Evaluation of preterm and low birth weight morbidity, mortality and standards of care in Lao PDR

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Abstract

Objective: we aimed to investigate the possible causes of death among preterm and LBW infants admitted to the post-delivery ward and/or NICU at Mahosot Hospital, Lao PDR, and the possible factors that influence preterm and LBW infants' survival.

Methods: A retrospective cross-sectional study was conducted between by reviewing the treatment and outcomes for preterm and LBW infants admitted July - November 2017 to Mahosot Hospital in Vientiane, Lao PDR.

Results: Of 3,500 births in 2017, 224 (6.4%) were preterm, 350 (9.4%) were LBW and 106 (30.2%) were term LBW; 98 preterm births (43.8%) and 21 (19.8%) term LBW babies were admitted to the NICU. Enrolment included 93 cases including 86 (92.5%) preterms and 7 term LBW neonates, of whom 47 (54.7%) and 2 were admitted to NICU, respectively. Enrollees were mostly male, Lao Loum, born vaginally at Mahosot Hospital; 3.2% were extreme preterm, 15.1% were very preterm, 74.2% moderate to late preterm and 7.5% term LBW; 2.2% were extremely LBW, 16.1% very LBW, 63.4% LBW and 18.3% normal birth weight. All 44 (47.3%) preterm or LBW babies admitted to the postnatal ward survived. Of the 49 (52.7%) admitted to the ICU, 18.4% died. All neonates who died were preterm of gestational age ranging 25-36 weeks and birth weight 730-2220g. Babies admitted to the NICU were mostly diagnosed with respiratory distress syndrome (RDS, 39.7%), neonatal infections (31.7%), asphyxia (9.5%) and congenital malformations (4.8%). *Patient care*. *Antenatal*: 5.9% of preterm births <32 weeks received magnesium sulfate, and 27% of births 24-34 weeks gestational age received antenatal steroids. *Postnatal*: 37.6% received skin-to-skin contact (SSC), and 15% maintained SCC until breastfeed completed, 68.8% received exclusive breastmilk as first feed and 24.5% kangaroo mother care. Only 7.5% were monitored for hypoxemia and 24.7% for hypothermia. Weights were not checked prior to discharge. *Case management*: Around two-thirds of babies with risk factors for sepsis received prophylactic antibiotics. Most (77.6%) babies during the NICU admission received antibiotics, all of whom had a CBC and blood culture; but half without a diagnosis of sepsis or risk factors. Most (79.6%) preterm and LBW babies admitted to the NICU were given oxygen. About one-quarter of babies with RDS died. Very LBW infants rarely received supplementation with vitamin D, phosphate, iron and calcium.

Conclusions: Most study participants were late preterm and LBW. Just under 10% died. Care can be improved, including antenatal administration of magnesium sulfate and antenatal steroids that needs to be vastly increased for eligible mother in preterm labor. Respiratory management needs further investigation for gaps. Feeding with breastmilk and checking vital signs appear to be strengths.

Keywords: Low birth weight, Mortality, Lao PDR

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Introduction

Newborn infants in Lao PDR are estimated to have the highest rate of death within the Western Pacific Region (WHO WPRO, 2014) and are estimated to account for 45% of all under-five deaths, with 12% of these thought to be due to preterm complications, although the exact reasons are unknown. While prematurity is the leading cause of under-5 deaths, the exact causes of death in premature infants is often unknown or not documented (Milner et al, 2013).

In 2013, the Lao Ministry of Health in collaboration with the World Health Organisation (WHO) and partners introduced the Early Essential Newborn Care (EENC) program to improve newborn care and reduce newborn deaths in Laos

(WHO WPRO, 2014a, 2014b). It is estimated that by implementing simple low cost interventions in the first few days of life, such as those embedded in the EENC program, overall newborn mortality could be reduced by up to 75% (Darmstadt et al., 2005).

In many countries, health care-acquired infections account for more than half of neonatal deaths. Newborns are at higher risk of acquiring health care-associated infection in developing countries, with infection rates three to 20 times higher than in high-income countries (WHO Global Alert and Response 2015). Poor hand hygiene is a major contributor. Thus, EENC starts with good quality hand hygiene. Immediately after birth, babies are dried and put in skin-to-skin contact (SSC) with their mothers which has many known benefits to the newborn baby including thermal regulation, reduction in hypoglycemia and improved bonding. Hypothermia can cause delayed foetal-to-newborn circulatory adjustment, acidosis, hyaline membrane disease, coagulation defects, infection and brain haemorrhage (Tunnel et al, 2000). This is even more so the case for preterm and low birth weight infants because of their low reserves, immature organs and high surface area compared to their weight (WHO WPRO, 2018). Every second of exposure to the outside environment results in heat loss via evaporation, conduction, convection and radiation. Thorough drying, direct SSC immediately upon delivery and covering with a blanket and bonnet (prior to cord clamping) mitigate this threat (WHO, 1993). Sustained SSC also initiates colonization of the newborn with maternal flora (as opposed to hospital flora) and facilitates olfactory learning, successful intake of colostrum and sustained breastfeeding (Mizuno et al, 2004; Moore et al, 2016). Breastfeeding is associated with fewer child infections, increases in intelligence, and probable reductions in overweight and diabetes (Victora et al, 2016). Breastfeeding initiation within the first hour is associated with a dose-related reduction in infection-related deaths compared to delayed breastfeeding initiation. It also increases the likelihood of sustained breastfeeding (Edmond et al, 2007). In a study across 8 countries including 150 hospitals, the duration of uninterrupted SSC showed a strong dose–response relationship with early initiation of breastfeeding through 90 min after birth. Furthermore, exclusive breastfeeding at discharge was strongly associated with uninterrupted SSC of 30–59, 60–89 and above 90 min after birth, regardless of mode of delivery (Li et al, 2020). Delaying cord clamping until cord pulsations stop, typically around one to three minutes, reduces the risk of anaemia (McDonald et al, 2013). Furthermore, in preterm infants, delayed cord clamping is associated with less need for transfusion, better circulatory stability, less intraventricular haemorrhage (all grades) and lower risk for necrotising enterocolitis (Rabe et al, 2012). Near continuous kangaroo mother care has numerous benefits for preterm and low birth weight infants, the most striking of which is a 40% reduction in neonatal mortality (Conde-Agudelo et al, 2016). In a pre-post study in Da Nang Hospital for Women and Children, Viet Nam, a total of 13,201 live births were delivered pre- and 14,180 live births post-EENC introduction. Post-EENC, delivery practice scores, rates of early and prolonged SSC and early breastfeeding rose significantly. NICU admissions (relative risk [RR] 0.68; 95% confidence interval [CI] 0.64–0.71; $p < 0.0001$), hypothermia on NICU admission (RR 0.72; 95% CI 0.65–0.81, $p < 0.0001$) and sepsis (RR 0.28; 95% CI 0.23–0.35, $p < 0.0001$) all decreased. Meanwhile, exclusive breastfeeding rates in NICU increased from 49% to 88% ($p < 0.0001$) and of kangaroo mother care (KMC) from 52% to 67% ($p < 0.0001$). Reduced formula use resulted in decreased monthly costs. (Tran et al, 2018). Another study showed that in the Philippines, newborn care practices have vastly and sustainably improved between 2008 and 2015 using EENC (Silvestre et al, 2018).

EENC has been widely implemented in the Western Pacific Region. By August 2017, 3366 facilities had introduced Early Essential Newborn Care (EENC) and 30 251 staff had been coached, with Cambodia and the Philippines achieving the regional Action Plan target of 80% of facilities adopting EENC. Term babies had improving rates of immediate SSC contact (75%), sustained STS contact until the first breastfeed (57%) and exclusive breastfeeding (85%). EENC teams had been formed by 55% of hospitals, a dramatic improvement from 2015, but only 19% conducted the routine quality of care assessments essential for sustaining practice. Overuse of caesarean section remains common in many countries but only 26% babies born by caesarean section receive EENC. High rates of separation of stable preterm babies and babies born by caesarean section for observation increases risk of hypothermia, infection and death (WHO WPRO, 2018).

Preterm babies account for half of all newborn deaths and benefit from EENC. However, they receive far less attention historically. In EENC assessments, they were less likely than term babies to receive immediate SSC (56%), breastfeeding without separation (29%) and exclusive breastfeeding (69%). Kangaroo Mother Care (KMC) was received by 35% of preterm babies, an increase from 7% in 2015, but only 15% received it for at least 18 of the previous 24 hours. Lao PDR at the time of data collection for this thesis, KMC had not yet been introduced (WHO WPRO, 2018).

As a result of these findings the Lao EENC team has requested assistance in further evaluating the case management of preterm and low birth weight (LBW) infants in Lao PDR to look at outcomes and opportunities for improvement in preterm and LBW care. This study aimed to evaluate preterm and low birth weight infants at all infants admitted to Mahosot Hospital, within the first 28 days of life who were born prematurely or with low birth weight. These infants were reviewed daily and information about their conditions, management and outcomes were collected. By collecting this research from this cohort of infants we provide how premature infants were cared for, and the areas where practice is misaligned with recommended management. The burden of prematurity and low birth weight infants in Lao PDR a central hospital was evaluated.

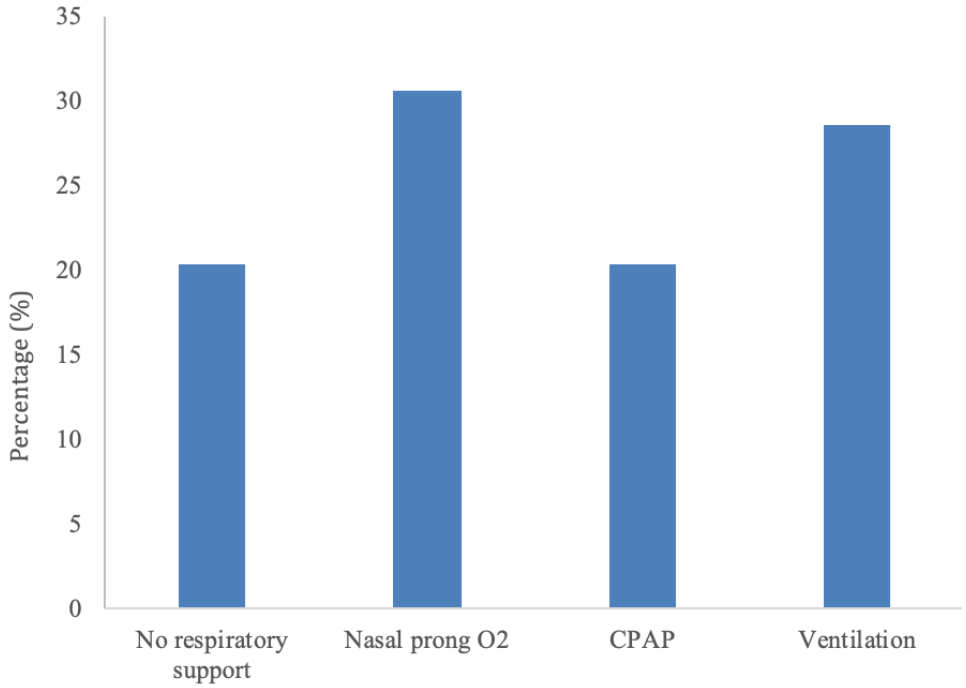

Figure 1. Respiratory support needed by subjects admitted to the NICU, Mahosot Hospital, 1 July - 26 November 2017.

Methodology

Study design:

A descriptive cross-sectional study was conducted for reviewed the treatment and outcomes for preterm and LBW infants admitted to Mahosot Hospital in Vientiane, Lao between July - November 2017.

Study population:

Our population was selected from NICU from Mahosot Hospital.

- Inclusion criteria: neonates with birth weight < 2500 g and/or gestation <37 weeks admitted to post-delivery or NICU wards at Mahosot Hospital with a parent has consented to involvement in the study
- Exclusion criteria: any infant >28 days of age at the time of admission to Mahosot Hospital

Research time and instruments:

The study team comprised of Lao paediatricians and paediatric residents working in the NICU from Mahosot Hospital.

Each day a NICU paediatric resident visited the delivery room, post-delivery ward and NICU to screen for study participants. Screening entailed reviewing the admission book and asking the doctors and nurses on the ward. If eligibility was confirmed (according to inclusion and exclusion criteria), a unique study ID was allocated to the study participant and their details recorded in the enrolment book. The study team approached eligible participants, explained the study aims and approach and obtained informed consent from the study participant parent (Annex 1).

Once enrolment was completed, the study team used the patient medical record to complete the details on a standardised case record form (CRF, Annex 2). Details were clarified with the health staff responsible or the guardian for the participant if the study team was unable to find the information in the medical record. Details recorded included antenatal history, birth details, condition of the newborn infant at birth, diagnoses, complications, and management and monitoring that occurs during the admission.

The study team assessed the study participants for new morbidities daily until the final outcome of

discharge or death. If any new morbidity had developed, the details were added to the CRF. At discharge, outcomes were entered into the CRF and a photocopy of the medical records were obtained. This was kept with the case record form in a secured storage within the study office.

It is estimated that approximately 15-20 preterm and/or LBW infants are admitted to NICU at Mahosot Hospital each month each month.

Data was collected on a standardised paper CRF. Data was then entered into KoBo Toolbox, a free open-source tool for mobile data collection. The data was then exported and statistical analysis completed in SPSS statistical program, Version 26.

Sample size and sampling method:

No calculation of the sample size was made

Ethical considerations:

Ethical approval from Human Research Ethic Committees, Ministry of Health was obtained on 11 January 2016.

Statistical Analyses:

Data obtained was entered into Microsoft Excel (ME) and analysed using SPSS software (version 20.0) Descriptive analyses of all the explanatory and outcome variables were done using mean and standard deviation for quantitative variables, frequency and percentages for categorical variables.

Table 1. Enrolment, place of admission and outcome per gestational and birth weight age categories, n (%), Mahosot Hospital, 1 July - 26 November 2017.

Variable	Total enrolled	Admitted to NICU	Not admitted to NICU	Died
	N = 93	N = 49 (52.7)	N = 44 (47.3)	N = 9 (9.8)
Gestation	**N (%)**	**N (%)**	**N (%)**	**N (%)**
<28	3 (3.2)	3 (100)	0 (0)	3 (100)
28-31	14 (15.1)	14 (100)	0 (0)	3 (21.4)
32-<37	69 (74.2)	30 (43.5)	39 (56.5)	3 (4.3)
>37	7 (7.5)	2 (28.6)	5 (71.4)	0 (0)
Birthweight (g)				
<1000	2 (2.2)	2 (100)	0 (0)	2 (100)
1000 to <1500	15 (16.1)	15 (100)	0 (0)	3 (20)
1500 to <2500	59 (63.4)	32 (54.2)	27 (45.8)	4 (6.9)
>2500	17 (18.3)	0 (0)	17 (100)	0 (0)

Results

Total births, gestational age, birthweight, place of admission and data completeness

Of the total 3500 births in 2017, 224 (6.4%) were preterm, 350 (9.4%) were low birth weight. Of the low birth weight babies, 106 (30.2%) were term but low birth weight. A total of 98 preterm births (43.8%) and 21 (19.8%) term low birth weight babies were admitted to the NICU. Enrolment included 93 cases which including 86 (92.5%) preterm, 47 (54.7%) of whom admitted to NICU. Of the seven term LBW neonates, two went to NICU and five went to post-delivery ward. Of the 93 preterm or low birth weight babies in the study population, 3 (3.2%) were extreme preterm, 14 (15.1%) were very preterm, 69 (74.2%) were moderate to late preterm and 7 (7.5%) were term babies. Of the 93 preterm or low birth weight babies in the study population, 2 (2.2%) were extremely low birth weight, 15 (16.1%) were very low birth weight, 59 (63.4%) were low birth weight, 17 (18.3%) were normal birth weight (Table 1).

Mortality and morbidity

All 44 preterm or low birth weight babies admitted to the postnatal ward survived and were discharged well. Of the 49 admitted to the ICU, 9 (18.4) died, 5 (10.2%) were discharged unwell and 14 (28.6%) had a poor outcome. All neonates who died were preterm of gestational age ranging 25-36 weeks and birth weight 730-2220g.

Table 2. Demographics and route of delivery, Mahosot Hospital, 1 July - 26 November 2017.

Variable	Total enrolled (N = 93) N (%)
Sex	
Male	53 (57)
Female	40 (43)
Ethnicity	
Lao Loum	91 (97.8)
Hmong	2 (2.2)
Place of birth	
Study hospital	86 (92.5)
Non study hospital	5 (5.4)
Home	1 (1.1)
Other	1 (1.1)
Type of delivery	
Vaginal birth	75 (80.6)
Caesarean section	17 (18.3)

The three extreme preterm babies all were admitted to the NICU and died. Of the 14 very preterm babies, all were admitted to the NICU, 3 (21.4%) died, 1 (7.1%) were discharged unwell and 10 (71.4%) were discharged well. Of the 69 moderates to late preterm, 30 (43.5%) were admitted to the NICU, 3 (4.3%) died, 4 (5.8%) were discharged unwell and 61 (88.4%) were discharged well. Finally, all 7 low birth weight term babies were discharged well. In total, 9 (9.6%) died, 5 (5.3%) were discharged unwell and 78 (83.8%) were discharged well (Table 1).

Table 3. Proportion of mothers of at-risk preterm babies receiving magnesium sulfate and antenatal steroids, Mahosot Hospital, 1 July - 26 November 2017

Intervention, N	Number eligible received, n (%)
Magnesium Sulfate for <32 weeks GA, N = 17	1 (5.9)
Antenatal steroids for 28-34 weeks GA*, N=37	10 (27.0)

*Without evidence of maternal infection including fever during labor, prolonged rupture of membranes or purulent or foul-smelling amniotic fluid.

Demographics and route of delivery

Babies were mostly male, Lao Loum, born vaginally at Mahosot Hospital (Table 2).

Current case management for preterm and low birthweight babies

Antenatal care

Very few mothers of babies needing neural protection or antenatal steroids for lung maturity received these medicines (Table 3).

Postnatal care

Of all 93 babies, 35 (37.6%) received skin-to-skin contact (SSC), 14 (15.0%) were maintained there through a completed breastfeed and 64 (68.8%) the first feed was exclusively breastmilk. Of the 49 admitted to the NICU, only 1 (2.0%) received SSC, but not through a completed breastfeed and 23 (46.9%) the first feed was exclusively breastmilk. Of the babies not admitted to the NICU, 34 (77.2%) received SSC which was maintained through a complete breastfeed and 42 (95%) the first feed was exclusively breastmilk. Of the 49 admitted to the NICU 12 (24.5%) received KMC (Table 4).

Resuscitation was reportedly given to 18 (19.4%) of all 93 babies and 7 (7.5%) suctioned, all of whom admitted to the NICU. Checking of oxygen in the delivery room was rarely done and temperature was checked for about a quarter, all of whom were on the postnatal ward. Vital signs seemed to have been checked routinely but repeat weights were not checked prior to discharge for any baby (Table 4).

Prevention and management of common conditions

Sepsis

There were 10 cases within the cohort who were identified to have risk factors for sepsis. Seven of these cases went to NICU and had a CBC and Blood culture performed and received appropriate antibiotics. However, three cases with sepsis risk factors were admitted to the post-delivery ward and did not get any investigations or antibiotics.

Of the 49 neonates admitted to the NICU 38 (77.6%) neonates, were given antibiotics. As mentioned, seven of these had documented risk factors for sepsis and an additional 12 cases were diagnosed with sepsis. However, 19 (50%) cases admitted to NICU were given antibiotics without a diagnosis of sepsis or risk factors. All neonates who were given antibiotics were investigated with a CBC and blood culture. There were no lumbar punctures documented within the cohort.

Respiratory Distress

Of the 49 NICU admissions, 39 (79.6%) received some form of respiratory support: 15 (30.6%),

oxygen by nasal prongs, 10 (20.4%) CPAP, and 14 (28.6%) ventilation (Figure 1). Of the 25 neonates diagnosed with Respiratory distress syndrome (RDS) all received respiratory support with 44% requiring ventilation and 40% requiring CPAP. Poor outcomes were high with a case fatality rate of 28% and an additional 8% discharged unwell. Thirteen (26.5%) had conditions other than sepsis including birth asphyxia, 7 (14.2%), congenital heart disease, 3 (4.0%), jaundice, 3 (6.1%); anaemia, hypoglycemia, ABO incompatibility, Down Syndrome, hypothermia all had 1 (2.0%); 4 (8.1%) had multiple conditions.

Management of Very Low Birthweight Infants

Very Low Birthweight Infants babies rarely received needed supplements (Table 5).

Discussion

Of 3500 total births, 224 (6.4%) were preterm and 350 (9.4%) were low birth weight. This compares to an estimated 10% of preterm for Lao PDR as a whole.

The study included 93 preterm or low birthweight infants during July-November 2017. Of the 87 preterm babies with data, 3 (3.4%) being extremely premature and 14 (20.3%) very preterm has slight over-representation of these categories compared to global averages. One might expect a tertiary care center to have a higher representation of extremely and very preterm babies than it does.

All three extremely preterm babies had died. However, very preterm (71.4%) and especially moderate and late preterms (88.4%) and term LBW (100%) had much higher rates of being discharged well. Overall 9.6% of preterm and low birth weight babies had died and 5.3% were discharged unwell. As all babies triaged to the postnatal ward were discharged well, triaging may be a strength of the hospital; however, the data does not include those originally in the postnatal ward and transferred to the NICU. About one-fifth (19.4%) of the babies received resuscitation. Neonates with respiratory distress syndrome had high mortality.

Table 4. Proportion of newborns receiving key postnatal interventions, Mahosot Hospital, 1 July – 26 November 2017

Variable	Total enrolled	Admitted to NICU	Not admitted to NICU
	N = 93	N = 49 (52.7)	N = 44 (47.3)
EENC	**N (% of total)**	**N (% of NICU)**	**N (% of not NICU)**
Skin to skin	35 (37.6)	1 (2.0)	34 (77.2)
Skin to skin until BF	14 (15.0)	0	34 (77.2)
First feed EBM (Breastfeed or orogastric)	64 (68.8)	23 (46.9)	42 (95.5)
Kangaroo mother care (KMC) (at any stage)		12 (24.5)	not documented
Delivery room care			
Resuscitation	18 (19.4)	18 (36.7)	0 (0)
Suctioning	7 (7.5))	7 (14.2)	not documented
Temperature check	23 (24.7)	0	23 (100)
Oximetry	7 (7.5)	0	7 (100)
Postnatal ward or NICU			
Vital signs checked	49 (100)	44 (100)	
Repeat weight checked prior to discharge	0		

Preterm and low birthweight infants were more likely to be male. This is a known phenomenon as males tend to have poorer neonatal outcomes overall. The population was overwhelmingly Lao Loum which is consistent with the population served by the hospital. Minorities besides Hmong were not found. Births included were primarily (92.5%) were born in the hospital but a small percentage were referred (5.4%) or born at home or elsewhere (1.1%). Most (80.6%) were born vaginally. The use of magnesium sulfate is recommended for women at risk of imminent preterm birth before 32 weeks of gestation for prevention of cerebral palsy in the infant and child;

however, only a few percentage (5.9%) of babies were recorded to have received it (WHO, 2014b, 2015). Skin-to-skin contact benefits newborn babies including preterm and low birth weight babies through improved thermal regulation, reduction in hypoglycemia and improved bonding. The duration of uninterrupted SSC was found in another study to have a strong dose–response relationship with early initiation of breastfeeding through 90 min after birth and exclusive breastfeeding at discharge. This was regardless of mode of delivery. About one-third (37.6%) and were placed in skin-to-skin contact (SSC), 15% maintained SSC through a completed breastfeed and two-thirds (68.8%), the first feed was exclusively breastmilk. Virtually none admitted to the NICU received SSC, yet half (46.9%) received exclusive breastmilk and a quarter (24.5%) received KMC. For those not admitted to the NICU most (77.2%) received SSC which was maintained through a complete breastfeed and 42 (95%) the first feed was exclusively breastmilk. Preterm and low birth weight babies are at risk of hypoxemia and hypothermia but only 7.5% and 24.7% had oxygenation and temperature checked. Vital signs seemed to have been checked in NICU four times in the NICU and at least once in the postnatal ward (but it is not clear how many times). Weights were not checked prior to discharge. Most babies meeting this definition received CBC, blood culture and appropriate antibiotics. However, one-third did not. Most (77.6%) at some point during the NICU admission received antibiotics, all of whom had a CBC and blood culture; however, half were given antibiotics without a diagnosis of sepsis or risk factors. Most (79.6%) preterm and low birth weight babies admitted to the NICU were given some form of respiratory support. Of the neonates diagnosed with RDS, about one-quarter (28%) died and 8% discharged unwell. Very low birthweight infants are at high risk of metabolic imbalances and need supplementation. However, 6.7% received vitamin D and phosphate, 13.3% received iron and 26.7% received calcium. Missing data was noted but probably did not greatly change the meaning of the results. It is unclear if all the babies receiving resuscitation (19.4%), suction (7.5%) and respiratory support (79.6%) received it appropriately and of good quality. Some interventions known to help preterm and low birth weight babies survive were either not measured. First, near continuous kangaroo mother care (at least 20 of 24 hours a day) is known to reduce mortality among low birth weight babies by 40% (Conde-Agudelo et al, 2016). Only one-quarter (24.5%) received KMC but it is not clear how many hours a day it was performed. Second, drying, which prevents hypothermia and its many complications, was not measured (Tunnel et al, 2000). Thirdly, delayed cord clamping, shown to be associated with less need for transfusion, better circulatory stability, less intraventricular haemorrhage (all grades) and lower risk for necrotising enterocolitis (Rabe et al., 2012), was not measured although EENC had already been introduced. The latter two limitations were inherent in the study design as getting an accurate measure would have required observation.

Table 5. Proportion of 15 very low birthweight infants that received appropriate supplementation, Mahosot Hospital, 1 July - 26 November 2017.

Supplement, N=15*	Number received (%)
Vitamin D	1 (6.7)
Calcium	4 (26.7)
Phosphate	1 (6.7)
Iron	2 (13.3)

*** 3 (20%) had missing data**

Finally, an alarming study in seven countries including Lao PDR showed major gaps in water, sanitation and hand hygiene. Of all hospital delivery rooms, 77% had a sink with water and soap or alcohol hand rub, 78% in neonatal care rooms and 42% in postnatal care rooms. Only 44% of hospitals had clean sinks with water, soap and hand drying methods in the delivery room, 40% in neonatal care units and 10% in postnatal care rooms. Countries with WASH standards had a higher proportion of hospitals with water and hand hygiene services. Appropriate hygiene was practiced by health workers in 65% of 371 deliveries observed, and more likely in delivery rooms with a sink, water and soap (Mannava et al, 2019). Gaps in water, sanitation and hand hygiene in many countries may lead to health care-acquired infections which is known to account for more than half of neonatal deaths in many low- and middle-income countries (WHO Global Alert and Response 2015). Thus, critical to improved care of newborn infants is improving WASH standards.

Potential conflicts of interest: None declared

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References

Blencowe H, Cousens S, Oestergaard MZ, Chou D, Moller AB, Narwal R, Adler A, Vera Garcia C, Rohde S, Say L, Lawn JE. (2012). National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: a systematic analysis and implications. Lancet. 2012 Jun 9;379(9832):2162-72.

Conde-Agudelo A, Díaz-Rossello JL. Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. Cochrane Database of Systematic Reviews 2016, Issue 8. Art. No.: CD002771. DOI: 10.1002/14651858.CD002771.pub4

Darmstadt, G. L., Bhutta, Z. A., Cousens, S., Adam, T., Walker, N., de Bernis, L., & Team, L. N. S. S. (2005). Evidence-based, cost-effective interventions: how many newborn babies can we save? Lancet, 365, 977-988.

Edmond KM, Kirkwood BR, Amenga-Etego S, Owusu-Agyei S, Hurt LS. Effect of early infant feeding practices on infection specific neonatal mortality: an investigation of the causal links with observational data from rural Ghana. Am J Clin Nutr 2007; 86: 1126–31.

Li Z, Mannava P, Murray JCS, et al. Association between early essential newborn care and breastfeeding outcomes in eight countries in Asia and the Pacific: a cross-sectional observational -study. BMJ Global Health 2020;5:e002581. doi:10.1136/bmjgh-2020-002581

Liu, L., Oza, S., Hogan, D., Perin, J., Rudan, I., Lawn, J. E., . . . Black, R. E. (2015). Global, regional, and national causes of child mortality in 2000–13, with projections to inform post-2015 priorities: an updated systematic analysis. The Lancet, 385(9966), 430-440. doi:10.1016/s0140-6736(14)61698-6

Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, Rudan I, Campbell H, Cibulskis R, Li M, Mathers C, Black RE; Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. Lancet. 2012 Jun 9;379(9832):2151-61. doi: 10.1016/S0140-6736(12)60560-1. Epub 2012 May 11.

Louangpradith Viengsakhone, Yoshitoku Yoshida, Harun-Or-Rashid and Junichi Sakamoto (2010). Factors affecting Low Birth Weight at four central hospitals in Vientiane, Lao PDR. Nagoya J. Med. Sci. 72. 51-58, 2010.

Mannava P, Murray JCS, Kim R, Sobel HL. Status of water, sanitation and hygiene services for childbirth and newborn care in seven countries in East Asia and the Pacific. J Glob Health. 2019 Dec; 9(2): 020430.

Milner, K. M., Duke, T., & Bucens, I. (2013). Reducing newborn mortality in the Asia-Pacific region: Quality hospital services and community-based care. J Paediatr Child Health, 49(7), 511-518. doi:10.1111/jpc.12249

Mizuno K, Mizuno N, Shinohara T, Noda M. Mother-infant skin-to-skin contact after delivery results in early recognition of own mother's milk odour. Acta Paediatr 2004; 93: 1640–5.

Moore ER, Bergman N, Anderson GC, Medley N. Early skin-to-skin contact for mothers and their healthy newborn infants. Cochrane Database of Systematic Reviews 2016, Issue 11. Art. No.: CD003519. DOI: 10.1002/14651858.CD003519.pub4.

Rabe H, Diaz-Rossello JL, Duley L, Dowswell T. Effect of timing of umbilical cord clamping and other strategies to influence placental transfusion at preterm birth on maternal and infant outcomes. Cochrane Database of Systematic Reviews 2012, Issue 8. Art. No.: CD003248. DOI: 10.1002/14651858.CD003248.pub3.

Silvestre MA, Mannava P, Corsino PH, Capili DS, Calibo AP, Tan CF Murray J Kitong J, Sobel HL. Improving immediate newborn care in Philippine hospitals: impact of a national quality of care initiative 2008-2015. Int J Qual Health Care 2018 Aug 1;30(7):537-544.

Sonja J. Olsen, Phommady Vetsaphong, Phouvanh Vonglokham, Sara Mirza, Viengphone Khanthamaly, Touy Chanthalangsy, Seth Chittanavanh, Bounkong Syhavong, Ann Moen, Joseph Bresee, Andrew Corwin and Anonh Xeuatvongsa. A retrospective review of birth outcomes at the Mother and Child Health Hospital in Lao People's Democratic Republic, 2004–2013. BMC Pregnancy and Childbirth. (2016) 16:379.

Subramanian, KN Siva (2014). Extremly Low Birth Weight infant. Retrieved from http://emedicine.medscape.com/article/979717-overview (Accessed 14 August 2020)

Sychareun V, Hansana V, Somphet V, Xayavong S, Phengsavanh A, Popenoe R. Reasons rural Laotians choose home deliveries over delivery at health facilities: a qualitative study. *BMC Pregnancy Childbirth*. 2012;12:86. Published 2012 Aug 28. doi:10.1186/1471-2393-12-86

Tran HT, Mannava P, Murray JCS, Nguyen PTT, Tuyen LTM, Tuan HA, Nga PTQ, Vinh ND, Sobel HL. Early Essential Newborn Care Is Associated With Reduced Adverse Neonatal Outcomes in a Tertiary Hospital in Da Nang, Viet Nam: A Pre- Post-Intervention Study. Lancet E-Clinical Medicine 2018;6:51–58.

Tunell R. Hypothermia: epidemiology and prevention. In: Costello A, Manandhar D, editors. Improving newborn health in developing countries. London, UK: Imperial College Press, 2000: 207–20.

United Nations Children's Fund and World Health Organization, Low Birthweight: Country, regional and global estimates. UNICEF, New York, 2004.

Vanphanom Sychareun, Alongkone; Phengsavanh, Visanou Hansana; Vatsana Somphet, Sysouvanh & Assoc. Prof. Sing Menorath (2009). Cultural beliefs and traditional rituals about child birth practice in Laos. Retrieved from: https://www.unfpa.org/sites/default/files/pub-pdf/Socio-cultural%20maternal%20health%20report%20laos.pdf (Access 14 August 2020)

Victora CG, Bahl R, Barros AJD, et al, MD, et al. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Lancet 387,10017, 475-490, 2016. DOI:https://doi.org/10.1016/S0140-6736(15)01024-7

Viengsakhone L, Yoshida Y, Harun-Or-Rashid M, Sakamoto J. Factors affecting low birth weight at four central hospitals in vientiane, Lao PDR. *Nagoya J Med Sci*. 2010;72(1-2):51-58.

World Health Organisation. (2013). Pocket Book of Hospital care for Children: Guideliens for the management of common childhood illnesses for children Retrieved from https://www.who.int/maternal_child_adolescent/documents/9241546700/en/g (Accessed 14 August 2020)

World Health Organisation (2014a). WHO recommendations on Postnatal care of the mother and newborn. Retrieved from Geneva: http://apps.who.int/iris/bitstream/10665/97603/1/9789241506649_eng.pdf (Access 14 August 2020)

World Health Organisation (2015). WHO recommendations on interventions to improve preterm birth outcomes. Retrieved from http://www.who.int/reproductivehealth/topics/maternal_perinatal/preterm-birth-guidelines/en/ (Accessed 14 August 2020)

World Health Organisation (2016). Fact Sheets: Preterm Birth. Retrieved from http://www.who.int/mediacentre/factsheets/fs363/en/ (accessed 14 August 2020)

World Health Organization Global Alert and Response. Health care-associated infections: fact sheet. World Health Organization. http://www.who.int/gpsc/country_work/gpsc_ccisc_fact_sheet_en.pdf (Accessed 14 August 2020).

World Health Organization (2010). International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). (2010). Retrieved from http://apps.who.int/classifications/icd10/browse/2010/en#/P07; and P07 - Disorders related to short gestation and low birth weight (Accessed 14 August 2020)

World Health Organization (1993). Thermal control of the newborn, a practical guide. Maternal Health And Safe Motherhood Programme. Geneva: WHO, 1993.

World Health Organization Regional Office for the Western Pacific. Annual implementation review and planning guide (early essential newborn care, module 1), 2016. Retrieved from: http:// iris. wpro. who. int/bitstream/ handle/ 10665. 1/ 13978/ 9789290618362-eng. pdf (Accessed 14 August 2020)

World Health Organisation Regional Office for the Western Pacific (2014a). Action Plan for Healthy Newborn Infants in the Western Pacific Region (2014-2020). Retrieved from https://iris.wpro.who.int/handle/10665.1/10454 (Accessed 14 August 2020)

World Health Organisation, Regional Office for the Western Pacific (2014b). Early Essential Newborn Care: Clnical practice

pocket guide Retrieved from http://iris.wpro.who.int/bitstream/handle/10665.1/10798/9789290616856_eng.pdf;jsessionid=997EC5F71A9FFFE94B9E00BA1AA23D2C?sequence=3. (accessed 14 August 2020)

World Health Organization Regional Office for the Western Pacific. Coaching for the First Embrace: Facilitator's Guide, 2016. Available at: https://apps.who.int/iris/handle/10665/208314 (accessed 14 August 2020)

World Health Organization, Regional Office for the Western Pacific (2018a). Management of preterm and low birth weight babies. Manila, Philippines (2018). file:///C:/Users/sobelh/Downloads/9789290618584-eng%20(3).pdf (Accessed 14 August 2020)

World Health Organization, Regional Office for the Western Pacific (2018b). Second biennial progress report:: 2016-2017 (Action Plan for Health Newborn Infants in the Western Pacific Region: 2014-2020). Manila. World Health Organization Regional Office for the Western Pacific. 2018. https://apps.who.int/iris/handle/10665/272803 (Accessed 14 August 2020)