Current Challenges in Reducing Neonatal Morbidity and Mortality in Thailand

Pakaphan Kiatchoosakun MD*,
Junya Jirapradittha MD*, Rosawan Areemitr MD*,
Sumitr Sutra MD*, Kaewjai Thepsuthammarat PhD**

** Department of Pediatrics, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand*
*** Clinical Epidemiology Unit, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand*

Background: *Information on neonatal mortality and burden of illness during the neonatal period is an essential guide for prioritizing interventions for solving health problems and allocating resources.*
Objective: *To evaluate the burden of diseases and the current health situation among Thai neonates under the Universal Health Insurance Coverage Scheme.*
Materials and Method: *The number of admissions according to mortality, length of hospital stay and cost of hospital charges during the neonatal period was analyzed.*
Results: *There were 638,795 live births according to the data extracted from the three healthcare schemes supporting 'universal healthcare' in Thailand, which is lower than the data from the Health Information Unit of the Bureau of Health Policy and Strategy at the Ministry of Public Health. The neonatal death rate was 3.98 per 1,000 live births comprising 58.9% of all infant deaths. Major proportion of neonatal deaths (70%) occurred in early neonatal period and 43% of which occurred within the first two days of life. The leading causes of neonatal deaths were prematurity, respiratory problems, congenital malformation, birth asphyxia and infection. The most prevalent diagnosis for admissions was neonatal jaundice, disorders related to short gestation, respiratory disorders and neonatal infection.*
Conclusion: *More investment is required to improve education and implement health interventions that can be integrated into existing health systems for better neonatal outcomes.*

Keywords: *Burden of illness, Mortality, Neonate, Prematurity*

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The WHO and the UN Millennium Development Goal aimed to reduce mortality of children under-5 years of age by two-thirds between 1990 and 2015. This goal cannot, however, be achieved without decreasing neonatal deaths which are responsible for as much as 40% of all under-5 deaths[1]. The focus of childhood mortality has been on infant and under-5 mortality rates but neonatal mortality, which covers deaths in the first month after birth, has received limited attention[2]. The Thai Ministry of Public Health has launched many measures and programs for the purpose of decreasing infant mortality, including programs to improve nutrition and immunization.

Although the neonatal death rate in Thailand is not high, its rate of decline has not been significant over the past ten years and the burden of disease according to admissions data remains comparatively high[3]. Health interventions to solve the major problems attributed to neonatal deaths generally differ from those needed for other age groups. Reduction of neonatal mortality requires links in continuous care from maternal health throughout pregnancy, childbirth and early neonatal care[2]. The first month of life is also very important because it is a time of transition necessary for establishing good health behaviors that will have an impact on the child's future growth, development and overall life.

Information on neonatal mortality rate and the causes of neonatal deaths, as well as burden of illness are essential for allocating resources. Health development strategies are, however, not feasible if the data are unreliable. The gold standard for mortality rate dependability is 100% coverage and a detailed,

Correspondence to:
Kiatchoosakun P, Department of Pediatrics, Faculty of Medicine, Khon Kaen University, Khon Kaen 40002, Thailand.
Phone: 043-348-382
E-mail: pakkia@kku.ac.th

accurate civil registration system. Even though over the last two decades there have been several reforms to improve the national civil and death registrations in the vital statistics systems in Thailand, the reliability and validity of the registrations remain uncertain due to incompleteness[4]. Under-reporting of neonatal deaths is possible especially if the baby died very soon after birth, died very premature or died at home so there might not be both birth and death registration. There may also be some misclassification of stillbirths and early neonatal deaths[5].

Since 2002, Thailand's three main public health financing schemes have provided coverage for most of the population, thus an evaluation of the health situation among neonates is timely.

Objective

The objective of the present study was to estimate the burden of diseases and in-hospital mortality among neonates (under-28 days of life) in Thailand in the fiscal year 2010, using data from the three national health insurance systems.

Material and Method

The present study is part of the "Health Situation Analysis of Thai People 2010: Implications for Health Education and Health Service Reform" which was described elsewhere. The authors analyzed in-patient data from the three national insurance schemes. The data were extracted and analyzed for number of admissions, mortality rate, length of hospital stay and hospital charges. The denominator used in the calculation of hospital admissions and death rate was from the Universal Health Insurance Coverage (UC) Scheme plus The Civil Servant Medical Benefit (CSMB) Scheme because the Social Security Scheme does not cover children under-15. The data on vital statistics in 2010 were accessed from the Health Information Unit, Bureau of Health Policy and Strategy, Ministry of Public Health (MoPH).

Results

Data in 2010 from the Health Information Unit, Bureau of Health Policy and Strategy, MoPH[3] registered 761,689 live births (birth rate of 1.2%) of which 86,216 had a birth weight < 2,500 g (11.3% of live births). Within 28 days of life 3,154 infants died (neonatal death rate = 4.1 per 1,000 live births) and 5,357 infants died within the first year of life (infant death rate = 7 per 1,000 live births).

In the same year, data from government and private hospitals reimbursed from the UC and CSMB schemes documented 638,795 live births; of which 37,413 infants (or 5.9% of live births) were premature and 2,544 died within 28 days of life (neonatal death rate = 3.98 per 1,000 live births). The number of birth and death registrations from the MoPH retrieved from The Registration Administration Bureau, Department of Local Administration, Ministry of the Interior, were found to be higher than the records of in-hospital deaths because births and deaths do take place in private hospitals or other places, which would not be included in the UC or CSMB Schemes combined database.

Neonatal deaths contributed to 58.9% of all infant deaths. Of which 1,797 (or 70%) occurred within the first week of life (*viz.*, early neonatal death), 43% within the first two days and 30% within the first day of life. Deaths in neonates were mostly caused by conditions originating in the perinatal period; such as disorders related to short gestation or prematurity (ICD-10 P07 = 41.9% of neonatal mortality rate (NMR)), respiratory distress (ICD-10 P22 = 20% of NMR), congenital malformation (ICD-10 Q00-Q99 = 17.7% of NMR), birth asphyxia (ICD-10 P21 = 10% of NMR), neonatal infection (ICD-10 P35-P39 = 7.1% of NMR) (Fig. 1).

The respective proportion of neonatal deaths that occurred in tertiary, secondary, primary care and private hospitals was 52, 40, 4.6 and 2.5%. Since most infants are born in hospitals, the largest group of admissions in the neonatal period was normal live births and certain conditions originating in the perinatal period.

(1) The most prevalent cause of admissions was neonatal jaundice (ICD-10 P58-P59), accounting for 110,676 admissions (173.2 per 1,000 live births), 20 of which were kernicterus and two of them died within the first week of life.

(2) The second most common diagnosis were disorders related to short gestation and low birth weight, accounting for 37,800 admissions (59.2 per 1,000 live births) of which 1,068 infants died within 28 days of life (2.8% of infants admitted with a diagnosis of prematurity and low birth weight, ICD-10 P70).

(3) Respiratory disorders accounted for 22,781 admissions (35.7 per 1,000 live births) of which 523 infants died within 28 days of life (*i.e.*, 2.3% of infants admitted with a diagnosis of respiratory disorders, ICD-10 P22-P28, J00-98)

(4) Neonatal infection accounted for 17,205 admissions (26.9 per 1,000 live births) of which 203 infants died within 28 days of life (1.2% of infants who

admitted with diagnosis of neonatal infection, ICD-10 P35-P39, A00-B99)

(5) Congenital malformation was diagnosed in 9,684 admissions (15.2 per 1,000 live births) of which 451 infants died within 28 days of life (4.7 % of infants who admitted with diagnosis of congenital malformation, ICD-10 Q00-99)

(6) Birth asphyxia and birth injury were diagnosed in 6,858 admissions (10.7 per 1,000 live births) of which 256 infants died within 28 days of life (5.8% of infants who admitted with diagnosis of birth asphyxia, ICD-10 P21, P10-P15) (Fig. 2).

The authors analyzed the cost of hospital charges and length of hospital stay (LOS) according to the primary diagnosis (Table 1) and found that the average cost for one premature infant was 26,172 baht and the length of hospital stay was 10.4 days. The average hospital charge for extremely low birth weight infants (< 1,000 g) was 165,912 baht and the LOS was 41.3 days. Overall, the cost for prematurity was nearly one thousand million baht/year. The respective average hospital charge for (a) birth asphyxia (b) respiratory distress (c) neonatal infection such as bacterial sepsis of the newborn and (d) congenital pneumonia was (a) 18,402 baht and LOS 7 d (b) 19,476 baht and LOS 8 d (c) 13,092 baht and LOS 7.4 d and (d) 22,929 baht and LOS 10 d. The average hospital charge for neonatal jaundice was 3,154 baht and LOS 3.8 d.

Discussion

The neonatal period-the first 28 days of life-carries a higher risk of death than any other 4-week-period of human life[5]. Neonates are a major focus of child health for both mortality and morbidity reduction in developed countries. In developing countries, however, the neonatal mortality rate has attracted relatively little attention compared to maternal health and children under-5 years of age[6]. The important components for increasing attention and guiding action-different from older children-include (a) the availability of reliable neonatal mortality rates (b) causes of death and (c) distribution of diseases in the neonatal period requiring health interventions[7]. Coordinated health policies supported through the UC Scheme provide the capacity for delivering services particularly in the district health system in Thailand. The development of provincial maternal and child health committees, the introduction of safe motherhood initiatives, as well as the Saiyairak Program, have also accelerated the progress toward decreasing maternal mortality and improving neonatal outcomes[8].

Neonatal death rate in Thailand was 3.98 per 1,000 live births, which accounts for 58.9% of all infant deaths; 70% of which were during the early neonatal period. Most of the babies died within 24 hours of life which is similar to a previous study[5]. Reports show variation in the causes of neonatal death between countries and how it is associated with the level of neonatal mortality. More than half of neonatal deaths-where rates are high (> 45 per 1,000 live births)-were due to infections; where the rates are low (< 15 per

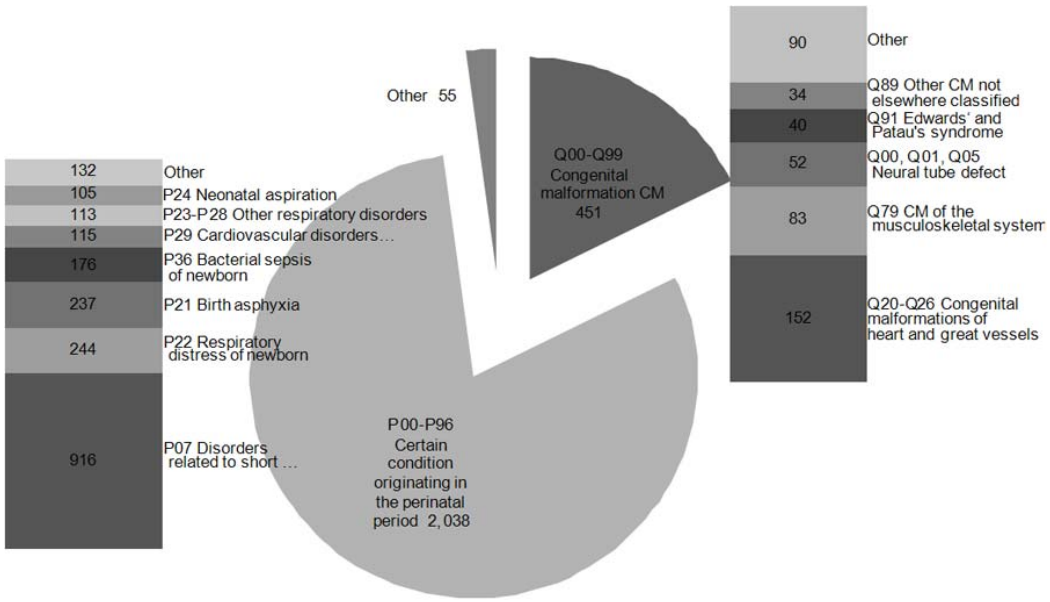

Fig. 1 Number and cause of death in infants 0-28 days after birth

1,000 live births)-to prematurity and congenital malformations[2]. In Thailand, the leading causes of neonatal deaths are prematurity, respiratory problems, congenital malformation, birth asphyxia and infection. The WHO has reported that preterm birth is a leading cause of neonatal mortality globally (*i.e.*, an estimated 28% of neonatal deaths)[2]. In Thailand, 41.9% of neonatal deaths are attributable to prematurity and low birth weight (LBW). Prematurity is also a risk factor for neonatal death associated with other complications such as infection. Improvement in neonatal intensive care has resulted in a decrease in the mortality rate of these high risk infants, however, the cost in hospital charge is very high. Because LBW may be due to prematurity, intrauterine growth restriction (IUGR) or both, so strategies to reduce incidence of LBW infants should include reduction of preterm births and prevention of IUGR, or in combination[2]. It then becomes increasingly important to find the cause and to try and prevent premature birth and LBW, as well as to properly manage the related problems.

Prevention of premature birth and LBW may be achieved by identifying high risk pregnancy, education in self-care, improvement in maternal nutrition, early detection and treatment of maternal infections, use of tocolytic and antenatal corticosteroid therapy[9]. Antibiotic treatment after rupture of the membrane may prolong gestation and reduce chorioamnionitis and neonatal sepsis[10]. In addition to early management for specific problems related to prematurity such as respiratory distress, these high risk neonates also require additional preventive measures *e.g.*, nutritional management, early breast-feeding and implementation of skin-to-skin contact with the mothers to prevent hypothermia and hypo-glycemia[1]. The positive effect of breastfeeding on neonatal mortality and morbidity has been documented[11].

Congenital malformation-including syn-dromes and chromosomal abnormalities-was the third most common cause of neonatal death in Thailand. The WHO stated that a prevention program against congenital anomalies should be implemented if the infant mortality rate is < 40 per 1,000 live births-where congenital anomalies will be the significant cause of infant deaths[12]. Accurate prenatal diagnosis can reduce mortality and morbidity from congenital malformation by providing perinatal management such as termination of pregnancy if the condition is incompatible with life. Primary prevention-through

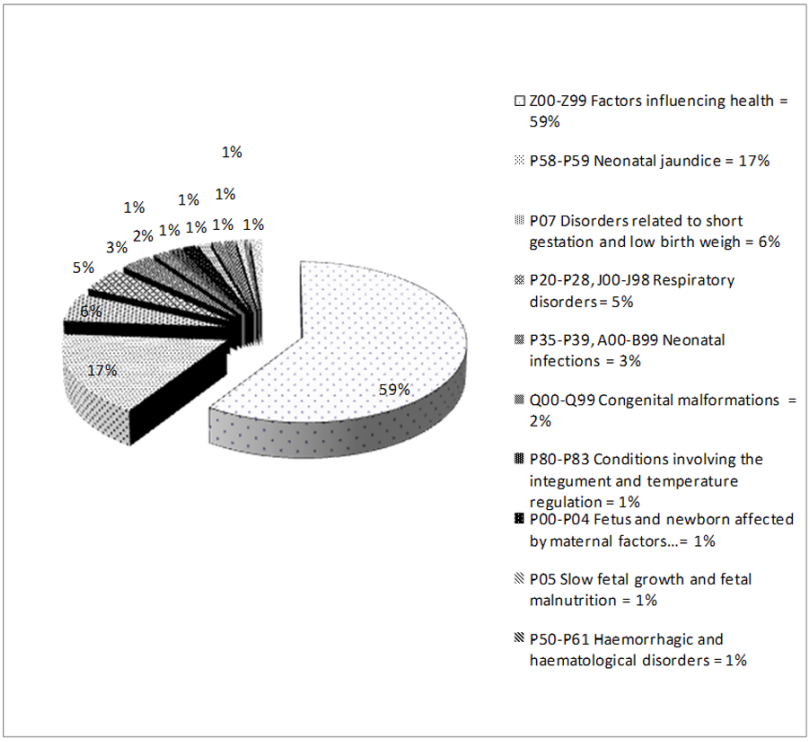

Fig. 2 Number of admissions in infants 0-28 days after birth, classified by primary diagnosis

removal of the cause-should be the primary means of reducing the incidence of congenital anomalies. The main preventive measures recommended in non-inherited congenital anomalies include (a) expansion of rubella immunization (b) family planning with encouragement of reproduction before 35 years of age (c) peri-conceptual folic acid supplementation (d) adequate prenatal nutrition (e) teratogen avoidance during pregnancy and (f) control of maternal infection[13]. Some developing countries have adopted mass prenatal screening, using maternal serum AFP and fetal ultrasound for all pregnancies to diagnose fetal anomalies, the program also includes genetic counseling, amniocentesis and termination of pregnancies in case of severe fetal anomalies as is done in developed countries[14]. Careful physical examination may be a method of secondary prevention for early detection and management by medical or surgical intervention[13].

In spite of the widely available of antenatal care, deliveries occurring in health facilities and being attended by trained health workers, asphyxia is still a major cause of both neonatal death and long-term handicaps such as cerebral palsy. Approaches to prevent asphyxia-related outcomes may include improving antenatal care by (a) identifying high-risk pregnancy (b) intra-partum care by a skilled birth attendant (c) fetal monitoring and (d) effective neonatal resuscitation[1].

More than 17,000 neonatal admissions were diagnosed as neonatal infection and 7.1% of neonatal deaths caused by infection. A key component in strengthening community-based health service is educating healthcare providers in early detection of signs and symptoms of neonatal infection-such as temperature instability and poor feeding. Infection control also requires effective prevention and intervention strategies as well as regional information of pathogen prevalence and antimicrobial susceptibility patterns[15].

Neonatal hyperbilirubinemia is one of the most important issues in Thailand because the incidence and burden of disease is so high and kernicterus-a devastating complication of bilirubin encephalopathy-continues to occur. Many cases of kernicterus could have been prevented by early bilirubin measurement and initiation of appropriate intervention with phototherapy or exchange transfusion. Detection of hyperbilirubinemia usually relies on the concern and experience of healthcare providers; that is, to visually distinguish between physiologic and clinically significant hyperbilirubinemia for the infant's age, specified on the hour, so as to determine the need of bilirubin measurements.

Most infants are now being discharged early (within 48 hours after birth), which is before the usual

Table 1. Hospital charge and length of stay according to primary diagnosis

Primary Diagnosis	Number	Hospital charge (baht)		Length of stay (day)	
		Total	Mean	Total	Mean
P07 Disorders related to short gestation and low birth weigh	37,801	989,347,323	26,173	394,655	10.4
P58-59 Neonatal jaundice	110,677	349,275,362	3,155	408,144	3.7
P22 Respiratory distress of newborn	12,993	253,573,907	19,516	105,173	8.1
P36 Bacterial sepsis of newborn	16,246	189,071,196	11,638	119,145	7.3
P23 Congenital pneumonia	4,875	112,078,265	22,990	48,683	10.0
P21 Birth asphyxia	4,415	81,255,330	18,404	32,334	7.3
P24 Neonatal aspiration syndromes	4,625	70,100,739	15,157	30,075	6.5
Q79 Congenital malformations of the musculoskeletal system	610	58,639,373	96,130	13,768	22.6
P05 Slow fetal growth and fetal malnutrition	7,976	46,111,355	5,781	34,371	4.3
P70 Transitory disorders of carbohydrate metabolism specific to fetus and newborn	6,574	33,804,189	5,142	27,930	4.2
Q25 Congenital malformations of great arteries	415	32,013,406	77,141	5,480	13.2
Q20 Congenital malformations of cardiac chambers and connection	149	27,695,709	185,877	3,343	22.4
Q39 Congenital malformations of esophagus	120	18,876,696	157,306	3,808	31.7
P55 Hemolytic disease of fetus and newborn	4,472	18,276,857	4,087	19,168	4.3
P81 Other disturbances of temperature regulation of newborn	6,959	17,178,541	2,469	23,563	3.4
Q41 Congenital absence atresia and stenosis of small intestine	202	16,986,483	84,091	4,920	24.4
P08 Disorders related to long gestation and high birth weight	4,760	15,229,216	3,199	16,340	3.4

peak of bilirubin levels. As a consequence, the most common reason for re-admission among neonates is the need for phototherapy. Since the catastrophic effects of kernicterus are so high and the costs and risks of screening relatively low, transcutaneous bilirubinometer should be used as a universal pre-discharge bilirubin screening to prevent severe hyperbilirubinemia and subsequent bilirubin encephalopathy. However, current evidence is insufficient grounds for recommending it as a practice guideline[16]. Ideally, there should be a follow-up within 48 hours after discharge because Thai infants are at risk of severe hyperbilirubinemia[16]. Mothers should, therefore, be educated to ensure that the infants are doing well and receiving adequate breastfeeding.

Even though the neonatal mortality rate in Thailand is quite low but the burden of diseases in neonatal period is very high in terms of admissions and cost of hospital charge.

One of the greatest challenges is to educate healthcare professionals to provide early recognition and appropriate management of problems during the neonatal period, including referral or, if possible, delivery of those with serious illness at more advanced facilities. Public concern needs to be raised so that the provision of high quality maternal and newborn services will be accomplished. In the interim, resource allocation should prioritize improvement of neonatal intensive care services at secondary and tertiary care centers since more than 90% of neonatal deaths occurred in those facilities.

Suggestion

More investment is required to improve pregnancy outcomes and neonatal care within the existing healthcare system. The majority of neonatal deaths could be prevented with low cost interventions that can be delivered at community level, including appropriate antenatal care highlighting (a) the importance of nutrition (b) self-care (c) prevention of preterm delivery (d) intrapartum care (e) neonatal care with effective neonatal resuscitation (f) breast-feeding (g) standard newborn care and (h) prevention of infection.

Study limitations

Some limitations of the present study merit consideration. In terms of methods for data analysis-using information from primary through tertiary care hospitals throughout the country-the reliability and validity of the results depend on correct diagnosis and coding, so misclassification biases may have occurred.

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Potential conflicts of interest

None.

References

1. Bhutta ZA, Darmstadt GL, Hasan BS, Haws RA. Community-based interventions for improving perinatal and neonatal health outcomes in developing countries: a review of the evidence. Pediatrics 2005; 115: 519-617.
2. Lawn JE, Zupan J, Begkoyian G, Knippenberg R. Newborn survival. In: Jamison DT, Breman JG, Measham AR, Alleyne G, Claeson M, Evans DB, et al., editors. Disease control priorities in developing countries. 2nd ed. Washington, DC: World Bank; 2006: 531-49.
3. Bureau of Policy and Strategy, Ministry of Public Health, Thailand. National health statistic 2010 [Internet]. 2010 [cited 2011 Dec 20]. Available from: http://bps.ops.moph.go.th/Healthinformation/statistic53/statistic53.pdf
4. Rao C, Porapakkham Y, Pattaraarchachai J, Polprasert W, Swampunyalert N, Lopez AD. Verifying causes of death in Thailand: rationale and methods for empirical investigation. Popul Health Metr 2010; 8: 11.
5. Lawn JE, Cousens S, Zupan J. 4 million neonatal deaths: when? Where? Why? Lancet 2005; 365: 891-900.
6. Shiffman J. Issue attention in global health: the case of newborn survival. Lancet 2010; 375: 2045-9.
7. Oestergaard MZ, Inoue M, Yoshida S, Mahanani WR, Gore FM, Cousens S, et al. Neonatal mortality levels for 193 countries in 2009 with trends since 1990: a systematic analysis of progress, projections, and priorities. PLoS Med 2011; 8: e1001080.
8. Acuin CS, Khor GL, Liabsuetrakul T, Achadi EL,

Htay TT, Firestone R, et al. Maternal, neonatal, and child health in southeast Asia: towards greater regional collaboration. Lancet 2011; 377: 516-25.
9. Roberts D, Dalziel S. Antenatal corticosteroids for accelerating fetal lung maturation for women at risk of preterm birth. Cochrane Database Syst Rev 2006; (3): CD004454.
10. ACOG Committee Opinion No. 445: antibiotics for preterm labor. Obstet Gynecol 2009; 114: 1159-60.
11. WHO Collaborative Study Team on the Role of Breastfeeding on the Prevention of Infant Mortality. Effect of breastfeeding on infant and child mortality due to infectious diseases in less developed countries: a pooled analysis. Lancet 2000; 355: 451-5.
12. World Health Organization. Prevention and care of genetic diseases and birth defects in developing countries. Geneva: WHO; 1999. (WHO/HGN/GL/WAOPBD/99.1).
13. Darmstadt GL, Black RE, Santosham M. Research priorities and postpartum care strategies for the prevention and optimal management of neonatal infections in less developed countries. Pediatr Infect Dis J 2000; 19: 739-50.
14. Penchaszadeh VB. Preventing congenital anomalies in developing countries. Community Genet 2002; 5: 61-9.
15. Heredero L. Medical genetic services in Cuba. In: Penchaszadeh VB, Beiguelman B, editors. Medical genetic services in Latin America. Geneva: World Health Organization; 1998. (WHO/HGN/CONS/MGS/98.4).
16. Newman TB. Universal bilirubin screening, guidelines, and evidence. Pediatrics 2009; 124: 1199-202.

การลดอัตราตายและความพิการในทารกแรกเกิดในประเทศไทย: ปัญหาที่ท้าทาย

ผกาพรรณ เกียรติชูสกุล, จรรยา จิระประดิษฐา, รสวันต์ อารีมิตร, สุมิตร สุตรา, แก้วใจ เทพสุธรรมรัตน์

ภูมิหลัง: *ข้อมูลเกี่ยวกับอัตราตายและภาระโรคของทารกแรกเกิดมีความสำคัญในการเรียงลำดับการแก้ปัญหาสุขภาพรวมทั้งการบริหารจัดการทรัพยากรอย่างเหมาะสม*

วัตถุประสงค์: *เพื่อประเมินภาวะสุขภาพและภาระโรคของทารกแรกเกิดที่อยู่ในระบบหลักประกันสุขภาพแห่งชาติ*

วัสดุและวิธีการ: *การวิจัยได้ใช้ข้อมูลการเจ็บป่วยและอยู่รักษาในโรงพยาบาลการเสียชีวิต จำนวนวันนอนค่าใช้จ่ายที่โรงพยาบาลส่งเบิกจ่ายจากระบบหลักประกันสุขภาพแห่งชาติในปี พ.ศ. 2553*

ผลการศึกษา: *จากข้อมูลของระบบหลักประกันสุขภาพแห่งชาติในปี พ.ศ. 2553 มีทารกเกิดมีชีพ 638,795 ราย ซึ่งต่ำกว่ารายงานของกลุ่มภารกิจด้านข้อมูลข่าวสารและสารสนเทศสุขภาพ สำนักนโยบายและยุทธศาสตร์ กระทรวงสาธารณสุขที่ได้ข้อมูลจากสำนักบริหารการทะเบียน กรมการปกครอง กระทรวงมหาดไทย อัตราตายของทารกแรกเกิดเท่ากับ 3.98 ต่อทารกเกิดมีชีพ 1,000 ราย คิดเป็นร้อยละ 58.9 ของการตายในทารกขวบปีแรก อัตราตายทารกแรกเกิดระยะต้นเท่ากับร้อยละ 70 ของการตายในทารกแรกเกิด โดยทารกร้อยละ 40 ตายใน 2 วันแรกของชีวิต สาเหตุการตายที่สำคัญคือการเกิดก่อนกำหนดและน้ำหนักแรกเกิดน้อย ปัญหาทางระบบหายใจ ความพิการแต่กำเนิด ภาวะขาดออกซิเจนปริกำเนิด และการติดเชื้อ สาเหตุที่พบบ่อยที่สุดของการที่ทำให้ทารกต้องอยู่รักษาในโรงพยาบาลคือภาวะตัวเหลือง รองลงมาได้แก่ การเกิดก่อนกำหนดและน้ำหนักแรกเกิดน้อย ปัญหาทางระบบหายใจ และการติดเชื้อ*

สรุป: *แม้ว่าการตายในทารกแรกเกิดจากข้อมูลที่ได้มีอัตราที่ต่ำแต่ภาระโรคยังสูงมาก ดังนั้นการเพิ่มสมรรถนะบุคลากรทางการแพทย์ในการดูแลมารดาและทารก รวมทั้งพัฒนาการบริการด้านสุขภาพ โดยสอดแทรกเข้ากับระบบบริการสุขภาพที่มีอยู่เดิมจึงมีความสำคัญเพื่อช่วยให้ผลการดูแลรักษาทารกแรกเกิดมีประสิทธิภาพและประสิทธิผลดียิ่งขึ้น*