 5.14: Distribution of Cases According to the Post-Kasai Age, Malaysia, 2016

Age (month)	Post Kasai death
<6	2
6-12	5
12-24	6
>24	3
Total	16

Congenital Diaphragmatic Hernia (CDH)

In 2016, 52 non-preventable mortality cases were reported due to CDH. It represents 92.9% of deaths among the non-preventable musculoskeletal system abnormalities (52/56) (Figure 5.5). Forty-five (86.5%) children with non-preventable CDH died at the age 0-7 days old (Table 5.15)

Table 5.15: Total Non-Preventable Deaths by Age in Surgical Related CM, Malaysia, 2016

Age (day)	0 - 7	8 - 30	31 - 366	> 366	Total
n	52 (45 CDH)	10	8	4	74
%	70.3	13.5	10.8	5.4	100.0

Discussion

Biliary Atresia

Biliary atresia is a condition where biliary flow is obstructed by the abnormal extrahepatic biliary ducts which if left untreated may lead to liver failure and death in infancy. The ultimate treatment is liver transplantation, however a surgical procedure known as Kasai portoenterostomy has been shown to be effective in restoring the biliary flow in most of cases and delaying the need for transplantation during the childhood. Overall survival among those who had successful Kasai (with native liver) is reported to be 30 to 75%, and if includes those underwent liver transplantation, the overall survival at 2 years is reported to be higher, 73 to 88%⁵².

From this study that 40% (21/53) of preventable surgical related congenital malformation deaths in Malaysia were biliary atresia. Since the main contributing factor of death among the biliary atresia are the delayed age of surgery, the death can be prevented by early detection and early surgery. Early screening for biliary atresia by serum bilirubin concentrations and stool colour cards are potentially lifesaving and cost effective⁵³. Harpavat et al retrospectively studied that elevated conjugated bilirubin concentration can be used as an early screening test for infants with biliary atresia. Malaysia public health has already implemented serum bilirubin investigation for prolonged jaundice as early as 2 weeks of life. The first universal national stool colour card screening program was implemented in Taiwan, where parents of all newborn infants were given colour cards that showed examples of normal and acholic stools and were asked to report the colour of their infant's stool to their paediatrician. In the Taiwanese population, the stool colour card screening program had a sensitivity of 89.7%, a specificity of 99.9%, a positive predictive value of 28.6%, and a negative predictive value of 99.9% for identification of biliary atresia⁵³. Positive results from the screening led to focused diagnostic evaluations. In subsequent

analyses, the authors concluded that implementation of this screening program led to earlier diagnosis and earlier Kasai surgery (66% vs 49% at <60 days of age) and was associated with improved 3-year jaundice-free survival (57% vs 31.5%) compared with a cohort of historical controls⁵⁵.

National centralization of biliary atresia care also can potentially provide high quality outcome. The recommendations, in European countries, to perform Kasai at centre doing at least 5 cases/year to achieve better outcome was comfortably achieved in Davenport et al⁵⁶ series study. From Hanna et al⁵² result after centralization, a total of 72 BA patients of whom 64 had undergone surgery for BA were identified. After centralization, the median caseload per centre increased from 0 (range, 0-3) to 4 (2-5) patients/year ($p < 0.001$), clearance of jaundice rate increased from 27% to 75% ($p = 0.001$), 2-year jaundice-free native liver survival from 25% to 75% ($p = 0.002$), transplant-free survival from 27% to 75% ($p = 0.005$), and overall survival from 64% to 92% ($p = 0.082$).

The remaining 20–25% are not helped by the Kasai procedure; they gain little or no bile flow. In these cases, the infants will require liver transplantation. Liver transplantation is the only cure for biliary atresia. In Malaysia, the progress of the paediatric liver transplantation programme is slower than the adult counterpart. This is compounded by the limitation of cadaveric donor. They died while waiting for donor, or otherwise underwent transplant overseas which cost of at least RM350,000. In Malaysian government hospital, the cost was heavily subsidized, with minimum payment of RM500 for public, or at most RM 3,000 for first class wards. With the recent development of Hospital Tunku Azizah Kuala Lumpur Women and Children Hospital, the service of paediatric liver transplantation has been restarted with 3 cases since December 2020. Perhaps this development is sustainable and progress further in order to ensure better survival among biliary atresia patients.

Congenital Diaphragmatic Hernia

In this under-5 mortality study 2016, we noted that most of non-preventable surgical related CM UCOD was congenital diaphragmatic hernia in which most of them died early within the first week of life. The causes were most like due to severe hypoplastic lung and severe persistent pulmonary hypertension of newborn (PPHN). Despite advances in management of babies with CDH, the mortality rate remained high. Survival rate ranges between 40 – 80% across various centre^{57,58}. Since 2017, the Malaysian National Neonatal Registry (MNNR) has produced a data on CDH death per total cases of CDH. Over the 3 years (2017-2019), mortality rate ranges in between 48 % to 61%; 2017 39/70 (55.7%), 2018 33/54 (61%) and 2019 38/78 (48%), which is still within the world-wide range. Jenisha C et al⁵⁹, a retrospective cohort of CDH admitted at a tertiary level hospital from 2005-2017 found the majority of neonates with CDH at the centre were >37 weeks and survival were at 60%. The predictors of adverse outcome were low Apgar score, presence of moderate to severe PPHN, need for higher ventilator setting and shock. Antenatal detection of diaphragmatic hernia otherwise did not impact survival rate. In this report, the absence of sub-specialty services at the place of birth especially paediatric surgeon and neonatologist as a potential contributing factor were not studied.

Key Findings

- Surgical-related malformation contributed to 9.8% of mortality in the congenital malformation group.
- Commonest cause of preventable death was from the congenital malformation of the digestive system in which 51.2% were due to biliary atresia.
- 87.5% were operated beyond 60 days of life with mean age for Kasai operation at 96 days.
- Majority died within 2 years of life.
- As for the non-preventable cause of death, congenital diaphragmatic hernia contributed to 92.9% of deaths from the musculoskeletal system abnormalities.
- Majority died within the first week of life.

Recommendations

- **Increase awareness and emphasis on the early referral of babies with suspected biliary atresia to paediatric surgery team.**

In the MOH Guideline⁶⁰, there is a clear flow chart on the referral of babies with high serum bilirubin and 20% fraction of direct hyperbilirubinaemia to paediatric team. However, a highlight on early referral to paediatric surgery team can be added upon high suspect cases (e.g. presence of pale stool), even before doing ultrasound or HIDA scan.

- **Stool colour chart**

The stool colour chart was already widely implement in public health clinic in Malaysia⁶⁰. However, it is easily accessible by clinician only. Perhaps by introducing the similar chart in the Child Health Record, parents and visiting nurse may have a visual reference to highlight any abnormalities upon clinic visit.

- **Centralization for biliary atresia surgery and care**

Paediatric surgical service should consider centralization of the biliary atresia care only to few centres in Malaysia, perhaps one in each region, namely Hospital Tunku Azizah (Central and Southern region), Hospital Sultanah Bahiyah (Northern region), Hospital Raja Perempuan Zainab II (East Coast region), Hospital Umum Sarawak (Sarawak region) and Sabah Women and Children Hospital (Sabah region).

- **Paediatric Liver Transplantation**

The service has been restarted recently in Hospital Tunku Azizah and is still in its infancy stage. Uninterrupted, continuous support from the government in terms of trained manpower, appropriate equipment, availability of medications and consumables, and support services are crucial in order to further strengthen the service and ensure its sustainability.

- **Development of more centres capable handling neonates with CDH**

Although this report did not specifically look at the place of birth without sub specialities' services as a factor for mortality, we believe that with the presence of more paediatric surgery services in each state, CDH babies can be managed efficiently with minimum morbidity and mortality in the future.

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CHAPTER 6: INJURY, POISONING AND CERTAIN OTHER CONSEQUENCES OF EXTERNAL CAUSES

There were 308 deaths in 2016 due to injuries, poisoning and external causes according to ICD10 classification. One hundred and seven (34.7%) were from motor vehicle accident (MVA), 68 (22.1%) were from drowning, 47 (15.3%) from assault or non-accidental injury (NAI) which are under category of suspected child abuse and neglect (SCAN), 42 (13.6%) were from asphyxia, followed by head injury, burn, fall and others as stated in Table 6.1.

Table 6.1: UCOD due to Injuries, Poisoning and External Causes by Frequency, Gender, Age, Location of Injury and Household Income, Malaysia, 2016

	MVA	Drowning	Assault	Asphyxia	Head injury	Burn	Fall	Others	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Number of deaths	107 (34.7)	68 (22.1)	47 (15.3)	42 (13.6)	17 (5.5)	9 (2.9)	7 (2.3)	11 (3.6)	308 (100)
Gender									
Male	56 (52.3)	45 (66.2)	27 (57.4)	21 (50)	11 (64.7)	6 (66.7)	3 (42.9)	8 (72.7)	177 (57.5)
Female	50 (46.7)	22 (32.4)	20 (42.6)	19 (45.2)	6 (35.3)	3 (33.3)	4 (57.1)	3 (27.3)	127 (41.2)
Not stated	1 (0.9)	1 (1.5)	0 (0)	2 (4.8)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1.3)
Age group									
0 -1 year	32 (29.9)	8 (11.7)	26 (55.3)	33 (78.5)	10 (58.8)	4 (44.4)	1 (14.3)	4 (36.4)	118 (38.3)
1 - 2 years	21 (19.6)	26 (38.2)	9 (19.1)	4 (9.5)	4 (23.5)	3 (33.3)	2 (28.6)	1 (9.1)	70 (22.7)
2 - 3 years	14 (13.1)	20 (29.4)	5 (10.6)	3 (7.1)	2 (11.8)	0 (0)	1 (14.3)	2 (18.2)	47 (15.3)
3 - 4 years	22 (20.6)	7 (10.3)	3 (6.4)	2 (4.8)	1 (5.9)	1 (11.1)	1 (14.3)	2 (18.2)	39 (12.7)
4 - 5 years	18 (16.8)	7 (10.3)	4 (8.5)	0 (0)	0 (0)	1 (11.1)	2 (28.6)	2 (18.2)	34 (11.0)
Household Income									
1000 and below	20 (18.7)	18 (26.5)	6 (12.8)	6 (14.3)	3 (17.6)	2 (22.2)	1 (14.3)	1 (9.1)	57 (18.5)
1001-3000	41 (38.3)	20 (29.4)	15 (31.9)	10 (23.8)	4 (23.5)	2 (22.2)	1 (14.3)	4 (36.4)	97 (31.5)
3001-5000	20 (18.7)	8 (11.8)	8 (17)	6 (14.3)	4 (23.5)	0 (0)	2 (28.6)	1 (9.1)	49 (15.9)
5001-7000	6 (5.6)	6 (8.8)	4 (8.5)	6 (14.3)	1 (5.9)	0 (0)	0 (0)	1 (9.1)	24 (7.8)
7001 and above	5 (4.7)	3 (4.4)	0 (0)	2 (4.8)	0 (0)	0 (0)	0 (0)	1 (9.1)	11 (3.6)
No income	1 (0.9)	1 (1.5)	3 (6.4)	0 (0)	0 (0)	0 (0)	1 (14.3)	1 (9.1)	7 (2.3)
Unknown	14 (13.1)	12 (17.6)	11 (23.4)	12 (28.6)	5 (29.4)	5 (55.6)	2 (28.6)	2 (18.2)	63 (20.5)
Location of Injury#									
*Home vicinity	14 (13.1)	33 (48.5)	46 (97.9)	42 (100)	14 (82.3)	9 (100)	6 (85.7)	10 (90.9)	174 (56.5)
Non home	69 (64.5)	31 (45.6)	1 (2.1)	0 (0)	1 (5.9)	0 (0)	1 (14.3)	1 (9.1)	104 (33.8)
Not stated	24 (22.4)	4 (5.9)	0 (0)	0 (0)	2 (11.8)	0 (0)	0 (0)	0 (0)	30 (9.7)

*Home vicinity is defined as child's home, childminder's place or the surrounding area

Denominator is based on the n in each cause of death

Socio-demography and socio-economic factors

Out of the 308 deaths under injuries, poisoning and external causes category, 177 (57.5%) were male and 216 (70.1%) were Malay. Nearly two thirds of the deaths were children below 2 years old (188 deaths, 61%). Majority of the deaths had household income less than RM3000.00 with overall deaths of 154 (50%) with highest at 57% were from MVA. One hundred and seventy four (56.5%) were reported to occur within the home vicinity. More than 80% deaths of assault/NAI, asphyxia, burn, head injury, and 48.5% of drowning deaths occurred within home vicinity. For the details on socio-demographic factors and the frequency by states in the UCOD due to Injuries, Poisoning and External Causes in 2016, please refer to [Appendix 22](#) and [Appendix 23](#).

Preventability

Nearly all deaths in this group were preventable (305/308, 99%) mainly due to socio-political factors (70.7%) especially injury prevention adherence (60.5%), followed by medical factors (16.6%) of which nearly all were due to suboptimal quality of care. Three (1%) were undetermined preventability (2 head injuries, 1 asphyxia) due to inadequate information (Figure 6.1).

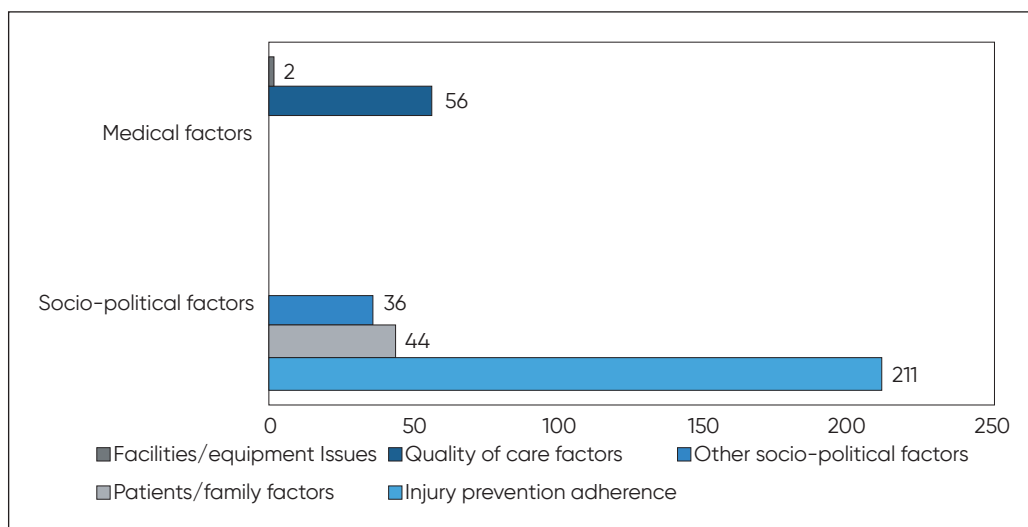


Figure 6.1: Preventable Risk Factors for Under-5 Mortalities due to Injuries, Poisoning and External Causes, Malaysia, 2016

Safety measures

Table 6.2: Frequency of Safety Measures for Motor Vehicle Accident (MVA), Drowning and Fall, Malaysia, 2016

Type of injuries	Safety measures present	Safety measures absent	Not stated	Total
	n (%)	n (%)	n (%)	
MVA (car Passengers)	12 (20.0)	27 (45.0)	21 (35.0)	60
Car seat	7 (11.7)			
Seat belt	5 (8.3)			
MVA (Motorcycle Passengers)				
Helmet	1 (1.2)	6 (42.1)	8 (43.9)	15
Drowning	22 (32.4)	32 (47.1)	14 (20.6)	68
Adult Supervision	15 (22.1)			
Barrier	4 (5.9)			
Warning sign	2 (2.9)			
Lifeguard	1 (1.5)			
Fall	0 (0)	2 (28.6)	5 (71.4)	7
Total	36 (24)	67 (44.7)	53 (35.3)	150

Only 12 from 60 (20%) deaths of car passengers in MVA had safety measures present: 7 (11.7%) used car seat and 5 (8.3%) wore seatbelt, 27 (45%) reported no child restraint system were used and not stated in 21 (35%). Only 1 from 15 (6.7%) deaths of motorcycle passengers in MVA wore helmet, 6 (40%) did not wear helmet and not stated in 8 (53.3%) deaths. Despite the safety measures in place, the deaths were categorized as preventable due to other remedial factors such as over-speeding, fatigue, dangerous

driving manoeuvres, unsafe vehicles, and delay in post-crash care. Out of 68 drowning deaths, 22 had safety measures present: 15 (22.1%) had adult supervision, 4 (5.9%) had safety barrier, 2 (2.9%) had warning sign and only 1 (1.5%) had lifeguard at swimming pool. Deaths were classified as preventable due to other remedial factors such as distracted adult supervisor, easy access to water at home and poor resuscitation by bystanders. For fall, 2 (28.6%) reported no safety measures (barrier, supervision, soft surface) and not stated in 5 (71.4%).

Sub-categories analysis

Motor Vehicle Accident

Table 6.3: Category of Victims and Location of Incident by Types of Vehicles, Malaysia, 2016

Motor Vehicle Accident	Car (N=75)	Motorcycle (N=16)	Bus (N=2)	*Other (N=11)	Not stated (N=3)	Total (N=107)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Category						
Passenger	60 (72.3)	15 (18.1)	2 (2.4)	5 (6.0)	1 (1.2)	83 (100)
Pedestrian	12 (66.7)	1 (5.6)	0 (0)	5 (27.8)	0 (0)	18 (100)
Other	2 (66.7)	0 (0)	0 (0)	1 (33.3)	0 (0)	3 (100)
Not stated	1 (33.3)	0 (0)	0 (0)	0 (0)	2 (66.7)	3 (100)
Location						
Main road	41 (73.2)	10 (17.9)	0 (0)	3 (5.4)	2 (3.6)	56 (100)
Feeder road	9 (64.3)	2 (14.3)	0 (0)	3 (21.4)	0 (0)	14 (100)
Highway	4 (66.7)	0 (0)	2 (33.3)	0 (0)	0 (0)	6 (100)
Other	5 (71.4)	0 (0)	0 (0)	2 (28.6)	0 (0)	7 (100)
Not stated	16 (66.7)	4 (16.7)	0 (0)	3 (12.5)	1 (4.2)	24 (100)

*Other vehicles were van, lorry, truck, tractor, horse cart, boat

There were 107 deaths from Motor Vehicle Accident (MVA). Types of vehicles involved in MVA were mainly cars (75, 70.1%) and motorcycles (16, 15%). Eighty-three (77.6%) were passengers and 18 (16.8%) were pedestrians. Main location of the MVA was main road at 56 (52.3%) followed by feeder road at 14 (13.1%).

Drowning

Table 6.4: Age Distribution and Location of Drowning, Malaysia, 2016

Drowning	Bucket (N=24)	River (N=10)	Drain/puddle (N=9)	Swimming pool (N=8)	Lake (N=6)	Sea (N=3)	Others (N=4)	Not stated (N=4)	Total (N=68)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Age									
0 - 1 year	4 (66.7)	0 (0)	0 (0)	0 (0)	0 (0)	2 (66.7)	2 (66.7)	0 (0)	8 (100)
1 - 2 years	14 (53.8)	3 (11.5)	3 (11.5)	1 (3.8)	3 (11.5)	0 (0)	1 (3.8)	1 (3.8)	26 (100)
2 - 3 years	4 (20.0)	3 (15.0)	4 (20.0)	3 (15.0)	3 (15.0)	1 (5)	0 (0)	2 (10.0)	20 (100)
3 - 4 years	2 (28.6)	1 (14.3)	1 (14.3)	2 (28.6)	0 (0)	0 (0)	0 (0)	1 (14.3)	7 (100)
4 - 5 years	0 (0)	3 (42.9)	1 (14.3)	2 (28.6)	0 (0)	0 (0)	1 (14.3)	0 (0)	7 (100)

There were 68 cases of fatal drowning in 2016 of which 33 (48.5%) deaths occurred at home vicinity with 24 (35.3%) drowned in bucket and 9 (13.2%) in nearby drain/puddle. Non home drowning occurred most in river, followed by swimming pool, lake and sea. Forty-six (67.6%) children were between 1-3 years old, of which 25 (54.3%) drowned within home vicinity.

Assault/Non-Accidental Injury (NAI)

Table 6.5: Age Distribution, Perpetrator, Suspected Abuse /Neglect Case and Post-mortem in Relation to Types of Assault, Malaysia, 2016

Assault/ NAI	Physical (n=44)	Neglect (n=2)	Physical & sexual (n=1)	Total (N=47)
	n	n	n	
Age				
0 - 1 year	25	1	0	26
1 - 2 years	8	0	1	9
2 - 3 years	5	0	0	5
3 - 4 years	2	1	0	3
4 - 5 years	4	0	0	4
Perpetrator				
Family member	22	2	1	25
Caregiver	7	0	0	7
Others	1	0	0	1
Not stated	14	0	0	14
Suspected abuse/neglect				
Yes	27	2	1	30
No	13	0	0	13
Not sure	4	0	0	4
Post-mortem				
Yes	35	2	1	38
No	9	0	0	9

There were 47 cases of assault/NAI in 2016 of which 44 (93.6%) were physical abuse, 2 (4.3%) were neglect and 1 (2.2%) was physical & sexual abuse. Thirty-five (74.5%) deaths were children below 2 years old. Twenty-five (75.6%) of the 33 known perpetrators were family members and 7 (21.2%) were caregivers. Thirty (63.8%) deaths were suspected as child abuse or neglect cases. Thirty-eight (80.9%) deaths had post-mortem done.

Asphyxia

Table 6.6: Age Distribution and Post-mortem in Relation to Types of Asphyxia, Malaysia, 2016

Asphyxia	Milk aspiration (N=26)	Suffocation (N=6)	Food (N=4)	Foreign body (N=3)	Not specified (N=3)	Total (N=42)
	n	n	n	n	n	n
Age						
Less than 6 months	23	2	0	0	2	27
6 months - 1 year	3	2	1	1	0	7
1 - 2 years	0	1	1	1	0	3
2 - 3 years	0	1	1	1	0	3
3 - 4 years	0	0	1	0	1	2
Post-mortem						
Yes	14	2	2	1	2	21
No	12	4	2	2	1	21

There were 42 cases of asphyxia in 2016 of which 26 (61.9%) were from milk aspiration, followed by suffocation, food inhalation and foreign body inhalation. Thirty-four (81%) deaths were in children below 1 year of age with nearly all deaths (23 deaths, 88.5%) from milk aspiration were below 6 months old. Twenty-one (50%) deaths had post-mortem performed. Fourteen from 26 (53.8%) milk aspiration diagnosis were made following post-mortem.

Discussion

Motor Vehicle Accidents

Motor vehicle accident at 34.7% remain the leading cause of death for the UCOD of injuries, poisoning and external causes in Malaysia for the year 2016. The average road traffic accidents fatalities are 18 persons every day in Malaysia⁶¹. Road Safety Plan of Malaysia (RSPM) 2021-2030 was developed to achieve the target of reducing 50% road accident fatalities by 2030 in accordance with United Nations (UN) global target following from Decade of Action for Road Safety 2011– 2020⁶². The framework of RSPM 2021-2030 was developed based on the five road safety pillars which are Road Safety Management, Safer Mobility and Roads, Safer Vehicles, Safer Road Users and Post-Crash Management. Road safety regulations in Malaysia include speed limit, seatbelt wearing, helmet wearing, and a maximum Blood Alcohol Concentration (BAC) level⁶². The use of Child Restraint System (CRS) in private vehicles in Malaysia was implemented in January 2020 and must comply with the UN Regulation standard – R44 and R129⁶². Road Safety Education system was developed in 2006 and incorporated into the education syllabus of Malaysian education system in 2010⁶¹.

World Health Organization (WHO) has reported human error is the major cause of road traffic accidents and has identified risk factors to road traffic accidents such as speeding; driving under influence of alcohol or substance; non-use of motorcycles helmet, car seats and child restraint; distracted driving; unsafe road infrastructure; unsafe vehicles; inadequate post-crash care and inadequate enforcement of traffic laws⁶³. Child restraint system (CRS) could lower the risk of death to infants below 1 year old by 71% and toddlers aged 1-4 years old by 54%⁶⁴. Malaysian Institute of Road Safety Research (MIROS) study in 2020 showed used CRS were widely available on online platforms with price range between RM200 – RM500 compared to new CRS price range RM500 – RM1000⁶⁵. Most parents in the MIROS study had household income below RM3000 per month and willing to pay up to RM200 for CRS⁶⁵. Our study showed 57% of MVA deaths were from families with monthly household income less than RM3000 and only 20% deaths of car passengers in MVA had been stated to use CRS.

Drowning

Our study finding showed 48.5% fatal drowning occurred at home vicinity and all home drowning were children less than 4 years of age which consistent with WHO statement that children below 4 years are at most risk of drowning as few cm of water can drown them and they lack the survival skill. WHO has released *Preventing Drowning: An Implementation Guide in 2017*⁶⁶. Recommended interventions such as installing barriers controlling access to water such as keeping the bathroom door locked when not in used may prevent home drowning in young children⁶⁷.

Assault/NAI

There were 4,982 SCAN cases reported to Welfare Department of Malaysia in 2016 and it has risen to 6,382 in 2019^{68,69}. In 2016, out of the total cases reported to Welfare Department of Malaysia, 26.2% were physical abuse, 20.8% were sexual abuse, 2% were emotional abuse and 51.1% were neglect⁶⁸. In our study where assault or NAI ended with death, 75.6% of the perpetrators were family members. This is comparable to the data from Welfare Department of Malaysia in 2016: 71.2% were family members with 31.8% were biological parents. Our study showed higher incidence of deaths where suspected perpetrators were caregivers at 26.9% compared to overall SCAN cases reported in 2016 at 6.6%⁶⁹. The main attributed causes of SCAN in 2016 were family dispute (18.6%), followed boyfriend (14.6%), financial problem (10.6%), parental neglect (10.6%) and substance abuse (9%)⁶⁹.

Asphyxia

In Malaysia, milk aspiration used to be quoted as the cause of death in infants especially when death occurred at home. This diagnosis is often disputed by clinicians as there is assumption that pooling of milk in oro-pharynx cavity is final 'agonal' event prior to death and should not be assumed the child had milk aspiration⁷⁰. Human body 'auto-resuscitate' in the event of hypoxia but recent studies have shown presence of liquid in the airway have prevented this mechanism⁷⁰. In general, gastro-oesophageal reflux is common in infants less than 3 months. Gastric contents are related to aspiration pneumonia and present in the lungs of 30% to 40% of infants whose deaths are attributed to sudden infant death⁷⁰. The most frequent causes of pulmonary aspiration were caused by milk (31.8%)⁷¹. Predisposing factors include any condition that alters the state of consciousness or creates dysfunction of deglutition such as prematurity, sepsis, neurometabolic conditions, gastro-oesophageal reflux disease⁷². Diagnosis of milk aspiration should be concluded from post-mortem⁷². Our study result showed 88.5% deaths attributed to milk aspiration were in children less than 6 months old. Safe sleeping habits has been shown to reduce incidence of sudden infant death syndrome (SIDS) in United States of America (USA) from 1.4 to 0.6 per 1000 live birth⁷³.

Fire and Burn Injury

WHO estimated 265,000 deaths per year worldwide with 50% in Southeast Asia⁷⁴. It is the eleventh leading cause of death in children 1-9 years old and fifth non-fatal childhood injuries⁷⁴. Infant and toddlers were at most risk of burn injury according to a local study as 79.8% of the 94 paediatric burn patients were in that age group, 76% due to scalding, 34% had serious injury with affected body surface area were more than 10% with 1 mortality⁷⁵. Our study showed 77.8% deaths from burn injury were children less than 2 years old.

Overview

In United Kingdom (UK), the health visitor is the main healthcare worker that monitor the wellbeing of children below 5 years old⁷⁶. The health visitor is registered nurse/midwife who is equivalent to staff nurse or community nurse in Malaysia⁷⁷. The health visitor is the key personnel in UK National Healthy Child Programme and mandated with 5 universal health visits at 28 weeks pregnancy, at 10-14 days after birth, at 6 – 8 weeks old, at 9 - 12 months old and at 2 -2.5 years old. The focus of the visits includes parental coping (emotional and financial), feeding, growth and development, safe sleeping, home and travelling safety, immunization⁷⁸. In Malaysia, similar national health program is in place with more frequent mandatory 12 days postnatal visits: daily for Day 1 to Day 8, Day 10, Day 15, Day 18 and Day 20; and more frequent if mother or child has problem. This program has great potential to improve home safety, safe sleeping, and early detection of unwell children during the visits and reduction in under-5 mortalities¹⁷.

The current Malaysian child health record was introduced in 2011⁷⁹. The Child Health Record is a comprehensive record of the child's wellbeing from birth to 5 years old. Parents were empowered to complete sections of the record as well as the attending healthcare workers. If fully utilized, it has potential to become a very useful tool in guiding the parents and healthcare workers to ensure the wellbeing of the child.

In Malaysia, tax relief childcare for each child below 18 years old is RM2000 and RM2000 – RM8000 for children above 18 and receive further education per year⁸⁰. There is provision for tax exemption if purchasing electronic device such as personal computer and hand phone up to RM3000⁸⁰. Our study has shown 50% of overall deaths in injuries, poisoning and external causes were from families with monthly household income below RM3000 with the highest at 57% from MVA category. Financial aid to buy child restraint system for vehicles and childcare with registered childcare provider may reduce mortality in children below 5 years.

Key Findings

- MVA contributed to 34.7% of all under-5 mortalities due to injury, poisoning and certain other consequences of external causes, followed by drowning (22.1%), assault/ NAI (15.3%), 13.6% from asphyxia, followed by head injury, burn, fall and others.
- 61% were below 2 years of age.
- 56.5% were reported to occur within the home vicinity.
- 99% of the under-5 mortalities was preventable.
- Main risk factors identified were injury prevention adherence and suboptimal quality of care.
- For MVA, only 20% had safety measures present. Majority involved cars and occurred in the main roads.
- Only 22.1% of the deaths due to drowning had safety measures.
- 93.6% of deaths due to assault were physical abuse. 75.6% of the perpetrators were family members.
- Milk aspiration contributed to 61.9% in the cause of death of asphyxia and 88.5% were below 6 months.

Recommendations

MOH especially FHDD and Violence and Injury Prevention (VIP) sector should proactively advocate home safety and formulate measures to prevent fatal home injuries. This Home Safety program should be incorporated into MOH current children and family wellbeing programs. Listed below are suggestions that can be implemented as short term measures with projected significant benefits:

- Develop infographics poster on Home Safety.
- Create public awareness on Home Safety via digital platform such as FHDD website or MyHealth portal and throughout MOH healthcare facilities.
- Have Home Safety Guideline for training of healthcare workers.
- Add Home Safety topic to antenatal counselling and recorded in maternal antenatal book and Child Health Record.
- Home Safety counselling to be added as part of pre-discharge plan for postnatal mother in hospital and incorporate Home Safety assessment into postnatal visits program.
- Identify children at risk of home violence and injury such as parental separation, parental substance abuse, low household income, parents with mental health problem, step/adopted children and to give the family appropriate support.
- Educate parents and healthcare providers on warning signs of seriously ill child to avoid delay in seeking medical attention.

FHDD and VIP sector to monitor the effectiveness of preventive measures implemented.

- Strengthening the current monitoring system of Under-5 Mortality.
- Developing a comprehensive Violence Injury Prevention (VIP) reporting system to monitor all cases under Injuries, Poisoning & External Causes is strongly recommended.

Inter-agency collaboration is essential to reduce the under-5 mortality rates in Malaysia and the recommended measures are outlined below:

- Legislation/Act
In Malaysia, the Child Restraint System (CRS) regulation has been gazetted by the Road Transport Department under the Road Transport Act 1978 - Motor Vehicles (Safety Seatbelts) (Amendment) Rules 2019). Law enforcement for all under-5 years old vehicle passengers to use Child Restraint System such as baby-seat or child car seat. This need multi agencies collaboration headed by Ministry of Transport.

- Child Safety Allowance

- i. Child safety allowance which is a one-off payment of RM200–RM300 to parents for any newborn of families with household income below RM3000 to purchase a Child Restraint System (baby-seat/car seat) to match the price of CRS available in the market is strongly advocated. This allowance shall be given during the newborn period once the child has been registered and has birth certificate.
- ii. Tax redemption for child restraint system for families with household income above RM3000 category up to RM2000.

This programme should be headed by Ministry of Women, Family & Community Development.

- Registered Child Care

Enforcement of childcare provider (private or commercial childminder) to be registered with the Welfare Department shall be improved to ensure provision of safe home environment and Basic Life Support in any emergency. Employers shall be encouraged to provide child care within the workplace.

Parents shall be empowered to choose childcare wisely and childcare allowance shall be provided for parents with household income below RM3000 to send child to registered childcare provider. This should be headed by Ministry of Women, Family & Community Development.

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CHAPTER 7: DISEASES OF THE RESPIRATORY SYSTEM

Underlying Cause of Death for Diseases of Respiratory System

Pneumonia was the commonest (90.7%) causes of death for diseases of respiratory system in children aged 5 years and below, followed by chronic lung disease (CLD) (3.2 %), asthma (1.4%) and diseases of upper respiratory tract (1.4%) as shown in Figure 7.1. Pneumonia contributed to 5.1% (253/4938) cases of all deaths in children under-5 years old.

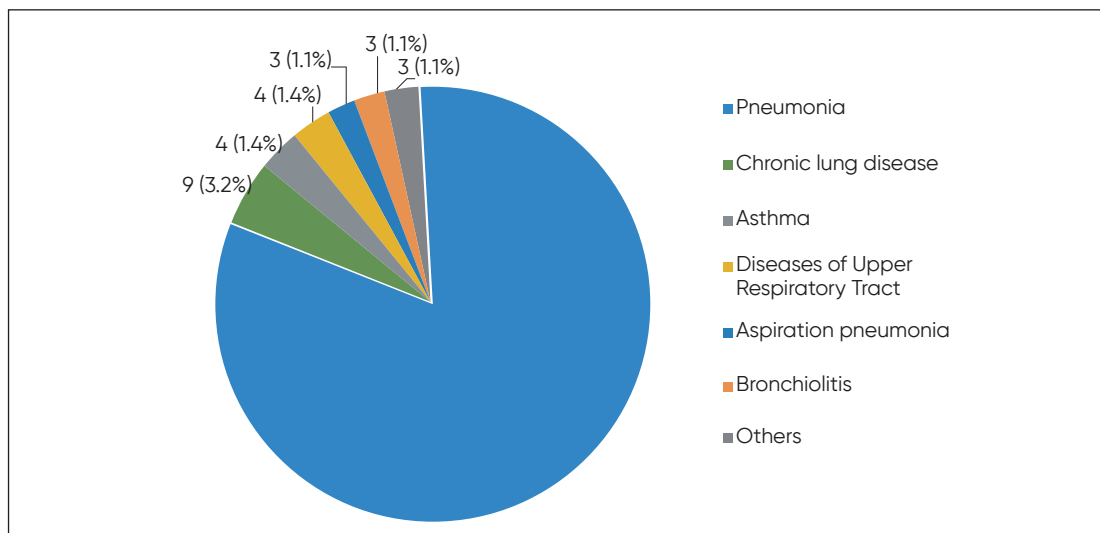


Figure 7.1: Causes of Death due to Diseases of Respiratory System in Children Under-5 years old, Malaysia, 2016

The aetiological agents for pneumonia were identified in 15.4 % (39/253) of cases. Viruses were isolated in the majority (23/39 cases, 59.0%) of pneumonia cases and while bacterial causes were identified in 41.0% (16/39 cases). Among the viruses, adenovirus was found to be the commonest virus identified (11 cases, 47.8%), followed by respiratory syncytial virus (7 cases, 30.4%), influenza, 17.4% (3 cases of Influenza A and 1 case of Influenza B) and parainfluenza virus (1 case, 4.3%). The bacteria isolated according to frequency were *Klebsiella pneumoniae* (4 cases, 25%), *Streptococcus pneumoniae* (2 cases, 12.5%), *Haemophilus influenzae* (2 cases, 12.5%), *Staphylococcus aureus* (2 cases, 12.5%), *Streptococcus pyogenes* (2 cases, 12.5%), *Pseudomonas aeruginosa* (2 cases, 12.5 %), *Escherichia coli* (2 cases, 12.5%) and 1 each for *Streptococcus viridans*, *Enterobacter aerogene* and gram-negative bacillus. Two patients have mixed viral and bacterial, while two patients had 2 bacteria isolated.

The majority (75.3%) of death due to respiratory disorders were potentially preventable. In fact, deaths due to asthma and upper respiratory disorders were preventable in all cases (100%), while 76.3% of death due to pneumonia were preventable. (Table 7.1).

Table 7.1: Causes of Deaths due to Diseases of Respiratory System in Children Under-5 years old in 2016 According to Preventability, Malaysia, 2016

UCOD	Preventable	Not preventable	Undetermined	Total	p-value
	n (%)	n (%)	n (%)	n (%)	
Pneumonia	193 (76.3)	49 (19.4)	11 (4.3)	253 (100)	0.051*
Chronic lung disease	4 (44.4)	4 (44.4)	1 (11.1)	9 (100)	
Asthma	4 (100)	0 (0)	0 (0)	4 (100)	
Diseases of Upper Respiratory Tract	4 (100)	0 (0)	0 (0)	4 (100)	
Aspiration pneumonia	2 (66.7)	0 (0)	1 (33.3)	3 (100)	
Bronchiolitis	2 (66.7)	0 (0)	1 (33.3)	3 (100)	
Others	1 (33.3)	2 (66.7)	0 (0)	3 (100)	
Total	210 (75.3)	55 (19.7)	14 (5.0)	279 (100)	

*Fisher exact test

While majority (118/210; 56.2%) of the preventable death due to respiratory disorders occurred at the hospital, a significant proportion (92/210; 42.8%) of preventable death occurred at non-hospital setting. For the non-hospital deaths, majority (93.3%) of BID and home deaths (83.7%) due to respiratory diseases were preventable death (Table 7.2).

Table 7.2: Deaths due to Diseases of Respiratory System in Children Under-5 years old According to Preventability and Place of Death, Malaysia, 2016

Place of death	Preventable	Not preventable	Undetermined	Total	p-value
	n (%)	n (%)	n (%)	n (%)	
Hospital	118 (67.8)	46 (26.4)	10 (5.7)	174 (100)	<0.001*
Non-hospital	92				
<i>BID</i>	56 (93.3)	3 (5.0)	1 (1.7)	60 (100)	
<i>Home</i>	36 (83.7)	6 (14.0)	1 (2.3)	43 (100)	
<i>Other</i>	0 (0)	0 (0)	2 (100)	2 (100)	
Total	210 (75.3)	55 (19.7)	14 (5.0)	279 (100)	

*Fisher exact test

Socio-demographic factors for diseases of respiratory system

Among the socio-demographic risk factors, lower maternal education and parental education (no formal education and primary education) were the significant risk factors for death due to respiratory causes. Other socio-demographic characteristics were not significantly different between the groups ([Appendix 24](#)).

Mother with no formal education has 5.3 times higher risk for their children to die due to diseases of respiratory system. Non-citizen appeared to have higher risk of death compared to other ethnicity, however it was not statistically significant. Children of Bumiputera Sabah ethnicity and other Malaysians were associated with lower risk of deaths. Similarly, children from the state of Sabah were associated with lower risk for death (Table 7.3).

Table 7.3: Socio-Demographic Risk Factors for Deaths due to Diseases of Respiratory System, Malaysia, 2016

Socio-demographic factor	OR	95%CI OR		p-value
		Lower	Upper	
Gender				
Male	1			
Female	0.91	0.50	1.65	0.744
Unknown	-			
Ethnicity				
Malay	1			
Chinese	0.44	0.10	1.87	0.266
Indian	0.88	0.09	8.19	0.908
Orang Asli	-			
Bumiputera Sabah	0.19	0.08	0.46	<0.001
Bumiputera Sarawak	0.82	0.25	2.69	0.746
Other Malaysian	0.18	0.04	0.70	0.014
Non-citizen	1.65	0.53	5.09	0.388
Unknown	-			
State				
Peninsular Malaysia	1			
Sabah	0.25	0.13	0.51	<0.001
Sarawak	0.54	0.21	1.39	0.201
Maternal age				
< 26years	1			
26 to 35 years	1.00	0.49	2.04	0.999
>35 years	1.34	0.52	3.49	0.543
Unknown	1.42	0.42	4.78	0.576

Mother's education				
College/ university	1			
No formal education	5.28	1.38	20.16	0.015
Primary	1.69	0.56	5.08	0.348
Secondary	1.22	0.57	2.62	0.613
Others	-			
Unknown	2.71	0.69	10.70	0.155
Household income				
1000 and below	1			
1001-3000	1.14	0.51	2.56	0.758
3001-5000	0.95	0.35	2.57	0.919
5001-7000	0.43	0.11	1.65	0.220
7001 and above	1.23	0.13	11.28	0.854
On social welfare support	0.25	0.02	4.15	0.331
No income	-			
Unknown	0.80	0.35	1.82	0.588

The results derived from univariate logistic regression test

Medical risk factors for death due to diseases of respiratory system

Intensive care admission was significantly higher (64.9%) in the group with preventable death, suggesting the more severe and critical state of conditions the patients had. The duration of NIV (non-invasive ventilation) did not differ between the groups, however most (75.7%) of the data for duration of NIV was not available. Comorbidities such as CLD (Chronic Lung Disease) and neurological disorders (neuromuscular disorders, Cerebral Palsy and epilepsy), were significantly higher in the preventable death group while assisted feeding were significantly lower in the preventable group (Table 7.4). Among the children in the preventable group, 72.1% of them had completed their immunization schedule as per national guideline, while quite a high percentage of the young children (19.7%) had incomplete immunization.

Table 7.4: Medical Risk Factors for Deaths due to Diseases of Respiratory System in Children Under-5 years, Malaysia, 2016

Medical risk factor	Preventable	Not preventable	Undetermined	Total	p-value
	n (%)	n (%)	n (%)	n (%)	
Duration of NIV					
1 day and less	5 (55.6)	3 (33.3)	1 (11.1)	9 (100)	0.306 ^a
2 to 3 days	5 (83.3)	1 (16.7)	0 (0)	6 (100)	
4 to 7 days	3 (60.0)	2 (40.0)	0 (0)	5 (100)	
> 7 days	0 (0)	1 (100)	0 (0)	1 (100)	
NA	134 (75.7)	35 (19.8)	8 (4.5)	177 (100)	
Intensive care admission	72 (64.9)	33 (29.7)	6 (5.4)	111 (100)	0.005 ^a
Previous antibiotic before admission	38 (73.1)	12 (23.1)	2 (3.8)	52 (100)	0.405 ^a
Immunization status					
Complete	129 (72.1)	39 (21.8)	11 (6.1)	179 (100)	0.617 ^a
Incomplete	55 (82.1)	10 (14.9)	2 (3.0)	67 (100)	
Not applicable/ available	26 (78.8)	6 (18.2)	1 (3.0)	33 (100)	
Co-morbid					
Perinatal condition	30 (69.8)	11 (25.6)	2 (4.7)	43 (100)	0.550 ^b
Neurological disorder	17 (50.0)	16 (47.1)	1 (2.9)	34 (100)	0.001 ^b
Cardiac disease	22 (71.0)	8 (25.8)	1 (3.2)	31 (100)	0.751 ^a
Chronic lung disease	12 (50.0)	10 (41.7)	2 (8.3)	24 (100)	0.023 ^a
Malnutrition	16 (80.0)	3 (15.0)	1 (5.0)	20 (100)	0.933 ^a
Assisted feeding	3 (33.3)	5 (55.6)	1 (11.1)	9 (100)	0.022 ^a
Recurrent pneumonia	3 (42.9)	2 (28.6)	2 (28.6)	7 (100)	0.055 ^a
Others	31 (68.9)	12 (26.7)	2 (4.4)	45 (100)	0.574 ^a

^aFisher's exact test, ^bChi-Square test

Medical and non-medical factors contributing to death due to diseases of respiratory system

Among of the medical factors that contribute to the preventable respiratory death, majority (95.7 %) of the factors were significantly related to issues with quality of medical care. The top five causes of short fall in quality (SIQ) in this area were failure to appreciate severity of respiratory diseases in 25.2%, followed by providing inadequate, inappropriate, and delayed therapy by health workers in 16.7% of cases, failure to diagnose (11.9%), delay in referral (11.4%) and inappropriate level of medical expertise handling those cases (9.5%) (Figure 7.2). Lack of regional retrieval system was also a significant contributory factor for preventable death.

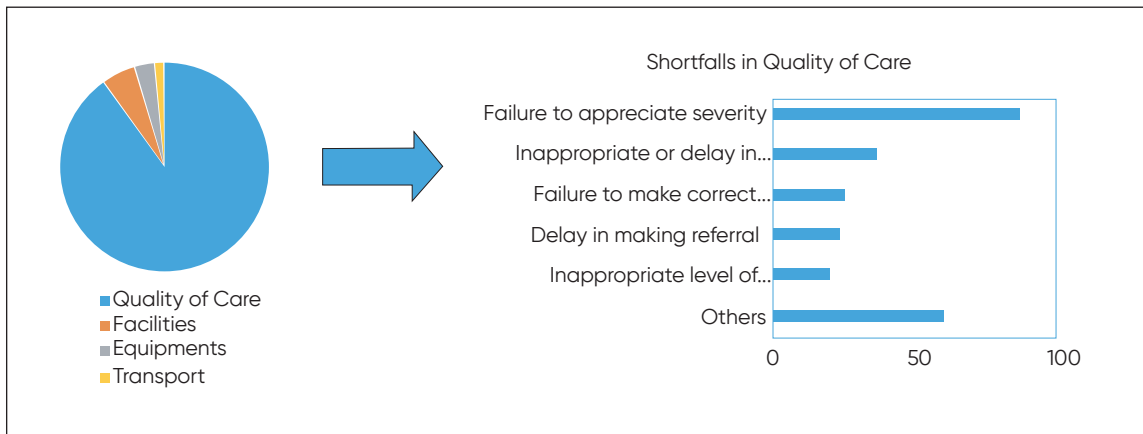


Figure 7.2: Medical Factors Contributing to Deaths due to Diseases of Respiratory System, Malaysia, 2016

For non-medical risk factors for the preventable respiratory death, majority (78.1%) were related to family and patient factors as compared to 21.9% were related to socio-economic factors. In family and patient factors, most respiratory deaths were significantly due to delay in seeking treatment (44.9%), lack of awareness of severity of illness (29.7%) and non-compliance/refusal of therapy or immunization (8.8%) (Figure 7.3). Transport issue was also a significant risk factor for preventable death under socio-economic factors.

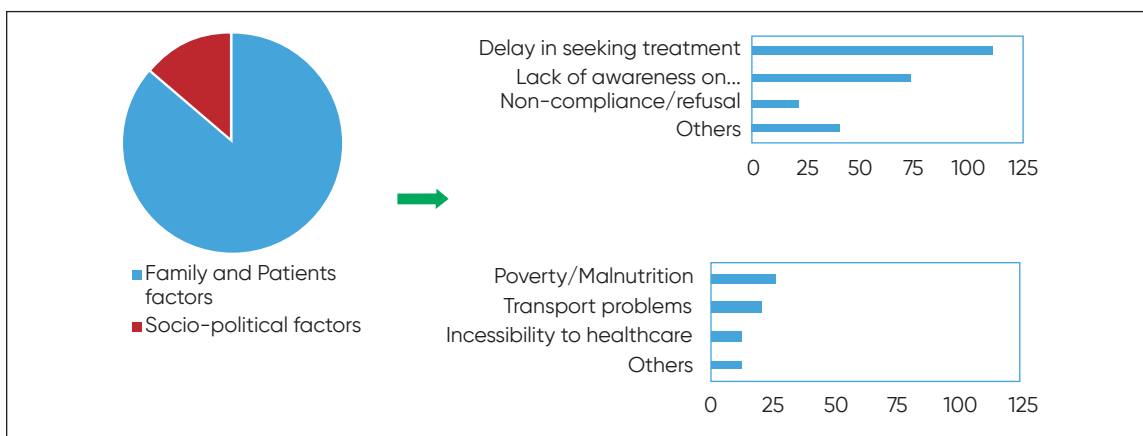


Figure 7.3: Non-Medical Factors Contributing to Deaths due to Diseases of Respiratory System, Malaysia, 2016

Discussion

Pneumonia remains a leading cause (90.7%) of death due to respiratory systems and it contributed to 5.1% of all deaths of children under-5 years of age. According to WHO, pneumonia killed more than 808 000 children under the age of 5 in 2017, accounting for 15% of all deaths of children under-5 years. Our results showed lower percentage of death due to pneumonia in 2016, probably reflecting our better standard of medical care compared to other developing countries.

Pneumonia can be caused by viruses, bacteria, or fungi. Knowledge of the pathogens causing CAP pneumonia constitutes the basis for selection of empirical antibiotic treatment, which has a substantial impact on the prognosis of the patient. In this study, pathogens were identified in 15.4% of death due to pneumonia. Majority of pneumonia death were due to viruses (59.0%) as compared to bacterial causes (41.0%). It is a known fact that viral infections were most common in children < 2 years old, though viral causes of pneumonia remain important in all age groups. Data in the literature showed that at least 1 virus was identified in 45-66% of children with pneumonia. A study in Thailand found that 48/91 cases (52.7%) of children between the age of 1 month to 4 years 5 months, hospitalized for severe CAP, were positive for respiratory viruses⁸⁴. This study found that Adenovirus contributed to the majority (47.8%) of the under-5 pneumonia deaths, followed by RSV (30.4%) and Influenza viruses (17.4%). In the Thailand study, the most common viruses identified were RSV (n=22, 45.8%), rhinovirus (n=11, 22.9%), and adenoviruses (n=9, 18.7%)⁸⁴. Similarly, RSV (27.1%) and Adenoviruses (23.6%) were the commonest viruses identified in a larger cohort of children (n=2575) with acute respiratory tract infections (ARTIs) in Parma, Italy⁸⁵.

The common bacteria isolated in this study were *Klebsiella pneumonia*, *Streptococcus pneumonia*, *Haemophilus influenza*, *Staphylococcus aureus*, *Streptococcus pyogenes*, *Pseudomonas aeruginosa* and *E. coli*. The finding concurred with other study that had identified *Streptococcus pneumoniae*, *Haemophilus influenzae* and *Respiratory Syncytial Virus* as the main pathogens associated with childhood community acquired pneumonia⁸⁶. The high yield of *Klebsiella pneumonia*, *Pseudomonas aeruginosa* and *Escherichia coli* were most probably related to hospital acquired infections that were not been able to ascertained fully with the design of this study.

Data shows that majority of mortality due to pneumonia cases were potentially preventable. Most of childhood pneumonia deaths in this study were related to family and patient factors, where the deaths were due to delay in seeking treatment, lack of awareness of severity of illness and non-compliance/refusal of therapy or immunization. We found that children with mothers who had no formal education were 5 times more likely to die as it was closely related with the family factors as mentioned above. Maternal education has been shown to modify women's knowledge and beliefs about disease causation, prevention, and cure and this has an influence on health care practices⁸⁷. Furthermore, educated mothers are more likely to seek early treatment and adhere to recommended treatment⁸⁷. Therefore, it's imperative to improve maternal education, educate the public about pneumonia, recognizing its danger signs and the importance of seeking early treatment which may reduce pneumonia related mortality. The proportion of children with incomplete immunization was quite high in this study. Therefore, more educational effort is needed to promote vaccination acceptance among parents.

Our data also showed that most of the preventable death due to respiratory disorders occurred in the hospital. However, most of them came in a severe state of illnesses as majority of them required intensive care management. Either they came very late due to social factors as discussed earlier, or there was contributory shortfall in the initial management of these cases at the medical facilities as shown in this study. These cases required early identification of the diagnosis and severity of the diseases, prompt and adequate therapy and early referral, combined with the availability of good-quality higher-level of care. Therefore, education and training of the front-liners are utmost important in early recognition of danger signs, prompt resuscitation, early initiation of appropriate therapy and early referral and consultation with the specialists.

Key Findings

- 75.3% of the deaths in the diseases of the respiratory system were preventable, out of which, the leading cause was pneumonia (76.3%).
- Aetiological cause was identified in 15.4% of all pneumonia cases, with 59% viruses and 41% were bacterial.
- 42.8% of preventable deaths in diseases from the respiratory system occurred in the non-hospital setting.
- Low maternal and parental education were significant risk factors for diseases of the respiratory system. Non-citizen also appears to have a higher risk.
- 19.7% of the children who died did not complete their immunization.
- Shortfall in quality of care contributed to 95.7% of the preventable deaths, with failure to appreciate severity, inadequate, inappropriate and delayed therapy, failure to diagnose, delay in referral, inappropriate level of medical expertise and lack of regional retrieval system identified as risk factors.
- 78.1% of the preventable deaths in this group had patient and family non-medical risk factors such as delay in seeking treatment (44.9%), lack of awareness of severity of illness (29.7%) and non-compliance or refusal to therapy or immunization (8.8%). Malnutrition and transport issues were also contributing risk factors.

Recommendations

Pneumonia remains a leading cause of preventable illness and death in this age group and overcoming this will require considerable effort. Many of the strategies needed to reduce the pneumonia burden and mortality are well known, though quite complex. Children need to have access to effective vaccines, improve living conditions, and have better nutrition and targeting the key risk factors for pneumonia to prevent this disease.

- Immunization is the most effective way to prevent pneumonia. Immunization against Hib, measles and whooping cough (pertussis) had been in National Immunization Programme (NIP) for a long time, however pneumococcal vaccine had been only recently incorporated in Malaysian NIP on 1st December 2020⁸⁸. Other vaccines against viruses, e.g. RSV monoclonal antibody and Influenza vaccines, are available but not readily accessible in the government hospitals or clinics even for high risk patients. Studies have shown that high-risk patients have higher mortality if contracted RSV or Influenza pneumonia. Therefore, these vaccines are essential especially for the high-risk patients and special budget allocation is needed to ensure no interruption in supply. Guideline about vaccines in special groups of children should be formulated at national level. More efforts need to be done to improve vaccinations coverage and to tackle vaccine hesitant groups.
- Testing for respiratory viruses can modify clinical decision making in children with suspected pneumonia. Antibiotics will not routinely be required for these children in the absence of clinical, laboratory, or radiographic findings that suggest bacterial infection. New PCR-based methods resulted in a higher microbiological yield in study population for CAP, and the yield were even higher if comprehensive combination of sampling and tests were performed⁸⁹. The use of highly sensitive molecular based diagnostics (especially PCR) facilitated the detection of multiple organisms (bacteria, viruses, atypical organisms, and even fungal species). Therefore, PCR test should be readily available at every MOH hospitals. Future research, with new molecular techniques to better detect infections due to the wide range of pathogens, will broaden our understanding of the cause of pneumonia and may highlight which pathogens should be the targets for new vaccines.

- Adequate nutrition is key to improving children's natural defences, starting with exclusive breastfeeding for the first 6 months of life, followed by complementary feeding. It helps to hasten the recovery and reduced the length of the illness in pneumonia and may also reduce pneumonia related mortality. Baby friendly Hospital Initiative has been implemented in MOH since 1991⁹⁰ but we still need to strengthen its implementation in the community. Education about healthy eating habits is very important as malnutrition is still prevalent in our communities. Healthy eating habits should be part of syllabus in pre-school or primary school to install the ideas as early as possible. Public health activities to improve nutritional status of young children need more consolidative approach.
- Improving early detection and appropriate and timely treatment of pneumonia and other respiratory disorders. Existing programmes such as IMCI (Integrated Management of Childhood Illnesses) and ATUCU 5 (Approach to Unwell Children Under 5 years) should be strengthen further and expanded to all the states in Malaysia.

Prepared by: Dr Mariana Daud

CHAPTER 8: CERTAIN INFECTIOUS AND PARASITIC DISEASES

Underlying causes of death and preventability in the Certain Infectious and Parasitic Diseases (CIPD)

The major groups of causes of death in the CIPD group are summarized in Table 8.1. Out of the total 267 deaths, about two third (167; 62.6%) were due to sepsis (both community- and hospital-acquired) followed by 53 (19.8% or about one fifth of the total) deaths were due to acute gastroenteritis (AGE).

Among the group who died from sepsis, majority were community-acquired (138 or 82.6 % of the 167 deaths due to sepsis) and 29 (17.4%) deaths were hospital-acquired. Despite being among the major infectious diseases in Malaysia, TB, dengue and HIV only resulted in 24 deaths (9% of total CIPD deaths) among the children under-5 years of age in 2016. The numbers of children died from other vaccine preventable diseases (VPD) were also relatively low, contributed to only 21 or 7.9% of total CIPD deaths.

Almost all (90.6 % or 242) the 267 deaths due to CIPD deaths were classified as preventable death. Only 15 (5.6%) deaths were considered not preventable. Thirteen of them were community-acquired sepsis, one due to TB and another one due to *Streptococcus pneumoniae* infection. The other details of the CIPD deaths and the overall preventability of the deaths in the group are as illustrated in Table 8.1.

Table 8.1: Major Causes of Deaths according to ICD 10 Classification and Preventability in CIPD, Malaysia, 2016

Major Group/ICD 10 classification	Preventable (%)	Not Preventable (%)	Undetermined (%)	Total (%)
Sepsis	146 (60.3)	13 (86.6)	8 (80.0)	167 (62.6)
- Community acquired	117 (48.3)	13 (86.6)	8 (80.0)	138 (51.7)
- Nosocomial sepsis	29 (12.0)	0 (0)	0 (0)	29 (10.9)
Acute Gastroenteritis	52 (21.5)	0 (0)	1 (10)	53 (19.8)
Other Vaccine Preventable Diseases	20 (8.3)	1 (6.7)	0 (0)	21 (7.9)
- <i>Diphtheria</i>	2	0	0	2
- <i>Measles</i>	3	0	0	3
- <i>Pertussis</i>	1	0	0	1
- <i>Streptococcus pneumoniae</i> infection	7	1	0	8
- <i>Varicella zoster</i>	7	0	0	7
Tuberculosis	11 (4.5)	1 (6.7)	0 (0)	12 (4.5)
Dengue	6 (2.5)	0 (0)	1 (10)	7 (2.6)
HIV	5 (2)	0 (0)	0 (0)	5 (1.9)
Encephalitis with known infectious agent	2 (0.8)	0 (0)	0 (0)	2 (0.7)
- <i>Herpes encephalitis</i>	1	0 (0)	0 (0)	1
- <i>Japanese encephalitis</i>	1	0 (0)	0 (0)	1
Total	242 (100)	15 (100)	10 (100)	267 (100)

Association between parental socio-demographic status and deaths in CIPD group

The parental socio-demographic status of children died from CIPD is as shown in [Appendix 25](#).

Parental citizenship

Among the deaths in the CIPD group, many of them were children of at least one non-citizen parent. Nearly one fifth (19%) of the father and one quarter (24%) of the mother were non-citizens. With exception of those who died from nosocomial sepsis and dengue, children of non-citizen contributed to nearly 20% or more (range 18.7% to 50%) of all causes of death under CIPD group. The cause of death with highest proportion of non-citizen children was Tuberculosis (41.7% non-citizen father and 58.3% non-citizen mother).

Maternal age, maternal occupation and parents' marital status

The deaths had no significant association with maternal age, occupation and marital status. Majority of the mothers were housewives and only 14 (5.2%) of them were single parents.

Parental education status

Overall, about one third (31.5%) of the parents of the children who died of CIPD did not have formal education or only received primary education. Children who died from HIV and AGE, had the highest proportion of parents who were not educated or only had received primary education, (ranged from 33.3 to 59.9%). Overall, the parents who received tertiary education were much less (14.2%) as compared to those parents who were not educated or only had received primary education (74.2%), with the exception of children who died from nosocomial sepsis (31%) and other VPD (33%).

Paternal occupation and household income

Only 17.2% of the children who died of CIPD had paternal occupation of professionals, associated professionals and technicians as opposed to 61.3% in the other groups of paternal occupation. However, it is interesting that among children who died of VPD, nearly one third (28.6%) of their fathers were working in the professional, associated professional and technician group of occupation.

In term of household income, majority (158 or 59%) of children under-5 years of age who died of CIPD were from the families in the low-income group with total household income of RM3000 and below. About one third (32.6%) in this group had the total household income of less than RM1000. Only a small minority or 6.4 % of children who died of CIPD came from family with higher total household income of more than RM5000.

Contributory and risk factors in CIPD mortality

Figure 8.1 & 8.2 and [Appendix 26](#) and [Appendix 27](#) showed the summary and details of contributory and risk factors identified for the deaths in CIPD group.

Medical risk factors

Out of the total 421 medical factors identified, only 18 (4.3%) were related to lack of facilities, equipment and transportation (ambulance). Majority (403 or 95.7%) of the remediable medical factors were related to quality of care as detailed in Figure 8.1 and [Appendix 26](#).

Lack of critical care beds, critical care and resuscitation equipment, and unavailability of retrieval system only contributed to < 2% of the total 267 deaths. In contrast, medical risk factors related to shortfall in quality of care played a much bigger role leading to the deaths.

The 5 most important medical risk factors related to quality of care reported were as following:

- i) Failure to appreciate severity
- ii) Inadequate, inappropriate or delayed therapy
- iii) Failure to diagnose
- iv) Delay in referral
- v) Inadequate medical expertise

These five risk factors contributed to about 12% to 32 % of the total 267 deaths, especially for children who died from community-acquired sepsis, AGE and other VPD. For nosocomial sepsis, as expected the most important factors were hospital infection control issues which were related to 76% (22 out of 29) of the deaths.

Among the 12 deaths due to tuberculosis, the 3 most important quality of care related medical risk factors were failure to diagnose, failure of home visit/defaulters tracing and failure to adhere to guideline/protocol. Each factor contributed to 3 (25%) of the TB deaths.

For the 7 deaths due to dengue, the two most important quality of care related medical risk factors were failure to diagnose and failure to appreciate the severity of the dengue infection; each factor contributed to 57% and 71 % of dengue deaths respectively. There were also 2 dengue deaths attributed to delay in resuscitation.

Among the 5 children died from HIV, failure of home visit/defaulting tracing was identified as the most important quality of care issue, as the failure might have contributed to 3 (60 %) out of the total 5 HIV deaths.

Non-medical risk factors

Among the children who died in CIPD group, 325 patient and family-risk factors and 135 socio-political risk factors were identified as shown in Figure 8.2 and [Appendix 27](#).

Socio-political factors

Poverty/malnutrition was the most important contributing socio-political factor to all deaths in the CIPD group except in dengue and encephalitis. It was reported as an important non-medical risk factors in 53 (20%) out of the total 267 CIPD deaths. It contributed to 35% to 42 % of deaths due to AGE, tuberculosis and HIV.

Family and patient factors

The two most important family and patient factors that might have contributed to many of the CIPD deaths were delay in seeking treatment and lack of awareness of severity of the disease itself. These two factors have been reported to be related to 131 (50%) and 93 (35%) of the total 267 CIPD deaths respectively. Both factors contributed significantly to all causes of death under CIPD group except deaths due to nosocomial sepsis.

Non-compliance and refusal of therapy/immunization was reported as risk factor in 4 (80 %) deaths of HIV, 8 (67 %) deaths of TB, and another 6 (29%) deaths due to other VPD. Non-compliance to medical advice were related to 17 (12 %) deaths of community acquired sepsis and 3 (60 %) cases of HIV death. Refusal of admission/hospitalization was also related to 7 deaths due to community acquired sepsis and 4 deaths of AGE. Finally, belief in alternative therapy or cultural belief also contributed to 8 deaths of community acquired sepsis, 2 cases of AGE and 2 cases of other VPD.

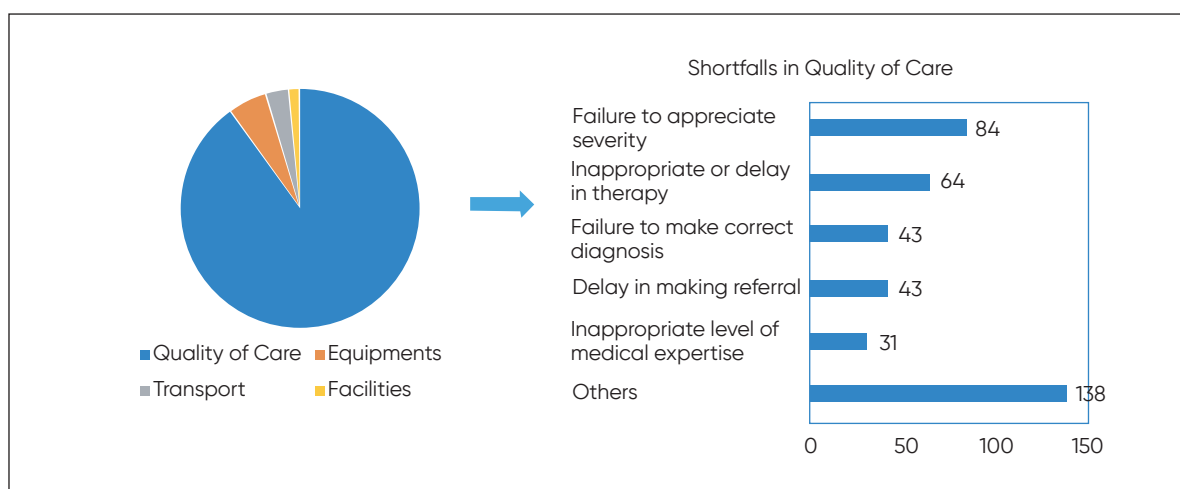


Figure 8.1: Medical Risk Factors Contributing to Deaths due to Certain Infectious and Parasitic Diseases, Malaysia, 2016

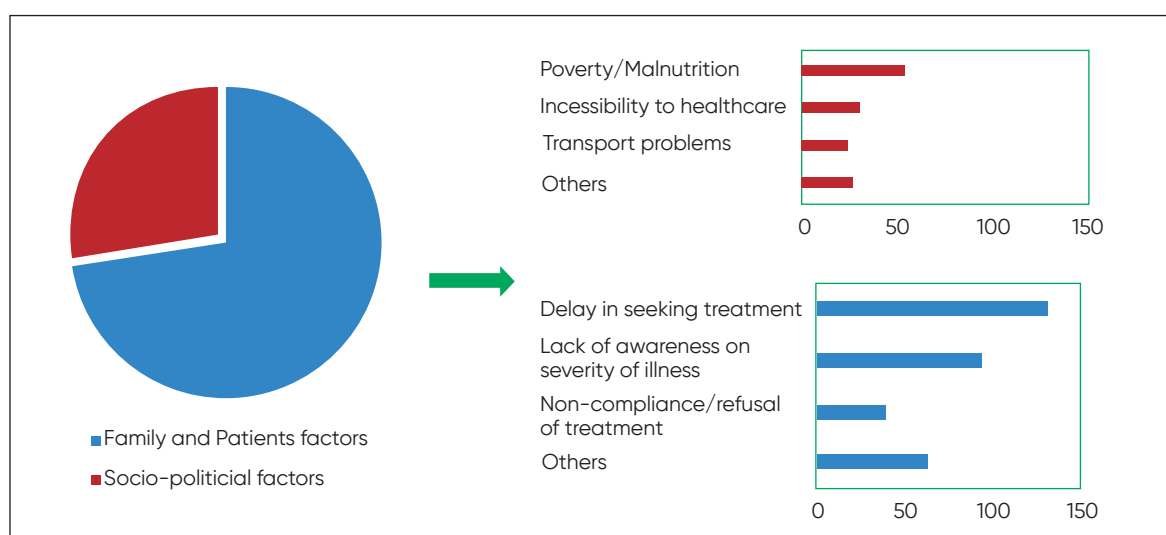


Figure 8.2: Non-Medical Risk Factors Contributing to Deaths due to Certain Infectious and Parasitic Diseases, Malaysia, 2016

Antimicrobial usage in the treatment of children who died of CIPD

The usage of antimicrobial therapy was reported in 225 (84%) deaths as summarised in Table 8.2.

Antimicrobials were not given in 68 (30%) of the 225 deaths who required it and 64 (94%) of them were community-acquired infection. Ninety-four percent of the 32 deaths of hospital-acquired infection was given antimicrobial as needed. Antimicrobials were not given in 4 cases of community-acquired infection because they were not available at the treating centres.

The timing of antimicrobial initiation was only reported in 102 cases (45 %) of the total 225 cases that required antimicrobial. Delayed in initiation of antimicrobial were reported in 26.5 % of the cases and the delays were more among the community-acquired infection (29 %) as compared to hospital-acquired infection (13.3%).

Table 8.2: Antimicrobial therapy and timing of therapy in Under-5 Deaths due to Certain Infectious and Parasitic Diseases, Malaysia, 2016

Management	Hospital-acquired	Community-acquired	Unknown	Total
	n (%)	n (%)	n (%)	n (%)
Antimicrobial therapy				
Required and given	30 (93.8)	116 (63.0)	7 (77.8)	153 (68.0)
Required but not given	2 (6.2)	64 (34.8)	2 (22.2)	68 (30.2)
Required but medication not available	0 (0)	4 (2.2)	0 (0)	4 (1.8)
TOTAL	32 (100)	184 (100)	9 (100)	225 (100)
Timing of therapy				
Appropriate	13 (86.7)	59 (71.0)	3 (75.0)	75 (73.5)
Delay	2 (13.3)	24 (29.0)	1 (25.0)	27 (26.5)
TOTAL	15 (100)	83 (100)	4 (100)	102 (100)

Discussion

As compared to earlier MOH data from 1993⁹¹, more than 20 years later in 2016, CIPD remained one of the top 5 common causes of death among children under the age of 5 years. This showed that despite the social-economic achievement of the country in last 2 decades, infectious diseases especially sepsis and AGE remain a major killer of children below 5 years of age.

Majority of deaths from infectious diseases among children below 5 are preventable from public health programmes such as vaccination, improved nutrition, early detection and treatment of the diseases. However, in our 2016 data, 13 cases of community-acquired sepsis, a case of TB and another case of *Streptococcus pneumoniae* infection were still classified as non-preventable, probably due to reporting bias or inadequate information in the death reports.

The socio-demographic background of under-5 CIPD deaths did not differ much from other major cause of deaths in the same age group. Overall, non-citizenship, lowly educated parents with low total household income were major risk factors. However, there were significantly more children from higher social-economic class who died from VPD and certain infectious disease like dengue compared to other infections. This could be explained by vaccine hesitancy which occurred across all different social-economic class including the rich and highly educated parents. Dengue infection was mainly endemic in urban and suburban areas and affected both the poor and rich population. Prevention of deaths from VPD and dengue may need additional strategies other than improving the socio-economic status.

The important remediable factors identified in under-5 deaths due to CIPD are similar to other major causes of under-5 deaths as described in the main section of this report. Quality of care is the most important medical risk factors that need to be addressed. Major causes of death in CIPD such as sepsis and AGE could be prevented by improving the quality of care which is to diagnose and detect severe diseases and initiate appropriate and effective treatment early. It is also important to train medical staff at ground level to avoid delay in referrals of children with severe diseases to secondary/tertiary centres.

Poverty and malnutrition were other major risk factors for death of children with infectious diseases and based on our data, this is especially true for AGE, TB and HIV. Improving childhood nutritional status will not only reduce the mortality of certain infectious diseases alone but also death due to many other childhood diseases including pneumonia⁹².

Despite the overall > 90% of children aged 12 to 23 months were covered under the national immunization program in 2016¹², we still had a significant number of deaths due to VPD. The mortality due to AGE (which is preventable by vaccination if it is due to rotavirus) remained high in Malaysia. At the moment, rotavirus vaccine is still not included in our national immunization program (NIP) whereas pneumococcal immunization programme has been started in all MOH health facilities since 1 December 2020. Rotavirus vaccination should be considered in our national vaccination program as the vaccine could reduce the trend of diarrhoea-related death up to 56.8% in children under-5 years of age. The other vaccine that should be considered in our national immunization program is varicella zoster vaccine. We still have 7 preventable under-5 deaths due to varicella in 2016.

The other major non-medical risk factors that contributed to under-5 CIPD deaths were those factors related to health seeking behaviours, attitude and cultural belief of the patient and family. Even though it is very difficult to change the community behaviour in short term but ongoing effort like health education and active intervention targeting on vaccine hesitant group need to be continued and improved. A study on local vaccine hesitancy groups in Malaysia has identified some unique local cultural, traditional and religious beliefs that need specific and targeted interventions⁹⁴.

About two third of CIPD deaths were due to sepsis but our data showed antimicrobial was not given in about 30% of deaths that required antimicrobial treatment. Delay in initiation of antimicrobial was also noted in a significant proportion of the deaths especially among the community-acquired infection. Majority of the deaths due to sepsis occurred within 48-72 hours of treatment, thus early diagnosis, appropriate resuscitation and management including antibiotics are critical in optimising the outcome.

Surviving Sepsis Campaign International Guideline for the management of sepsis in children have strong recommendation on implementing a protocol/guideline for management of children with sepsis to improve the survival and outcome⁹⁵. Studies have shown timely delivery of “bundle of therapies” (e.g., blood culture, fluid bolus, and antibiotics) reduce the mortality of sepsis in children^{96,97,98}. Many quality improvement (QI) programmes also have shown improved paediatric sepsis outcome following completion of sepsis bundle care (that include rapid delivery of antimicrobial) within 1 hour of sepsis recognition^{99,100,101}. In Malaysia, a national clinical practice guideline on management of sepsis in children is still not available. Further research and data collection are also needed to guide other interventions to reduce the under-5 deaths due to sepsis.

Key Findings

- 90.6% of the under-5 mortalities in this group were preventable. Sepsis contributed to 60.3%, followed by acute gastroenteritis at 21.5%.
- Among the deaths in this group, 19% had non-citizen fathers and 24% non-citizen mothers with tuberculosis as the commonest cause of death among them.
- 31.5% of the parents did not have formal education or received only primary school level of education. Children who died of HIV and AGE had the highest proportion of parents either uneducated or received only primary education.
- 28.6% of children who died of vaccine-preventable deaths had fathers working in the professional, associated professional and technician.
- Majority of the deaths had medical risk factors, namely shortfall in quality of care which included failure to appreciate severity, inadequate, inappropriate delayed therapy, failure to diagnose, delay in referral and inadequate medical expertise.
- Poverty/ malnutrition contributed to 35%-42% of deaths due to AGE, tuberculosis and HIV. Delay in seeking treatment and lack of awareness of severity of the illness contributed to 50% and 35% of the deaths respectively.
- Antimicrobials were not given to 30% of deaths which required it and majority of it was from community-acquired infection.

Recommendations

In conclusion, almost all under-5 deaths due to CIPD in Malaysia are preventable. Many contributory and risk factors were identified to guide our intervention to reduce the mortality.

The following are our recommendations:

- To improve the quality of health care to children with infectious disease especially at the primary care setting. In children who present as acutely unwell, we recommend implementing a systematic screening to ensure timely recognition and initiation of resuscitation for severe condition like septic shocks, AGE with severe dehydration or other infectious diseases related life threatening event. A National CPG on Management of Paediatric Sepsis that could be widely implemented in all health care facilities is urgently needed.
- To expand the current National Immunization Programme by including more vaccines especially rotavirus and varicella zoster vaccines targeting on young infants and children below 5 years of age. Vaccination programme should cover the non-citizen children population as well.
- To revise and strengthen the current community nutrition rehabilitation programme for malnourished children especially for the socially and economically disadvantaged families as the mortality rate is high in this group of children due to AGE, TB, HIV and other communicable diseases.
- To urgently address vaccine hesitancy and resurgence of vaccine preventable diseases, further research with real-time and accurate data collection through an electronic vaccination record and alerts should be implemented.

Prepared by: Dr. Choo Chong Ming

CHAPTER 9: STRENGTH AND LIMITATION

STRENGTH AND LIMITATION

The under-5 mortality reporting system allowed the study to be undertaken for all deaths reported to the Family Health Development Division.

The strength of our study lies in a fairly complete national under-5 mortality data for congenital malformation especially related to cardiovascular and central nervous system mortalities reported in 2016.

The data analysed in this study were secondary data obtained from the under-5 mortality reporting system in place. It was self-reported data collected via interview post death and based on the clinical findings during follow up visits in health care facility and events leading to death. Diagnosis was made at the district level meeting and reviewed by the Maternal Child Health Unit at the state level, hence, the investigators were heavily reliant on the data available in the forms and reports⁶. Although majority of the forms and accompanying consolidation reports were available, there were inconsistent and incomplete information in the forms to allow the investigators to make a conclusive diagnosis and preventability in some of the deaths. This study is also limited by the quality of data which was highly dependent on the data entry from the primary provider. Inadequate or incorrect information may influence the overall result.

Quality of the consolidation report

The consolidation reports that accompanied the SU5MR forms were a source of further information in assisting the districts and states to verify the UCOD and preventability of the deaths. However, there was no standardized format and the information included in the reports varied from very detailed to scanty.

Table 9.1: Adequacy of the Consolidation Reports and Reasons Cited for the Inadequacy, Malaysia, 2016

Consolidation report	Frequency	Percent
Overall		
Adequate	3515	71.2
Inadequate	1423	28.8
Reasons for inadequacy of consolidation reports		
Incomplete clinical data to determine UCOD/preventable vs non preventable death	919	64.6
External cause of death with public health factor concluded as non-preventable	53	3.7
Wrong diagnosis of immediate cause of death	136	9.6
Consolidation report not available	118	8.3
Death wrongly classified as preventable/non preventable	215	15.1
Inconsistency of information	37	2.6
Post-mortem report not available/not traced	67	4.7
Other comments	339	23.8

More than two-thirds of the consolidation reports had adequate information regarding the UCOD and preventability. Reasons behind the inadequate consolidation reports were mainly incomplete clinical data followed by wrong classification of preventability of the deaths.

Key Findings

- This study analysed secondary data, hence, the information obtained was from the under-5 mortality reporting system.
- There was inadequate information obtained from 28.8% of the accompanying consolidation report.

Recommendations

- Improving data collection and processing

At present, data for under-5 mortality is collected using manual forms manually entered into an electronic database by the maternal child health unit in the respective states. This is prone to incomplete and inconsistent entries.

i. Electronic database

Variables collected in the SU5MR form could be streamlined and updated to facilitate collection of information directly from the district

By using electronic forms, the data may be cleaned and ready to be analysed by the respective states. This may be done by having a template for the data and collaboration with the state clinical research centres and visiting statistician. This will be helpful for the individual states to monitor the outcome of the under-5 mortalities and monitor the remedial measures in place.

The data can also be shared with the FHDD which may generate the national data easier, with collaboration with National Institute of Health.

ii. Standardized template for consolidation reports.

During the study period, it was obvious that the information obtained from the consolidation reports may not be adequate. Some reports could be too lengthy or too short, or emphasis was given to information that was not relevant to the mortality.

In January 2020, FHDD introduced a standardized format to streamline the information that should be included in the report to supplement the SU5MR forms. Further audit to evaluate the effectiveness of the format will be required¹⁰².

iii. Strengthening the district under-5 mortality committee

All under-5 mortalities are discussed, and conclusion made during the district level meetings before the forms and reports are sent to the state level, before finally sent to FHDD. It is important that all the information required to make the decision on the UCOD and preventability. The paediatrician together with the family medicine specialist should establish the UCOD and preventability as best as possible before the information is sent to the maternal child health unit at the state level⁵.

iv. Establish an up-to-date list of preventable UCOD

It is important to have an up-to-date list of diseases or conditions that are currently considered preventable in Malaysia. This list needs to be periodically revised with time as our country progress. For example in 2016, deaths due to neural tube defects were often classified as non-preventable, but it is clearly preventable if folic acid fortification was put in place. Similarly, many deaths due to injuries, poisoning and external causes were wrongly classified as non-preventable because lack of injury preventive measures were not taken into consideration.

CHAPTER 10: SUMMARY OF RECOMMENDATIONS AND CONCLUSION

SUMMARY OF RECOMMENDATIONS

KEY RECOMMENDATIONS	AGENCIES INVOLVED
A. Improving data collection and processing	
<ol style="list-style-type: none"> 1. Introduce an electronic database for collecting data of the under-5 mortalities with template for analysing data at the state and national levels 2. Use a standardized template for consolidation reports to improve data collection 3. Strengthen the district under-5 mortality committee with strong collaboration between the district health office and the hospital. 	MOH <ul style="list-style-type: none"> • FHDD • Medical Development Division • Information Management Division
B. Improvement in the determination of UCOD and preventability.	
<ol style="list-style-type: none"> 1. Establish an up-to-date list of preventable UCOD 2. Provide guidance to the medical officer and staff from specialists of related disciplines in the investigation of the under-5 mortality and decision on the UCOD and preventability 	MOH <ul style="list-style-type: none"> • O&G and Paediatric Services Unit, Medical Development Division, • Child Health Sector, FHDD
C. Addressing contributory and risk factors	
<ol style="list-style-type: none"> 1. Identify the high-risk population such as Orang Asli, Bumiputera Sarawak and non-Malaysian, and the lower socioeconomic groups, to ensure that pre-existing and future programmes can be tailored to suit the needs of the high-risk population. 	MOH <ul style="list-style-type: none"> • Public Health Development Division IMMIGRATION DEPT MINISTRY OF WOMEN, FAMILY AND COMMUNITY DEVELOPMENT MINISTRY OF RURAL DEVELOPMENT <ul style="list-style-type: none"> • Department of Orang Asli Development PRIME MINISTER OFFICE, Malaysia <ul style="list-style-type: none"> • Sabah Sarawak Affairs

<p>2. Malnutrition remains a significant comorbidity. Existing programs that address the problem of malnutrition should be strengthened and accessible to all children. Breastfeeding should be encouraged especially in the vulnerable children.</p>	<p>MOH</p> <ul style="list-style-type: none"> ● Nutrition Division ● FHDD
<p>3. Strengthen data collection and provide on time schedule alert to parents for immunization in children under-5 years of age using digital records.</p>	<p>MOH</p> <ul style="list-style-type: none"> ● FHDD ● Information Management Division
<p>4. Expand of the current National Immunization Program (NIP) to include rotavirus and varicella zoster vaccine targeting on young infants and children below 5 years of age. Protection against viruses such as respiratory syncytial virus and influenza should be offered to high-risk children such as premature babies and children with chronic lung disease.</p>	<p>MOH</p> <ul style="list-style-type: none"> ● Vaccine Preventable Disease Unit, Disease Control Division ● FHDD
<p>5. To achieve overall coverage and herd immunity, vaccination program should cover all children residing in Malaysia regardless of nationality.</p>	<p>MOH</p> <ul style="list-style-type: none"> ● FHDD <p>IMMIGRATION DEPT</p>
<p>6. Address the issue of vaccine hesitancy by equipping the health care workers with training and knowledge.</p>	<p>MOH</p> <ul style="list-style-type: none"> ● FHDD
<p>7. Improve and upgrade medical services by:</p> <ul style="list-style-type: none"> ● Improve the overcrowding and relatively lack of resources in most Neonatal Intensive Care Unit (NICU) throughout country. ● Cooling therapy facility to be made available in all Neonatal Intensive Care Unit (NICU) in the country. ● Safe transportation of all critically ill children especially from the remote and interior of Malaysia. ● Enhance the accessibility to critical care units by improving transportation via retrieval systems. 	<p>MOH</p> <ul style="list-style-type: none"> ● Medical Development Division
<p>8. Expand or enhance the specialized units in the regions to cater children requiring cardiac and paediatric surgical intervention.</p> <ul style="list-style-type: none"> ● To facilitate accessibility to cardiac consultation and intervention, more centres can be set up to cater for these patients and improve waiting time for treatment. ● Centralization for biliary atresia surgery and care and developing more centres which can manage congenital diaphragmatic hernia may also reduce the number of deaths due to surgical related congenital malformation. 	<p>MOH</p> <ul style="list-style-type: none"> ● Medical Development Division

<p>9. Improve the knowledge among the healthcare workers by strengthening programs such as neonatal resuscitation programs, paediatric life support and advanced paediatric life support training, IMCI, ATUCU 5. Guidelines such as CPG, paediatric protocols should be readily accessible. Hands-on training with regular refresher courses should be scheduled</p>	<p>MOH</p> <ul style="list-style-type: none"> ● All Paediatric Departments ● Medical Development Division ● FHDD
<p>10. Strengthen and enhance early detection of illness by:</p> <ul style="list-style-type: none"> ● Improving antenatal detection of congenital malformation by foetal ultrasound. ● Strengthening postnatal detection of critical cardiac malformations that will require intervention. Pulse oximetry screening and neonatal diagnosis of congenital heart disease should be widely available. ● Improve the availability of testing for organisms using PCR techniques to better manage infections especially from the respiratory system. This will also reduce the unnecessary usage of antibiotics in viral diseases in accordance with antimicrobial stewardship program in Malaysia. 	<p>MOH</p> <ul style="list-style-type: none"> ● Medical Development Division
<p>11. Integrated digital health care record should be the way forward to improve accessibility to patients' medical history. This would be especially crucial in emergency situation.</p>	<p>MOH</p> <ul style="list-style-type: none"> ● Planning Division ● Information Management Division
<p>12. Implementation and legislation of mandatory folic acid fortification as a cost-effective national program to prevent neural tube defects.</p>	<p>MOH</p> <ul style="list-style-type: none"> ● Nutrition Division <p>ATTORNEY- GENERAL CHAMBERS</p> <p>MINISTRY OF DOMESTIC TRADE AND CONSUMERS AFFAIR</p>

<p>13. Reduce teenage pregnancies and single motherhood. Empowering girls and women with comprehensive sexuality education.</p> <p>Advocate for legal form to increase the age of marriage to 18 years.</p>	<p>MOH</p> <ul style="list-style-type: none"> • FHDD <p>MINISTRY OF WOMEN, FAMILY AND COMMUNITY DEVELOPMENT</p> <p>With collaboration with other agencies</p>
<p>14. Empower parents through health education by:</p> <ul style="list-style-type: none"> • Adding guidance on home safety into the ante-natal, postnatal, and child health program. • Updating the child health records to emphasize on home safety program, and addition of stool colour chart for early detection of biliary atresia. • Improving the knowledge of parents on general danger signs through health education and get it incorporated during routine health care visits. • Addressing parental beliefs that may be detrimental to the child, by empowering the health care workers with communication and behavioural skills and knowledge. 	<p>MOH</p> <ul style="list-style-type: none"> • FHDD • Institute for Health Behavioural Research (NIH) <p>MINISTRY OF WOMEN, FAMILY AND COMMUNITY DEVELOPMENT</p> <p>With collaboration with other agencies</p>
<p>15. Enhance child safety and injury prevention initiative by:</p> <ul style="list-style-type: none"> • Child Safety Allowance as a one-off payment to allow the lower income parents to purchase child safety restraint, spearheaded by suggested child care allowance for parents in the lower household income. • Legislative change for injury prevention such as mandatory use of child safety restraint • Water and fire safety education may be incorporated into the education syllabus by Ministry of Education. • Monitoring and evaluation childcare establishment availability of child minder service in the workplace 	<p>MINISTRY OF WOMEN, FAMILY & COMMUNITY DEVELOPMENT.</p> <ul style="list-style-type: none"> • Social Welfare Department <p>MINISTRY OF TRANSPORTATION</p> <p>MINISTRY OF EDUCATION</p>

D. Additional CPGs, standard operating procedures, and management protocol such as:	
<ol style="list-style-type: none"> 1. Antenatal detection of congenital heart disease 2. Neonatal echocardiography 3. Management of Paediatric Sepsis 	MOH <ul style="list-style-type: none"> • Medical Development Division • Health Technology Assessment
E. Strengthen / establish registries related to under-5 mortalities	
<ol style="list-style-type: none"> 1. Drowning 2. SCAN 3. Home injuries 4. Violence, Injury Prevention 5. Congenital malformation <ul style="list-style-type: none"> • Congenital malformation of central nervous system • Congenital malformation of cardiovascular system • Surgical related congenital malformation 	MOH <ul style="list-style-type: none"> • Health Informatics Centre (PIK), Planning Division
F. Further research	
<ol style="list-style-type: none"> 1. A regular audit of the under-5 mortalities should be done in 5 yearly interval using sampling of the mortality cases. 2. A collaborative study with the obstetrics and public health division to investigate in-depth factors affecting premature births. This would be essential in formulating preventive measures to reduce death due to prematurity. 3. Further research should be carried out to determine the association between holoprosencephaly and maternal risk factors such as diabetes mellitus and obesity. This would be important to formulate any preventive measures that can be taken to reduce the incidence of holoprosencephaly. 4. A comprehensive Violence Injury Prevention (VIP) reporting system to monitor all cases under Injuries, Poisoning & External Causes as nearly all deaths are preventable will be important to monitor the effectiveness of the programs implemented. 	MOH <ul style="list-style-type: none"> • Medical Development Division • FHDD

CONCLUSION

The proportion of preventable deaths in this study was 46.0%, which differs from the reported preventability of 30.52%. There is room for improvement in the decision for preventability of deaths. Contributory and risk factors have been addressed in detail especially for the 5 main UCOD in order to reduce the number of preventable deaths in this age group. Recommendations suggested may reduce and subsequently end preventable deaths in the under-5 age group in accordance to SDG. In order to achieve the SDG target, collaborative effort within the Ministry of Health and also inter agency and inter-ministerial collaboration are required.

'It takes a village to raise a child'

- African proverb -

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CASE DEFINITION^{1,2,103}

Livebirth

A birth of an infant with birth weight equal to or more than 500 gm (or 22 completed weeks of pregnancy if birth weight is not known) which shows any sign of life such as a beating heart, pulsations of the umbilical cord or definite movement of the voluntary muscles.

Neonatal death

Deaths among live births during less than 28 days of life **and** with birth weight equal or more than **500gm**.

Early neonatal death

Deaths among live births during less than 7 days of life **and** with birth weight equal or more than **500gm**.

Late neonatal death

Deaths among live births from 7 to at less than 28 days of life.

Under-5 death

Death that occurs from the first day of life (day 0) to < 5 years old (1824 completed days) after birth.

Neonatal Mortality Rate

Number of neonatal deaths per 1 000 live births.

Infant Mortality Rate

The number of infant deaths for every 1 000 live births.

Under-5 Mortality Rate

The number of deaths that occur from the first day of life (day 0) to < 5 years old (1824 completed days) after birth, per 1 000 live births.

GLOSSARY

Bumiputera	Native-born citizens; include Malay, Orang Asli, Bumiputera Sarawak and Bumiputera Sabah <i>* Anak negeri (Kamus DBP edisi ke 4)</i>
Consultant	Senior specialist on grade JUSA C and above.
Ethnicity of child	Ethnicity of father. If ethnicity of father is not available, ethnicity of mother.
Hospital death	Death in a patient who arrived at the hospital with signs of life and had treatment in the hospital whether in the A&E, ward, intensive care etc. before he died. Included deaths occurring in all disciplines in the hospital and included death during ambulance transportation from one hospital to another.
Integrated Management of Childhood Illness (IMCI)	WHO and UNICEF child health strategy with the objectives of reducing death and frequency of illness and disability associated with the 5 major causes of diseases in children (pneumonia, diarrhoea, measles, malaria and malnutrition) and promoting improved growth and development. The components of this strategy are improvements in case management of the sick child in first level health facilities through the provision of training and clinical guidelines, improvements in the health system required for effective management of childhood illness and improvements in family and community practices
Non hospital death	Death that occurred outside the hospital which also included <ul style="list-style-type: none"> a. Brought in dead to the hospital b. Death while on the way to care/hospital c. Death in clinic/polyclinic d. Death at home or elsewhere
Non-preventable deaths	Deaths due to life limiting diseases such as lethal congenital malformation (e.g. Edward syndrome, hypoplastic left heart, pulmonary hypoplasia, Patau syndrome, multiple congenital anomalies, holoprosencephaly etc.), inborn error of metabolism, severe inoperable congenital heart disease etc.
Other Malaysian	Malaysian other than Malay, Chinese, Indian, Orang Asli, Bumiputera Sarawak and Bumiputera Sabah.

Parent education	The highest level of education of either father or mother
Preventable Deaths	<p>Preventable deaths are divided into 2 components:</p> <ul style="list-style-type: none"> i. preventable through medical intervention ii. preventable through non-medical intervention <p>i. Preventable deaths through medical intervention</p> <p>This includes modifiable factors such as delayed referral, delayed diagnosis and treatment, poor resuscitation etc. These are preventable through medical intervention</p> <ul style="list-style-type: none"> ii. Preventable deaths through non-medical intervention <p>This refers to conditions such as drowning, choking, teenage pregnancies, non-accidental injury etc. These conditions are potentially preventable through nonmedical intervention such as public health policies and intervention encompassing social, patient and family factors</p>
Specialist	Doctor with a postgraduate qualification and had been gazetted as a specialist.
Deaths of Undetermined Preventability	These deaths are situations where the committee cannot accurately determine the appropriate classification of death into preventable or non-preventable

ABBREVIATIONS

AGE	Acute Gastroenteritis
ASD	Atrial Septal Defect
AVSD	Atrioventricular Septal Defect
BA	Biliary Atresia
BAC	Blood Alcohol Concentration
BID	Brought In Dead
CAP	Community Acquired Pneumonia
CCHD	Critical Congenital Heart Disease
CDH	Congenital Diaphragmatic Hernia
CHD	Congenital Heart Disease
CIPD	Certain Infectious and Parasitic Diseases
CIRC	Circulatory System
CLD	Chronic Lung Disease
CM	Congenital malformations, Deformations & Chromosomal Abnormalities
CM-CNS	Congenital Malformations of The Central Nervous System
CM-CVS	Congenital Malformation of the Cardiovascular System
CNS	Diseases of the Nervous System
COD	Cause Of Death
CPG	Clinical Practice Guideline
CRS	Child Restraint System
DBIS	Diseases of Blood & Immune System
DOB	Date Of Birth
DOSM	Department Of Statistics Malaysia
ENDO	Endocrine, Nutritional, Metabolic Diseases
ETD	Emergency and Trauma Department
FHDD	Family Health Development Division
FMS	Family Medicine Specialist
GBS	Group B Streptococcus
GIT	Gastrointestinal Tract
GUT	Genitourinary Tract
HIDA	Hepato-biliary scintigraphy
HIE	Hypoxic Ischemic Encephalopathy
HIV	Human Immunodeficiency Virus
HKL	Hospital Kuala Lumpur
HLHS	Hypoplastic Left Heart Syndrome
IMCI	Integrated Management of Childhood Illness
INJ	Injury, poisoning and certain other consequences of external causes
JOH	Johor
KED	Kedah
KTN	Kelantan
MAS	Meconium Aspiration Syndrome
MDG	Millennium Development Goals
MEL	Melaka

MIROS	Malaysian Institute of Road Safety Research
MNNR	Malaysian National Neonatal Registry
MO	Medical Officer
MOH	Ministry Of Health
MREC	Medical Research and Ethics Committee
MVA	Motor Vehicle Accident
NAI	Non-Accidental Injury
NEC	Necrotizing Enterocolitis
NEO	Neoplasms
NICU	Neonatal Intensive Care Unit
NIP	National Immunization Program
NIV	Non-Invasive Ventilation
NPE	Neonatologist-performed echocardiography
NS	Negeri Sembilan
NTD	Neural Tube Defect
O&G	Obstetrics and Gynaecology
OTH	Others
PAIVS	Pulmonary Atresia Intact Ventricular Septum
PCR	Polymerase Chain Reaction
PDA	Patent Ductus Arteriosus
PEN	Pulau Pinang
PERINATAL	Certain conditions originating in the perinatal period
PHDW	Paediatric High Dependency Ward
PHG	Pahang
PICU	Paediatric Intensive Care Unit
PKD	Pejabat Kesihatan Daerah (District Health Office)
PLS	Perlis
PPHN	Persistent Pulmonary Hypertension of the Newborn
PRK	Perak
QI	Quality Improvement
RESP	Diseases of the respiratory system
RN	Registration Number
RSV	Respiratory Syncytial Virus
RTA	Road Traffic Accident
SAB	Sabah
SCAN	Suspected Child Abuse and Neglect
SEL	Selangor
SIDS	Sudden Infant Death Syndrome
SIQ	Short Fall in Quality
SPSS	Statistical Package for the Social Sciences
SS	Symptoms, Signs & abnormal findings, Not Elsewhere Classified
STD	Sexually Transmitted Disease
SWK	Sarawak
TAPVD	Total Anomalous Pulmonary Venous Drainage
TB	Tuberculosis

TEF	Tracheo-Oesophageal Fistula
TGA	Transposition of Great Arteries
TGN	Terengganu
TOF	Tetralogy Of Fallot
TOT	Total
UCOD	Underlying Cause Of Death
UK	United Kingdom
UKN	Unknown
UN	United Nation
UNICEF	United Nations Children's Fund
USA	United States of America
VIP	Violence and Injury Prevention
VPD	Vaccine Preventable Diseases
VSD	Ventricular Septal Defect
WHO	World Health Organization
WPKL	Wilayah Persekutuan Kuala Lumpur
WPL	Wilayah Persekutuan Labuan
WPP	Wilayah Persekutuan Putrajaya

ICD 10 Classification Definition for the 5 Main UCOD

Certain infectious and parasitic diseases (A00–B99)

Including diseases generally recognized as communicable or transmissible.

Use additional code, if desired, to identify resistance to antimicrobial drugs.

Excluding carrier or suspected carrier of infectious disease, certain localized infections, infectious and parasitic diseases complicating pregnancy, childbirth and the puerperium [except obstetrical tetanus], infectious and parasitic diseases specific to the perinatal period [except tetanus neonatorum, congenital syphilis, perinatal gonococcal infection and perinatal human immunodeficiency virus [HIV] disease], influenza and other acute respiratory infections

Diseases of the respiratory system (J00–J99)

When a respiratory condition is described as occurring in more than one site and is not specifically indexed, it should be classified to the lower anatomic site.

Excluding certain conditions originating in the perinatal period, certain infectious and parasitic diseases, complications of pregnancy, childbirth and the puerperium, congenital malformations, deformations and chromosomal abnormalities, endocrine, nutritional and metabolic diseases, injury, poisoning and certain other consequences of external causes, neoplasms, symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified

Certain conditions originating in the perinatal period (P00–P96)

This includes conditions that have their origin in the perinatal period even though death or morbidity occurs later.

Excluding congenital malformations, deformations and chromosomal abnormalities, endocrine, nutritional and metabolic diseases, injury, poisoning and certain other consequences of external causes, neoplasms, tetanus neonatorum,

Congenital malformations, deformations, and chromosomal abnormalities (Q00–Q99)

Inborn errors of metabolism are excluded.

Injury, poisoning and certain other consequences of external causes (S00–T98)

This excludes birth trauma, obstetric trauma, malunion of fracture, non-union of fracture [pseudarthrosis] pathological fracture, pathological fracture with osteoporosis, stress fracture

Reclassified Preventable Deaths ICD10 Underlying Cause of Death According to States in Malaysia, 2016

ICD 10 classification of cause of death	JOH n (%)	KED n (%)	KTN n (%)	MEL n (%)	NS n (%)	PHG n (%)	PRK n (%)	PLS n (%)	PEN n (%)	SAB n (%)	SWK n (%)	SEL n (%)	TGN n (%)	WPKL n (%)	WPL n (%)	WPP n (%)	Total n (%)
Certain condition originating in the perinatal period	99 (41.9)	36 (30.3)	53 (32.7)	9 (22.5)	23 (35.4)	38 (26.0)	55 (33.1)	6 (40.0)	37 (37.0)	91 (25.3)	54 (29.3)	161 (36.9)	30 (26.3)	30 (30.0)	9 (42.9)	4 (40.0)	735 (32.3)
Congenital malformation, deformations and chromosomal abnormalities	36 (15.3)	25 (21)	34 (21)	9 (22.5)	12 (18.5)	32 (21.9)	27 (16.3)	4 (26.7)	30 (30.0)	56 (15.6)	30 (16.3)	83 (19)	39 (34.2)	18 (18.0)	0 (0)	1 (10.0)	436 (19.2)
Diseases of the respiratory system	20 (8.5)	14 (11.8)	11 (6.8)	2 (5)	5 (7.7)	29 (19.9)	12 (7.2)	0 (0)	5 (5.0)	31 (8.6)	22 (12.0)	28 (6.4)	9 (7.9)	14 (14.0)	6 (28.6)	2 (20.0)	210 (9.2)
Injuries, poisoning and external causes	37 (15.7)	21 (17.6)	16 (9.9)	10 (25)	13 (20)	18 (12.3)	22 (13.3)	2 (13.3)	13 (13.0)	30 (8.3)	18 (9.8)	67 (15.4)	15 (13.2)	19 (19.0)	3 (14.3)	1 (10.0)	305 (13.4)
Certain infectious & parasitic diseases	15 (6.4)	7 (5.9)	21 (13.0)	3 (7.5)	2 (3.1)	21 (14.4)	19 (11.4)	1 (6.7)	2 (2.0)	76 (21.1)	25 (13.6)	37 (8.5)	7 (6.1)	4 (4.0)	1 (4.8)	1 (10.0)	242 (10.6)
Diseases of nervous system	7 (3)	3 (2.5)	4 (2.5)	0 (0)	0 (0)	1 (0.7)	6 (3.6)	0 (0)	3 (3.0)	20 (5.6)	17 (9.2)	7 (1.6)	1 (0.9)	3 (3.0)	2 (9.5)	0 (0)	74 (3.3)
Neoplasms	5 (2.1)	2 (1.7)	8 (4.9)	2 (5)	0 (0)	1 (0.7)	1 (0.6)	0 (0)	4 (4.0)	3 (0.8)	0 (0)	5 (1.1)	6 (5.3)	3 (3.0)	0 (0)	0 (0)	40 (1.8)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	2 (0.8)	3 (2.5)	4 (2.5)	0 (0)	1 (1.5)	0 (0)	3 (1.8)	0 (0)	1 (1.0)	9 (2.5)	2 (1.1)	23 (5.3)	1 (0.9)	0 (0)	0 (0)	1 (10.0)	50 (2.2)
Endocrine, nutritional and metabolic diseases	0 (0)	0 (0)	3 (1.9)	1 (2.5)	0 (0)	2 (1.4)	5 (3)	0 (0)	1 (1.0)	11 (3.1)	4 (2.2)	2 (0.5)	1 (0.9)	0 (0)	0 (0)	0 (0)	30 (1.3)
Diseases of the digestive system	3 (1.3)	2 (1.7)	1 (0.6)	0 (0)	3 (4.6)	2 (1.4)	2 (1.2)	0 (0)	2 (2.0)	3 (0.8)	2 (1.1)	6 (1.4)	0 (0)	3 (3.0)	0 (0)	0 (0)	29 (1.3)
Diseases of the circulatory system	3 (1.3)	0 (0)	2 (1.2)	0 (0)	0 (0)	0 (0)	1 (0.6)	0 (0)	0 (0)	2 (0.6)	1 (0.5)	5 (1.1)	0 (0)	1 (1.0)	0 (0)	0 (0)	15 (0.7)
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	0 (0)	0 (0)	0 (0)	0 (0)	2 (3.1)	0 (0)	1 (0.6)	0 (0)	1 (1.0)	1 (0.3)	0 (0)	1 (0.2)	2 (1.8)	1 (1.0)	0 (0)	0 (0)	9 (0.4)
Diseases of the genitourinary system	1 (0.4)	1 (0.8)	1 (0.6)	1 (2.5)	1 (1.5)	0 (0)	1 (0.6)	0 (0)	0 (0)	2 (0.6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8 (0.4)
Others	0 (0)	0 (0)	2 (1.2)	0 (0)	0 (0)	1 (0.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.2)	1 (0.9)	0 (0)	0 (0)	0 (0)	5 (0.2)
Unknown	8 (3.4)	5 (4.2)	2 (1.2)	3 (7.5)	3 (4.6)	1 (0.7)	11 (6.6)	2 (13.3)	1 (1)	25 (6.9)	9 (4.9)	10 (2.3)	2 (1.8)	4 (4.0)	0 (0)	0 (0)	86 (3.8)
Total	236 (100)	119 (100)	162 (100)	40 (100)	65 (100)	146 (100)	166 (100)	15 (100)	100 (100)	360 (100)	184 (100)	436 (100)	114 (100)	100 (100)	21 (100)	10 (100)	2274 (100)

Overall Comparison of ICD 10 UCOD between Reported and Reclassified Deaths, Malaysia, 2016

ICD 10 classification	Audited														TOT n (%)	
	PERI n (%)	CM n (%)	RESP n (%)	INJ n (%)	CIPD n (%)	CNS n (%)	NEO n (%)	SS n (%)	ENDO n (%)	GIT n (%)	CIRC n (%)	DIBS n (%)	GUT n (%)	OTH n (%)		UKN n (%)
Certain condition originating in the perinatal period	1518 (83.9)	41 (2.8)	12 (4.3)	2 (0.6)	7 (2.6)	16 (9.1)	0 (0)	2 (2.4)	0 (0)	4 (8.3)	0 (0)	1 (4.8)	0 (0)	0 (0)	11 (4.3)	1614 (32.7)
Congenital malformation, deformations and chromosomal abnormalities	50 (2.8)	1321 (91.3)	22 (7.9)	4 (1.3)	9 (3.4)	9 (5.1)	7 (6.2)	2 (2.4)	2 (3.1)	0 (0)	8 (17.4)	1 (4.8)	7 (43.8)	0 (0)	32 (12.5)	1474 (29.9)
Diseases of the respiratory system	13 (0.7)	14 (1)	190 (68.1)	5 (1.6)	19 (7.1)	6 (3.4)	0 (0)	4 (4.8)	1 (1.6)	1 (2.1)	2 (4.3)	0 (0)	1 (6.3)	1 (16.7)	14 (5.5)	271 (5.5)
Injuries, poisoning and external causes	1 (0.1)	2 (0.1)	1 (0.4)	282 (91.6)	2 (0.7)	2 (1.1)	0 (0)	2 (2.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	32 (12.5)	324 (6.6)
Certain infectious & parasitic diseases	83 (4.6)	7 (0.5)	12 (4.3)	1 (0.3)	183 (68.5)	8 (4.6)	1 (0.9)	0 (0)	2 (3.1)	6 (12.5)	2 (4.3)	1 (4.8)	1 (6.3)	2 (33.3)	17 (6.7)	326 (6.6)
Diseases of nervous system	19 (1.1)	10 (0.7)	10 (3.6)	1 (0.3)	24 (9.0)	125 (71.4)	0 (0)	5 (6.0)	1 (1.6)	1 (2.1)	2 (4.3)	0 (0)	0 (0)	0 (0)	24 (9.4)	222 (4.5)
Neoplasms	2 (0.1)	3 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)	104 (92.0)	0 (0)	0 (0)	0 (0)	1 (2.2)	1 (4.8)	0 (0)	0 (0)	0 (0)	111 (2.2)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	13 (0.7)	3 (0.2)	6 (2.2)	1 (0.3)	0 (0)	1 (0.6)	0 (0)	39 (46.4)	0 (0)	0 (0)	0 (0)	1 (4.8)	0 (0)	0 (0)	22 (8.6)	86 (1.7)
Endocrine, nutritional and metabolic diseases	4 (0.2)	1 (0.1)	3 (1.1)	1 (0.3)	7 (2.6)	2 (1.1)	0 (0)	2 (2.4)	52 (81.3)	2 (4.2)	0 (0)	1 (4.8)	0 (0)	0 (0)	6 (2.4)	81 (1.6)
Diseases of the digestive system	4 (0.2)	9 (0.6)	3 (1.1)	0 (0)	2 (0.7)	0 (0)	0 (0)	0 (0)	3 (4.7)	31 (64.6)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.8)	54 (1.1)
Diseases of the circulatory system	4 (0.2)	3 (0.2)	2 (0.7)	2 (0.6)	0 (0)	1 (0.6)	0 (0)	0 (0)	0 (0)	0 (0)	30 (65.2)	0 (0)	0 (0)	1 (16.7)	3 (1.2)	46 (0.9)
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	7 (0.4)	1 (0.1)	0 (0)	0 (0)	1 (0.4)	0 (0)	0 (0)	1 (1.2)	0 (0)	0 (0)	0 (0)	14 (66.7)	1 (6.3)	0 (0)	0 (0)	25 (0.5)
Diseases of the genitourinary system	1 (0.1)	1 (0.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (4.8)	6 (37.5)	0 (0)	0 (0)	9 (0.2)
Others	10 (0.6)	1 (0.1)	1 (0.4)	0 (0)	5 (1.9)	0 (0)	0 (0)	0 (0)	1 (1.6)	0 (0)	0 (0)	0 (0)	0 (0)	2 (33.3)	3 (1.2)	23 (0.5)
Unknown	80 (4.4)	30 (2.1)	17 (6.1)	9 (2.9)	8 (3.0)	5 (2.9)	1 (0.9)	27 (32.1)	2 (3.1)	3 (6.3)	1 (2.2)	0 (0)	0 (0)	0 (0)	89 (34.9)	272 (5.5)
Total	1809 (100)	1447 (100)	279 (100)	308 (100)	267 (100)	175 (100)	113 (100)	84 (100)	64 (100)	48 (100)	46 (100)	21 (100)	16 (100)	6 (100)	255 (100)	4938 (100)

Number and Percentage of Reported Deaths compared to Reclassified Causes of Death According to Preventability of Deaths, Malaysia, 2016

ICD 10 classification	Technical report						Reclassified							
	Preventable		Not preventable		Undetermined		Preventable		Not preventable		Undetermined		Total	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Certain condition originating in the perinatal period	415 (27.5)	1175 (37.1)	24 (9.3)	1614 (32.7)	735 (32.3)	812 (38.1)	262 (49.0)	1809 (36.6)						
Congenital malformation, deformations and chromosomal abnormalities	175 (11.6)	1280 (40.4)	19 (7.3)	1474 (29.9)	436 (19.2)	975 (45.8)	36 (6.7)	1447 (29.3)						
Injuries, poisoning and external causes	259 (17.2)	57 (1.8)	8 (3.1)	324 (6.6)	305 (13.4)	0 (0)	3 (0.6)	308 (6.2)						
Certain infectious & parasitic diseases	218 (14.4)	104 (3.3)	4 (1.5)	326 (6.6)	242 (10.6)	15 (0.7)	10 (1.9)	267 (5.4)						
Diseases of the respiratory system	178 (11.8)	91 (2.9)	2 (0.8)	271 (5.5)	210 (9.2)	55 (2.6)	14 (2.6)	279 (5.7)						
Diseases of nervous system	100 (6.6)	118 (3.7)	4 (1.5)	222 (4.5)	74 (3.3)	83 (3.9)	18 (3.4)	175 (3.5)						
Neoplasms	22 (1.5)	88 (2.8)	1 (0.4)	111 (2.2)	40 (1.8)	67 (3.1)	6 (1.1)	113 (2.3)						
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	19 (1.3)	61 (1.9)	6 (2.3)	86 (1.7)	50 (2.2)	13 (0.6)	21 (3.9)	84 (1.7)						
Endocrine, nutritional and metabolic diseases	24 (1.6)	55 (1.7)	2 (0.8)	81 (1.6)	30 (1.3)	22 (1)	12 (2.2)	64 (1.3)						
Diseases of the digestive system	27 (1.8)	25 (0.8)	2 (0.8)	54 (1.1)	29 (1.3)	11 (0.5)	8 (1.5)	48 (1)						
Diseases of the circulatory system	13 (0.9)	31 (1)	2 (0.8)	46 (0.9)	15 (0.7)	29 (1.4)	2 (0.4)	46 (0.9)						
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	8 (0.5)	16 (0.5)	1 (0.4)	25 (0.5)	9 (0.4)	11 (0.5)	1 (0.2)	21 (0.4)						
Diseases of the genitourinary system	5 (0.3)	3 (0.1)	1 (0.4)	9 (0.2)	8 (0.4)	7 (0.3)	1 (0.2)	16 (0.3)						
Others	8 (0.5)	14 (0.4)	1 (0.4)	23 (0.5)	5 (0.2)	1 (0)	0 (0)	6 (0.1)						
Unknown	38 (2.5)	52 (1.6)	182 (70.3)	272 (5.5)	86 (3.8)	28 (1.3)	141 (26.4)	255 (5.2)						
Total	1509 (100)	3170 (100)	259 (100)	4938 (100)	2274 (100)	2129 (100)	535 (100)	4938 (100)						

Comparison of Reported and Reclassified Preventable Deaths by ICD10 Underlying Cause of Death According to States, Malaysia, 2016 (Pt 1)

ICD 10 classification of cause of death	JOH		KED		KTN		MEL		NS		PHG		PRK		PLS	
	Rec n (%)	Tech n (%)	Rec n (%)	Tech n (%)	Rec n (%)	Tech n (%)	Rec n (%)	Tech n (%)	Rec n (%)	Tech n (%)	Rec n (%)	Tech n (%)	Rec n (%)	Tech n (%)	Rec n (%)	Tech n (%)
Certain condition originating in the perinatal period	243 (43.4)	218 (38.9)	100 (30.8)	95 (29.2)	96 (30.9)	87 (28.0)	43 (35.2)	40 (32.8)	50 (33.3)	54 (36.0)	88 (31.5)	77 (27.6)	118 (34.3)	102 (29.7)	14 (4.6)	15 (50.0)
Congenital malformation, deformations and chromosomal abnormalities	147 (26.3)	158 (28.2)	127 (39.1)	129 (39.7)	106 (34.1)	110 (35.4)	39 (32.0)	41 (33.6)	47 (31.3)	46 (30.7)	87 (31.2)	94 (33.7)	105 (30.5)	110 (32.0)	9 (30.0)	8 (26.7)
Injuries, poisoning and external causes	37 (6.6)	35 (6.3)	21 (6.5)	21 (6.5)	17 (5.5)	18 (5.8)	10 (8.2)	8 (6.6)	13 (8.7)	17 (11.3)	18 (6.5)	18 (6.5)	23 (6.7)	22 (6.4)	2 (6.7)	1 (3.3)
Certain infectious & parasitic diseases	18 (3.2)	35 (6.3)	8 (2.5)	12 (3.7)	21 (6.8)	21 (6.8)	3 (2.5)	4 (3.3)	4 (2.7)	3 (2.0)	22 (7.9)	18 (6.5)	19 (5.5)	18 (5.2)	1 (3.3)	1 (3.3)
Diseases of nervous system	16 (2.9)	21 (3.8)	10 (3.1)	16 (4.9)	14 (4.5)	18 (5.8)	3 (2.5)	2 (1.6)	4 (2.7)	5 (3.3)	10 (3.6)	10 (3.6)	15 (4.4)	19 (5.5)	0 (0)	0 (0)
Diseases of the respiratory system	32 (5.7)	31 (5.5)	16 (4.9)	18 (5.5)	14 (4.5)	12 (3.9)	3 (2.5)	5 (4.1)	5 (3.3)	7 (4.7)	31 (11.1)	26 (9.3)	14 (4.1)	9 (2.6)	0 (0)	0 (0)
Neoplasms	14 (2.5)	12 (2.1)	8 (2.5)	7 (2.2)	13 (4.2)	14 (4.5)	5 (4.1)	5 (4.1)	3 (2.0)	3 (2.0)	6 (2.2)	7 (2.5)	10 (2.9)	9 (2.6)	1 (3.3)	1 (3.3)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	6 (1.1)	6 (1.1)	5 (1.5)	8 (2.5)	6 (1.9)	6 (1.9)	0 (0)	1 (0.8)	3 (2.0)	4 (2.7)	0 (0)	0 (0)	5 (1.5)	1 (0.3)	1 (3.3)	1 (3.3)
Endocrine, nutritional and metabolic disease	2 (0.4)	9 (1.6)	3 (0.9)	4 (1.2)	8 (2.6)	10 (3.2)	1 (0.8)	2 (1.6)	3 (2.0)	2 (1.3)	5 (1.8)	7 (2.5)	5 (1.5)	4 (1.2)	0 (0)	0 (0)
Diseases of the digestive system	5 (0.9)	6 (1.1)	3 (0.9)	3 (0.9)	1 (0.3)	1 (0.3)	0 (0)	0 (0)	3 (2.0)	3 (2.0)	4 (1.4)	3 (1.1)	3 (0.9)	4 (1.2)	0 (0)	0 (0)
Diseases of the circulatory system	9 (1.6)	7 (1.3)	0 (0)	2 (0.6)	6 (1.9)	6 (1.9)	0 (0)	2 (1.6)	3 (2.0)	2 (1.3)	1 (0.4)	3 (1.1)	5 (1.5)	2 (0.6)	0 (0)	1 (3.3)
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	2 (0.4)	5 (0.9)	1 (0.3)	2 (0.6)	0 (0)	1 (0.3)	0 (0)	0 (0)	2 (1.3)	1 (0.7)	1 (0.4)	2 (0.7)	1 (0.3)	2 (0.6)	0 (0)	0 (0)
Diseases of the genitourinary system	3 (0.5)	0 (0)	1 (0.3)	1 (0.3)	1 (0.3)	1 (0.3)	1 (0.8)	0 (0)	1 (0.7)	1 (0.7)	0 (0)	0 (0)	1 (0.3)	1 (0.3)	0 (0)	0 (0)
Others	0 (0)	0 (0)	0 (0)	1 (0.3)	2 (0.6)	3 (1.0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.4)	1 (0.4)	0 (0)	2 (0.6)	0 (0)	0 (0)
Unknown	26 (4.6)	17 (3.0)	22 (6.8)	6 (1.8)	6 (1.9)	3 (1.0)	14 (11.5)	12 (9.8)	9 (6.0)	2 (1.3)	5 (1.8)	13 (4.7)	20 (5.8)	39 (11.3)	2 (6.7)	2 (6.7)
Total	560 (100)	560 (100)	325 (100)	325 (100)	311 (100)	311 (100)	122 (100)	122 (100)	150 (100)	150 (100)	279 (100)	279 (100)	344 (100)	344 (100)	30 (100)	30 (100)

Rec= reclassified, Tech= reported

Comparison of Reported and Reclassified Preventable Deaths by ICD10 Underlying Cause of Death According to States, Malaysia, 2016 (Pt 2)

ICD 10 classification of cause of death	PEN		SAB		SWK		SEL		TGN		WPKL		WPL		WPP		Total	
	Rec	Tech	Rec	Tech	Rec	Tech	Rec	Tech	Rec	Tech	Rec	Tech	Rec	Tech	Rec	Tech	Rec	Tech
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Certain condition originating in the perinatal period	80 (39.6)	74 (36.6)	256 (35.4)	198 (27.3)	130 (37.0)	116 (33.0)	395 (40.0)	354 (35.9)	76 (31.3)	75 (30.9)	91 (37.0)	85 (34.6)	15 (44.1)	14 (46.7)	14 (46.7)	10 (33.3)	1809 (36.6)	1614 (32.7)
Congenital malformation, deformations and chromosomal abnormalities	70 (34.7)	68 (33.7)	156 (21.5)	157 (21.7)	90 (25.6)	98 (27.9)	281 (28.5)	277 (28.1)	96 (39.5)	95 (39.1)	75 (30.5)	74 (30.1)	5 (14.7)	7 (23.3)	5 (14.7)	4 (13.3)	1447 (29.3)	1474 (29.9)
Injuries, poisoning and external causes	13 (6.4)	13 (6.4)	30 (4.1)	38 (5.2)	18 (5.1)	22 (6.3)	68 (6.9)	70 (7.1)	15 (6.2)	21 (8.6)	19 (7.7)	16 (6.5)	3 (8.8)	1 (3.3)	3 (8.8)	1 (3.3)	308 (6.2)	324 (6.6)
Certain infectious & parasitic diseases	5 (2.5)	6 (3.0)	86 (11.9)	105 (14.5)	26 (7.4)	27 (7.7)	40 (4.1)	58 (5.9)	8 (3.3)	8 (3.3)	4 (1.6)	6 (2.4)	1 (2.9)	1 (3.3)	4 (11.8)	0 (0)	267 (5.4)	326 (6.6)
Diseases of nervous system	5 (2.5)	8 (4.0)	28 (3.9)	42 (5.8)	21 (6)	29 (8.3)	32 (3.2)	34 (3.4)	4 (1.6)	10 (4.1)	10 (4.1)	5 (2.0)	2 (5.9)	1 (3.3)	2 (6.7)	2 (6.7)	175 (3.5)	222 (4.5)
Disease of the respiratory system	7 (3.5)	7 (3.5)	55 (7.6)	66 (9.1)	29 (8.3)	18 (5.1)	37 (3.7)	46 (4.7)	10 (4.1)	8 (3.3)	16 (6.5)	11 (4.5)	6 (17.6)	4 (13.3)	5 (14.7)	2 (6.7)	279 (5.7)	271 (5.5)
Neoplasms	7 (3.5)	8 (4.0)	10 (1.4)	10 (1.4)	1 (0.3)	1 (0.3)	20 (2.0)	19 (1.9)	7 (2.9)	7 (2.9)	8 (3.3)	8 (3.3)	0 (0)	0 (0)	0 (0)	0 (0)	113 (2.3)	111 (2.2)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	5 (2.5)	4 (2.0)	10 (1.4)	8 (1.1)	2 (0.6)	3 (0.9)	33 (3.3)	30 (3.0)	5 (2.1)	9 (3.7)	1 (0.4)	4 (1.6)	0 (0)	2 (6.7)	0 (0)	1 (3.3)	84 (1.7)	86 (1.7)
Endocrine, nutritional and metabolic diseases	4 (2)	5 (2.5)	12 (1.7)	15 (2.1)	5 (1.4)	5 (1.4)	12 (1.2)	14 (1.4)	3 (1.2)	3 (1.2)	0 (0)	0 (0)	1 (2.9)	0 (0)	1 (2.9)	0 (0)	64 (1.3)	81 (1.6)
Diseases of the digestive system	3 (1.5)	4 (2.0)	10 (1.4)	10 (1.4)	4 (1.1)	3 (0.9)	8 (0.8)	8 (0.8)	0 (0)	1 (0.4)	4 (1.6)	8 (3.3)	0 (0)	0 (0)	0 (0)	0 (0)	48 (1)	54 (1.1)
Diseases of the circulatory system	0 (0)	0 (0)	7 (1.0)	4 (0.6)	2 (0.6)	4 (1.1)	11 (1.1)	11 (1.1)	1 (0.4)	1 (0.4)	1 (0.4)	1 (0.4)	0 (0)	0 (0)	0 (0)	0 (0)	46 (0.9)	46 (0.9)
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	1 (0.5)	2 (1.0)	3 (0.4)	2 (0.3)	2 (0.6)	3 (0.9)	4 (0.4)	3 (0.3)	2 (0.8)	0 (0)	2 (0.8)	2 (0.8)	0 (0)	0 (0)	0 (0)	0 (0)	21 (0.4)	25 (0.5)
Diseases of the genitourinary system	1 (0.5)	0 (0)	6 (0.8)	2 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.4)	3 (1.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	16 (0.3)	9 (0.2)
Others	0 (0)	0 (0)	0 (0)	5 (0.7)	0 (0)	0 (0)	2 (0.2)	7 (0.7)	1 (0.4)	1 (0.4)	0 (0)	1 (0.4)	0 (0)	0 (0)	0 (0)	0 (0)	6 (0.1)	23 (0.5)
Unknown	1 (0.5)	3 (1.5)	55 (7.6)	62 (8.6)	21 (6.0)	20 (5.7)	44 (4.5)	56 (5.7)	14 (5.8)	1 (0.4)	15 (6.1)	25 (10.2)	1 (2.9)	0 (0)	1 (2.9)	10 (33.3)	255 (5.2)	272 (5.5)
Total	202 (100)	202 (100)	724 (100)	724 (100)	351 (100)	351 (100)	987 (100)	987 (100)	243 (100)	243 (100)	246 (100)	246 (100)	34 (100)	30 (100)	34 (100)	30 (100)	4938 (100)	4938 (100)

Rec= reclassified, Tech= reported

Comparison of ICD 10 UCOD between Reclassified and Technical Report by Individual States, Malaysia, 2016

ICD 10 classification	Reclassified														TOT n (%)	
	PERI n (%)	CM n (%)	INJ n (%)	CIPD n (%)	RESP n (%)	CNS n (%)	NEO n (%)	SS n (%)	ENDO n (%)	GIT n (%)	CIRC n (%)	DIBS n (%)	GUT n (%)	OTH n (%)		UKN n (%)
Certain condition originating in the perinatal period	203 (83.5)	4 (2.7)	0 (0)	3 (16.7)	3 (9.4)	3 (18.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (7.7)	218 (38.9)
Congenital malformation, deformations and chromosomal abnormalities	7 (2.9)	135 (91.8)	0 (0)	0 (0)	4 (12.5)	0 (0)	3 (21.4)	1 (16.7)	0 (0)	0 (0)	1 (11.1)	0 (0)	2 (66.7)	0 (0)	5 (19.2)	158 (28.2)
Injuries, poisoning and external causes	0 (0)	0 (0)	35 (94.6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	35 (6.3)
Certain infectious & parasitic diseases	12 (4.9)	3 (2.0)	0 (0)	12 (66.7)	3 (9.4)	0 (0)	0 (0)	0 (0)	0 (0)	1 (20)	1 (11.1)	0 (0)	0 (0)	0 (0)	3 (11.5)	35 (6.3)
Diseases of the respiratory system	2 (0.8)	0 (0)	2 (5.4)	1 (5.6)	21 (65.6)	0 (0)	0 (0)	1 (16.7)	0 (0)	1 (20.0)	0 (0)	0 (0)	1 (33.3)	0 (0)	2 (7.7)	31 (5.5)
Diseases of nervous system	4 (1.6)	1 (0.7)	0 (0)	0 (0)	0 (0)	12 (75.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (15.4)	21 (3.8)
Neoplasms	0 (0)	1 (0.7)	0 (0)	0 (0)	0 (0)	0 (0)	11 (78.6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	12 (2.1)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	3 (1.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (50.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (1.1)
Endocrine, nutritional and metabolic diseases	0 (0)	0 (0)	0 (0)	2 (11.1)	0 (0)	1 (6.3)	0 (0)	0 (0)	2 (100)	20 (20.0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (11.5)	9 (1.6)
Diseases of the digestive system	1 (0.4)	2 (1.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	40 (40.0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3.8)	6 (1.1)
Diseases of the circulatory system	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	7 (77.8)	0 (0)	0 (0)	0 (0)	0 (0)	7 (1.3)
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	3 (1.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	0 (0)	5 (0.9)
Unknown	8 (3.3)	1 (0.7)	0 (0)	0 (0)	1 (3.1)	0 (0)	0 (0)	1 (16.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (23.1)	17 (3.0)
Total	243 (100)	147 (100)	37 (100)	18 (100)	32 (100)	16 (100)	14 (100)	6 (100)	2 (100)	5 (100)	9 (100)	2 (100)	3 (100)	0 (0)	26 (100)	560 (100)

Johor

Certain condition originating in the perinatal period	95 (80.5)	2 (1.9)	0 (0)	0 (0)	1 (7.1)	0 (0)	0 (0)	0 (0)	2 (40.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (10.0)	102 (29.7)
Congenital malformation, deformations and chromosomal abnormalities	2 (1.7)	97 (92.4)	0 (0)	3 (15.8)	1 (7.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (60.0)	0 (0)	0 (0)	0 (0)	4 (20.0)	110 (32.0)	
Injuries, poisoning and external causes	0 (0)	0 (0)	21 (91.3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (20.0)	1 (20.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	22 (6.4)	
Certain infectious & parasitic diseases	6 (5.1)	0 (0)	0 (0)	11 (57.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (33.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18 (5.2)	
Diseases of the respiratory system	1 (0.8)	0 (0)	0 (0)	0 (0)	8 (57.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	9 (2.6)	
Diseases of nervous system	2 (1.7)	0 (0)	0 (0)	1 (5.3)	1 (7.1)	15 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	19 (5.5)	
Neoplasms	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	9 (90.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	9 (2.6)	
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (20.0)	1 (20.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.3)	
Endocrine, nutritional and metabolic diseases	0 (0)	0 (0)	0 (0)	1 (5.3)	1 (7.1)	0 (0)	0 (0)	0 (0)	0 (0)	2 (40.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1.2)	
Diseases of the digestive system	0 (0)	2 (1.9)	0 (0)	1 (5.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (33.3)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1.2)	
Diseases of the circulatory system	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (40.0)	0 (0)	0 (0)	0 (0)	2 (0.6)	
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	1 (100)	0 (0)	2 (0.6)	
Diseases of the genitourinary system	1 (0.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.3)	
Others	0 (0)	0 (0)	0 (0)	1 (5.3)	0 (0)	0 (0)	0 (0)	1 (20.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.6)	
Unknown	11 (9.3)	4 (3.8)	2 (8.7)	1 (5.3)	2 (14.3)	0 (0)	1 (10.0)	1 (20.0)	1 (20.0)	1 (33.3)	0 (0)	0 (0)	0 (0)	0 (0)	14 (70.0)	39 (11.3)	
Total	118 (100)	105 (100)	23 (100)	19 (100)	14 (100)	15 (100)	10 (100)	5 (100)	5 (100)	3 (100)	5 (100)	1 (100)	1 (100)	1 (100)	20 (100)	344 (100)	

Unknown	18 (7.0)	9 (5.8)	1 (3.3)	2 (2.3)	3 (5.5)	1 (3.6)	0 (0)	9 (90.0)	0 (0)	1 (10.0)	1 (14.3)	0 (0)	0 (0)	17 (30.9)	62 (8.6)
Total	256 (100)	156 (100)	30 (100)	86 (100)	55 (100)	28 (100)	10 (100)	10 (100)	12 (100)	10 (100)	7 (100)	3 (100)	6 (100)	55 (100)	724 (100)
Sarawak															
Certain condition originating in the perinatal period	110 (84.6)	3 (3.3)	0 (0)	0 (0)	3 (10.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	116 (33.0)
Congenital malformation, deformations and chromosomal abnormalities	5 (3.8)	83 (92.2)	0 (0)	1 (3.8)	5 (17.2)	2 (9.5)	0 (0)	0 (0)	1 (20)	0 (0)	0 (0)	0 (0)	0 (0)	1 (4.8)	98 (27.9)
Injuries, poisoning and external causes	0 (0)	0 (0)	18 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (19.0)	22 (6.3)
Certain infectious & parasitic diseases	3 (2.3)	0 (0)	0 (0)	17 (65.4)	0 (0)	3 (14.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (19.0)	27 (7.7)
Diseases of the respiratory system	0 (0)	1 (1.1)	0 (0)	1 (3.8)	14 (48.3)	1 (4.8)	0 (0)	1 (50.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18 (5.1)
Diseases of nervous system	1 (0.8)	2 (2.2)	0 (0)	6 (23.1)	4 (13.8)	13 (61.9)	0 (0)	1 (50.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (9.5)	29 (8.3)
Neoplasms	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.3)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	1 (0.8)	0 (0)	0 (0)	0 (0)	1 (3.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (4.8)	3 (0.9)
Endocrine, nutritional and metabolic diseases	1 (0.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (80)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (1.4)
Diseases of the digestive system	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (75.0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (0.9)
Diseases of the circulatory system	1 (0.8)	1 (1.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	0 (0)	4 (1.1)
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	1 (0.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (100)	0 (0)	0 (0)	3 (0.9)
Others	2 (1.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.6)
Unknown	5 (3.8)	0 (0)	0 (0)	1 (3.8)	2 (6.9)	2 (9.5)	0 (0)	0 (0)	0 (0)	1 (25.0)	0 (0)	0 (0)	0 (0)	9 (42.9)	20 (5.7)
Total	130 (100)	90 (100)	18 (100)	26 (100)	29 (100)	21 (100)	1 (100)	2 (100)	5 (100)	4 (100)	2 (100)	2 (100)	2 (100)	21 (100)	351 (100)

Overall Comparison of Preventability of Deaths between Reclassified and Technical Report, Malaysia, 2016

Death preventability	Audited			
	Preventable	Not preventable	Undetermined	Total
	n (%)	n (%)	n (%)	n (%)
Preventable	1279 (56.2)	111 (5.2)	119 (22.2)	1509 (30.6)
Not preventable	880 (38.7)	1961 (92.1)	329 (61.5)	3170 (64.2)
Undetermined	115 (5.1)	57 (2.7)	87 (16.3)	259 (5.2)
Total	2274 (100)	2129 (100)	535 (100)	4938 (100)

Comparison of Preventability of Deaths between Reclassified and Technical Report by States, Malaysia, 2016

ICD 10 classification	Reclassified			Total n (%)
	Preventable	Not preventable	Undetermined	
	n (%)	n (%)	n (%)	
Johor				
Preventable	128 (54.2)	4 (1.6)	16 (23.5)	148 (26.4)
Not preventable	102 (43.2)	250 (97.7)	43 (63.2)	395 (70.5)
Undetermined	6 (2.5)	2 (0.8)	9 (13.2)	17 (3.0)
Total	236 (100)	256 (100)	68 (100)	560 (100)
Kedah				
Preventable	65 (54.6)	10 (5.6)	2 (7.4)	77 (23.7)
Not preventable	51 (42.9)	164 (91.6)	22 (81.5)	237 (72.9)
Undetermined	3 (2.5)	5 (2.8)	3 (11.1)	11 (3.4)
Total	119 (100)	179 (100)	27 (100)	325 (100)
Kelantan				
Preventable	96 (59.3)	9 (7.6)	9 (30.0)	114 (36.7)
Not preventable	65 (40.1)	109 (91.6)	17 (56.7)	191 (61.4)
Undetermined	1 (0.6)	1 (0.8)	4 (13.3)	6 (1.9)
Total	162 (100)	119 (100)	30 (100)	311 (100)
Melaka				
Preventable	27 (67.5)	4 (5.9)	0 (0)	31 (25.4)
Not preventable	13 (32.5)	57 (83.8)	13 (92.9)	83 (68.0)
Undetermined	0 (0)	7 (10.3)	1 (7.1)	8 (6.6)
Total	40 (100)	68 (100)	14 (100)	122 (100)
Negeri Sembilan				
Preventable	39 (60.0)	8 (12.5)	6 (28.6)	53 (35.3)
Not preventable	24 (36.9)	56 (87.5)	15 (71.4)	95 (63.3)
Undetermined	2 (3.1)	0 (0)	0 (0)	2 (1.3)
Total	65 (100)	64 (100)	21 (100)	150 (100)
Pahang				
Preventable	89 (61.0)	5 (4.8)	3 (10.7)	97 (34.8)
Not preventable	48 (32.9)	100 (95.2)	21 (75.0)	169 (60.6)
Undetermined	9 (6.2)	0 (0)	4 (14.3)	13 (4.7)
Total	146 (100)	105 (100)	28 (100)	279 (100)
Perak				
Preventable	89 (53.6)	6 (4.1)	2 (6.3)	97 (28.2)
Not preventable	56 (33.7)	130 (89.0)	19 (59.4)	205 (59.6)
Undetermined	21 (12.7)	10 (6.8)	11 (34.4)	42 (12.2)
Total	166 (100)	146 (100)	32 (100)	344 (100)
Perlis				
Preventable	8 (53.3)	0 (0)	0 (0)	8 (26.7)
Not preventable	4 (26.7)	7 (100)	8 (100)	19 (63.3)
Undetermined	3 (20.0)	0 (0)	0 (0)	3 (10.0)
Total	15 (100)	7 (100)	8 (100)	30 (100)
Pulau Pinang				
Preventable	62 (62.0)	12 (12.8)	3 (37.5)	77 (38.1)
Not preventable	34 (34.0)	77 (81.9)	4 (50.0)	115 (56.9)
Undetermined	4 (4.0)	5 (5.3)	1 (12.5)	10 (5.0)
Total	100 (100)	94 (100)	8 (100)	202 (100)

Sabah				
Preventable	172 (47.8)	22 (8.1)	26 (27.7)	220 (30.4)
Not preventable	154 (42.8)	235 (87.0)	62 (66.0)	451 (62.3)
Undetermined	34 (9.4)	13 (4.8)	6 (6.4)	53 (7.3)
Total	360 (100)	270 (100)	94 (100)	724 (100)
Sarawak				
Preventable	140 (76.1)	13 (10.4)	14 (33.3)	167 (47.6)
Not preventable	40 (21.7)	110 (88.0)	15 (35.7)	165 (47.0)
Undetermined	4 (2.2)	2 (1.6)	13 (31.0)	19 (5.4)
Total	184 (100)	125 (100)	42 (100)	351 (100)
Selangor				
Preventable	224 (51.4)	9 (2.0)	24 (22.0)	257 (26.0)
Not preventable	198 (45.4)	426 (96.4)	59 (54.1)	683 (69.2)
Undetermined	14 (3.2)	7 (1.6)	26 (23.9)	47 (4.8)
Total	436 (100)	442 (100)	109 (100)	987 (100)
Terengganu				
Preventable	59 (51.8)	2 (1.9)	11 (47.8)	72 (29.6)
Not preventable	54 (47.4)	104 (98.1)	12 (52.2)	170 (70.0)
Undetermined	1 (0.9)	0 (0)	0 (0)	1 (0.4)
Total	114 (100)	106 (100)	23 (100)	243 (100)
WP Kuala Lumpur				
Preventable	58 (58.0)	7 (5.8)	3 (11.5)	68 (27.6)
Not preventable	30 (30.0)	108 (90.0)	15 (57.7)	153 (62.2)
Undetermined	12 (12)	5 (4.2)	8 (30.8)	25 (10.2)
Total	100 (100)	120 (100)	26 (100)	246 (100)
WP Labuan				
Preventable	21 (100)	0 (0)	0 (0)	21 (61.8)
Not preventable	0 (0)	9 (100)	3 (75.0)	12 (35.3)
Undetermined	0 (0)	0 (0)	1 (25.0)	1 (2.9)
Total	21 (100)	9 (100)	4 (100)	34 (100)
WP Putrajaya				
Preventable	2 (20.0)	0 (0)	0 (0)	2 (6.7)
Not preventable	7 (70.0)	19 (100)	1 (100)	27 (90.0)
Undetermined	1 (10)	0 (0)	0 (0)	1 (3.3)
Total	10 (100)	19 (100)	1 (100)	30 (100)

Comparison of Preventability of Deaths between Reclassified and Technical Report by Hospital Deaths, Malaysia, 2016

Preventability by hospital death	Reclassified			Total
	Preventable	Not preventable	Undetermined	
	n (%)	n (%)	n (%)	
District hospital with specialist				
Preventable	315 (58.9)	32 (5.3)	23 (22.5)	370 (29.8)
Not preventable	211 (39.4)	561 (93.0)	75 (73.5)	847 (68.3)
Undetermined	9 (1.7)	10 (1.7)	4 (3.9)	23 (1.9)
Total	535 (100)	603 (100)	102 (100)	1240 (100)
State hospital				
Preventable	335 (52.4)	36 (5.1)	25 (19.4)	396 (27.0)
Not preventable	293 (45.9)	652 (93.0)	88 (68.2)	1033 (70.3)
Undetermined	11 (1.7)	13 (1.9)	16 (12.4)	40 (2.7)
Total	639 (100)	701 (100)	129 (100)	1469 (100)
Gov. hospital without specialist				
Preventable	67 (62.6)	4 (9.1)	5 (33.3)	76 (45.8)
Not preventable	35 (32.7)	40 (90.9)	10 (66.7)	85 (51.2)
Undetermined	5 (4.7)	0 (0)	0 (0)	5 (3.0)
Total	107 (100)	44 (100)	15 (100)	166 (100)
University hospital				
Preventable	23 (48.9)	0 (0)	0 (0)	23 (22.5)
Not preventable	22 (46.8)	49 (98.0)	3 (60.0)	74 (72.5)
Undetermined	2 (4.3)	1 (2.0)	2 (40.0)	5 (4.9)
Total	47 (100)	50 (100)	5 (100)	102 (100)
Private hospital/maternity home > 50 beds				
Preventable	13 (48.1)	0 (0)	2 (66.7)	15 (32.6)
Not preventable	12 (44.4)	16 (100)	1 (33.3)	29 (63.0)
Undetermined	2 (7.4)	0 (0)	0 (0)	2 (4.3)
Total	27 (100)	16 (100)	3 (100)	46 (100)
Private hospital/maternity home < 50 beds with specialist				
Preventable	4 (28.6)	0 (0)	1 (33.3)	5 (16.1)
Not preventable	9 (64.3)	14 (100)	2 (66.7)	25 (80.6)
Undetermined	1 (7.1)	0 (0)	0 (0)	1 (3.2)
Total	14 (100)	14 (100)	3 (100)	31 (100)
Private hospital/maternity home < 50 beds without specialist				
Preventable	0 (0)	(0)	1 (100)	1 (25.0)
Not preventable	3 (100)	(0)	0 (0)	3 (75.0)
Total	3 (100)	(0)	1 (100)	4 (100)
Military hospital				
Preventable	1 (100)	0 (0)	1 (100)	2 (66.7)
Undetermined	0 (0)	1 (100)	0 (0)	1 (33.3)
Total	1 (100)	1 (100)	1 (100)	3 (100)

Relationship between Place of Death and Ethnicity for Preventable Deaths, Malaysia, 2016

Ethnicity	Hospital	Non-hospital	Total
	n (%)	n (%)	n (%)
Malaysian			
Malay	1033 (58.5)	305 (59.9)	1338 (58.8)
Chinese	103 (5.8)	22 (4.3)	125 (5.5)
Indian	61 (3.5)	18 (3.5)	79 (3.5)
Orang Asli	44 (2.5)	42 (8.3)	86 (3.8)
Bumiputera Sabah	160 (9.1)	29 (5.7)	189 (8.3)
Bumiputera Sarawak	81 (4.6)	34 (6.7)	115 (5.1)
Others	58 (3.3)	7 (1.4)	65 (2.9)
Non-Malaysian	205 (11.6)	49 (9.6)	254 (11.2)
Unknown	20 (1.1)	3 (0.6)	23 (1.0)
Total	1765 (100)	509 (100)	2274 (100)

Relationship between Age of Death and ICD10 Reclassified Preventable UCOD, Malaysia, 2016

ICD 10 classification	Early Neonatal Death		Late Neonatal Death		28 Days - < 1 Year		1 year		2 Year		3 Year		4 Year		Total	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Certain condition originating in the perinatal period	492(78.0)	177(68.3)	66(8.1)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	735(32.3)
Congenital malformation, deformations and chromosomal abnormalities	120(19.0)	44(17.0)	196(24.0)	41(16.7)	14(11.7)	14(11.7)	12(11.5)	9(9.3)	436(19.2)							
Injuries, poisoning and external causes	8(1.3)	8(3.1)	100(12.2)	70(28.5)	46(38.3)	39(37.5)	34(35.1)	305(13.4)								
Certain infectious & parasitic diseases	2(0.3)	13(5.0)	137(16.8)	46(18.7)	16(13.3)	13(12.5)	15(15.5)	242(10.6)								
Diseases of the respiratory system	0(0)	7(2.7)	124(15.2)	45(18.3)	14(11.7)	11(10.6)	9(9.3)	210(9.2)								
Diseases of nervous system	0(0)	0(0)	39(4.8)	11(4.5)	10(8.3)	5(4.8)	9(9.3)	74(3.3)								
Neoplasms	0(0)	1(0.4)	8(1)	9(3.7)	7(5.8)	9(8.7)	6(6.2)	40(1.8)								
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	2(0.3)	4(1.5)	37(4.5)	2(0.8)	2(1.7)	1(1.0)	2(2.1)	50(2.2)								
Endocrine, nutritional and metabolic diseases	4(0.6)	2(0.8)	14(1.7)	4(1.6)	3(2.5)	1(1.0)	2(2.1)	30(1.3)								
Diseases of the digestive system	0(0)	1(0.4)	14(1.7)	3(1.2)	2(1.7)	3(2.9)	6(6.2)	29(1.3)								
Diseases of the circulatory system	0(0)	1(0.4)	9(1.1)	1(0.4)	1(0.8)	3(2.9)	0(0)	15(0.7)								
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	0(0)	0(0)	6(0.7)	0(0)	2(1.7)	0(0)	1(1.0)	9(0.4)								
Diseases of the genitourinary system	0(0)	0(0)	3(0.4)	2(0.8)	1(0.8)	0(0)	2(2.1)	8(0.4)								
Others	0(0)	0(0)	4(0.5)	0(0)	0(0)	1(1.0)	0(0)	5(0.2)								
Unknown	3(0.5)	1(0.4)	60(7.3)	12(4.9)	2(1.7)	6(5.8)	2(2.1)	86(3.8)								
Total	631(100)	259(100)	817(100)	246(100)	120(100)	104(100)	97(100)	2274(100)								

Relationship between Socioeconomic factors to the Reclassified Preventable Deaths, Malaysia, 2016

Socioeconomic factor	Preventable	
	n	%
Father education		
College/ University	395	17.4
Secondary	1042	45.8
Primary	206	9.1
No formal education	195	8.6
Others	54	2.4
Unknown	382	16.8
Mother education		
College/ University	462	20.3
Secondary	1082	47.6
Primary	227	10.0
No formal education	260	11.4
Others	63	2.8
Unknown	180	7.9
Parent education		
College/ University	553	24.3
Secondary	1087	47.8
Primary	207	9.1
No formal education	203	8.9
Other	54	2.4
Unknown	170	7.5
Mother occupation		
Housewife	1236	54.4
Professionals	284	12.5
Clerical support workers	161	7.1
Technicians and associate professionals	63	2.8
Service and sales workers	80	3.5
Elementary occupations	76	3.3
Self employed	55	2.4
Plant and machine operators and assemblers	45	2.0
Unemployed	32	1.4
Student	25	1.1
Managers	19	0.8
Craft and related trades workers	6	0.3
Skilled agricultural, forestry, livestock and fishery workers	3	0.1
Armed forces	3	0.1
Retiree/pensioner	0	0
Unknown	186	8.2
Father occupation		
Elementary occupations	397	17.5
Technicians and associate professionals	300	13.2
Self employed	257	11.3
Plant and machine operators and assemblers	205	9.0
Professionals	192	8.4
Service and sales workers	105	4.6
Skilled agricultural, forestry, livestock and fishery workers	102	4.5
Craft and related trades workers	98	4.3
Clerical support workers	55	2.4
Armed forces	49	2.2
Unemployed	28	1.2
Managers	26	1.1
Student	8	0.4
Retiree/pensioner	3	0.1
Unknown	449	19.7

Household income		
1000 and below	472	20.8
1001-3000	707	31.1
3001-5000	311	13.7
5001-7000	121	5.3
7001 and above	68	3.0
On social welfare support	8	0.4
No income	51	2.2
Unknown	536	23.6
Maternal age		
Less than 18	44	1.9
18 to 25	540	23.7
26 to 35	1123	49.4
36 to 40	271	11.9
41 to 45	112	4.9
46 and above	16	0.7
Unknown	168	7.4
Marital status		
Married	1994	87.7
Unmarried	134	5.9
Divorced	19	0.8
Widow	6	0.3
Unknown	121	5.3
Total	2274	100

Relationship between Socioeconomic factors to the ICD 10 Reclassified Preventable Deaths, Malaysia, 2016

Socio-demography variable	PERI	CM	RESP	INJ	CIPD	CNS	NEO	SS	ENDO	GIT	CIRC	DIBS	GUT	OTH	UKN	TOT
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Mother's education																
College/ University	156 (21.2)	109 (25.0)	32 (15.2)	74 (24.3)	30 (12.4)	12 (16.2)	8 (20.0)	11 (22.0)	4 (13.3)	7 (24.1)	3 (20.0)	1 (11.1)	2 (25.0)	2 (40.0)	11 (12.8)	462 (20.3)
Secondary	355 (48.3)	236 (54.1)	90 (42.9)	159 (52.1)	91 (37.6)	31 (41.9)	24 (60.0)	20 (40.0)	8 (26.7)	16 (55.2)	6 (40.0)	4 (44.4)	5 (62.5)	2 (40.0)	35 (40.7)	1082 (47.6)
Primary	72 (9.8)	30 (6.9)	25 (11.9)	21 (6.9)	34 (14.0)	10 (13.5)	3 (7.5)	7 (14.0)	5 (16.7)	1 (3.4)	3 (20.0)	1 (11.1)	1 (12.5)	0 (0)	14 (16.3)	227 (10.0)
No formal education	74 (10.1)	74 (6.2)	39 (18.6)	10 (3.3)	58 (24.0)	13 (17.6)	4 (10.0)	5 (10.0)	8 (26.7)	2 (6.9)	1 (6.7)	2 (22.2)	0 (0)	0 (0)	17 (19.8)	260 (11.4)
Others	28 (3.8)	8 (1.8)	4 (1.9)	6 (2.0)	8 (3.3)	3 (4.1)	0 (0)	0 (0)	1 (3.3)	1 (3.4)	0 (0)	0 (0)	0 (0)	0 (0)	4 (4.7)	63 (2.8)
Unknown	50 (6.8)	26 (6.0)	20 (9.5)	35 (11.5)	21 (8.7)	5 (6.8)	1 (2.5)	7 (14.0)	4 (13.3)	2 (6.9)	2 (13.3)	1 (11.1)	0 (0)	1 (20.0)	5 (5.8)	180 (7.9)
Father's education																
College/ University	127 (17.3)	95 (21.8)	29 (13.8)	63 (20.7)	19 (7.9)	13 (17.6)	9 (22.5)	12 (24.0)	4 (13.3)	4 (13.8)	4 (26.7)	0 (0)	3 (37.5)	3 (60.0)	10 (11.6)	395 (17.4)
Secondary	316 (43.0)	229 (52.5)	87 (41.4)	158 (51.8)	108 (44.6)	31 (41.9)	26 (65.0)	17 (34.0)	7 (23.3)	17 (58.6)	6 (40.0)	5 (55.6)	5 (62.5)	2 (40.0)	28 (32.6)	1042 (45.8)
Primary	57 (7.8)	36 (8.3)	29 (13.8)	21 (6.9)	25 (10.3)	7 (9.5)	2 (5.0)	6 (12.0)	4 (13.3)	1 (3.4)	3 (20.0)	2 (22.2)	0 (0)	0 (0)	13 (15.1)	206 (9.1)
No formal education	54 (7.3)	16 (3.7)	32 (15.2)	9 (3.0)	46 (19.0)	9 (12.2)	1 (2.5)	4 (8.0)	10 (33.3)	1 (3.4)	0 (0)	1 (11.1)	0 (0)	0 (0)	12 (14.0)	195 (8.6)
Others	21 (2.9)	8 (1.8)	2 (1.0)	4 (1.3)	11 (4.5)	3 (4.1)	0 (0)	0 (0)	1 (3.3)	1 (3.4)	0 (0)	0 (0)	0 (0)	0 (0)	3 (3.5)	54 (2.4)
Unknown	160 (21.8)	52 (11.9)	31 (14.8)	50 (16.4)	33 (13.6)	11 (14.9)	2 (5.0)	11 (22.0)	4 (13.3)	5 (17.2)	2 (13.3)	1 (11.1)	0 (0)	0 (0)	20 (23.3)	382 (16.8)

Parent's education		185	132	37	87	33	15	10	16	5	8	3	3	14	553
		(25.2)	(30.3)	(17.6)	(28.5)	(13.6)	(20.3)	(25.0)	(32.0)	(16.7)	(27.6)	(37.5)	(60.0)	(16.3)	(24.3)
Tertiary										4 (26.7)	1 (11.1)	1 (11.1)	4 (4.7)	3 (3.5)	14 (16.3)
Secondary		354	227	93	156	105	33	26	18	8 (26.7)	16 (55.2)	5 (62.5)	2 (40.0)	34 (39.5)	1087 (47.8)
		(48.2)	(52.1)	(44.3)	(51.1)	(43.4)	(44.6)	(65.0)	(36.0)	6 (40.0)	4 (44.4)	4 (44.4)	5 (40.0)	2 (40.0)	1087 (47.8)
Primary		60	30	25	19	29	11	5	5	4 (13.3)	1 (3.4)	3 (33.3)	0 (0)	16 (18.6)	207 (9.1)
		(8.2)	(6.9)	(11.9)	(6.2)	(12.0)	(14.9)	(10.0)	(10.0)	3 (20.0)	1 (3.4)	3 (33.3)	0 (0)	0 (0)	207 (9.1)
No formal education		63 (8.6)	14 (3.2)	31 (14.8)	10 (3.3)	48 (19.8)	8 (10.8)	2 (5.0)	4 (8.0)	8 (26.7)	1 (3.4)	0 (0)	0 (0)	14 (16.3)	203 (8.9)
Other		24 (3.3)	7 (1.6)	5 (2.4)	2 (0.7)	7 (2.9)	3 (4.1)	0 (0)	0 (0)	1 (3.3)	1 (3.4)	0 (0)	0 (0)	4 (4.7)	54 (2.4)
Unknown		49 (6.7)	26 (6.0)	19 (9.0)	31 (10.2)	20 (8.3)	4 (5.4)	1 (2.5)	7 (14.0)	4 (13.3)	2 (6.9)	1 (11.1)	0 (0)	4 (4.7)	170 (7.5)
Mother's occupation															
Housewife		373	237	119	134	155	52	31	24	20 (66.7)	17 (58.6)	4 (50)	2 (40.0)	51 (59.3)	1236 (54.4)
		(50.7)	(54.4)	(56.7)	(43.9)	(64)	(70.3)	(77.5)	(48.0)	11 (73.3)	6 (66.7)	6 (66.7)	4 (50)	2 (40.0)	1236 (54.4)
Professionals		85	72	16	51	20	6	6	7	3 (10.0)	5 (17.2)	1 (12.5)	2 (40.0)	7 (8.1)	284 (12.5)
		(11.6)	(16.5)	(7.6)	(16.7)	(8.3)	(8.1)	(15.0)	(14.0)	3 (10.0)	5 (17.2)	1 (12.5)	2 (40.0)	7 (8.1)	284 (12.5)
Clerical support workers		49 (6.7)	41 (9.4)	13 (6.2)	26 (8.5)	10 (4.1)	5 (6.8)	1 (2.5)	5 (10.0)	1 (3.3)	2 (6.9)	2 (22.2)	1 (12.5)	5 (5.8)	161 (7.1)
Service and sales workers		33 (4.5)	13 (3.0)	11 (5.2)	12 (3.9)	5 (2.1)	1 (1.4)	0 (0)	3 (6.0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2.3)	80 (3.5)
Elementary occupations		25 (3.4)	8 (1.8)	4 (1.8)	8 (2.6)	11 (4.5)	4 (5.4)	0 (0)	1 (2.0)	2 (6.7)	1 (3.4)	0 (0)	0 (0)	6 (7.0)	76 (3.3)
Technicians and associate professionals		25 (3.4)	13 (3.0)	3 (1.4)	12 (3.9)	9 (3.7)	0 (0)	0 (0)	1 (2.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	63 (2.8)
Self employed		20 (2.7)	6 (1.4)	6 (2.9)	9 (3.0)	6 (2.5)	0 (0)	0 (0)	2 (4.0)	1 (3.3)	1 (3.4)	0 (0)	0 (0)	3 (3.5)	55 (2.4)
Plant and machine operators and assemblers		19 (2.6)	8 (1.8)	5 (2.4)	7 (2.3)	0 (0)	1 (1.4)	1 (2.5)	1 (2.0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2.3)	45 (2)
Unemployed		21 (2.9)	4 (0.9)	1 (0.5)	3 (1.0)	1 (0.4)	1 (1.4)	0 (0)	1 (2.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	32 (1.4)
Student		17 (2.3)	0 (0)	2 (1)	2 (0.7)	2 (0.8)	0 (0)	0 (0)	1 (2.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	25 (1.1)
Managers		7 (1.0)	5 (1.1)	1 (0.5)	4 (1.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3.4)	0 (0)	0 (0)	1 (1.2)	19 (0.8)
Craft and related trades workers		1 (0.1)	2 (0.5)	1 (0.5)	2 (0.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (0.3)

Household income	119	68	65	57	79	23	6	12	6	1	1	23	472
1000 and below	(16.2)	(15.6)	(31.0)	(18.7)	(32.6)	(31.1)	(15.0)	(14.0)	(20.7)	(11.1)	(20.0)	(26.7)	(20.8)
1001-3000	227	157	60	97	63	25	14	17	6	4	3	25	707
	(30.9)	(36.0)	(28.6)	(31.8)	(26.0)	(33.8)	(35.0)	(34.0)	(20.7)	(44.4)	(20.0)	(29.1)	(31.1)
3001-5000	104	66	27	48	26	3	8	9	6	0	2	7	311
	(14.1)	(15.1)	(12.9)	(15.7)	(10.7)	(4.1)	(20.0)	(18.0)	(20.7)	0	(40.0)	(8.1)	(13.7)
5001-7000	34	34	7	23	7	3	3	2	1	2	0	2	121
	(4.6)	(7.8)	(3.3)	(7.5)	(2.9)	(4.1)	(7.5)	(4.0)	(3.4)	(22.2)	0	(2.3)	(5.3)
7001 and above	16	12	5	12	8	2	3	1	3	0	1	4	68
	(2.2)	(2.8)	(2.4)	(3.9)	(3.3)	(2.7)	(7.5)	0	(10.3)	0	(12.5)	(4.7)	(3)
On social welfare support	1	1	1	1	1	1	1	1	0	0	0	0	8
	(0.1)	(0.2)	(0.5)	(0.3)	(0.4)	(1.4)	(2.5)	0	0	0	0	0	(0.4)
No income	26	6	3	6	2	2	0	2	0	0	1	3	51
	(3.5)	(1.4)	(1.4)	(2.0)	(0.8)	(2.7)	0	(4.0)	0	0	(20.0)	(3.5)	(2.2)
Unknown	208	92	42	61	56	15	5	13	7	4	2	22	536
	(28.3)	(21.1)	(20.0)	(20.0)	(23.1)	(20.3)	(12.5)	(26.0)	(24.1)	(26.7)	(25.0)	(25.6)	(23.6)
Maternal age	27	3	4	3	3	2	0	1	0	0	0	1	44
Less than 18	(3.7)	(0.7)	(1.9)	(1.2)	(1.2)	(2.7)	0	(2.0)	0	0	0	(1.2)	(1.9)
18 to 25	215	81	49	53	67	18	3	14	3	1	0	25	540
	(29.3)	(18.6)	(23.3)	(17.4)	(27.7)	(24.3)	(7.5)	(28.0)	(10.3)	(11.1)	(12.5)	(29.1)	(23.7)
26 to 35	344	247	99	158	97	37	23	29	8	5	4	44	1123
	(46.8)	(56.7)	(47.1)	(51.8)	(40.1)	(50.0)	(57.5)	(58.0)	(27.6)	(55.6)	(80.0)	(51.2)	(49.4)
36 to 40	84	57	22	31	38	6	10	2	8	1	1	7	271
	(11.4)	(13.1)	(10.5)	(10.2)	(15.7)	(8.1)	(25.0)	(4.0)	(27.6)	(11.1)	(20.0)	(8.1)	(11.9)
41 to 45	26	24	15	16	12	4	3	1	4	0	0	2	112
	(3.5)	(5.5)	(7.1)	(5.2)	(5.0)	(5.4)	(7.5)	(2.0)	(13.8)	0	0	(2.3)	(4.9)
46 and above	4	4	1	5	1	1	0	0	0	0	0	0	16
	(0.5)	(0.9)	(0.5)	(1.6)	(0.4)	(1.4)	0	0	0	0	0	0	(0.7)
Unknown	35	20	20	39	24	6	1	3	6	2	0	7	168
	(4.8)	(4.6)	(9.5)	(12.8)	(9.9)	(8.1)	(2.5)	(6.0)	(20.7)	(11.1)	0	(8.1)	(7.4)
Marital status	608	407	190	266	212	66	40	44	28	9	8	72	1994
Married	(82.7)	(93.3)	(90.5)	(87.2)	(87.6)	(89.2)	(100)	(88.0)	(96.6)	(100)	(100)	(83.7)	(87.7)
Unmarried	86	13	4	10	8	3	0	2	0	0	0	8	134
	(11.7)	(3.0)	(1.9)	(3.3)	(3.3)	(4.1)	0	(4.0)	0	0	0	(9.3)	(5.9)

Divorced	0 (0)	3 (0.7)	2 (1.0)	7 (2.3)	2 (0.8)	2 (2.7)	0 (0)	1 (2.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1.2)	19 (0.8)
Widow	0 (0)	0 (0)	1 (0.5)	0 (0)	2 (0.8)	0 (0)	0 (0)	1 (2.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2.3)	6 (0.3)
Unknown	41 (5.6)	13 (3.0)	13 (6.2)	22 (7.2)	18 (7.4)	3 (4.1)	0 (0)	2 (4.0)	0 (0)	1 (3.4)	4 (13.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (3.5)	121 (5.3)
Total	735 (100)	436 (100)	210 (100)	305 (100)	242 (100)	74 (100)	40 (100)	50 (100)	29 (100)	30 (100)	15 (100)	9 (100)	8 (100)	5 (100)	86 (100)	2274 (100)					

Relationship of Co-morbidities to ICD10 Preventable UCOD, Malaysia, 2016

ICD 10 classification	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Certain condition originating in the perinatal period	372 (76.2)	21 (6.7)	16 (5.3)	15 (17.9)	2 (2.6)	18 (34.0)	3 (7.7)	3 (10.7)	7 (31.8)	2 (10.5)	0 (0)	2 (20.0)	0 (0)	1 (20.0)	0 (0)
Congenital malformation, deformations and chromosomal abnormalities	32 (6.6)	234 (75.0)	236 (78.7)	56 (66.7)	7 (9.2)	17 (32.1)	13 (33.3)	2 (7.1)	6 (27.3)	13 (68.4)	4 (22.2)	6 (60.0)	1 (16.7)	1 (20.0)	0 (0)
Injuries, poisoning and external causes	3 (0.6)	3 (1.0)	4 (1.3)	1 (1.2)	3 (3.9)	0 (0)	2 (5.1)	0 (0)	0 (0)	0 (0)	1 (5.6)	0 (0)	1 (16.7)	0 (0)	0 (0)
Certain infectious & parasitic diseases	23 (4.7)	15 (4.8)	15 (5.0)	7 (8.3)	19 (25)	2 (3.8)	3 (7.7)	4 (14.3)	2 (9.1)	0 (0)	2 (11.1)	2 (20.0)	1 (16.7)	1 (20.0)	2 (66.7)
Diseases of the respiratory system	30 (6.1)	22 (7.1)	17 (5.7)	1 (1.2)	16 (21.1)	12 (22.6)	9 (23.1)	6 (21.4)	3 (13.6)	3 (15.8)	4 (22.2)	4 (40.0)	3 (50.0)	3 (100)	1 (33.3)
Diseases of nervous system	7 (1.4)	1 (0.3)	1 (0.3)	0 (0)	11 (14.5)	2 (3.8)	4 (10.3)	13 (46.4)	4 (18.2)	1 (5.3)	6 (33.3)	0 (0)	0 (0)	0 (0)	0 (0)
Neoplasms	0 (0)	2 (0.6)	4 (1.3)	0 (0)	0 (0)	0 (0)	1 (2.6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (40.0)	0 (0)
Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	5 (1.0)	2 (0.6)	1 (0.3)	0 (0)	3 (3.9)	0 (0)	2 (5.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Endocrine, nutritional and metabolic diseases	3 (0.6)	0 (0)	1 (0.3)	1 (1.2)	9 (11.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Diseases of the digestive system	3 (0.6)	2 (0.6)	1 (0.3)	2 (2.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Diseases of the circulatory system	0 (0)	5 (1.6)	2 (0.7)	0 (0)	1 (1.3)	1 (1.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Diseases of blood & blood-forming organs and certain disorders involving the immune mechanism	2 (0.4)	1 (0.3)	0 (0)	0 (0)	1 (1.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Diseases of the genitourinary system	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Others	1 (0.2)	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Unknown	7 (1.4)	3 (1.0)	2 (0.7)	1 (1.2)	4 (5.3)	1 (1.9)	2 (5.1)	0 (0)	0 (0)	0 (0)	1 (5.6)	0 (0)	0 (0)	0 (0)	0 (0)
Total	488 (100)	312 (100)	300 (100)	84 (100)	76 (100)	53 (100)	39 (100)	28 (100)	22 (100)	19 (100)	18 (100)	10 (100)	6 (100)	5 (100)	3 (100)

A=Condition from perinatal, B=Cardiac disease, C=Syndromic, D= Surgical condition, E=Malnutrition, F= Chronic lung disease, G= Neuromuscular, H= Cerebral palsy, I= Assisted feeding, J= Recurrent pneumonia, K= Epilepsy, L= Renal, M=Asthma, N= Malignancy, O=Immunodeficiency

Relationship between UCOD and Medical Risk Factors leading to Preventable Deaths, Malaysia, 2016

Medical risk factor	PERI	CM	RESP	INJ	CIPD	CNS	NEO	SS	ENDO	GIT	CIRC	DIBS	GUT	OTH	UKN	TOT
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Facilities																
No availability of critical care beds locally/referral centre	20 (2.7)	37 (8.6)	6 (2.9)	1 (0.3)	4 (1.7)	2 (2.7)	0 (0)	0 (0)	1 (3.4)	1 (3.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	72 (3.2)
Overcrowding	5 (0.7)	3 (0.7)	1 (0.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	9 (0.4)
Equipment																
No availability of critical care equipment	29 (4.0)	2 (0.5)	3 (1.4)	1 (0.3)	5 (2.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (12.5)	0 (0)	0 (0)	41 (1.8)
No availability of appropriate resuscitation equipment	12 (1.6)	1 (0.2)	1 (0.5)	0 (0)	4 (1.7)	0 (0)	1 (2.0)	0 (0)	0 (0)	0 (0)	1 (7.1)	0 (0)	1 (12.5)	0 (0)	0 (0)	21 (0.9)
Transport																
Lack of regional retrieval system	3 (0.4)	2 (0.5)	3 (1.4)	0 (0)	5 (2.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (2.4)	15 (0.7)
No availability of well-equipped ambulance	10 (1.4)	2 (0.5)	2 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (1.2)	15 (0.7)
Quality of care																
Failure to appreciate severity	126 (17.2)	75 (17.4)	53 (25.2)	8 (2.7)	83 (35.5)	17 (23.0)	1 (2.5)	7 (14.3)	10 (34.5)	9 (31.0)	6 (42.9)	2 (22.2)	0 (0)	4 (80.0)	11 (13.4)	412 (18.3)
Inadequate, inappropriate or delay therapy	194 (26.5)	56 (13)	35 (16.7)	11 (3.7)	62 (26.5)	11 (14.9)	3 (7.5)	5 (10.2)	7 (24.1)	8 (27.6)	2 (14.3)	3 (33.3)	1 (12.5)	3 (60.0)	9 (11)	410 (18.3)
Failure to diagnose	129 (17.6)	50 (11.6)	25 (11.9)	7 (2.3)	42 (17.9)	10 (13.5)	6 (15.0)	6 (12.2)	7 (24.1)	8 (27.6)	2 (14.3)	3 (33.3)	0 (0)	2 (40.0)	6 (7.3)	303 (13.5)
Level of medical expertise	72 (9.8)	85 (19.7)	20 (9.5)	5 (1.7)	30 (12.8)	8 (10.8)	3 (7.5)	0 (0)	1 (3.4)	2 (6.9)	0 (0)	0 (0)	0 (0)	0 (0)	8 (9.8)	234 (10.4)
Health care associated infection	72 (9.8)	92 (21.3)	9 (4.3)	1 (0.3)	27 (11.5)	1 (1.4)	3 (7.5)	0 (0)	1 (3.4)	0 (0)	1 (7.1)	0 (0)	0 (0)	1 (20.0)	0 (0)	208 (9.3)
Delay in referral	58 (7.9)	29 (6.7)	24 (11.4)	6 (2)	43 (18.4)	6 (8.1)	7 (17.5)	6 (12.2)	7 (24.1)	3 (10.3)	1 (7.1)	1 (11.1)	1 (12.5)	0 (0)	6 (7.3)	198 (8.8)
Inadequate resuscitation	60 (8.2)	15 (3.5)	14 (6.7)	7 (2.3)	26 (11.1)	5 (6.8)	0 (0)	2 (4.1)	0 (0)	1 (3.4)	0 (0)	0 (0)	0 (0)	0 (0)	3 (3.7)	133 (5.9)
Inadequate stabilization	36 (4.9)	7 (1.6)	8 (3.8)	3 (1.0)	19 (8.1)	5 (6.8)	0 (0)	0 (0)	0 (0)	1 (3.4)	1 (7.1)	0 (0)	1 (12.5)	0 (0)	2 (2.4)	83 (3.7)

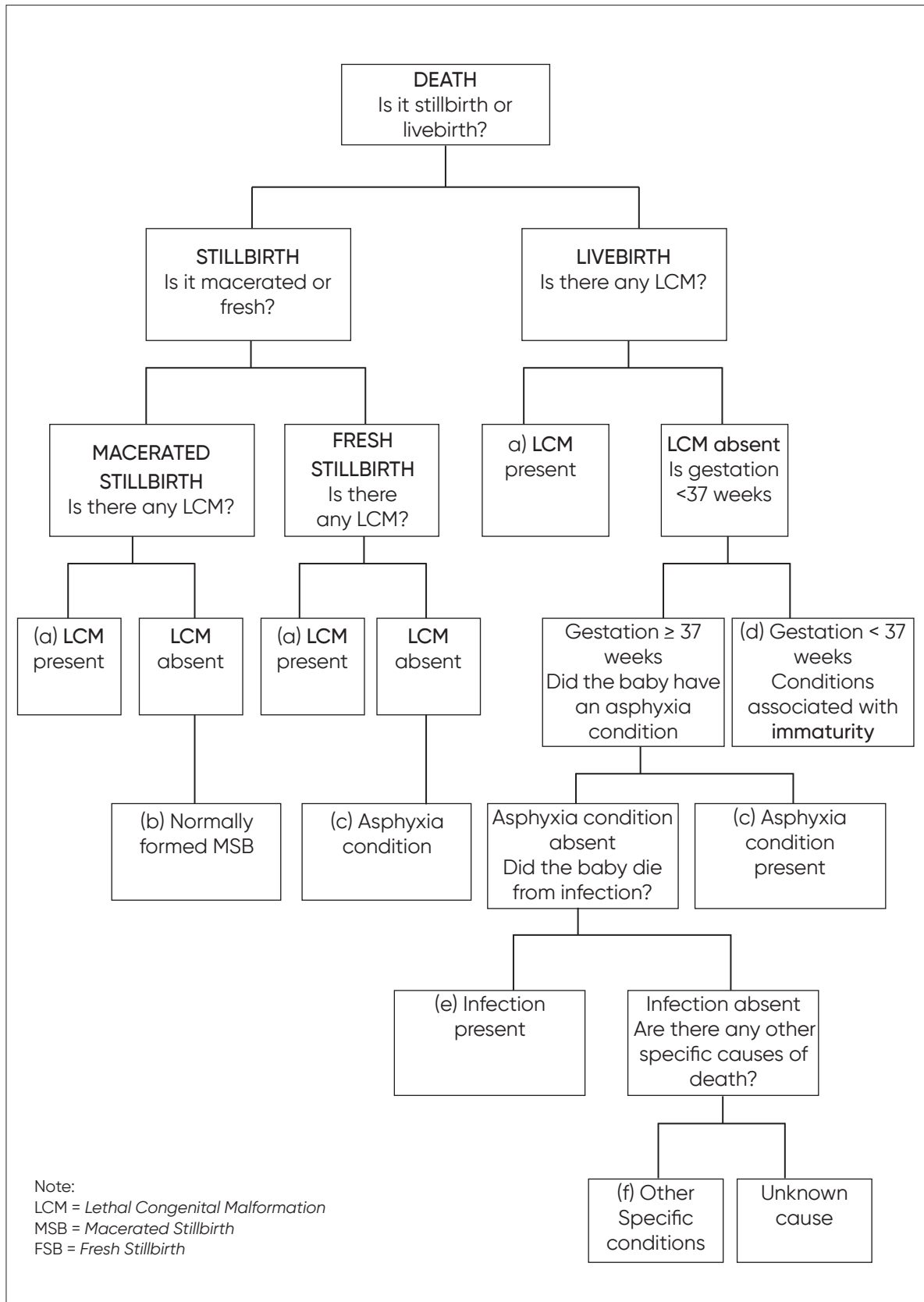
Failure to inform senior	27 (3.7)	6 (1.4)	7 (3.3)	1 (0.3)	18 (7.7)	3 (4.1)	1 (2.5)	0 (0)	1 (3.4)	4 (13.8)	0 (0)	0 (0)	0 (0)	0 (0)	5 (6.1)	73 (3.3)
Failure of home visits/defaulting tracing	19 (2.6)	18 (4.2)	4 (1.9)	0 (0)	18 (7.7)	2 (2.7)	4 (10)	1 (2.0)	2 (6.9)	1 (3.4)	0 (0)	1 (11.1)	0 (0)	0 (0)	2 (2.5)	72 (3.2)
Failure of communication	29 (4)	5 (1.2)	5 (2.4)	2 (0.7)	9 (3.8)	5 (6.8)	3 (7.5)	1 (2.0)	0 (0)	2 (6.9)	0 (0)	1 (11.1)	0 (0)	0 (0)	3 (3.7)	65 (2.9)
Failure of adherence to protocol	18 (2.5)	6 (1.4)	4 (1.9)	2 (0.7)	11 (4.7)	0 (0)	0 (0)	1 (2.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	20.0	1 (1.2)	44 (2.0)
Failure to inform other specialist	16 (2.2)	2 (0.5)	4 (1.9)	2 (0.7)	6 (2.6)	4 (5.4)	0 (0)	0 (0)	0 (0)	1 (3.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	35 (1.6)
Failure of combined care	12 (1.6)	7 (1.6)	3 (1.4)	2 (0.7)	2 (0.9)	2 (2.7)	3 (7.5)	0 (0)	1 (3.4)	1 (3.4)	2 (14.3)	1 (11.1)	0 (0)	0 (0)	2 (2.4)	38 (1.7)
Insufficient human resource	11 (1.5)	4 (0.9)	1 (0.5)	1 (0.3)	1 (0.4)	0 (0)	0 (0)	2 (2.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	19 (0.8)
Total	732 (100)	431 (100)	210 (100)	300 (100)	234 (100)	74 (100)	40 (100)	49 (100)	29 (100)	29 (100)	14 (100)	9 (100)	8 (100)	5 (100)	82 (100)	2246 (100)

Relationship between States and Medical Risk Factors leading to Preventable Deaths, Malaysia, 2016

Medical risk factors	JOH	KED	KTN	MEL	NS	PHG	PRK	PLS	PEN	SAB	SWK	SEL	TGN	WPKL	WPL	WPP	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Facilities																	
No availability of critical care beds locally/referral centre	5 (2.1)	4 (3.4)	10 (6.3)	0 (0)	2 (3.1)	10 (6.9)	3 (1.8)	1 (6.7)	3 (3.0)	11 (3.2)	5 (2.7)	12 (2.8)	5 (4.4)	1 (1.0)	0 (0)	0 (0)	72 (3.2)
Overcrowding	3 (1.3)	1 (0.8)	3 (1.9)	0 (0)	1 (1.5)	0 (0)	0 (0)	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	9 (0.4)
Equipment																	
Lack of critical care equipment	3 (1.3)	3 (2.5)	3 (1.9)	0 (0)	0 (0)	4 (2.8)	5 (3.0)	0 (0)	1 (1.0)	9 (2.6)	1 (0.5)	9 (2.1)	1 (0.9)	1 (1.0)	1 (4.8)	0 (0)	41 (1.8)
Lack of appropriate resuscitation equipment	2 (0.8)	2 (1.7)	0 (0)	0 (0)	0 (0)	2 (1.4)	1 (0.6)	0 (0)	0 (0)	4 (1.2)	2 (1.1)	5 (1.1)	3 (2.6)	0 (0)	0 (0)	0 (0)	21 (0.9)
Transport																	
Lack of regional retrieval system	0 (0)	0 (0)	1 (0.6)	0 (0)	0 (0)	2 (1.4)	3 (1.8)	0 (0)	0 (0)	3 (0.9)	1 (0.5)	2 (0.5)	3 (2.6)	0 (0)	0 (0)	0 (0)	15 (0.7)
No availability of well-equipped ambulance	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.7)	5 (3.0)	0 (0)	1 (1.0)	1 (0.3)	2 (1.1)	4 (0.9)	1 (0.9)	0 (0)	0 (0)	0 (0)	15 (0.7)
Quality of care																	
Failure to appreciate severity	36 (15.3)	18 (15.1)	31 (19.4)	6 (15.4)	16 (24.6)	25 (17.2)	38 (23.2)	4 (26.7)	15 (15.2)	45 (13.2)	37 (20.1)	96 (22.1)	24 (21.1)	14 (14.3)	6 (28.6)	1 (10.0)	412 (18.3)
Inadequate, inappropriate or delay therapy	28 (11.9)	20 (16.8)	30 (18.8)	5 (12.8)	17 (26.2)	24 (16.6)	41 (25.0)	5 (33.3)	18 (18.2)	44 (12.9)	40 (21.7)	92 (21.1)	29 (25.4)	9 (9.2)	6 (28.6)	2 (20.0)	410 (18.3)
Failure to diagnose	28 (11.9)	14 (11.8)	22 (13.8)	3 (7.7)	11 (16.9)	13 (9.0)	31 (18.9)	2 (13.3)	14 (14.1)	30 (8.8)	26 (14.1)	67 (15.4)	26 (22.8)	12 (12.2)	2 (9.5)	2 (20.0)	303 (13.5)
Level of medical expertise	8 (3.4)	14 (11.8)	14 (8.8)	1 (2.6)	9 (13.8)	26 (17.9)	25 (15.2)	3 (20)	7 (7.1)	41 (12.0)	27 (14.7)	40 (9.2)	11 (9.6)	6 (6.1)	1 (4.8)	1 (10.0)	234 (10.4)
Health care associated infection	28 (11.9)	19 (16.0)	25 (15.6)	1 (2.6)	4 (6.2)	17 (11.7)	17 (10.4)	2 (13.3)	11 (11.1)	12 (3.5)	12 (6.5)	32 (7.4)	14 (12.3)	12 (12.2)	1 (4.8)	1 (10.0)	208 (9.3)
Delay in referral	12 (5.1)	9 (7.6)	24 (15.0)	2 (5.1)	5 (7.7)	7 (4.8)	24 (14.6)	1 (6.7)	5 (5.1)	28 (8.2)	21 (11.4)	31 (7.1)	18 (15.8)	5 (5.1)	5 (23.8)	1 (10.0)	198 (8.8)
Inadequate resuscitation	11 (4.7)	5 (4.2)	6 (3.8)	0 (0)	4 (6.2)	12 (8.3)	20 (12.2)	2 (13.3)	2 (2.0)	19 (5.6)	12 (6.5)	27 (6.2)	5 (4.4)	7 (7.1)	0 (0)	1 (10.0)	133 (5.9)
Inadequate stabilization	7 (3.0)	4 (3.4)	1 (0.6)	1 (2.6)	3 (4.6)	5 (3.4)	15 (9.1)	1 (6.7)	1 (1.0)	12 (3.5)	6 (3.3)	19 (4.4)	7 (6.1)	0 (0)	0 (0)	1 (10.0)	83 (3.7)
Failure to inform senior	10 (4.2)	0 (0)	8 (5.0)	1 (2.6)	4 (6.2)	6 (4.1)	8 (4.9)	1 (6.7)	0 (0)	9 (2.6)	6 (3.3)	12 (2.8)	8 (7.0)	0 (0)	0 (0)	0 (0)	73 (3.3)
Failure of home visits/defaulting tracing	2 (0.9)	3 (2.5)	13 (8.1)	0 (0)	2 (3.1)	7 (4.8)	1 (0.6)	0 (0)	0 (0)	12 (3.5)	7 (3.8)	8 (1.8)	13 (11.4)	1 (1.0)	3 (14.3)	0 (0)	72 (3.2)

Failure of communication	10 (4.2)	3 (2.5)	5 (3.1)	1 (2.6)	4 (6.2)	5 (3.4)	5 (3.0)	0 (0)	0 (0)	0 (0)	5 (1.5)	5 (2.7)	8 (1.8)	7 (6.1)	4 (4.1)	3 (14.3)	0 (0)	65 (2.9)
Failure of adherence to protocol	3 (1.3)	1 (0.8)	4 (2.5)	1 (2.6)	3 (4.6)	5 (3.4)	2 (1.2)	1 (6.7)	2 (2.0)	6 (1.8)	4 (2.2)	4 (2.2)	5 (1.1)	5 (4.4)	2 (2.0)	0 (0)	0 (0)	44 (2.0)
Failure of combined care	7 (3.0)	1 (0.8)	4 (2.5)	1 (2.6)	2 (3.1)	3 (2.1)	4 (2.4)	0 (0)	0 (0)	1 (0.3)	4 (2.2)	2 (0.5)	5 (4.4)	3 (3.1)	1 (4.8)	0 (0)	0 (0)	38 (1.7)
Failure to inform other specialist	2 (0.8)	1 (0.8)	3 (1.9)	2 (5.1)	0 (0)	5 (3.4)	4 (2.4)	0 (0)	0 (0)	3 (0.9)	6 (3.3)	5 (1.1)	3 (2.6)	0 (0)	1 (4.8)	0 (0)	0 (0)	35 (1.6)
Insufficient human resource	4 (1.7)	1 (0.8)	4 (2.5)	0 (0)	1 (1.5)	3 (2.1)	1 (0.6)	0 (0)	0 (0)	1 (0.3)	3 (1.6)	1 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	19 (0.8)
Total	236 (100)	119 (100)	160 (100)	39 (100)	65 (100)	145 (100)	164 (100)	15 (100)	99 (100)	342 (100)	184 (100)	435 (100)	114 (100)	98 (100)	21 (100)	10 (100)	2246 (100)	

Modified Wigglesworth Classification



Association of Socio-demographic Factors and Preventable Deaths from the UCOD ICD10 Conditions Originating from the Perinatal Group, Malaysia, 2016

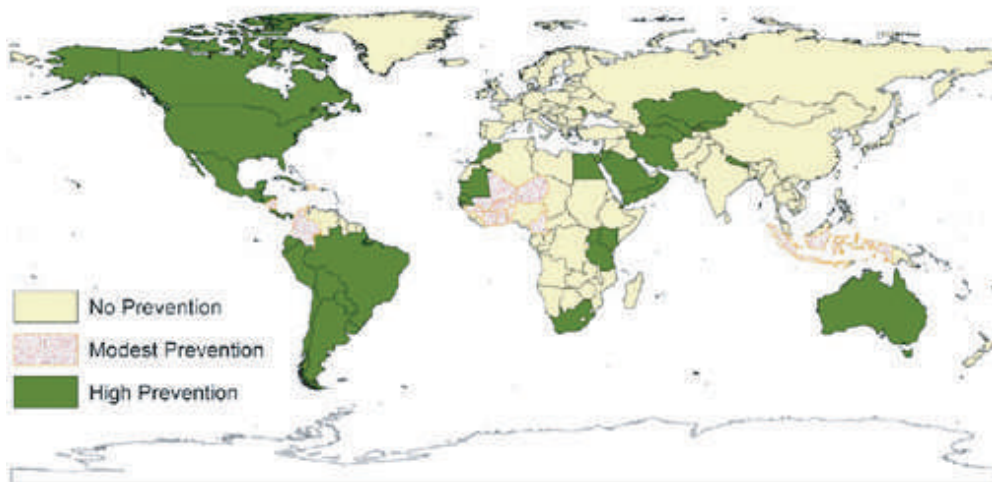
Socio-demography	Prematurity	Asphyxia	Infection	Others	Unknown	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Mother's education						
College/ University	63 (19.0)	50 (23.6)	31 (23.5)	9 (26.5)	3 (12.0)	156 (21.2)
Secondary	166 (50.0)	100 (47.2)	64 (48.5)	13 (38.2)	12 (48.0)	355 (48.3)
Primary	29 (8.7)	23 (10.8)	13 (9.8)	4 (11.8)	3 (12.0)	72 (9.8)
No formal education	36 (10.8)	20 (9.4)	11 (8.3)	3 (8.8)	4 (16.0)	74 (10.1)
Others	14 (4.2)	7 (3.3)	4 (3.0)	2 (5.9)	1 (4.0)	28 (3.8)
Unknown	24 (7.2)	12 (5.7)	9 (6.8)	3 (8.8)	2 (8.0)	50 (6.8)
Father's education						
College/ University	56 (16.9)	35 (16.5)	28 (21.2)	4 (11.8)	4 (16.0)	127 (17.3)
Secondary	129 (38.9)	99 (46.7)	60 (45.5)	19 (55.9)	9 (36.0)	316 (43.0)
Primary	25 (7.5)	21 (9.9)	9 (6.8)	1 (2.9)	1 (4.0)	57 (7.8)
No formal education	21 (6.3)	18 (8.5)	10 (7.6)	3 (8.8)	2 (8.0)	54 (7.3)
Others	9 (2.7)	5 (2.4)	4 (3.0)	2 (5.9)	1 (4.0)	21 (2.9)
Unknown	92 (27.7)	34 (16)	21 (15.9)	5 (14.7)	8 (32.0)	160 (21.8)
Mother's occupation						
Housewife	155 (46.7)	110 (51.9)	71 (53.8)	19 (55.9)	18 (72.0)	373 (50.7)
Professionals	33 (9.9)	28 (13.2)	17 (12.9)	5 (14.7)	2 (8.0)	85 (11.6)
Clerical support workers	24 (7.2)	12 (5.7)	9 (6.8)	3 (8.8)	1 (4.0)	49 (6.7)
Service and sales workers	23 (6.9)	4 (1.9)	6 (4.5)	0 (0)	0 (0)	33 (4.5)
Technicians and associate professionals	13 (3.9)	8 (3.8)	4 (3.0)	0 (0)	0 (0)	25 (3.4)
Elementary occupations	11 (3.3)	10 (4.7)	3 (2.3)	1 (2.9)	0 (0)	25 (3.4)
Unemployed	13 (3.9)	5 (2.4)	1 (0.8)	1 (2.9)	1 (4.0)	21 (2.9)
Self employed	8 (2.4)	6 (2.8)	4 (3.0)	2 (5.9)	0 (0)	20 (2.7)
Plant and machine operators and assemblers	6 (1.8)	8 (3.8)	4 (3.0)	1 (2.9)	0 (0)	19 (2.6)
Student	10 (3.0)	2 (0.9)	3 (2.3)	0 (0)	2 (8.0)	17 (2.3)
Managers	2 (0.6)	3 (1.4)	2 (1.5)	0 (0)	0 (0)	7 (1.0)
Armed forces	0 (0)	1 (0.5)	0 (0)	0 (0)	0 (0)	1 (0.1)
Craft and related trades workers	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.1)
Unknown	33 (9.9)	15 (7.1)	8 (6.1)	2 (5.9)	1 (4.0)	59 (8.0)
Father's occupation						
Elementary occupations	50 (15.1)	36 (17.0)	23 (17.4)	7 (20.6)	4 (16.0)	120 (16.3)
Technicians and associate professionals	27 (8.1)	29 (13.7)	22 (16.7)	2 (5.9)	2 (8.0)	82 (11.2)
Self employed	42 (12.7)	13 (6.1)	14 (10.6)	5 (14.7)	1 (4.0)	75 (10.2)
Plant and machine operators and assemblers	26 (7.8)	22 (10.4)	7 (5.3)	4 (11.8)	1 (4.0)	60 (8.2)
Professionals	17 (5.1)	19 (9.0)	10 (7.6)	3 (8.8)	1 (4.0)	50 (6.8)
Craft and related trades workers	17 (5.1)	12 (5.7)	4 (3.0)	1 (2.9)	3 (12.0)	37 (5.0)
Clerical support workers	9 (2.7)	9 (4.2)	6 (4.5)	1 (2.9)	0 (0)	25 (3.4)
Service and sales workers	10 (3.0)	10 (4.7)	7 (5.3)	0 (0)	1 (4.0)	28 (3.8)
Skilled agricultural, forestry, livestock and fishery workers	7 (2.1)	9 (4.2)	7 (5.3)	1 (2.9)	1 (4.0)	25 (3.4)
Managers	5 (1.5)	5 (2.4)	2 (1.5)	1 (2.9)	2 (8.0)	15 (2.0)
Armed forces	9 (2.7)	3 (1.4)	2 (1.5)	1 (2.9)	0 (0)	15 (2.0)
Unemployed	3 (0.9)	4 (1.9)	0 (0)	0 (0)	0 (0)	7 (1.0)
Student	2 (0.6)	1 (0.5)	1 (0.8)	1 (2.9)	0 (0)	5 (0.7)
Unknown	108 (32.5)	40 (18.9)	27 (20.5)	7 (20.6)	9 (36.0)	191 (26.0)

Household income						
1000 and below	51 (15.4)	38 (17.9)	21 (15.9)	4 (11.8)	5 (20.0)	119 (16.2)
1001-3000	98 (29.5)	73 (34.4)	38 (28.8)	12 (35.3)	6 (24.0)	227 (30.9)
3001-5000	47 (14.2)	30 (14.2)	21 (15.9)	4 (11.8)	2 (8.0)	104 (14.1)
5001-7000	13 (3.9)	11 (5.2)	8 (6.1)	1 (2.9)	1 (4.0)	34 (4.6)
7001 and above	7 (2.1)	5 (2.4)	2 (1.5)	2 (5.9)	0 (0)	16 (2.2)
On social welfare support	1 (0.3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.1)
No income	18 (5.4)	6 (2.8)	0 (0)	1 (2.9)	1 (4.0)	26 (3.5)
Unknown	97 (29.2)	49 (23.1)	42 (31.8)	10 (29.4)	10 (40.0)	208 (28.3)
Maternal age						
Less than 18	19 (5.7)	2 (0.9)	3 (2.3)	0 (0)	3 (12.0)	27 (3.7)
18 to 25	104 (31.3)	57 (26.9)	36 (27.3)	10 (29.4)	8 (32.0)	215 (29.3)
26 to 35	144 (43.4)	105 (49.5)	71 (53.8)	17 (50.0)	7 (28.0)	344 (46.8)
36 to 40	33 (9.9)	31 (14.6)	14 (10.6)	4 (11.8)	2 (8.0)	84 (11.4)
41 to 45	9 (2.7)	9 (4.2)	4 (3.0)	2 (5.9)	2 (8.0)	26 (3.5)
46 and above	3 (0.9)	0 (0)	0 (0)	0 (0)	1 (4.0)	4 (0.5)
Unknown	20 (6.0)	8 (3.8)	4 (3.0)	1 (2.9)	2 (8.0)	35 (4.8)
Marital status						
Married	253 (76.2)	189 (89.2)	118 (89.4)	28 (82.4)	20 (80.0)	608 (82.7)
Unmarried	60 (18.1)	14 (6.6)	4 (3.0)	4 (11.8)	4 (16.0)	86 (11.7)
Unknown	19 (5.7)	9 (4.2)	10 (7.6)	2 (5.9)	1 (4.0)	41 (5.6)

Types of CM-CNS according to ICD10 Classification leading to Under-5 Mortality, Malaysia, 2016

Type of CM-CNS	n	%
Q00 Anencephaly and similar malformations		
Q00.0 Anencephaly	83	40.1
Q01 Encephalocele		
Q01.1 Nasofrontal encephalocele	1	0.5
Q 01.2 Occipital encephalocele	2	1.0
Q01.8 Encephalocele of other sites	1	0.5
Q01.9 Encephalocele unspecified	6	2.9
Q02 Microcephaly	5	2.4
Q03 Congenital Hydrocephalus		
Q03.0 Malformations of Aqueduct Of Sylvius	3	1.4
Q03.1 Atresia of Foramina Of Magendie & Luschka (including Dandy Walker Malformation)	11	4.8
Q03.9 Congenital Hydrocephalus, Unspecified	17	8.2
Q04 Other Congenital malformations of the brain		
Q04.2 Holoprosencephaly	32	15.5
Q04.3 Other reduction deformities of brain (include Lissencephaly, hydranencephaly)	30	13.5
Q04.4 Septo-optic dysplasia of brain	2	1.0
Q04.6 Congenital cerebral cysts (include Schizencephaly, Porencephaly)	2	1.0
Q04.8 Other specified congenital malformations of brain	2	1.0
Q05 Spina Bifida		
Q05.1 Thoracic spina bifida with hydrocephalus	1	0.5
Q05.2 Lumbar spina bifida with hydrocephalus	3	1.5
Q05.4 Unspecified spina bifida with hydrocephalus	3	1.4
Q05.8 Sacral spina bifida without hydrocephalus	1	0.5
Q05.9 Spina bifida, unspecified	2	1.0
Q06 Other Congenital Malformations of the spinal cord		
Q07 Other congenital malformations of nervous system		
Q07.02 Arnold-Chiari syndrome with hydrocephalus	1	0.5
Q07.03 Arnold-Chiari syndrome with spina bifida and hydrocephalus	2	1.0
Total	210	100.0

Global Status of Folic Acid-Preventable Spina Bifida and Anencephaly through Mandatory Folic Acid Fortification in 2015



Source: Obeid R, Pietrzik K, Oakley G et al, Preventable spina bifida and anencephaly in Europe. *Birth Defects Res a Clin Mol Teratol.* 2015 Sep;103(9):763-71

Frequency of ICD10 UCOD Injuries, Poisoning and Other Consequences of External Causes by States, Malaysia, 2016

State	MVA	Drowning	Assault	Asphyxia	Head injury	Burn	Fall	Others	Total
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Selangor	18 (16.8)	16 (23.5)	11 (23.4)	14 (36.8)	6 (35.3)	1 (11.1)	0 (0)	2 (18.2)	68 (22.1)
Johor	15 (14.0)	5 (7.4)	5 (10.6)	7 (13.2)	2 (11.8)	0 (0)	1 (14.3)	2 (18.2)	37 (12.0)
Sabah	8 (7.5)	11 (16.2)	0 (0)	1 (2.4)	3 (17.6)	4 (44.4)	3 (42.9)	0 (0)	30 (9.7)
Perak	9 (8.4)	7 (10.3)	4 (8.5)	1 (2.6)	2 (11.8)	0 (0)	0 (0)	0 (0)	23 (7.6)
Kedah	6 (5.6)	4 (5.9)	4 (8.5)	3 (7.9)	2 (11.8)	0 (0)	0 (0)	2 (18.2)	21 (6.9)
WP Kuala Lumpur	3 (2.8)	5 (7.4)	5 (10.6)	5 (13.2)	0 (0)	0 (0)	0 (0)	1 (9.1)	19 (6.3)
Pahang	10 (9.3)	4 (5.9)	3 (6.4)	1 (2.6)	0 (0)	0 (0)	0 (0)	0 (0)	18 (5.9)
Sarawak	6 (5.6)	6 (8.8)	2 (4.3)	1 (2.6)	0 (0)	1 (11.1)	1 (14.3)	1 (9.1)	18 (5.9)
Kelantan	12 (11.2)	2 (2.9)	0 (0)	2 (5.3)	1 (5.9)	0 (0)	0 (0)	0 (0)	17 (5.6)
Terengganu	9 (8.4)	3 (4.4)	3 (6.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	15 (4.9)
Negeri Sembilan	7 (6.5)	1 (1.5)	1 (2.1)	1 (2.6)	0 (0)	2 (22.2)	0 (0)	1 (9.1)	13 (4.3)
Pulau Pinang	3 (2.8)	1 (1.5)	4 (8.5)	2 (5.3)	0 (0)	1 (11.1)	1 (14.3)	1 (9.1)	13 (4.3)
Melaka	1 (0.9)	2 (2.9)	3 (6.4)	3 (7.1)	0 (0)	0 (0)	0 (0)	1 (9.1)	10 (3.0)
WP Labuan	0 (0)	1 (1.5)	1 (2.1)	0 (0)	1 (5.9)	0 (0)	0 (0)	0 (0)	3 (1.0)
Perlis	0 (0)	0 (0)	1 (2.1)	1 (2.6)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.7)
WP Putrajaya	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (14.3)	0 (0)	1 (0.3)
Total	107 (100)	68 (100)	47 (100)	42 (100)	17 (100)	9 (100)	7 (100)	11 (100)	308 (100)

Relationship between Socio-demographic Factors by ICD10 UCOD Injuries, Poisoning and Other Consequences of External Causes Group, Malaysia, 2016

Socio-demographic factor	MVA (N=107)		Drowning (N=68)		Assault (N=47)		Asphyxia (N=42)		Head Injury (N=17)		Burn (N=9)		Fall (N=7)		Others (N=11)		Total (N=308)		
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Gender																			
Male	56 (52.3)	45 (66.2)	27 (57.4)	21 (50.0)	11 (64.7)	6 (66.7)	3 (42.9)	8 (72.7)	17 (57.5)										
Female	50 (46.7)	22 (32.4)	20 (42.6)	19 (45.2)	6 (35.3)	3 (33.3)	4 (57.1)	3 (27.3)	127 (41.2)										
Indeterminate	0 (0)	0 (0)	0 (0)	1 (2.4)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.3)										
Unknown	1 (0.9)	1 (1.5)	0 (0)	1 (2.4)	0 (0)	0 (0)	0 (0)	0 (0)	3 (1.0)										
Age group																			
0 to 27 days	2 (1.9)	2 (2.9)	3 (6.4)	8 (19.0)	1 (5.9)	0 (0)	0 (0)	1 (9.1)	17 (5.5)										
28 days to 1 year	30 (28)	6 (8.8)	22 (46.8)	26 (61.9)	9 (52.9)	4 (44.4)	1 (14.3)	3 (27.3)	101 (32.8)										
1- 2 years	21 (19.6)	26 (38.2)	10 (21.3)	3 (7.1)	4 (23.5)	3 (33.3)	2 (28.6)	1 (9.1)	70 (22.7)										
2 - 3 years	14 (13.1)	20 (29.4)	5 (10.6)	3 (7.1)	2 (11.8)	0 (0)	1 (14.3)	2 (18.2)	47 (15.3)										
3 - 4 years	22 (20.6)	7 (10.3)	3 (6.4)	2 (4.8)	1 (5.9)	1 (11.1)	1 (14.3)	2 (18.2)	39 (12.7)										
4 - 5 years	18 (16.8)	7 (10.3)	4 (8.5)	0 (0)	0 (0)	1 (11.1)	2 (28.6)	2 (18.2)	34 (11.0)										
Ethnicity																			
Malay	82 (76.6)	48 (70.6)	32 (68.1)	33 (78.6)	8 (47.1)	1 (11.1)	3 (42.9)	8 (72.7)	215 (69.8)										
Chinese	8 (7.5)	2 (2.9)	7 (14.9)	2 (4.8)	1 (5.9)	1 (11.1)	0 (0)	2 (18.2)	23 (7.5)										
Indian	3 (2.8)	0 (0)	6 (12.8)	1 (2.4)	1 (5.9)	1 (11.1)	0 (0)	0 (0)	12 (3.9)										
Orang Asli	0 (0)	1 (1.5)	0 (0)	0 (0)	1 (5.9)	0 (0)	0 (0)	0 (0)	2 (0.6)										
Bumiputera Sabah	7 (6.5)	7 (10.3)	0 (0)	1 (2.4)	5 (29.4)	0 (0)	3 (42.9)	0 (0)	23 (7.5)										
Bumiputera Sarawak	4 (3.7)	4 (5.9)	1 (2.1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (9.1)	10 (3.2)										
Other Malaysian	1 (0.9)	1 (1.5)	0 (0)	2 (4.8)	0 (0)	1 (11.1)	0 (0)	0 (0)	5 (1.6)										
Non-citizen	0 (0)	5 (7.4)	1 (2.1)	3 (7.1)	1 (5.9)	3 (33.3)	1 (14.3)	0 (0)	14 (4.5)										
Unknown	2 (1.9)	0 (0)	0 (0)	0 (0)	0 (0)	2 (22.2)	0 (0)	0 (0)	4 (1.3)										
Marital status																			
Married	101 (94.4)	60 (88.2)	36 (76.6)	38 (90.5)	15 (88.2)	5 (55.6)	5 (71.4)	8 (72.7)	268 (87)										
Unmarried	1 (0.9)	1 (1.5)	4 (8.5)	0 (0)	1 (5.9)	1 (11.1)	1 (14.3)	2 (18.2)	11 (3.6)										
Divorced	0 (0)	3 (4.4)	3 (6.4)	1 (2.4)	0 (0)	0 (0)	0 (0)	0 (0)	7 (2.3)										
Unknown	5 (4.7)	4 (5.9)	4 (8.5)	3 (7.1)	1 (5.9)	3 (33.3)	1 (14.3)	1 (9.1)	22 (7.1)										
Maternal age																			
25 and below	20 (18.7)	12 (17.6)	11 (23.4)	7 (16.7)	2 (11.8)	1 (11.1)	2 (28.6)	1 (9.1)	56 (18.2)										
26 to 35	64 (59.8)	30 (44.1)	21 (44.7)	23 (54.8)	11 (64.7)	2 (22.2)	2 (28.6)	6 (54.5)	159 (51.6)										
36 to 45	11 (10.3)	14 (20.6)	10 (21.3)	6 (14.3)	2 (11.8)	0 (0)	2 (28.6)	3 (27.3)	48 (15.6)										
46 and above	12 (11.2)	12 (17.6)	5 (10.6)	6 (14.3)	2 (11.8)	6 (66.7)	1 (14.3)	1 (9.1)	45 (14.6)										

Paternal age	10 (9.3)	7 (10.3)	8 (17.0)	4 (9.5)	2 (11.8)	0 (0)	0 (0)	0 (0)	31 (10.1)
25 and below	49 (45.8)	23 (33.8)	19 (40.4)	22 (52.4)	7 (41.2)	3 (33.3)	3 (42.9)	3 (27.3)	129 (41.9)
26 to 35	28 (26.2)	18 (26.5)	10 (21.3)	6 (14.3)	3 (17.6)	1 (11.1)	2 (28.6)	5 (45.5)	73 (23.7)
36 to 45	20 (18.7)	20 (29.4)	10 (21.3)	10 (23.8)	5 (29.4)	5 (55.6)	2 (28.6)	3 (27.3)	75 (24.4)
46 and above									
Maternal education	30 (28)	11 (16.2)	13 (27.7)	14 (33.3)	1 (5.9)	1 (11.1)	1 (14.3)	4 (36.4)	75 (24.4)
College/ University	63 (58.9)	36 (52.9)	20 (42.6)	20 (47.6)	11 (64.7)	1 (11.1)	4 (57.1)	5 (45.5)	160 (51.9)
Secondary	5 (4.7)	8 (11.8)	3 (6.4)	2 (4.8)	2 (11.8)	0 (0)	1 (14.3)	0 (0)	21 (6.8)
Primary	1 (0.9)	4 (5.9)	1 (2.1)	2 (4.8)	0 (0)	1 (11.1)	0 (0)	1 (9.1)	10 (3.2)
No formal education	0 (0)	1 (1.5)	3 (6.4)	1 (2.4)	0 (0)	1 (11.1)	0 (0)	0 (0)	6 (1.9)
Others	8 (7.5)	8 (11.8)	7 (14.9)	3 (7.1)	3 (17.6)	5 (55.6)	1 (14.3)	1 (9.1)	36 (11.7)
Unknown									
Paternal education	25 (23.4)	13 (19.1)	9 (19.1)	9 (21.4)	3 (17.6)	1 (11.1)	0 (0)	3 (27.3)	63 (20.5)
College/ University	62 (57.9)	34 (50.0)	22 (46.8)	23 (54.8)	9 (52.9)	1 (11.1)	5 (71.4)	4 (36.4)	160 (51.9)
Secondary	7 (6.5)	6 (8.8)	3 (6.4)	3 (7.1)	1 (5.9)	1 (11.1)	0 (0)	0 (0)	21 (6.8)
Primary	1 (0.9)	3 (4.4)	3 (6.4)	1 (2.4)	0 (0)	1 (11.1)	0 (0)	0 (0)	9 (2.9)
No formal education	1 (0.9)	0 (0)	1 (2.1)	1 (2.4)	0 (0)	0 (0)	0 (0)	1 (9.1)	4 (1.3)
Others	11 (10.3)	12 (17.6)	9 (19.1)	5 (11.9)	4 (23.5)	5 (55.6)	2 (28.6)	3 (27.3)	51 (16.6)
Unknown									
Maternal occupation	49 (45.8)	36 (52.9)	15 (31.9)	18 (42.9)	8 (47.1)	4 (44.4)	3 (42.9)	2 (18.2)	135 (43.8)
Housewife	19 (17.8)	8 (11.8)	9 (19.1)	11 (26.2)	1 (5.9)	0 (0)	0 (0)	4 (36.4)	52 (16.9)
Professionals	9 (8.4)	6 (8.8)	5 (10.6)	4 (9.5)	1 (5.9)	0 (0)	0 (0)	1 (9.1)	26 (8.4)
Clerical support workers	5 (4.7)	2 (2.9)	2 (4.3)	2 (4.8)	1 (5.9)	0 (0)	0 (0)	0 (0)	12 (3.9)
Service and sales workers									
Technicians and associate professionals	5 (4.7)	2 (2.9)	0 (0)	0 (0)	2 (11.8)	0 (0)	2 (28.6)	1 (9.1)	12 (3.9)
Self employed	3 (2.8)	5 (7.4)	1 (2.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	9 (2.9)
Elementary occupations	3 (2.8)	1 (1.5)	1 (2.1)	2 (4.8)	1 (5.9)	0 (0)	0 (0)	0 (0)	8 (2.6)
Plant and machine operators and assemblers	1 (0.9)	1 (1.5)	3 (6.4)	1 (2.4)	1 (5.9)	0 (0)	0 (0)	0 (0)	7 (2.3)
Managers	2 (1.9)	1 (1.5)	1 (2.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1.3)
Unemployed	0 (0)	0 (0)	1 (2.1)	0 (0)	0 (0)	0 (0)	1 (14.3)	1 (9.1)	3 (1)
Craft and related trades workers	0 (0)	0 (0)	1 (2.1)	0 (0)	0 (0)	0 (0)	0 (0)	1 (9.1)	2 (0.6)
Student	1 (0.9)	0 (0)	1 (2.1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.6)
Armed forces	1 (0.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.3)
Unknown	9 (8.4)	6 (8.8)	7 (14.9)	4 (9.5)	2 (11.8)	5 (55.6)	1 (14.3)	1 (9.1)	35 (11.4)
Paternal occupation	22 (20.6)	8 (11.8)	10 (21.3)	5 (11.9)	3 (17.6)	0 (0)	1 (14.3)	1 (9.1)	50 (16.2)
Technicians and associate professionals	11 (10.3)	14 (20.6)	7 (14.9)	3 (7.1)	2 (11.8)	0 (0)	0 (0)	1 (9.1)	38 (12.3)
Self employed	16 (15.0)	11 (16.2)	4 (8.5)	2 (4.8)	1 (5.9)	1 (11.1)	1 (14.3)	0 (0)	36 (11.7)
Elementary occupations	17 (15.9)	8 (11.8)	2 (4.3)	5 (11.9)	1 (5.9)	0 (0)	0 (0)	2 (18.2)	35 (11.4)
Professionals									

Plant and machine operators and assemblers	11 (10.3)	3 (4.4)	2 (4.3)	8 (19.0)	2 (11.8)	1 (11.1)	1 (14.3)	1 (9.1)	29 (9.4)
Service and sales workers	2 (1.9)	1 (1.5)	5 (10.6)	1 (2.4)	3 (17.6)	0 (0)	1 (14.3)	2 (18.2)	15 (4.9)
Skilled agricultural, forestry, livestock and fishery workers	3 (2.8)	6 (8.8)	1 (2.1)	1 (2.4)	0 (0)	1 (11.1)	0 (0)	0 (0)	12 (3.9)
Craft and related trades workers	7 (6.5)	2 (2.9)	2 (4.3)	1 (2.4)	0 (0)	0 (0)	0 (0)	0 (0)	12 (3.9)
Clerical support workers	1 (0.9)	2 (2.9)	1 (2.1)	2 (4.8)	0 (0)	0 (0)	1 (14.3)	0 (0)	7 (2.3)
Armed forces	3 (2.8)	0 (0)	0 (0)	1 (2.4)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1.3)
Unemployed	0 (0)	0 (0)	2 (4.3)	0 (0)	0 (0)	0 (0)	0 (0)	1 (9.1)	3 (1.0)
Managers	0 (0)	0 (0)	0 (0)	1 (2.4)	0 (0)	1 (11.1)	0 (0)	0 (0)	2 (0.6)
Student	0 (0)	0 (0)	0 (0)	1 (2.4)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.3)
Retiree/pensioner	0 (0)	1 (1.5)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.3)
Unknown	14 (13.1)	12 (17.6)	11 (23.4)	11 (26.2)	5 (29.4)	5 (55.6)	2 (28.6)	3 (27.3)	63 (20.5)
Household income									
1000 and below	20 (18.7)	18 (26.5)	6 (12.8)	6 (14.3)	3 (17.6)	2 (22.2)	1 (14.3)	1 (9.1)	57 (18.5)
1001-3000	41 (38.3)	20 (29.4)	16 (34.0)	9 (21.4)	4 (23.5)	2 (22.2)	1 (14.3)	4 (36.4)	97 (31.5)
3001-5000	20 (18.7)	8 (11.8)	8 (17.0)	6 (14.3)	4 (23.5)	0 (0)	2 (28.6)	1 (9.1)	49 (15.9)
5001-7000	6 (5.6)	6 (8.8)	4 (8.5)	6 (14.3)	1 (5.9)	0 (0)	0 (0)	1 (9.1)	24 (7.8)
7001 and above	5 (4.7)	3 (4.4)	0 (0)	3 (7.1)	0 (0)	0 (0)	0 (0)	1 (9.1)	12 (3.9)
On social welfare support	1 (0.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.3)
No income	0 (0)	1 (1.5)	3 (6.4)	0 (0)	0 (0)	0 (0)	1 (14.3)	1 (9.1)	6 (1.9)
Unknown	14 (13.1)	12 (17.6)	10 (21.3)	12 (28.6)	5 (29.4)	5 (55.6)	2 (28.6)	2 (18.2)	62 (20.1)

Socio-demographic Risk Factors for Death due to ICD10 UCOD Diseases of Respiratory Systems, Malaysia, 2016

Socio-demographic	Preventable	Not preventable	Undetermined	Total
	n (%)	n (%)	n (%)	n (%)
Mother's education				
College/ University	32 (69.6)	13 (28.3)	1 (2.2)	46 (100)
Secondary	90 (68.2)	30 (22.7)	12 (9.1)	132 (100)
Primary	25 (80.6)	6 (19.4)	0 (0)	31 (100)
No formal education	39 (90.7)	3 (7.0)	1 (2.3)	43 (100)
Others	4 (100)	0 (0)	0 (0)	4 (100)
Unknown	20 (87.0)	3 (13.0)	0 (0)	23 (100)
Father's education				
College/ University	29 (64.4)	15 (33.3)	1 (2.2)	45 (100)
Secondary	87 (69.0)	28 (22.2)	11 (8.7)	126 (100)
Primary	29 (87.9)	4 (12.1)	0 (0)	33 (100)
No formal education	32 (84.2)	5 (13.2)	1 (2.6)	38 (100)
Others	2 (100)	0 (0)	0 (0)	2 (100)
Unknown	31 (88.6)	3 (8.6)	1 (2.9)	35 (100)
Parent education				
Tertiary	37 (67.3)	17 (30.9)	1 (1.8)	55 (100)
Secondary	93 (68.9)	30 (22.2)	12 (8.9)	135 (100)
Primary	25 (89.3)	3 (10.7)	0 (0)	28 (100)
No Formal Education	31 (91.2)	2 (5.9)	1 (2.9)	34 (100)
Other	5 (100)	0 (0)	0 (0)	5 (100)
Unknown	19 (86.4)	3 (13.6)	0 (0)	22 (100)
Mother's occupation				
Housewife	119 (71.7)	34 (20.5)	13 (7.8)	166 (100)
Professionals	16 (64.0)	9 (36.0)	0 (0)	25 (100)
Clerical support workers	13 (81.3)	3 (18.8)	0 (0)	16 (100)
Service and sales workers	11 (91.7)	1 (8.3)	0 (0)	12 (100)
Elementary occupations	10 (100)	0 (0)	0 (0)	10 (100)
Self employed	6 (66.7)	2 (22.2)	1 (11.1)	9 (100)
Plant and machine operators and assemblers	5 (100)	0 (0)	0 (0)	5 (100)
Technicians and associate professionals	3 (75.0)	1 (25.0)	0 (0)	4 (100)
Skilled agricultural, forestry, livestock and fishery workers	2 (100)	0 (0)	0 (0)	2 (100)
Craft and related trades workers	1 (50.0)	1 (50.0)	0 (0)	2 (100)
Unemployed	1 (50.0)	1 (50.0)	0 (0)	2 (100)
Student	2 (100)	0 (0)	0 (0)	2 (100)
Managers	1 (100)	0 (0)	0 (0)	1 (100)
Armed forces	1 (100)	0 (0)	0 (0)	1 (100)
Unknown	19 (86.4)	3 (13.6)	0 (0)	22 (100)
Father's occupation				
Elementary occupations	51 (79.7)	10 (15.6)	3 (4.7)	64 (100)
Technicians and associate professionals	29 (80.6)	7 (19.4)	0 (0)	36 (100)
Plant and machine operators and assemblers	24 (85.7)	3 (10.7)	1 (3.6)	28 (100)
Self employed	19 (70.4)	7 (25.9)	1 (3.7)	27 (100)
Professionals	13 (59.1)	7 (31.8)	2 (9.1)	22 (100)
Skilled agricultural, forestry, livestock and fishery workers	13 (72.2)	5 (27.8)	0 (0)	18 (100)
Service and sales workers	8 (57.1)	4 (28.6)	2 (14.3)	14 (100)
Craft and related trades workers	7 (53.8)	4 (30.8)	2 (15.4)	13 (100)
Unemployed	4 (66.7)	1 (16.7)	1 (16.7)	6 (100)
Armed forces	4 (80.0)	0 (0)	1 (20.0)	5 (100)
Managers	4 (100)	0 (0)	0 (0)	4 (100)

Student	0 (0)	1 (100)	0 (0)	1 (100)	
Unknown	34 (82.9)	6 (14.6)	1 (2.4)	41 (100)	
Household income					
1000 and below	65 (78.3)	16 (19.3)	2 (2.4)	83 (100)	0.725 ^b
1001-3000	60 (77.9)	13 (16.9)	4 (5.2)	77 (100)	
3001-5000	27 (73.0)	7 (18.9)	3 (8.1)	37 (100)	
5001-7000	7 (63.6)	4 (36.4)	0 (0)	11 (100)	
7001 and above	5 (71.4)	1 (14.3)	1 (14.3)	7 (100)	
On social welfare support	1 (50.0)	1 (50.0)	0 (0)	2 (100)	
No income	3 (100)	0 (0)	0 (0)	3 (100)	
Unknown	42 (71.2)	13 (22.0)	4 (6.8)	59 (100)	
Maternal age					
Less than 18	4 (100)	0 (0)	0 (0)	4 (100)	0.858 ^b
18 to 25	49 (73.1)	15 (22.4)	3 (4.5)	67 (100)	
26 to 35	99 (71.7)	28 (20.3)	11 (8.0)	138 (100)	
36 to 40	22 (84.6)	4 (15.4)	0 (0)	26 (100)	
41 to 45	15 (78.9)	4 (21.1)	0 (0)	19 (100)	
46 and above	1 (100)	0 (0)	0 (0)	1 (100)	
Unknown	20 (83.3)	4 (16.7)	0 (0)	24 (100)	
Marital status					
Married	190 (74.2)	53 (20.7)	13 (5.1)	256 (100)	0.817 ^b
Unknown	13 (86.7)	1 (6.7)	1 (6.7)	15 (100)	
Unmarried	4 (80.0)	1 (20.0)	0 (0)	5 (100)	
Divorced	2 (100)	0 (0)	0 (0)	2 (100)	
Widow	1 (100)	0 (0)	0 (0)	1 (100)	

^aChi-square test, ^bFisher's exact test

Relationship between Socio-demographic status and ICD10 UCOD Certain Infectious and Parasitic Disease Group, Malaysia, 2016

Socio-demography	Sepsis (Community) (N=138)		Sepsis (Nosocomial Acquired) (N=29)		AGE (N=53)		Other VPD (N=21)		Tuberculosis (N=12)		Dengue (N=7)		HIV (N=5)		Encephalitis (N=2)		Total (N=267)		
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	
Father's citizen																			
Citizen	98 (71.0)	25 (86.2)	34 (64.2)	16 (76.2)	3 (25.0)	5 (71.4)	4 (80.0)	1 (50.0)	186 (69.7)										
Non-citizen	26 (18.8)	2 (6.9)	11 (20.8)	4 (19.0)	5 (41.7)	1 (14.3)	0 (0)	1 (50.0)	50 (18.7)										
Unknown	14 (10.1)	2 (6.9)	8 (15.1)	1 (4.8)	4 (33.3)	1 (14.3)	1 (20.0)	0 (0)	31 (11.6)										
Mother's citizen																			
Citizen	99 (71.7)	26 (89.7)	40 (75.5)	15 (71.4)	4 (33.3)	5 (71.4)	3 (60.0)	1 (50.0)	193 (72.3)										
Non-citizen	33 (23.9)	3 (10.3)	11 (20.8)	6 (28.6)	7 (58.3)	1 (14.3)	2 (40.0)	1 (50.0)	64 (24.0)										
Unknown	6 (4.3)	0 (0)	2 (3.8)	0 (0)	1 (8.3)	1 (14.3)	0 (0)	0 (0)	10 (3.7)										
Maternal age																			
< 18 years	1 (0.7)	2 (6.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	3 (1.1)										
18 to 45 years	117 (84.8)	26 (89.7)	50 (94.3)	21 (100)	9 (75.0)	6 (85.7)	4 (80.0)	2 (100)	235 (88.0)										
> 45 years	2 (1.4)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.7)										
Unknown	18 (13)	1 (3.4)	3 (5.7)	0 (0)	3 (25.0)	1 (14.3)	1 (20.0)	0 (0)	27 (10.1)										
Marital status																			
Married	121 (87.7)	27 (93.1)	46 (86.8)	19 (90.5)	8 (66.7)	6 (85.7)	5 (100)	2 (100)	234 (87.6)										
Unmarried/ Divorced/ Widowed	5 (3.6)	2 (6.9)	4 (7.5)	2 (9.5)	1 (8.3)	0 (0)	0 (0)	0 (0)	14 (5.2)										
Unknown	12 (8.7)	0 (0)	3 (5.7)	0 (0)	3 (25.0)	1 (14.3)	0 (0)	0 (0)	19 (7.1)										
Parent education																			
No formal/ primary	36 (26.1)	5 (17.2)	27 (50.9)	7 (33.3)	4 (33.3)	2 (28.6)	3 (60.0)	0 (0)	84 (31.5)										
Secondary	65 (47.1)	15 (51.7)	18 (34)	7 (33.3)	3 (25.0)	3 (42.9)	2 (40.0)	1 (50.0)	114 (42.7)										
Tertiary	18 (13.0)	9 (31.0)	3 (5.7)	7 (33.3)	0 (0)	0 (0)	0 (0)	1 (50.0)	38 (14.2)										
Others/ unknown	19 (13.8)	0 (0)	5 (9.4)	0 (0)	5 (41.7)	2 (28.6)	0 (0)	0 (0)	31 (11.6)										
Mother's occupation																			
Housewife/ student/ unemployed	88 (63.8)	16 (55.2)	40 (75.5)	10 (47.6)	8 (66.7)	2 (28.6)	3 (60.0)	2 (100)	169 (63.3)										
Professional/ technician & associated professional	14 (10.1)	7 (24.1)	3 (5.7)	7 (33.3)	0 (0)	1 (14.3)	0 (0)	0 (0)	32 (12.0)										

Elementary	2 (1.4)	2 (6.9)	4 (7.5)	1 (4.8)	1 (8.3)	0 (0)	1 (20.0)	0 (0)	11 (4.1)
Clerical support/ sales & service/ skilled agricultural/ plant & machinery	12 (8.7)	1 (3.4)	1 (1.9)	2 (9.5)	0 (0)	2 (28.6)	0 (0)	0 (0)	18 (6.7)
Self employed	5 (3.6)	2 (6.9)	0 (0)	1 (4.8)	0 (0)	0 (0)	1 (20.0)	0 (0)	9 (3.4)
Unknown	17 (12.3)	1 (3.4)	5 (9.4)	0 (0)	3 (25.0)	2 (28.6)	0 (0)	0 (0)	28 (10.5)
Father's occupation									
Unemployed	4 (2.9)	0 (0)	1 (1.9)	2 (9.5)	0 (0)	0 (0)	0 (0)	0 (0)	7 (2.6)
Army forces	2 (1.4)	1 (3.4)	0 (0)	1 (4.8)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1.5)
Professional/ technician & associated professional	26 (18.8)	5 (17.2)	7 (13.2)	6 (28.6)	1 (8.3)	0 (0)	0 (0)	1 (50.0)	46 (17.2)
Elementary	27 (19.6)	8 (27.6)	18 (34.0)	4 (19.0)	3 (25.0)	2 (28.6)	2 (40.0)	1 (50.0)	65 (24.3)
Clerical support/ sales & service/ skilled agricultural/ plant & machinery	35 (25.4)	7 (24.1)	12 (22.6)	4 (19.0)	2 (16.7)	1 (4.3)	0 (0)	0 (0)	61 (22.8)
Self employed	18 (13.0)	5 (17.2)	4 (7.5)	3 (14.3)	0 (0)	2 (28.6)	2 (40.0)	0 (0)	34 (12.7)
Unknown	26 (18.8)	3 (10.3)	11 (20.8)	1 (4.8)	6 (50.0)	2 (28.6)	1 (20.0)	0 (0)	50 (18.7)
Household income									
No income/ Social welfare/ <1000	40 (29.0)	5 (17.2)	27 (50.9)	6 (28.6)	6 (50.0)	1 (4.3)	1 (20.0)	1 (50.0)	87 (32.6)
1000 to 3000	40 (29.0)	12 (41.4)	10 (18.9)	4 (19.0)	1 (8.3)	3 (42.9)	0 (0)	1 (50.0)	71 (26.6)
3001 to 5000	18 (13.0)	4 (13.8)	3 (5.7)	4 (19.0)	0 (0)	0 (0)	1 (20.0)	0 (0)	30 (11.2)
> 5000	8 (5.8)	3 (10.3)	2 (3.8)	3 (14.3)	0 (0)	1 (4.3)	0 (0)	0 (0)	17 (6.4)
Unknown	32 (23.2)	5 (17.2)	11 (20.8)	4 (19.0)	5 (41.7)	2 (28.6)	3 (60.0)	0 (0)	62 (23.2)

Medical Risk Factors of Preventable Deaths ICD10 UCOD Certain Infectious and Parasitic Diseases, Malaysia, 2016


Medical Factor	Sepsis (Community) (N=138)	Sepsis (Nosocomial Acquired) (N=29)	AGE (N=53)	Other VPD (N=21)	Tuberculosis (N=12)	Dengue (N=7)	HIV (N=5)	Encephalitis (N=2)	Total (N=267)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Facility									
Lack of critical care bed	2 (1.4)	0 (0)	0 (0)	1 (4.8)	1 (8.3)	0 (0)	0 (0)	0 (0)	4 (1.5)
Equipment									
Lack of critical care equipment	3 (2.2)	0 (0)	0 (0)	1 (4.8)	0 (0)	1 (14.3)	0 (0)	0 (0)	5 (1.9)
Lack of resuscitation equipment	1 (0.7)	0 (0)	3 (5.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1.5)
Transport									
Lack of retrieval system	3 (2.2)	0 (0)	1 (2.0)	0 (0)	1 (8.3)	0 (0)	0 (0)	0 (0)	5 (1.9)
Quality of care									
Inadequate medical expertise	19 (13.8)	0 (0)	7 (13.7)	2 (9.5)	2 (16.7)	1 (14.3)	0 (0)	0 (0)	31 (11.7)
Inadequate resuscitation	13 (9.4)	0 (0)	7 (13.7)	3 (14.3)	1 (8.3)	2 (28.6)	0 (0)	0 (0)	26 (9.8)
Inadequate stabilization before and during transfer	10 (7.2)	0 (0)	7 (13.7)	1 (4.8)	1 (8.3)	0 (0)	0 (0)	0 (0)	19 (7.2)
Insufficient human resource	1 (0.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.4)
Failure to inform senior	13 (9.4)	0 (0)	5 (9.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	18 (6.8)
Failure to inform other specialist	5 (3.6)	0 (0)	1 (2.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	6 (2.3)
Failure of combined care	1 (0.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (20.0)	0 (0)	2 (0.8)
Failure of communication	5 (3.6)	0 (0)	1 (2.0)	0 (0)	2 (16.6)	0 (0)	1 (20.0)	0 (0)	9 (3.4)
Failure to diagnose	19 (13.8)	3 (10.3)	8 (15.7)	5 (23.8)	3 (25.0)	4 (57.1)	1 (20.0)	0 (0)	43 (16.2)
Failure to appreciate severity	45 (32.6)	6 (20.7)	21 (41.2)	6 (28.6)	1 (8.3)	5 (71.4)	0 (0)	0 (0)	84 (31.7)
Inadequate, inappropriate or delay therapy	37 (26.8)	4 (13.8)	16 (31.4)	4 (19.0)	2 (16.7)	1 (14.3)	0 (0)	0 (0)	64 (24.2)
Delay in referral	25 (18.1)	2 (6.9)	11 (21.6)	3 (14.3)	1 (8.3)	1 (14.3)	0 (0)	0 (0)	43 (16.2)
Failure of home visits/defaulting tracing	6 (4.3)	2 (7.1)	3 (5.9)	0 (0)	3 (25.0)	0 (0)	3 (60.0)	1 (50.0)	18 (6.8)
Failure of adherence to protocol	4 (2.9)	1 (3.4)	1 (2.0)	1 (4.8)	3 (25.0)	0 (0)	1 (20.0)	0 (0)	11 (4.2)
Health care associated infection	6 (4.3)	22 (75.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	28 (10.6)

Non-Medical Risk Factors of Preventable Deaths ICD10 UCOD Certain Infectious and Parasitic Diseases Group, Malaysia, 2016

Non-medical Factor	Sepsis (Community) (N=138)		Sepsis (Nosocomial Acquired) (N=29)		AGE (N=53)		Other VPD (N=21)		Tuberculosis (N=12)		Dengue (N=7)		HIV (N=5)		Encephalitis (N=2)		Total (N=267)	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Socio-politic																		
Poverty/malnutrition	21 (15.2)	4 (13.8)	18 (34.6)	3 (14.3)	5 (41.7)	0 (0)	2 (40.0)	0 (0)	53 (19.9)									
Transport	13 (9.4)	0 (0)	7 (13.5)	2 (9.5)	2 (16.7)	0 (0)	0 (0)	0 (0)	24 (9.0)									
Inaccessibility/remoteness	9 (6.5)	1 (3.4)	15 (28.8)	1 (4.8)	3 (25)	0 (0)	0 (0)	1 (50.0)	30 (11.3)									
Poor living condition	5 (3.6)	1 (3.4)	8 (15.4)	1 (4.8)	3 (25)	0 (0)	0 (0)	0 (0)	18 (6.8)									
Untrained/unlicensed child minder	0 (0)	0 (0)	1 (1.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.4)									
Teenage pregnancies	1 (0.7)	2 (6.9)	1 (1.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4 (1.5)									
Substance abuse	1 (0.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (20.0)	0 (0)	2 (0.8)									
Injury prevention	1 (0.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (0.4)									
Family & patient																		
Delay in seeking treatment	65 (48.5)	3 (10.3)	42 (80.8)	10 (47.6)	6 (50.0)	2 (33.3)	2 (40.0)	1 (50.0)	131 (50.2)									
Non-compliance to advice	17 (12.3)	3 (10.3)	5 (9.6)	2 (9.5)	4 (33.3)	0 (0)	3 (60.0)	0 (0)	34 (12.8)									
Non-compliance/refuse admission	7 (5.1)	1 (3.4)	4 (7.7)	1 (4.8)	0 (0)	1 (14.3)	0 (0)	0 (0)	14 (5.3)									
Non-compliance/refusal of therapy/immunization	17 (12.3)	0 (0)	4 (7.7)	6 (28.6)	8 (66.7)	0 (0)	4 (80.0)	0 (0)	39 (14.7)									
Health philosophy (alternative treatment/cultural belief)	8 (5.8)	1 (3.4)	2 (3.8)	2 (9.5)	1 (8.3)	0 (0)	0 (0)	0 (0)	14 (5.3)									
Lack of awareness of severity of illness	51 (37.0)	3 (10.3)	24 (46.2)	7 (33.3)	4 (33.3)	1 (14.3)	2 (40.0)	1 (50.0)	93 (35.0)									

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ACKNOWLEDGEMENT

First and foremost, the investigators would like to thank Datuk Dr. Hishamshah Mohd Ibrahim, Deputy Director General (Research and Technical Support) and Dr. Sabeera Begum Kader Ibrahim, Head of Paediatric Services, Ministry of Health, Malaysia, for their support and encouragement to complete this study. We are grateful for the support and understanding extended to us from the Hospital Directors, Paediatric Head of Departments and colleagues in the Ministry of Health, the Family Health Division Director and all staff especially in the Child Health Sector, the Medical Development Division especially from the paediatric services unit, National Institute of Health and Medical Research and Ethics Committee, Ministry of Health, Malaysia.

We would also like to extend a special thank you to the following individuals for their contributions to this study:

Dato' Dr. Zainudin Mohd Ali, Dato' Dr Amar Singh HSS, Datuk Dr Faridah Abu Bakar, Dr Rozita Ab Rahman, Datin Dr. Sheamini Sivasampu, Dr Jafanita Jamaludin, Puan Nor Azizi Abu Bakar, Dr Siti Hafsa binti Abdul Halim, Dr Vaniprabha Gopal, Dr Dakshnamoorthy a/l Vythinathan, Dr Choo Minn Yin, Dr Justin Ho, Dr Pook Sow Zhung, Dr Gayathri a/p Dorai Raj, Dr Hounng Chui Tin, Dr Mohd Haqif Hasnol, Dr Chua Hooi Chee, Dr Khor Ru Yi, Dr Sarah binti Mohd Rashid, Dr Wong Lee Ching, Dr Hani Syazwani, Dr Muhammad Muizz Abdul Manan, Dr Diana Ranees a/p Anantham, Dr Heng Ming Choo, Dr Nurul Athirah bt Yaacob, Dr Maria Elina binti Zaid, Puan Norhayati Bt. Mustapa Kamal, Mohammad Muzzaqir Affan B. Mohd Zulkifli, Cutt Fazzlieanie Binti Bactiar, DK Nurshahidah Nafesah Adzim, Siti Aisyah binti Alias.

Lastly, we would like to thank everyone who has contributed directly and indirectly to this audit.


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KEMENTERIAN KESIHATAN MALAYSIA
Aras 7 & 8, Blok E10, Kompleks E
Pusat Pentadbiran Kerajaan Persekutuan
62590 Putrajaya**

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ISBN 978-967-19800-4-0



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