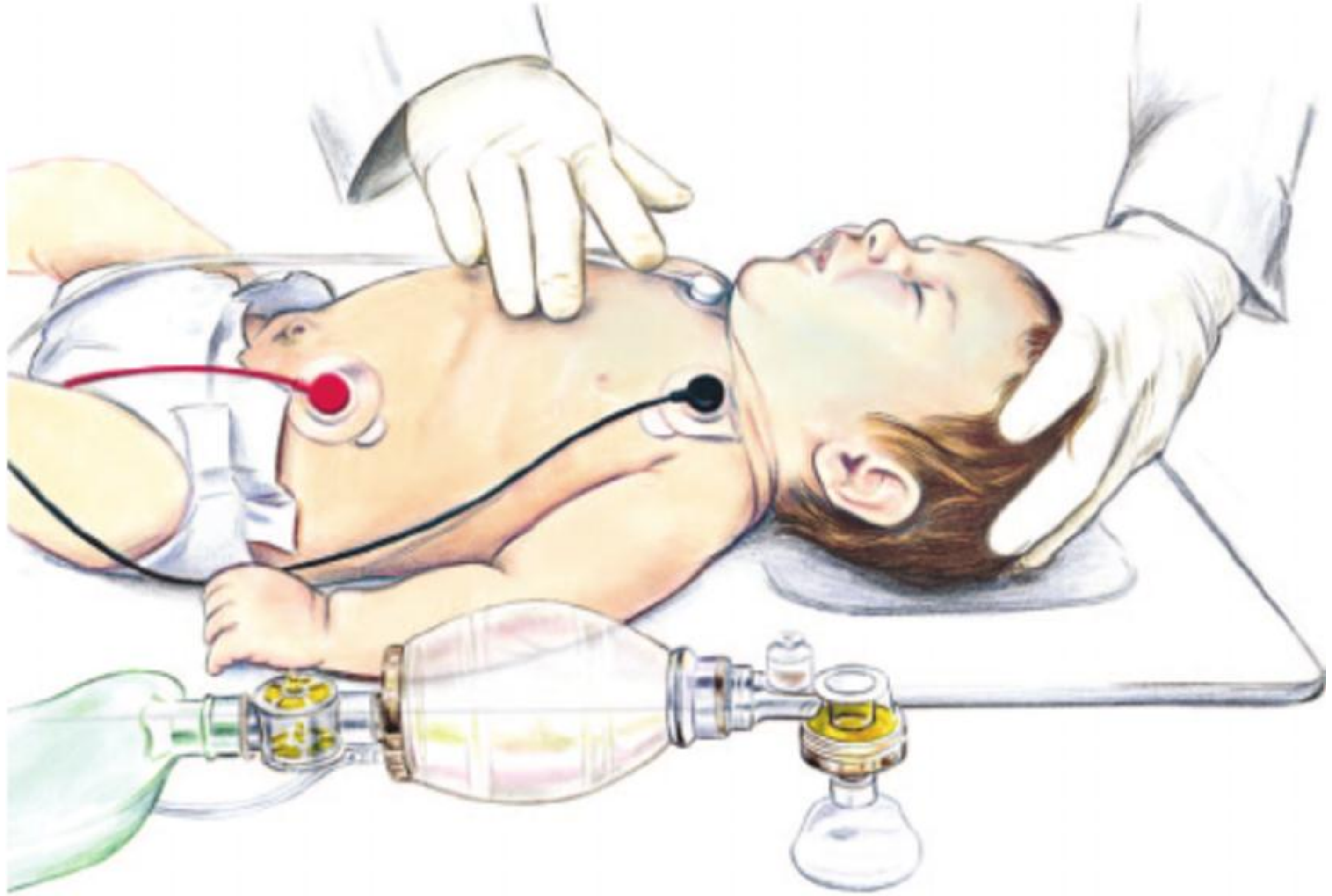

Neonatal Resuscitation in MNSC of TLEMCEN
Gaps between guidelines and practice

ا لجمهورية الشعبية الديمقراطية الجزائرية

République Algérienne Démocratique et Populaire

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Neonatal Resuscitation in MNSC of TLEMCEN

Gaps between guidelines and practice Presented by :

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ABSTRACT

Birth asphyxia accounts for about 23% of the approximately 4 million neonatal deaths each year worldwide* Transition at birth is mediated by significant changes in circulatory and respiratory physiology. Approximately 10% of infants require some assistance to undergo this transition in order to adapt to extrauterine. Less than 1% need extensive resuscitative measures such as chest compressions and epinephrine*.

Research in the field of neonatal resuscitation has expanded the understanding of neonatal physiology enabling the implementation of improved recommendations and guidelines on how to best approach newborns in need for intervention at birth.

In an effort to determine the actual conduct of neonatal resuscitation in the MNSC of TLEMCEN, we developed a checklist with the resuscitation steps, all of which are evaluated at the same time as the newborn's resuscitation.

Reducing infant deaths relies on improving the quality of care delivered in low resource countries where 99% of deaths occur. The key elements to a successful neonatal resuscitation include ventilation of the lungs while minimizing injury, the judicious use of oxygen to improve pulmonary blood flow, circulatory support with chest compressions, and vasopressors and volume that would hasten return of spontaneous circulation. Several exciting new avenues in neonatal resuscitation such as delayed cord clamping, sustained inflation breaths, and alternate vasopressor agents are briefly discussed

*(Black et al., Lancet, 2010, 375(9730):1969-87); (Wyllie et al. Resuscitation, 2010, 81 Suppl 1:e260–e287).

ACKNOWLEDGMENT

After an intensive period of four months, today is the day: writing this note of thanks is the finishing touch on my thesis. It has been a period of intense learning for me, not only in the scientific arena, but also on a personal level. Writing this thesis has had a big impact on me. I would like to reflect on the people who have supported and helped me so much throughout this period.

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Basma Chentouf

Tlemcen, September 25, 2016.

Table Of Contents

List of figures

List of tables

Abbreviations

-	MNSC	Maternal and Newborn Service Center
-	DR	Delivery Room
-	ILCOR	International Liaison Committee on Resuscitation
-	AHA	American Heart Association
-	AAP	American Academy of Pediatrics
-	ERC	European Resuscitation Council
-	NR	Neonatal Resuscitation
-	NRP	Neonatal Resuscitation Program
-	CVO	Combined Ventricular Output
-	PaO2	Partial Pressure of Oxygen in Arterial Blood.
-	RDS	Respiratory Distress Syndrome
-	BP	Blood Pressure
-	DCC	Delayed Cord Clamping
-	PPV	Positive Pressure Ventilation
-	SI	Sustained Inflation
-	FRC	Functional Residual Capacity
-	HR	Heart Beat
-	PEEP	End-Expiratory Pressure
-	CPAP	Continuous Positive Airway Pressure
-	ECG	Electrocardiograph
-	CPP	Coronary Perfusion Pressure
-	IV	Intra Venous
-	ICU	Intensive Care Unit
-	NICU	Neonatal Intensive Care Unit
-	PICCs	Peripherally Inserted Central Catheters

INTRODUCTION

INTRODUCTION

Attempts to revive depressed newborns immediately after birth have been made for hundreds of years. Dr James Blundell's description of the resuscitation of a “still-born” infant in 1834 is remarkably similar to procedures practiced currently, including evaluating the chord pulsations and attempting artifcial respirations with a “tracheal pipe ” **(1).**

The procedures involved in neonatal resuscitation have been organized into a sequential process of evaluation and interventions. International clinical guidance describes a standardized approach to newborn resuscitation in the delivery room (DR) and clinical algorithms are guided by these consensus statements **(2)**. These guidelines aim to provide an organized, sequential and standardized approach to DR resuscitation of the newborn.

Among several established newborn resuscitation guidelines, the most referenced worldwide are those of the International Liaison Committee on Resuscitation (ILCOR). In 1992, the ILCOR was established, aiming to provide a forum for the main resuscitation organizations in the world, including the American Heart Association (AHA), American Academy of Pediatrics (AAP), and the European Resuscitation Council (ERC), to establish international guidelines. The creation of ILCOR established a unique opportunity for international collaboration in the development of guidelines and training programs on resuscitation over the past twenty years. One of the main objectives of ILCOR is to produce practice statements that reflect international consensus on resuscitation-specific issues for patients of any age. The international resuscitation guidelines are revised every five years after an extensive evidence evaluation **(3)**. The most recent guidance on resuscitation practices and equipment was updated in 2015.

Whilst the majority of newborn infants successfully transition from fetal life with minimal assistance, up to 10% (4–7 million per year) will need some form of additional support, and 1% will require significant resuscitation (such as cardiac compressions and medication) **(4)**. Decreasing gestational age is associated with increasing need for resuscitative interventions **(5).**

Surveys of DR resuscitation performed in several countries have revealed considerable differences in practice between and within countries **(6–8)**. Our overall aim with this thesis was to compare alternative resuscitation protocols with the accepted algorithm by auditing the DR resuscitation practices and available equipment, within the MNSC of Tlemcen in Algeria against the international standards.

For the purpose of evaluating practices and availability of equipment in the DR we developed a survey on NR equipment and to determine the extent of variation or consistency that exists in neonatal programs in the MNSC. Questionnaires were given to pediatricians and midwives assigned to Nursery and DR Units; trained in neonatal resuscitation within the MNSC of TLEMCEN. In total, 15 persons were surveyed.The team consisted of public health professionals (pediatric residents assigned to Nursery Unit and DR midwives) having at least 3 years of education in public health.

DR interventions were reviewed over a 4 months period and it was found that 5% of infants right after the delivery, needed some assistance and sometimes resuscitation. This makes neonatal resuscitation a frequently performed medical intervention in our DR.

The study for this thesis was conducted in MNSC of TLEMCEN. The hospital is a publicly funded hospital, which provides obstetric and gynecological services and is the referral center in TLEMCEN. The hospital provides antenatal, delivery and postpartum services. The hospital has an annual delivery rate of approximately 12474 (variying between 700 and 1000 deliveries per month) with a stillbirth rate of 3 per thousand deliveries.

There is one delivery unit in the hospital: a maternal and newborn service center (MNSC), a labor unit and an operation theatre. The low-risk vaginal deliveries take place in the labor unit, which is staffed with nurse midwives; high-risk vaginal deliveries take place in the labor unit, and/or in the operation theatre, which is staffed with anesthesiologists, obstetricians, medical doctors and nurse-midwives, caesarean sections take place in the operation theatre. There is a neonatal resuscitation corner where the resuscitation of newborns takes place. The hospital also has a Nursery Unit for the management of caesarean sections newborns.

Babies who have complications at birth or during the postpartum period are treated in the special newborn care unit, which is staffed with neonatologist, pediatricians, doctors and nurses. The special newborn care unit provides treatment for perinatal depression, hyperbilirubinemia, neonatal sepsis and respiratory distress syndrome. The annual admission rate in the special newborn care unit is approximately equal to 6 per thousand deliveries.

LITTERATURE REVIEW

CHAPTER I : Adaptation for life : A review of neonatal physiology

The neonatal period (first 28 days of life) contains the most dramatic and rapid physiological changes seen in humans. They vary from the immediate changes seen in the respiratory and cardiovascular systems to the slower progression seen in the hepatic, hematological and renal systems **(9).**

1. The respiratory system

1.1. The fetal respiratory system

Lungs develop from the third week of gestation. However, type I and II pneumocytes are distinguishable only by 20- 22 weeks and surfactant is present only after 24 weeks. The oxygen supplied to the fetus comes from the placenta, lungs contain no air and serve no ventilatory purpose. The alveoli of the fetus are filled instead with fluid that has been produced by the lungs. Since the fetal lungs are fluid filled and do not contain oxygen, blood passing through the lungs cannot pick up oxygen to deliver throughout the body. Thus, blood flow through the lungs is markedly diminished compared to that which is required following birth. Diminished blood flow through the lungs of the fetus is a result of the partial closing of the arterioles in the lungs. This results in the majority of blood flow diverted away from the lungs through the ductus arteriosus.

1.2. The first breath

As the infant takes the first few breaths, several changes occur whereby the lungs take over the lifelong function of supplying the body with oxygen. At birth, the alveoli are still filled with “fetal lung fluid.” It takes a considerable amount of pressure in the lungs to overcome the fluid forces and open the alveoli for the first time.

Approximately one-third of fetal lung fluid is removed during vaginal delivery as the chest is squeezed and lung fluid exits through the nose and mouth. The remaining fluid passes through the alveoli into the lymphatic tissues surrounding the lungs. How quickly fluid leaves the lungs depends on the effectiveness of the first few breaths.

Fortunately, the first few breaths of most newborn infants are generally effective. The coordinated first breath is initiated centrally secondary to arousal from sound, temperature changes and touch associated with delivery. Central chemoreceptors stimulated by hypoxia and hypercarbia further increase respiratory drive. Alveolar distension, cortisol and epinephrine all stimulate type II pneumocytes to produce surfactant and reduce alveolar surface tension; facilitating lung expansion. Lung expansion and increased alveolar oxygen content reduce pulmonary vascular resistance, increasing blood flow and initiating the cardiovascular changes described later **(10, 11).**

Table 01. Normal pulmonary function and cardiovascular values :

Measurement	term neonate	2 years old
Heart rate (beats/min)	120-160	75-115
Systolic blood pressure (mmHg)	60	95
Diastolic blood pressure	35	60
Cardiac-output (ml/kg/min)	200	100
Circulating-blood voulume (ml/kg)	90	80
Haemoglobin(g/dl)	16-18	10.5-13.5
Total lung capacity (ml/kg)	55-70	55-70
Tidal volume (ml/kg)	5-7	5-7
Functional residual capacity (ml/kg)	20-25	27-30
Vital capacity (ml/kg)	35-40	35-40
Respiratory rate (breaths/min)	30-50	30-50
Alveolar ventilation (ml/kg/min)		100-150

Adapted from Rennie JM, Robertson NRC, eds. A manual of neonatal intensivecare, 4th edn. London: Hodder Education, 2002.

2. Cardiac changes

2.1. The fetal circulation

Oxygenated placental blood is preferentially delivered to the brain, myocardium and upper torso. Preferential splitting is achieved via intra- and extracardiac shunts that direct blood into two parallel circulations. Oxygenated blood returning from the placenta divides equally to pass either through the liver or via the ductus venous to reach the inferior vena cava. Oxygenated blood from the ductus venous remains on the posterior wall of the inferior vena cava, allowing it to be directed across the foramen ovale into the left atrium by the Eustachian valve. This oxygenated blood then passes through the left ventricle and aorta to supply the head and upper torso. Deoxygenated blood returning from the superior vena cava and myocardium via the coronary sinus is directed through the right ventricle and into the pulmonary artery. Most of this blood is returned to the descending aorta via the ductus arteriosus; however, 8- 10% of total cardiac output passes through the high-resistance pulmonary circulation. (**Figure 01**).

Blood in the descending aorta either supplies the umbilical artery to be re-oxygenated at the placenta or continues to supply the lower limbs. The fetal circulation therefore runs in parallel, the left ventricle providing 35% and the right 65% of cardiac output. Fetal cardiac output is therefore measured as a combined ventricular output (CVO) **(12,13).**

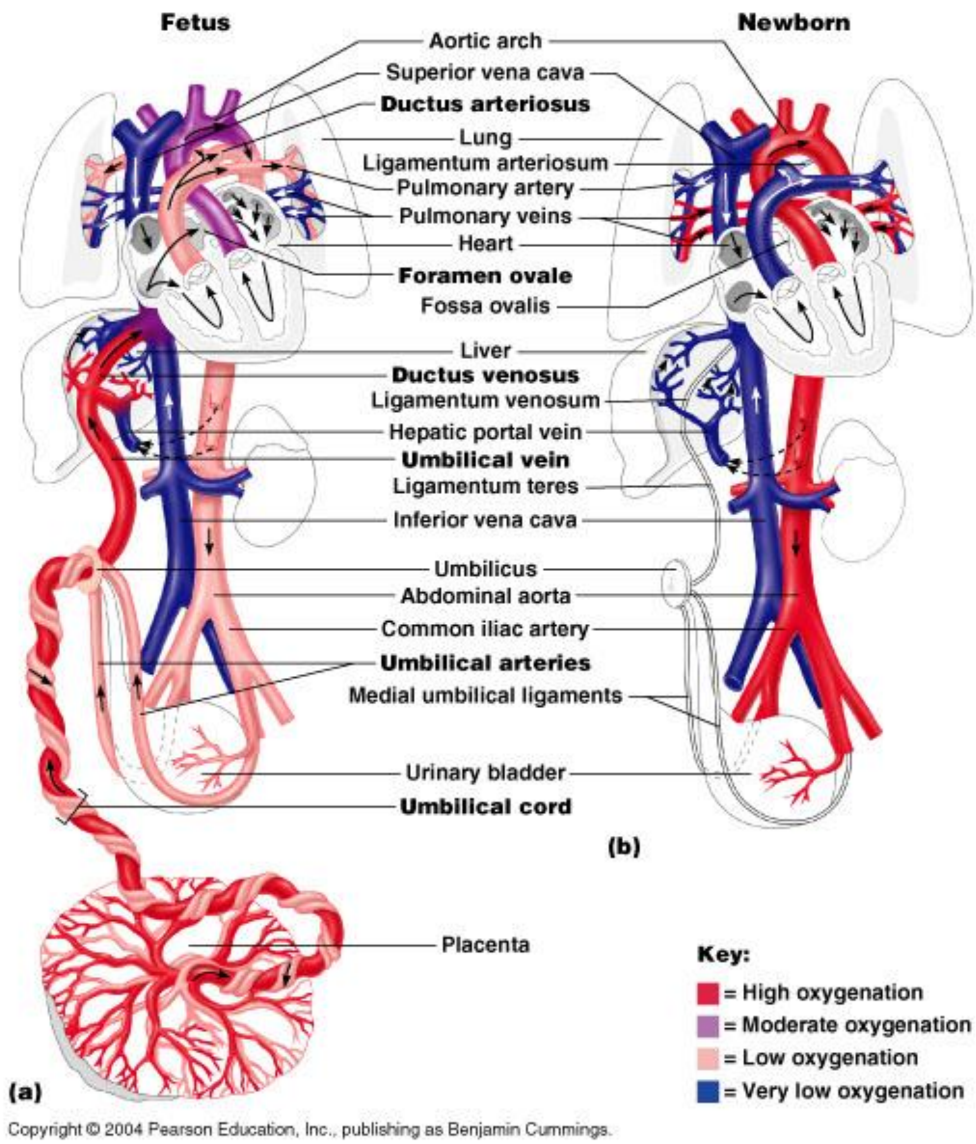

Figure 01. **Difference between fetal and neonatal circulation**

2.2. At birth

Successful transition from fetal to postnatal circulation requires increased pulmonary blood flow, removal of the placenta and closure of the intracardiac (foramen ovale) and extracardiac shunts (ductus venous and ductus arteriosus). These changes produce an adult circulation in series with right ventricular output equaling that of the left. Any stimulus such as hypoxia, acidaemia or structural anomaly can increase pulmonary vascular resistance and potentially re-open the ductus arteriosus or foramen ovale. This allows a right-to-left shunt, which worsens hypoxia. This effect is seen in persistent pulmonary hypertension of the newborn **(14, 15).**

3. Thermoregulation

3.1. Heat loss

Neonates and, in particular, premature neonates are at high risk of heat loss and subsequent hypothermia. Hypothermic preterm babies have a poor outcome in the intensive care setting and therefore body temperature **must be aggressively regulated**. Neonates have a 2.5- 3.0 times higher surface area to bodyweight ratio compared with adults, increasing the relative potential surface for heat loss. This is exacerbated by the limited insulating capacity from subcutaneous fat and the inability of neonates to generate heat by shivering until 3 months of age **(16).**

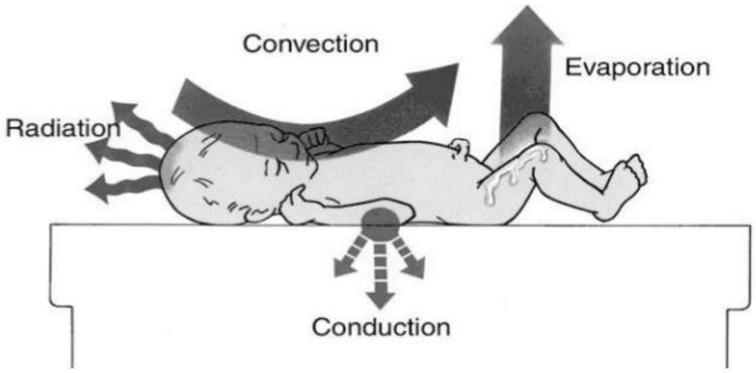

Figure 02. Mechanisms of Heat Loss in Delivery Room

3.2. Mechanisms of thermogenesis

The neonate can produce heat by limb movement and by stimulation of brown fat (non-shivering thermogenesis). Brown fat makes up about 6% of term bodyweight and is found in the interscapular region, mediastinum, axillae, and vessels of the neck and perinephric fat **(16).**

It is highly vascular with sympathetic innervation and high mitochondrial content to facilitate heat generation. Non-shivering thermogenesis can double heat production, but at the expense of markedly increasing oxygen demand. This homeostatic mechanism can be impaired in the first 12 hours of life due to maternal sedation, particularly with benzodiazepines and during/after general anesthesia, increasing the risk of hypothermia unless anticipated **(16).**

The term neonate is able to vasoconstrict, diverting blood from the peripheries to the body core maintaining temperature. However, this homeostatic control mechanism is not present in the preterm neonate further increasing the risk of hypothermia in this age group **(16).**

4. Nervous system

The nervous system accounts for 10% of total body weight at birth and the neonatal cerebral circulation is one-third of cardiac output. The blood-brain barrier is immature in the neonatal period, with increased permeability to fat-soluble molecules, potentially increasing the sensitivity to certain anaesthetic drugs. Cerebral autoregulation is fully developed at term, maintaining cerebral perfusion down to a mean arterial pressure of 30 mmHg, reflecting the lower blood pressures found in neonates. The autonomic responses of the neonate are better developed to protect against hypertension than hypotension because the parasympathetic system predominates. This is reflected in the propensity of neonates to bradycardia and relative vasodilation. Neonates undergoing awake nasal intubation increase mean arterial pressure by 57% and intracranial pressure by a similar amount. Noxious stimulus exposure in the neonatal period can also affect behavioural patterns in later childhood, suggesting adaptive behaviour and memory for previous experience **(17).**

CHAPTER II: Neonatal respiratory distress syndrome

1. Physiology of Asphxia – Apnea

In an attempt to establish normal respirations, the infant can develop problems in two areas:

- **Lungs :** Persistent pulmonary Hypertension due to the failure of pulmonary arterioles to relax or blood flow to increase in the lungs as desired. Also, lungs not filling with air when fluid remains in the alveoli despite initial breaths or a meconium blockage.
- **Heart :** Systemic hypotension due to poor cardiac contractility and bradycardia.

It is not enough to have air entering the lungs. There must also be an adequate supply of blood flowing through the capillaries of the lungs so that oxygen can pass into the blood and be carried throughout the body. This requires a considerable increase in the amount of blood perfusing the lungs at birth by pulmonary vasoconstriction. The vessels that open in the lungs of a normal infant remain in a constricted state in an asphyxiated infant.

Early in asphyxia, arterioles in the bowels, kidneys, muscles, and skin constrict. The resulting redistribution of blood flow helps preserve function by preferentially supplying oxygen and substances to the heart and brain. As asphyxia is prolonged, there is deterioration of myocardial function and cardiac output. Therefore, blood flow to vital organs is reduced. This sets the stage for progressive organ damage. When infants become asphyxiated (either in utero or following delivery), they undergo a well-defined sequence of events.

1.1. Primary Apnea

When a fetus or infant is deprived of oxygen, an initial period of rapid breathing occurs. If the asphyxia continues, the respiratory movements cease, the heart rate begins to fall, and the infant enters a period known as primary apnea. Exposure to oxygen and stimulation during this period in most instances will induce respirations.**(18)**

1.2. Secondary Apnea

If the asphyxia continues, the infant develops deep gasping respirations, the heart rate continues to decrease, and the blood pressure begins to fall. The respirations become weaker until the infant takes a last gasp and enters a period called secondary apnea. During secondary apnea the heart rate, blood pressure,and oxygen in the blood (PaO2) continue to fall. The infant now is unresponsive to stimulation, and positive pressure ventilation must be initiated at once. **(18)**

1.3. Primary vs. Secondary Apnea

It is important to note that, as a result of fetal hypoxia, the infant may go through primary apnea and into secondary apnea while in utero. Thus an infant may be born in either primary or secondary apnea. In a clinical setting, primary and secondary apnea are virtually indistinguishable from one another. In both instances the infant is not breathing, and the heart rate may be below 100 per minute. **(18)**

A newborn infant in primary apnea will reestablish a breathing pattern (although irregular and possibly ineffective) without intervention. An infant in secondary apnea will not resume breathing of his or her own accord. Also, and of great importance, the longer an infant is in secondary apnea, the greater is the chance that brain damage will occur. **(18)**

2. Respiratory Distress Syndrome in Neonates (Hyaline Membrane Disease)

Respiratory distress syndrome (RDS) is caused by pulmonary surfactant deficiency in the lungs of neonates, most commonly in those born at < 37 wk gestation. With surfactant deficiency, alveoli close or fail to open, and the lungs become diffusely atelectatic, triggering inflammation and pulmonary edema.Symptoms and signs include grunting respirations, use of accessory muscles, and nasal flaring appearing soon after birth. As atelectasis and respiratory failure progress, symptoms worsen, with cyanosis, lethargy, irregular breathing, and apnea. Diagnosis is clinical; prenatal risk can be assessed with tests of fetal lung maturity. **(19)**

Surfactant is not produced in adequate amounts until relatively late in gestation (34 to 36 wk); thus, risk of RDS increases with greater prematurity. Other risk factors include multifetal pregnancies, maternal diabetes, and being male and white. **(19)**

Risk decreases with fetal growth restriction, preeclampsia or eclampsia, maternal hypertension, prolonged rupture of membranes, and maternal corticosteroid use. Rare cases are hereditary, caused by mutations in surfactant protein (SP-B and SP-C) and ATP-binding cassette transporter A3 (ABCA3) genes. **(19)**

Complications of RDS include intraventricular, periventricular white matter injury, tension pneumothorax, bronchopulmonary, sepsis, and neonatal death. Intracranial complications have been linked to hypoxemia, hypercarbia, hypotension, swings in arterial BP, and low cerebral perfusion. **(19)**

Treatment consists in adequate, oxygenation, ventilatory support and intratrachealsurfactant therapy. Options for surfactant replacement include: Beractant, Poractant alfa, Calfactant, and Lucinactan . **(19)**

When a fetus must be delivered between 24 wk and 34 wk, giving the mother 2 doses of betamethasone 12 mg IM 24 h apart or 4 doses of dexamethasone 6 mg IV or IM q 12 h at least 48 h before delivery induces fetal surfactant production and reduces the risk of RDS or decreases its severity.Prophylactic intratracheal surfactant therapy given to neonates that are at high risk of developing RDS (infants < 30 wk completed gestation especially in absence of antenatal corticosteroid exposure) has been shown to decrease risk of neonatal death and certain forms of pulmonary morbidity (eg, pneumothorax**). (19)**

Table 02. Common causes of neonatal respiratory distress :

Pretermpathology	**Termpathology**	**Congenital anomalies/ surgical conditions**	**Non-respiratory causes of respiratory distress**
- Respiratory distress syndrome - Pneumothorax - Pneumonia - Pulmonary hemorrhage - Aspiration - Pleural effusion (chylothorax) - Chronic lung disease	- Transient tachypnea of the newborn - Respiratory distress syndrome - Meconium aspiration - Primary or secondary persistent - pulmonary hypertension of the - newborn - Pneumonia - Pneumothorax - Aspiration - Pleural effusion (chylothorax) - Pulmonary hemorrhage - Surfactant protein deficiencysyndromes - Alveolar capillary dysplasia	- Congenital pulmonary airway malformation - Congenital diaphragmatic hernia - Tracheo-oesphageal fistula - Choanal atresia - Pulmonary sequestration - Congenital lobar emphysema	- Heart failure (due to congenital heart disease) - Neuromuscular disorders - Hypoxic ischemic encephalopathy - Metabolic acidosis (due to inborn error of metabolism)

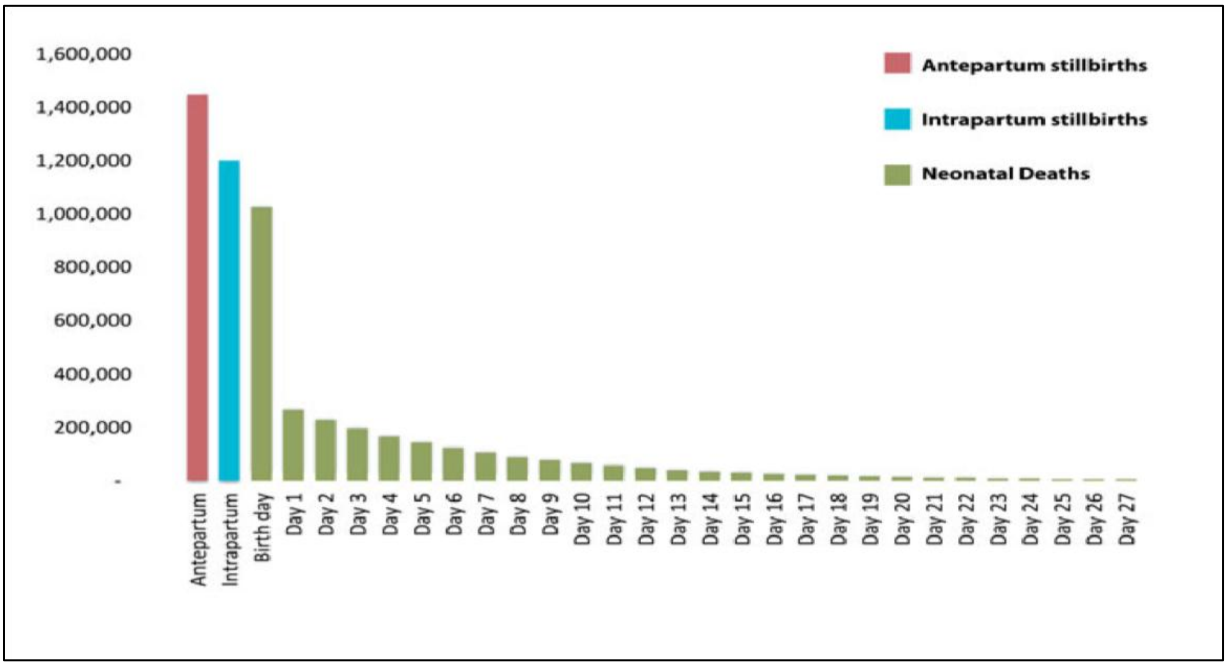

Figure 03. Timing of babies' deaths (third trimester stillbirth and neonatal death)

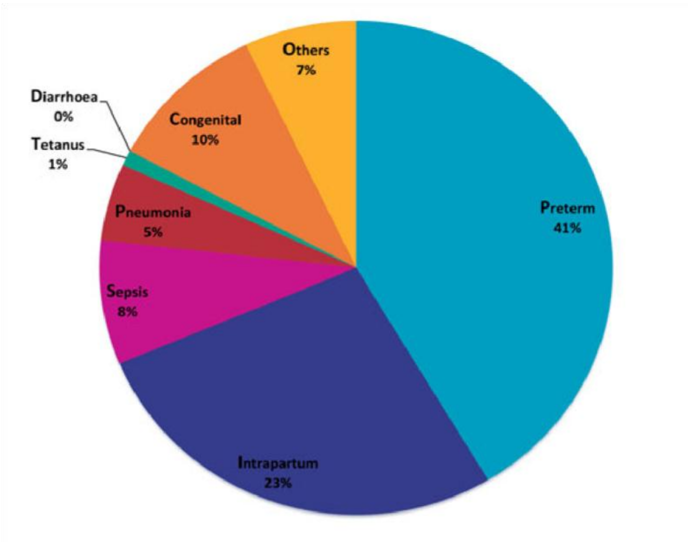

Figure 04. Causes of death during first seven days of life

1. **Lawn JE, Blencowe H, Oza S, You D, Lee AC, Waiswa P, Lalli M, Bhutta Z, Barros AJ, Christian P, Mathers C, Cousens SN, Lancet Every Newborn Study Group: Every Newborn: progress, priorities, and potential beyond survival. *Lancet* 2014, 384(9938):189-205.** *1*

CHAPTER III : Neonatal Resuscitation

1. Introduction

Initiation of breathing is critical in the physiologic transition from intrauterine to extra-uterine life . The time between a hypoxic event during labor or delivery and death can be very short—a baby who does not breathe at birth could die in less than an hour.

Neonatal resuscitation is defined as the set of interventions at the time of birth to support the establishment of breathing and circulation. Of the 136 million births annually, an estimated 10 million of non-breathing babies require some level of intervention during the first minute after they are born—the “Golden minute™”. Some non-breathing babies with primary apnea will respond to simple stimulation alone, such as drying and rubbing. Basic resuscitation with bag and mask is required for 3–6% of the babies and is sufficient to resuscitate most neonates with secondary apnea as their bradycardia primarily results from hypoxemia and respiratory failure. More advanced measures, including endotracheal intubation, chest compressions and medication, are required in <1% of births and most of these require intensive care **(20-28).**

Observational studies conducted to evaluate the effect of neonatal resuscitation on birth outcomes have reported that these interventions reduce stillbirth and neonatal mortality **(29, 30-33).** Observation is the preferred method in this area because it would be unethical to conduct a randomized controlled trial on the effectiveness of neonatal resuscitation on individuals (treatment versus placebo) **(34).**

2. Challenges for Neonatal Resuscitation

Despite the evidence that neonatal resuscitation has an effect on improving neonatal survival and reducing stillbirth burden, challenges remain in terms of ensuring the implementation of the standard neonatal resuscitation protocol into routine practices **(35, 36-38).**

There are several barriers to standard neonatal resuscitation and pediatric care in health facility settings, such as lack of standard training procedures, unavailability of resuscitation equipment at the time of birth, lack of periodic skill practice and assessment, lack of motivation, and a lack of hospital and clinical leadership to improve clinical performance **(39-43).**

3. Some of the new changes in the NRP Flow Diagram of 2015

Every 5 years, ILCOR coordinates an in-depth international review, debates the science, and determines new international resuscitation treatment recommendations for newborns, children, and adults. The 7th edition NRP Flow Diagram is similar to the 6th edition diagram. Revisionsinclude :

- ✓ Begin the resuscitation with antenatal counseling (when appropriate) and a team briefing and equipment check.
- ✓ Thermoregulation It is recommended that the temperature of newly born non asphyxiated infants be maintained between 36.5°C and 37.5°C after birth through resuscitation or stabilization.
- ✓ Non-vigorous newborns with meconium-stained fluid do not require routine intubation and tracheal suctioning. Initial steps may be performed at the radiant warmer. Meconium-stained amniotic fluid is a perinatal risk factor that requires the presence of one resuscitation team member with full resuscitation skills, including endotracheal intubation.
- ✓ Ensure ventilation that inflates and moves the chest.
- ✓ Consider using a cardiac monitor when PPV begins and to accurately assess heart rate during chest compressions.
- ✓ Recommendation to intubate prior to beginning chest compressions.
- ✓ End the resuscitation with team debriefing.

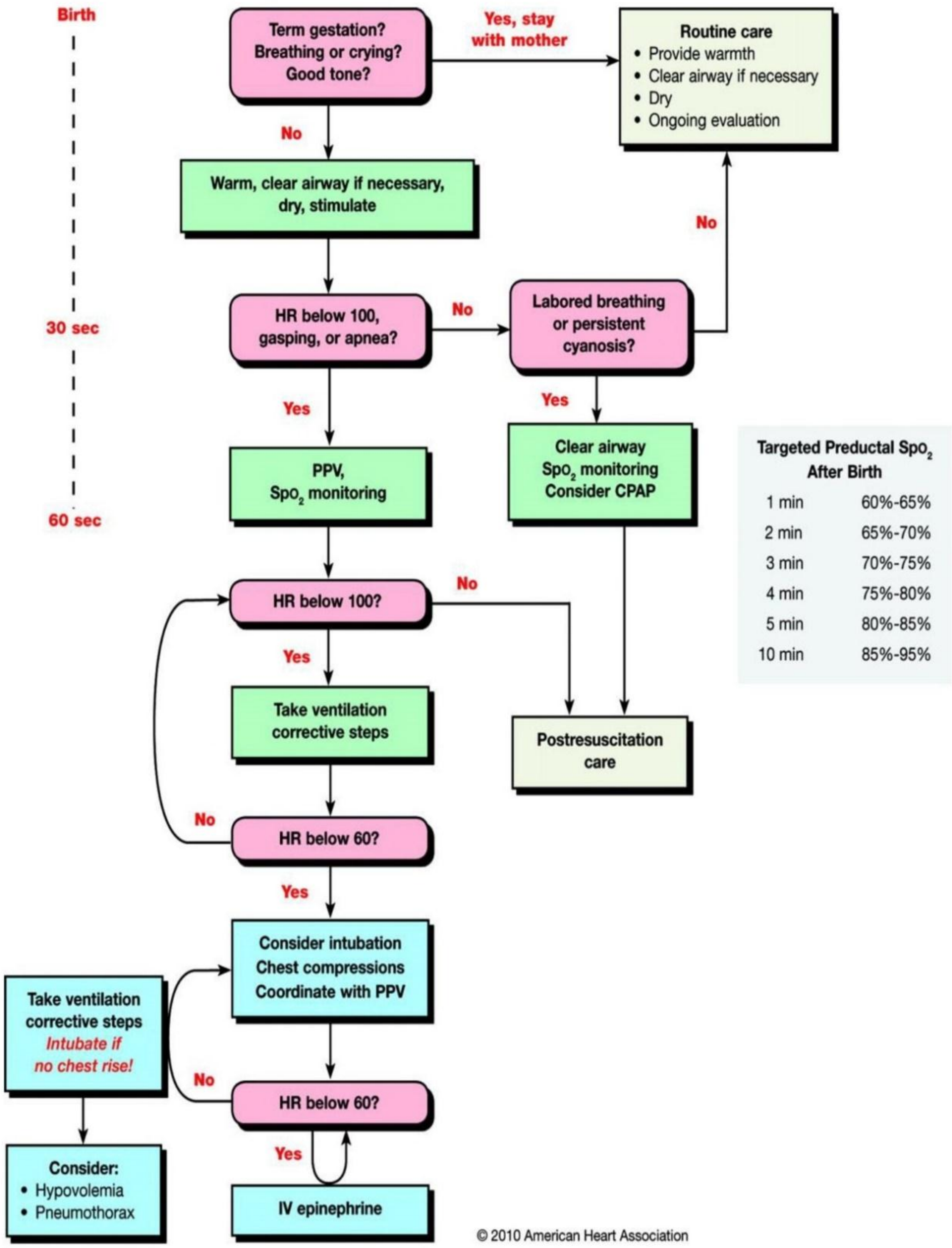

Figure 05. The current 2015 ILCOR algorithm for newborn resuscitation

(with permission from Elsevier.)

4. Delayed Cord Clamping

DCC for longer than 30 seconds is reasonable for both term and preterm infants who do not require resuscitation at birth(Class IIa, Level of Evidence [LOE] C-LD). The 2015 ILCOR systematic review confirms that DCC is associated with less intraventricular hemorrhage (IVH) of any grade, higher blood pressure and blood volume, less need for transfusion after birth, and less necrotizing enterocolitis **(44,45).**

The only negative consequence appears to be a slightly increased level of bilirubin, associated with more need for phototherapy. These findings have led to national recommendations that DCC be practiced when possible **(46,47).**

There is insufficient evidence to recommend an approach to cord clamping for infants who require resuscitation at birth. In light of the limited information regarding the safety of rapid changes in blood volume for extremely preterm infants, use of cord milking is suggested for infants born at less than 29 weeks of gestation. Further study is warranted because cord milking may improve initial mean blood pressure and hematologic indices and reduce intracranial hemorrhage. (Class IIb, LOE C-LD).

5. The ABC's of Resuscitation

The newly born infants who do not require resuscitation can generally be identified by a rapid assessment of the following 3 questions:

- ✓ Term gestation?
- ✓ Crying or breathing?
- ✓ Good muscle tone?

If the answer to all these questions is “yes” the baby does not need resuscitation. Besides, the baby should be dried, placed skin-to-skin with the mother, and covered with dry linen to maintain temperature. Observation of breathing, activity, and color should be ongoing though. If the answer to any of these assessment questions is “no” the infant should be moved to a radiant warmer to receive one or more of the following categories of action in sequence. **(48)**

The steps in resuscitating newborn infants follow the well-known “ABCs” of resuscitation.

A- Airway: Establish an open airway :

• Position the infant (Neutral position), the head in a “sniffing” position to open the airway.

• Suction the mouth and nose and clearing of secretions only if copious and/or obstructing the airway with a bulb syringe or suction catheter.

B- Breathing: Initiate breathing :

• Use tactile stimulation to initiate respirations.

• Employ positive-pressure ventilation when necessary, using bag and valve mask

C- Circulation: Maintain circulation :

• Stimulate and maintain the circulation of blood with chest compressions and administration of epinephrine and/or volume expansion.

A very important aspect of efficient and effective resuscitation is *evaluating the infant*. After the initiation of any action, there must be an evaluation of its effect on the neonate and a decision about the next step. The Apgar score is not used in determining when to initiate a resuscitation or in making decisions regarding the course of resuscitation. Evaluation is primarily based on simultaneous assessment of 2 vital characteristics which are respirations (apnea, gasping, or labored or unlabored breathing) and heart rate (less than 100 beats per minute). **(48)**

6. Clearing the airway

6.1. When Amniotic Fluid Is Clear

There is evidence that suctioning of the nasopharynx can create bradycardia during resuscitation **(49,50)** and that suctioning of the trachea in intubated babies receiving mechanical ventilation can be associated with deterioration of pulmonary compliance and oxygenation and reduction in cerebral blood flow velocity when performed routinely (ie, in the absence of obvious nasal or oral secretions) **(51,52).**

However, there is also evidence that suctioning in the presence of secretions can decrease respiratory resistance. Therefore it is recommended that suctioning immediately following birth (including suctioning with a bulb syringe) should be reserved for babies who have obvious obstruction to spontaneous breathing or who require positive-pressure ventilation (PPV) (Class IIb, LOE C).

6.2. When Meconium is Present

Current published human evidence does not support a recommendation for routine intervention of intubation and suction for the nonvigorous newborn with meconium-stained amniotic fluid.**(53–62)** Appropriate intervention to support ventilation and oxygenation should be initiated as indicated for each individual infant. This may include intubation and suction *if the airway is obstructed*.

Because the presence of meconium-stained amniotic fluid may indicate fetal distress and increases the risk that the infant will require resuscitation after birth, a team that includes an individual skilled in tracheal intubation should be present at the time of birth. (Class IIb, LOE C-LD).

7. Positive-Pressure Ventilation

The ILCOR guidelines advocate the establishment of effective ventilation as the primary objective in the management of the apneic or bradycardic newborn infant in the DR **(57, 58).**

Most apneic newborn infants respond well to aeration of the lungs (**59)**. The most important and fastest indicator of initial lung inflation is an improvement in the baby`s heart rate. If the heart rate does not increase quickly, ventilation might not be effective or adequate **(60).** An airtight seal between the mask and the face is important for successful ventilation, but too much pressure applied to the mask to prevent leak may on the other hand lead to obstruction of the mouth and nose **(61).**

The initial peak inflating pressures needed are variable and unpredictable and should be individualized to achieve an increase in heart rate or movement of the chest with each breath. Inflation pressure should be monitored; an initial inflation pressure of 20 cm H2O may be effective, but =30 to 40 cm H2O may be required in some term babies without spontaneous ventilation (Class IIb, LOE C). In summary, assisted ventilation should be delivered at a rate of 40 to 60 breaths per minute to promptly achieve or maintain a heart rate >100 per minute (Class IIb, LOE C).

In term-asphyxiated infants, there is a lack of evidence to support any specific ventilation strategy for the initial inflations. Several recent studies have, however, shown that one sustained inflation (SI) of 2-5s could improve functional residual capacity (FRC) during transition from fluid-filled to air-filled lungs after birth and a more rapid circulatory recovery compared with an approach not using a SI.

For infants who require positive pressure inflations, the goal is to deliver a pressure and tidal volume that will lead to adequate lung inflation without inducing additional lung injury because it has been shown that significant pathologic changes in the lung, including epithelial damage, protein leak into the alveolar spaces, and inhibition of surfactant function, may be induced by administering only a few inflations with high tidal volumes immediately after birth and thereafter may be exacerbated by the use of mechanical ventilation, especially in preterm lungs. PPV can be discontinued in case of a HR >100, an appropriate O_2 saturations and onset of spontaneous respirations. **(66-71).**

The use of colorimetric CO_2 detectors during mask ventilation of small numbers of preterm infants in the intensive care unit and in the delivery room has been reported, and such detectors may help to identify airway obstruction.(Class IIb, LOE C).

7.1. End-Expiratory Pressure (PEEP)

The maximum amount of supplementary oxygen required to achieve target oxygen saturation may be slightly less when using PEEP. Hence, when PPV is administered to preterm newborns, use of approximately 5 cm H_2O PEEP is suggested. It can easily be given with a flow-inflating bag or T-piece resuscitator, but it cannot be given with a self-inflating bag unless an optional PEEP valve is used. (Class IIb, LOE B-R)

7.2. Continuous positive airway pressure (CPAP)

CPAP sends air into the nose to help keep the airways open. It can be given by a ventilator (while the baby is breathing independently) or with a separate CPAP device. Many experts recommend administration of CPAP to infants who are breathing spontaneously, but with difficulty, following birth. Starting infants on CPAP reduced the rates of intubation and mechanical ventilation, surfactant use, and duration of ventilation, but increased the rate of pneumothorax. The use of early CPAP has been associated with low rates of BPD (Bronchopulmonary dysplasia).Based on this evidence, spontaneously breathing preterm infants with respiratory distress may be supported with CPAP initially rather than routine intubation for administering PPV (Class IIb, LOE B-R).

8. Assessment of Heart Rate

Immediately after birth, assessment of the newborn’s heart rate is used to evaluate the effectiveness of spontaneous respiratory effort and determine the need for subsequent interventions. During resuscitation, an increase in the newborn’s heart rate is considered the most sensitive indicator of a successful response to each intervention **(72).**

The 2015 ILCOR systematic review evaluated 1 study comparing clinical assessment with electrocardiography (ECG) in the delivery room and 5 studies comparing simultaneous pulse oximetry and ECG. Clinical assessment was found to be both unreliable and inaccurate. Among healthy newborns, providers frequently could not palpate the umbilical pulse and underestimated the newborn’s heart rate by auscultation or palpation. Four studies found that 3-lead ECG displayed a reliable heart rate faster than pulse oximetry. In 2 studies, ECG was more likely to detect the newborn’s heart rate during the first minute of life. Although the mean differences between the series of heart rates measured by ECG and pulse oximetry were small, pulse oximetry tended to underestimate the newborn’s heart rate and would have led to potentially unnecessary interventions. During the first 2 minutes of life, pulse oximetry frequently displayed the newborn’s heart rate below either 60/min or 100/min, while a simultaneous ECG showed the heart rate greater than 100/min. **(73, 78)**

During resuscitation of term and preterm newborns, the use of 3-lead ECG for the rapid and accurate measurement of the newborn’s heart rate may be reasonable. The use of ECG does not replace the need for pulse oximetry to evaluate the newborn’s oxygenation. (Class IIb, LOE C-LD).

It is recommended that oximetry be used when resuscitation can be anticipated, when PPV is administered, when central cyanosis persists beyond the first 5 to 10 minutes of life, or when supplementary oxygen is administered.The probe should be attached to a preductal location (ie, the right upper extremity, usually the wrist or medial surface of the palm). There is some evidence that attaching the probe to the baby before connecting the probe to the instrument facilitates the most rapid acquisition of signal (Class IIb, LOE C).

9. Oxygen Management

Optimal management of oxygen during neonatal resuscitation becomes particularly important because of the evidence that either insufficient or excessive oxygenation can be harmful to the newborn infant.Pure oxygen seems to trigger a long-term increase in oxidativ stress and more injury to the myocardium and kidney **(79).**

Since 2010, the European Resuscitation Council guidelines advise to start resuscitation in term infants with air rather than 100% oxygen and to follow oxygen saturation (SpO2) targets for the first 10 min after birth**(80,81)**. These targets are based on observational studies by Dawson et al **(82)**. The authors suggest that median oxygen saturations rise steadily from around 60% at 1 min of age to above 90% by 10 min.

Clinical studies of newborns in need of resuscitation have indicated that those receiving PPV with air had a higher Apgar score at 5 min, higher heart rate at 90 s of age and took their first breath 30 s earlier than those who received 100% oxygen **(83)**.

9.1. Term infants

It is reasonable to initiate resuscitation with air (21% oxygen at sea level). Supplementary oxygen may be administered and titrated to achieve a preductal oxygen saturation approximating the interquartile range measured in healthy term infants after vaginal birth at sea level. **(84, 85, 86)**

9.2. Preterm infants

The blood vessels of the retina in the premature infant are extremely sensitive to hyperoxia. It is important to wean or remove oxygen from premature infants who are pink. Resuscitation of preterm newborns of less than 35 weeks of gestation should be initiated with low oxygen (21% to 30%), and the oxygen concentration should be titrated to achieve preductal oxygen saturation approximating the interquartile range measured in healthy term infants after vaginal birth at sea level1 (Class I, LOE B-R).

If blended oxygen is not available, resuscitation should be initiated with air (Class IIb, LOE B). If the baby is bradycardic (HR <60 per minute) after 90 seconds of resuscitation with a lower concentration of oxygen, oxygen concentration should be increased to 100% until recovery of a normal heart rate (Class IIb, LOE B).

10. Endotracheal Tube Placement

Endotracheal intubation was practisec in of time

- Initial endotracheal suctioning of nonvigorous meconium-stained newborns
- If bag-mask ventilation is ineffective or prolonged
- When chest compressions are performed
- For special resuscitation circumstances, such as congenital diaphragmatic hernia or extremely low birth weight

When PPV is provided through an endotracheal tube, the best indicator of successful endotracheal intubation with successful inflation and aeration of the lungs is a prompt increase in heart rate. Although last reviewed in 2010, **(87)** exhaled CO2 detection remains the most reliable method of confirmation of endotracheal tube placement. **(88)** Failure to detect exhaled CO2 in neonates with adequate cardiac output strongly suggests esophageal intubation. Poor or absent pulmonary blood flow (eg, during cardiac arrest) may result in failure to detect exhaled CO2 despite correct tube placement in the trachea and may result in unnecessary extubation and reintubation in these critically ill newborns. **(89)** Clinical assessment such as chest movement, presence of equal breath sounds bilaterally, and condensation in the endotracheal tube are additional indicators of correct endotracheal tube placement.

11. Chest Compressions

Cardiac compressions are estimated to occur in approximately 1 in 1000 term deliveries, with a higher frequency in preterm infants **(90).** Cardiac compressions achieve only a fraction of native perfusion even under optimal conditions, so optimizing compressions could be critical in improving outcomes **(91).** Cardiac compressions are indicated when the heart rate is less than 60 beats per minute despite adequate ventilation. In contrast to the resuscitation guidelines for children and adults, guidelines for neonatal resuscitation recommend 90 cardiac compressions synchronized with 30 manual inflations (3:1) per minute **(92, 93).**

In animal models of asphyxia at cardiac arrest, pigs resuscitated with a combination of cardiac compressions and ventilations had better outcomes than those resuscitated with ventilations or compressions alone **(94, 95).** If the arrest is clearly due to a cardiac etiology, a higher compression:ventilation (C:V) ratio, e.g. 15:2 may be considered **(92, 93).** However, because ventilation is critical to reversal of newborn asphyxia arrest, any higher ratio that decreases minute ventilation should be introduced with caution **(92).**

The two main goals of providing perfusion via cardiac compressions are to reperfuse the heart and the brain. If the myocardium is not adequately perfused with too low diastolic pressures as a surrogate for coronary perfusion pressure (CPP), resuscitation efforts can be unsuccessful **(96).**

There are two possible methods that can be used during cardiac compressions: the two thumb-encircling hands, and the two-finger method. Because the 2 thumb–encircling hands technique may generate higher peak systolic and coronary perfusion pressure than the 2-finger technique, **(97-101)** The it is recommended, also because it is less tiring and allows for better cardiac compression depth control **(102).** Compressions should be delivered over the lower third of the sternum rather than the midsternum **(103, 104)** and the depth of the cardiac compressions should be one third of the external anterior-posterior diameter of the chest rather than deeper 25 cardiac compressions **(105)**. It is also of paramount importance to release the pressure on the chest between every chest compression so that circulating blood can refill the heart and then in the next cardiac compression be pushed out of the heart again like in the systole.

Newborns that require prolonged cardiac compressions with no signs of life beyond 10 minutes are at risk for exceptionally poor outcomes, with up to 83% mortality and 77% severe disability noted in survivors **(106).** Optimized cardiac compressions can only achieve approximately 30% of normal perfusion **(107, 108)**. However, du to preferential perfusion of the heart and brain during cardiac compressions, myocardial and cerebral blood flow of greater than 50% of normal may be achieved **(109-110).**

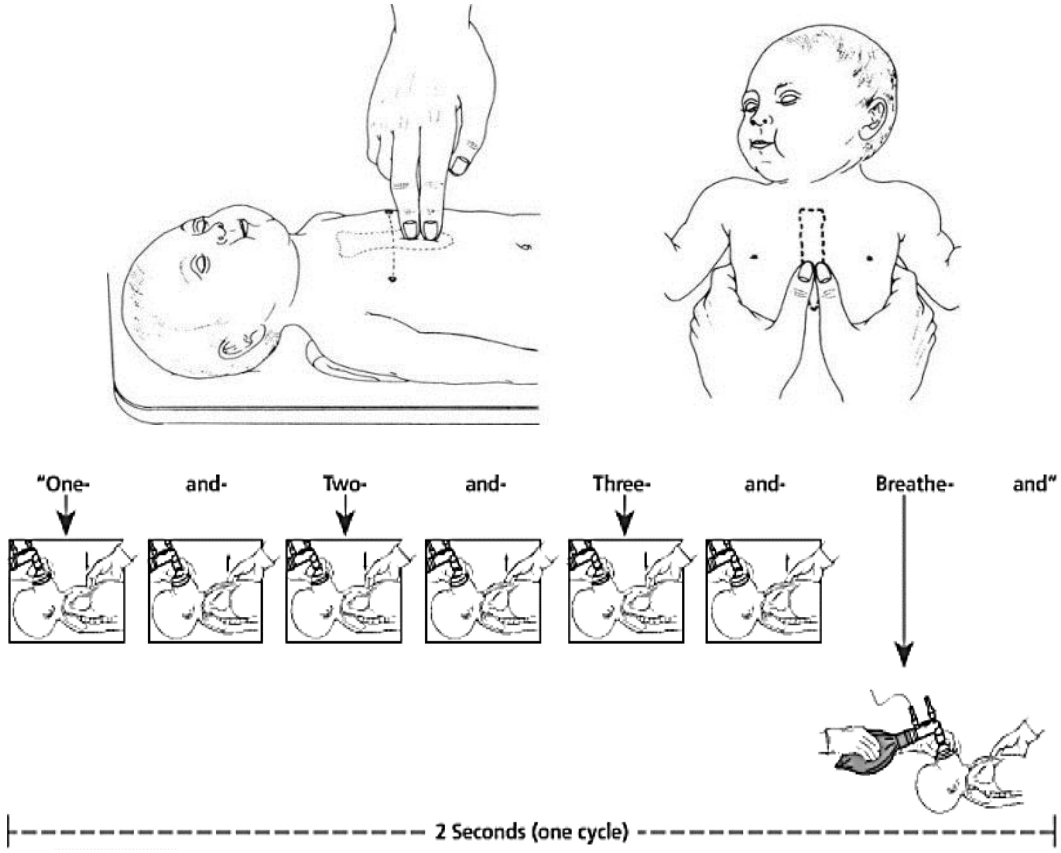

Figure 06. Chest compression techniques for neonatal resuscitation.(American Heart Association/American Academy of Pediatrics: Textbook of Neonatal Resuscitation, Dallas, American Heart Association/American Academy of Pediatrics, 1991)

Because ventilation is the most effective action in neonatal resuscitation and because chest compressions are likely to compete with effective ventilation, rescuers should ensure that assisted ventilation is being delivered optimally before starting chest compressions. Compressions and ventilations should be coordinated to avoid simultaneous delivery. **(111)**

The Neonatal Guidelines Writing Group endorses increasing the oxygen concentration to 100% whenever chest compressions are provided (Class IIa, LOE C-EO). However, to reduce the risks of complications associated with hyperoxia, the supplementary oxygen concentration should be weaned as soon as the heart rate recovers (Class I, LOE C-LD).

12. Medication

Drugs are rarely indicated in resuscitation of the newly born infant. Bradycardia is usually the result of inadequate lung inflation or profound hypoxemia, and establishing adequate ventilation is the most important step toward correcting it. However, if the HR remains <60 per minute despite adequate ventilation (usually with endotracheal intubation) with 100% oxygen and chest compressions, administration of epinephrine or volume expansion, or both, may be indicated. **(112).**

12.1. Rate and Dose of Epinephrine Administration

Epinephrine is recommended to be administered intravenously (Class IIb, LOE C).Initial doses of epinephrine can be given through an endotracheal tube because the dose can be administered more quickly.The recommended IV dose is 0.01 to 0.03 mg/kg per dose. Higher IV doses are not recommended because studies show exaggerated hypertension, decreased myocardial function, and worse neurological function after administration of IV doses in the range of 0.1 mg/kg. If the endotracheal route is used, doses of 0.01 or 0.03 mg/kg will likely be ineffective. Therefore, IV administration of 0.01 to 0.03 mg/kg per dose is the preferred route. While access is being obtained, administration of a higher dose (0.05 to 0.1 mg/kg) through the endotracheal tube may be considered. **(113-116)**

12.2. Volume Expansion

Volume expansion should be considered when blood loss is known or suspected (pale skin, poor perfusion, weak pulse) and the baby's heart rate has not responded adequately to other resuscitative measures (Class IIb, LOE C). An isotonic crystalloid solution or blood is recommended for volume expansion in the delivery room (Class IIb, LOE C). The recommended dose is 10 mL/kg, which may need to be repeated. When resuscitating premature infants, care should be taken to avoid giving volume expanders rapidly, because rapid infusions of large volumes have been associated with intraventricular hemorrhage. **(117)**

12.3. Glucose

Newborns with lower blood glucose levels should receive glucose infusion to avoid brain injury and adverse outcomes after a hypoxic-ischemic insult. Due to the paucity of data, no specific target glucose concentration range can be identified at present and intravenous glucose infusion should be considered as soon as practical after resuscitation, with the goal of avoiding hypoglycemia (Class IIb, LOE C).

13. Postresuscitation Care

Babies who require resuscitation are at risk for deterioration after their vital signs have returned to normal. Once adequate ventilation and circulation have been established, the infant should be maintained in, or transferred to an environment where close monitoring and anticipatory care can be provided. **(118)**

13.1. Induced Therapeutic Hypothermia

It is recommended that infants born at 36 weeks gestation with evolving moderate to severe hypoxic-ischemic encephalopathy should be offered therapeutic hypothermia. The treatment should be implemented according to the studied protocols, which currently include commencement within 6 hours following birth, continuation for 72 hours, and slow rewarming over at least 4 hours.(Class IIa, LOE A).

13.2. Withholding Resuscitation

It is possible to identify conditions associated with high mortality and poor outcome in which withholding resuscitative efforts may be considered reasonable, particularly when there has been the opportunity for parental agreement (Class IIb, LOE C). When gestation, birth weight, or congenital anomalies are associated with almost certain early death and when unacceptably high morbidity is likely among the rare survivors, resuscitation is not indicated. Examples include extreme prematurity (gestational age <23 weeks or birth weight <400 g), anencephaly, and some major chromosomal abnormalities, such as trisomy 13 (Class IIb, LOE C). In a newly born baby with no detectable heart rate, it is appropriate to consider stopping resuscitation if the HR remains undetectable for 10 minutes (Class IIb, LOE C). The decision to continue resuscitation efforts beyond 10 minutes with no heart rate should take into consideration factors such as the presumed etiology of the arrest, the gestation of the baby, the presence or absence of complications, the potential role of therapeutic hypothermia, and the parents' previously expressed feelings about acceptable risk of morbidity.The decision to continue or discontinue resuscitative efforts must be individualized. Variables to be considered may include whether the resuscitation was considered optimal; availability of advanced neonatal care, such as therapeutic hypothermia; specific circumstances before delivery (eg, known timing of the insult); and wishes expressed by the family (Class IIb, LOE C-LD).

Figure 10. Polyethylen Wrapping Of A Preterm Newborn

14. Equipment

Equipping the DR resuscitation space with supplies that are currently used routinely in the ICU will allow a higher level of care from the first moments of life, enhance survival rates and reduce morbidity of extremely preterm infants.To provide adequate oxygenation during initial transition by using a targeted oxygen saturation protocol in the DR, pulse oximeters, blenders -to mix oxygen and compressed air with flowmeter- and a source of compressed air are essential. Because the average duration of DR care is 20 minutes, these tools are also critical for avoiding hyperoxia after the initial transition. It it also necessary to equip the DR with: Suction, warmer, intubation kit, umbilical catheter set and laryngeal mask airway (size 1).

Figure 7. From left to right Laryngeal Mask, PICCs, Suction bulb, Warmer

14.1. Laryngeal Mask

Laryngeal mask is recommended during resuscitation of term and preterm newborns at 34 weeks or more of gestation when tracheal intubation is unsuccessful or is not feasible (Class I, LOE C-EO).

14.2. Assisted-Ventilation Devices

PPV can be delivered effectively with a flow-inflating bag, self-inflating bag, or T-piece resuscitator (Class IIa, LOE B-R).

- **Selfinflating bags** :

Are the most commonly used resuscitation devices worldwide and are used in 40% of the DRs in the United States. These devices do not provide CPAP, and they provide inconsistent PEEP even with a PEEP valve. The self-inflating bag remains the only device that can be used when a compressed gas source is not available.

- **Flow-inflating bags:**

Have the ability to provide both CPAP and PEEP but require significant training and experience to be used effectively.

Figure 08. Self-inflating bag (Left) Flow-inflating bag (Right)

- **The T-piece**

May be desirable because pressures, including CPAP and PEEP, can be set and delivered at target levels easily without a significant chance of unintended overshootof pressure.

Figure 09. Neonatal Resuscitation- PPV

15. Thermoregulation

It has long been recognized (since Budin's 1907 publication of The Nursling) that the admission temperature of newly born nonasphyxiated infants is a strong predictor of mortality at all gestational ages.

Hypothermia is also associated with serious morbidities, such as increased risk of IVH, respiratory issues, hypoglycemia, and late-onset sepsis**.** Because of this, admission temperature should be recorded as a predictor of outcomes as well as a quality indicator (Class I, LOE B-NR.) It is recommended that the temperature of newly born nonasphyxiated infants be maintained between 36.5°C and 37.5°C after birth through admission and stabilization (Class I, LOE C-LD). Heat can be lost by radiation (39%), convection (34%), evaporation (24%) and conduction (3%).

- Loss of heat by radiation can be minimized by **increasing the temperature of the surrounding environment to 26°c**
- Evaporation of water from body surfaces draws heat from the neonate, and is particularly important at birth when the newborn baby is covered in amniotic fluid or in the premature baby where the skin is porous to water. Evaporative heat loss and convective heat loss from exposed surfaces to the surrounding air is reduced by **warming surrounding air, increasing ambient humidity and reducing air speed across the neonate.**
- Insensible water loss through the skin can be minimized by **covering the baby in plastic wrapping** (food or medical grade, heat-resistant plastic) (Class I, LOE A14,15) The use of polyethylene occlusive skin wrapping used without drying has been shown to reduce temperature loss in the DR.

When these techniques are used in combination, the infant's temperature must be monitored closely because of the slight risk of hyperthermiawhich can be harmful as the ability to sweat is present only after 36 weeks post conceptual age(Class IIb, LOE B16). All resuscitation procedures, including endotracheal intubation, chest compression, and insertion of intravenous lines, can be performed with these temperature-controlling interventions in place (Class IIb, LOE C).

Infants born to febrile mothers have been reported to have a higher incidence of perinatal respiratory depression, neonatal seizures, and cerebral palsy and an increased risk of mortality. Animal studies indicate that hyperthermia during or after ischemia is associated with progression of cerebral injury. Lowering the temperature reduces neuronal damage. Hyperthermia should be avoided (Class IIb, LOE C). The goal is to achieve normothermia and avoid iatrogenic hyperthermia. The traditional recommendation for the method of rewarming neonates who are hypothermic after resuscitation has been that slower is preferable to faster rewarming to avoid complications such as apnea and arrhythmias. **(119-126)**

METHODOLOGY

METHODOLOGY

Neonatal resuscitation skills are essential for all health care providers who are involved in the delivery of newborns. The transition from fetus to newborn requires intervention by a skilled individual or team in approximately 10% of all deliveries.

Nearly one half of newborn deaths (many of which involve extremely premature infants) occur during the first 24 hours after birth. Many of these early deaths also have a component of asphyxia or respiratory depression as an etiology. For the surviving infants, effective management of asphyxia in the first few minutes of life may influence long-term outcome.

For this reason, all personnel involved in delivery room care of the newborn should be trained adequately in all aspects of neonatal resuscitation. Additionally, equipment that is appropriately sized to resuscitate infants of all gestational ages should be available in all delivering institutions.

Our overall aim with this thesis was to compare alternative resuscitation protocols with the accepted algorithm by auditing the DR resuscitation practices and available equipment, within the MNSC of Tlemcen in Algeria versus the international standards.

For the purpose of evaluating practices and availability of equipment in the DR we developed a survey on NR equipment and practices to determine the extent of variation or consistency that exists in neonatal programs in the MNSC.

The survey consisted of a yes/no questions table regarding common interventions performed during neonatal resuscitation and based on guidelines of Neonatal Resuscitation. The survey focused on establishing and comparing DR practice, and use of resuscitation devices such as oxygen blenders, pulse oximeters, monitors, plastic wrap for ELBW infants, carbon dioxide detectors for intubation, and use of CPAP or positive end expiratory pressure (PEEP) during resuscitation (Appendix) with the ILCOR 2015 recommandations. It was consensually validated by Neonatologist Pr. SMAHI.

The survey was conducted over a period of 4 months from March to June 2016, amongst pediatricians and midwives who were trained in neonatal resuscitation within the MNSC of TLEMCEN.

Respondents were mainely 4^{th} year pediatric residents and midwives. Most programs resuscitate newborns in the delivery room. The remaining programs resuscitate newborns in the NICU. The number and background of individuals attending deliveries vary greatly. Usual resuscitation teams are composed of <3 individuals. Team members may include pediatric residents and midwives.

A total of 40 surveys (response rate: 80%) were completed and returned, 10 returned as unanswered; of those, were the surveys of pediatricians and midwives who didn’t assest a resuscitation case in the DR. In a review of the responses, it was determined that a survey represented the main work of the respondent who was in charge of the newborn.

Repeat questionnaires were sent to non-respondersand and the data register of the deliveries was also exploited. In total, 15 professionals were surveyed, including both pediatric residents assigned to Nursery Unit and the DR midwives. Data were downloaded as Microsoft Excel 2013 spreadsheets and analysed using SPSS. Descriptive Univariate analysis was done to compare the practices.

RESULTS

& DISCUSSION

RESULTS

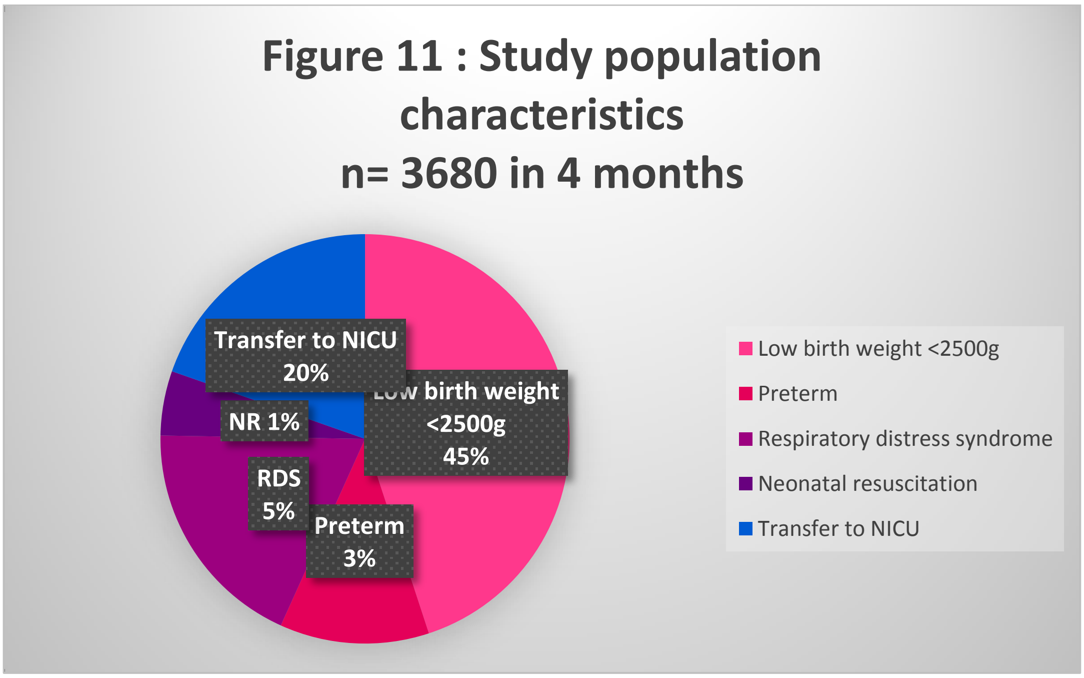

Figure 11. Study population charecteristics

Table 03. The representative sample characteristics :

N	30
Male	16 (53.3%)
Female	14 (46.7%)
Age	34+/-3
Weight	1940 +/- 841
VD (Vaginal Delivery)	21 (70%)
CS (Cesarean Section)	9 (30%)

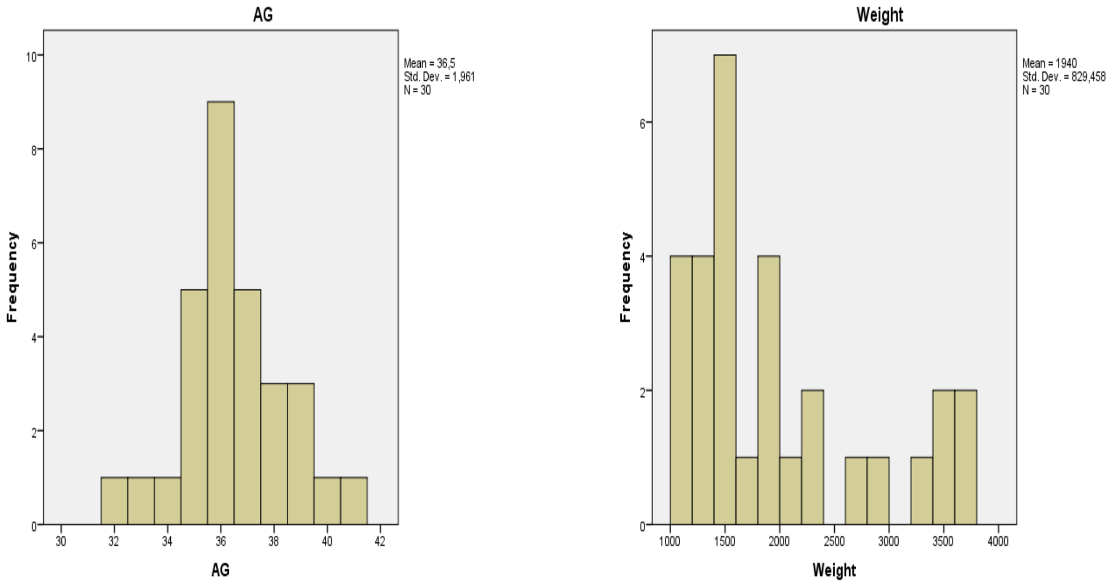

Figure 12. Frequency of gestational age (left) and weight (right)

As shown in the findings from this study and several other studies, babies who are SGA have an increased risk of respiratory distress syndrome (RDS)

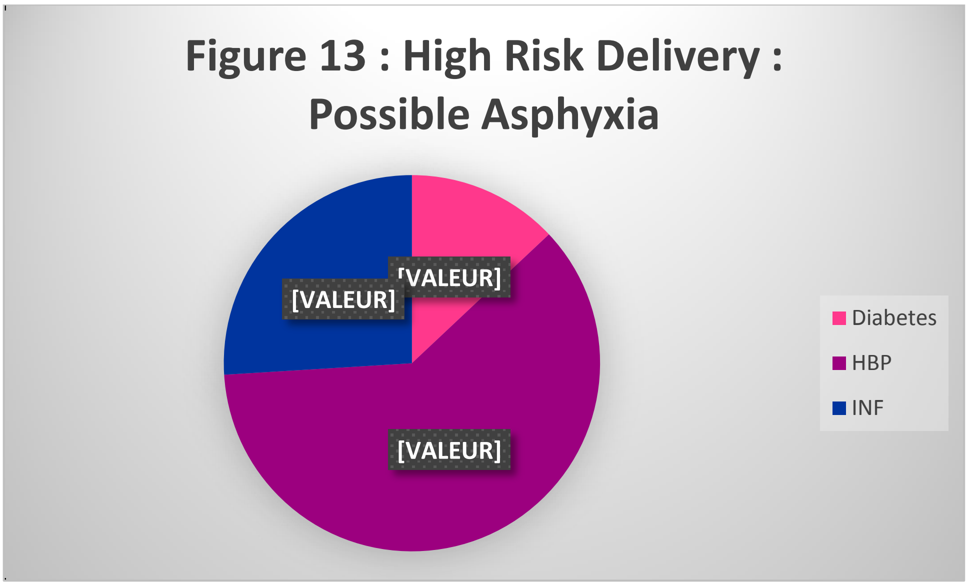

Figure 13. High risk delivery: Possible asphyxia

The risk and need of resuscitation for newborns was higher among women with hypertensive disorder. Similarly, the risk also increased for women who had diabetes, antepartum hemorrhage or infection, small-for-gestational age babies. Similar to our results, studies in developed countries have identified several modifiable risk factors for resuscitation such as lack of antenatal care, antepartum hemorrhage, hypertensive disorder during pregnancy, and small for- gestational age babies. A study conducted in India has also identified lack of antenatal care as a modifiable risk factor for neonatal resuscitation. There are possible explanations for the associations seen between some of these risk factors and the need of resuscitation. For example, women with hypertensive disorder during pregnancy are more likely to have placental compromise, and thus a higher risk of fetal asphyxia.

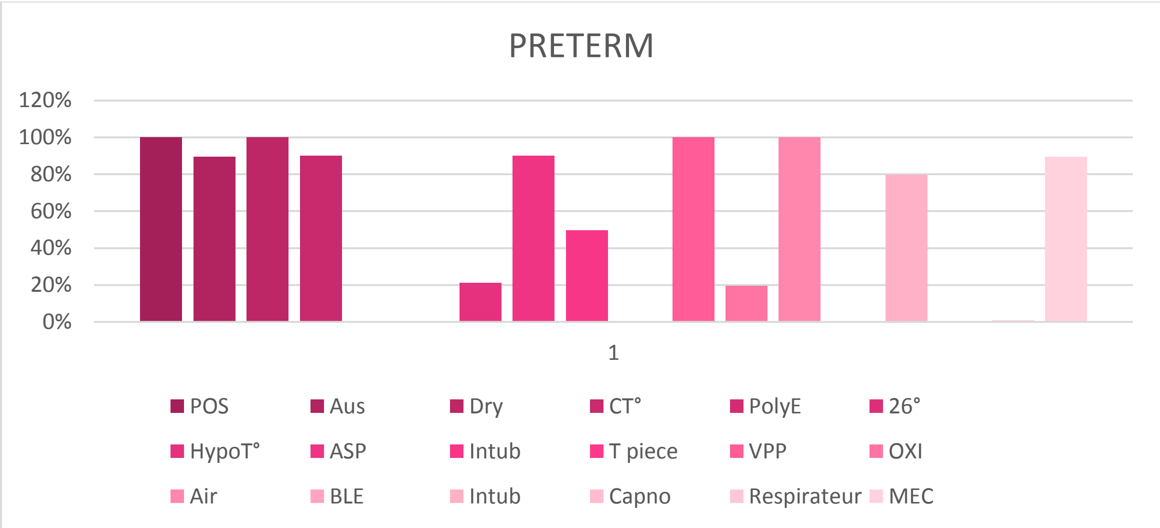

Figure 14. Intervention for neonatal resuscitation at the resuscitation table for preterms.

Figures (14,15,16,17) describes resuscitation practices in DR. Thus, all the newborns are positioned in neutral position, dried and 56.7% (17) were placed under a radiant warmer. Temperature monitoring in DR was performed in 83.3% (25). Premature infants are never wrapped in plastic (polyethylene/polyurethane bags) however, therapeutic hypothermia was employed in 16.7% (5). The delivery room temperature is at 25 C°.

About 93.3% (28) of newborns were examined at first by ausculting the chest. 90% (27) were suctioned, with 6.0 mm suction probe in 80% (24) and 8.0 mm suction probe in 20% (6). Of these 27, 53.3% (16) needed intubation for suctioning. Pulse oximetry was occasionally used 13.3% (4).

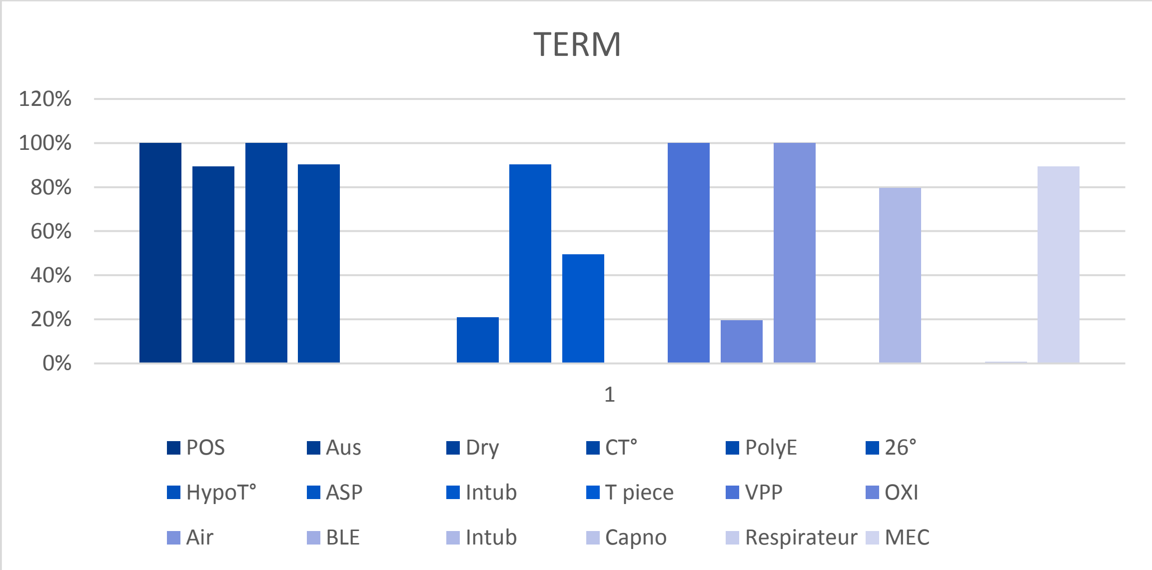

Figure 15. Intervention for neonatal resuscitation at the resuscitation table for term newborns.

PPV was provided routinely in the resuscitation area with self-inflating bags 93.3% (28). Devices used to provide CPAP or PEEP in the delivery room including fow-infating bags, self-infating bags with PEEP valves , and T-piece resuscitators are not of the DR material routine. Thus, CPAP or PEEP can't be concidered.Oxygen administration was started for all newborns with room air. The mode of application was mask size 2.0 which was not suitable for all age and weight. Oxygen blenders are never used because of installations constraints.and the decision to vary the inspired oxygen levels is made with use of gestational age, color, heart rate or other clinical signs. 60% (18) newborns needed intubation, with 73% (22) who have had chest compressions, 60% (18) who received epinephrine. Tracheal administration was used in 53% (16) of cases. Artificial respirator for these newborns were used in only 10% (3). 13.3% (4) of newborns received SSI and 70% (21) have had their glycemia corrected.

Asepsis was fully respected in 43.3% (13), speed and coordination in the practise were respectively achieved in 93,3% (28) and 70% (21). The resuscitation of a newborn is occasionnaly 6.7% (2) or never stopped at 10mn.

Despite the existence of the standard protocol for neonatal resuscitation, skilled providers do not adhere to the guidelines for neonatal resuscitation and there is a tendency for over-use of simple resuscitation techniques such as suctioning and stimulation along with inadequate use of bag and mask.

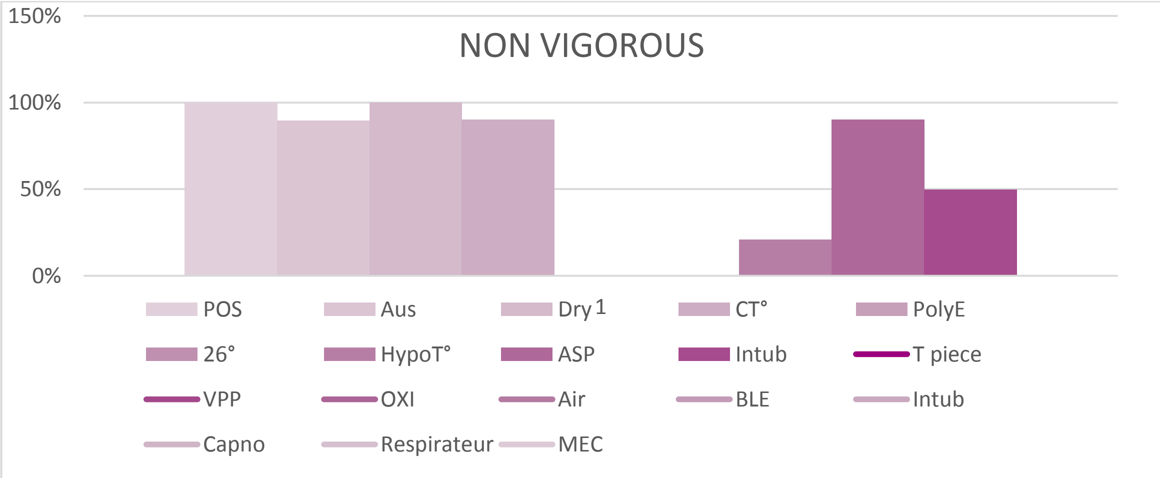

Figure 16. Intervention for neonatal resuscitation at the resuscitation table for non vigorous newborns

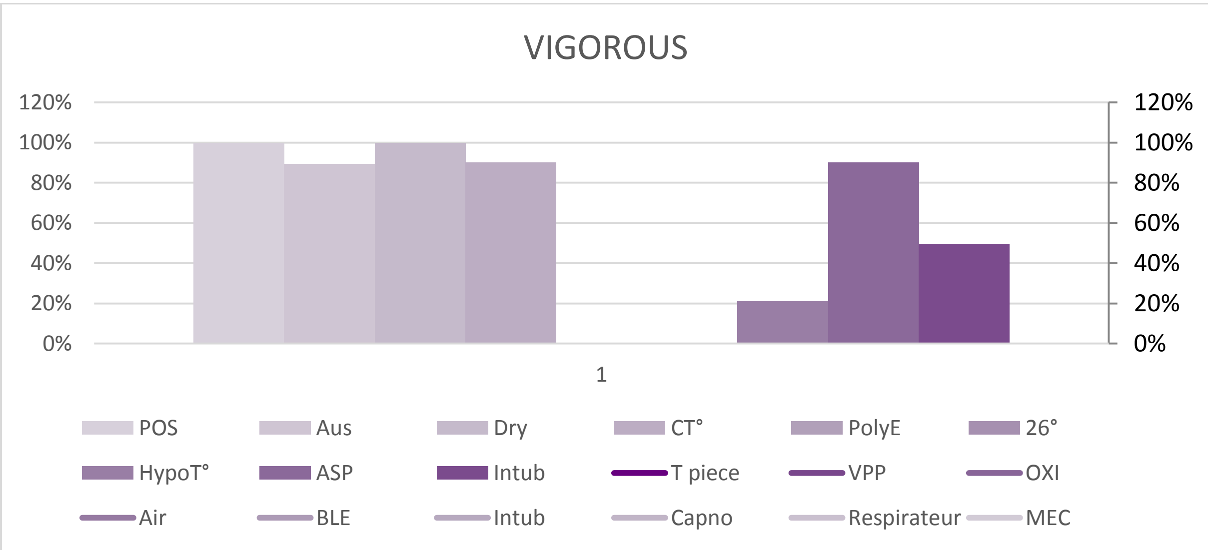

Figure 17. Intervention for neonatal resuscitation at the resuscitation table for vigorous newborns

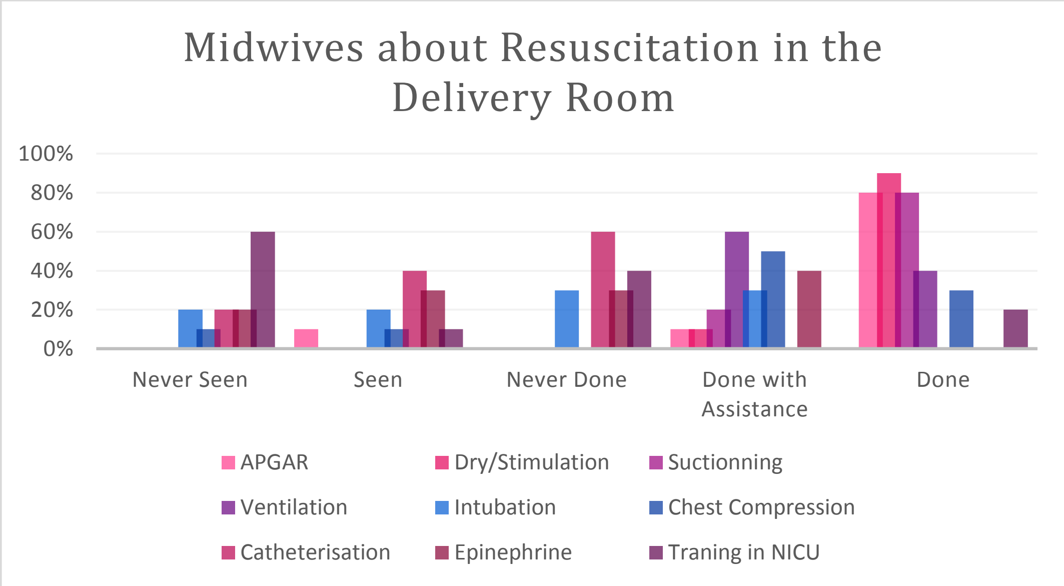

Figure 18. Midwives about Resuscitation in the delivery room

At every delivery there is always at least 1 person whose primary responsibility is the newly born. 90% of midwives acknowledge to be capable of initiating resuscitation, including administration of positive-pressure ventilation 40% and chest compressions 30%. However 10% of midwives complain about the non immediate availablity of a person with skills required to perform a complete resuscitation, including endotracheal intubation and administration of medications.

Several studies in high-income and low-income countries have shown that resuscitation knowledge and skill improves immediately after the training, however, the resuscitation skills tend to deteriorate over a period of time. Therefore, neonatal resuscitation training is in itself not an effective implementation strategy to retain resuscitation skills. Similar to our findings from this study, a study conducted in Canada has shown that a review of schematic posters on neonatal resuscitation before or after resuscitation of babies is not an effective strategy for the retention of neonatal skills. Systematic reviews have also shown that a combination of educational strategies, such as weekly review meetings, and periodic simulated skill checks, checklists and self-evaluation is a more effective strategy to improve the clinical performance than a single strategy

Resuscitation equipment :

Delivery room should be equipped with all the tools necessary for successful resuscitation of a newborn of any size or gestational age. The equipment in our DR includes (**table 04**) :

Table 04. The equipment in our DR

	Available	Not Available
Respiration equipment	-Oxygen supply. -Neonatal bag and tubing to connect to an oxygen source. -Manometer. -Endotracheal tubes (size 2.5-4). includes the following: *Laryngoscope (with size 0 and 1 blades). *Extra bulbs and batteries.	-Assorted masks. -Tape and scissors. -Carbon dioxide detectors. -Stylettes for endotracheal tubes (optional). -Laryngeal mask airway (optional).
Suction equipment	-Suction catheters (6, 8, and 10 French). -Replogle or Salem pump (10 French catheter). -Feeding tube (8 French catheter). -Syringe, catheter-tipped (20 mL). -Meconium aspirator.	-Bulb syringe. -Regulated mechanical suction. -Suction catheters (10 French). -Suction tubing. -Suction caniste.r
Fluid equipment	-IV catheters (22 g) --Dextrose 10% in water (D10W) -Isotonic saline solution -Syringes, assorted (1-20 mL) -Drugs used include epinephrine (1:10,000).	-Tape and sterile dressing material. -T-connectors.
Procedural equipment	-Umbilical catheters (2.5 and 5 French). -Chest tube (10 French catheter). -Sterile procedure trays (eg, scalpels, hemostats, forceps).	

This survey in the MNSC of TLEMCEN is,to our knowledge, the first survey of delivery room resuscitation practices. Because we solicited responses from pediatrecians and midwives, the resultsrepresents the individual's practises in the DR. However, muchof the information obtained in this survey is related toavailable equipment and intent to use different practices.

The results of this survey are most reflective of practices of pediatricians and midwives of the one and only DR in the MNSC of TLEMCEN. Therefore, the response rate among them does not seemto show significant differences.

Attending and anticipating a high risk delivery :

There is a lack of uniformity in the numbers of individualswho attend deliveries, as well as the compositionof the team. The NRP manual states that there should bea minimum of 2 resuscitators attending every delivery.

In our own experience, the tasks involved in a complicatedresuscitation, including airway management, suctioning,heart rate monitoring, and oxygen saturationmonitoring, are performed more easily with a minimumof 3 individuals. We asked participants to indicate thenumber and discipline of members of their "usual resuscitationteam." It was of interest that in 42% of times, teams are composed of 2 individuals. In fact, it is probablyfrequent practice that the number of team membersand the team composition are determined by the specificcircumstances of the delivery.

Thermoregulation of ELBW :

Providing adequate thermoregulation for preterm infantsis especially important. The EPICure study showed that admission temperatures of 35°C among infants of26 weeks' gestation were associated with increasedmortality rates. The occurrence of hypothermia (admission temperature of 35°C) in that study was 29.6%among infants born at 25 weeks, 42.7% among infantsborn at 24 weeks, and 58.3% among infants born at 23weeks. At least 2 prospective randomized trials reportedthe benefit of polyethylene wrap for preventing heat loss among ELBW infants. In those studies, the resuscitatorsdried the infants' head and placed the polyethylenewrap over the body without drying, and they found animprovement in admission temperatures for infants of<28 weeks' gestation. Direct application of the wrapwithout drying reduces evaporative and convective heat losses. Additional measures to improve infant admissiontemperatures may include elevation of the temperatureof the room, regular use of a preheated radiant warmer, and, inour own experience, use of servo-controlled probes toprevent the radiant warmer from shutting down after 15minutes of non–servo-controlled operation. Althoughmore studies are needed to determine the short- andlong-term benefits of the use of occlusive wrap, the dataavailable at the present time suggest that this is a relativelysimple intervention that can prevent heat lossamong ELBW infants.

Use of pulse oximetry :

There have been studies evaluating the useof pulse oximetry during neonatal resuscitation, which are compared to our study of resuscitation without pulse oximetry.However, all infants with any form of distress are monitoredcontinuously with pulse oximetry after admissionto a NICU. Pulse oximeters not only provide informationabout oxygen saturation but also provide a continuousaudible heart rate signal, allowing all team members toperform other tasks. In 1993 already, the American Associationfor Respiratory Care made a recommendation that pulseoximetry should be available for neonatal resuscitation.Of arecent survey of neonatal resuscitation in Spain respondents who use pulse oximeters,23% indicated that they had useful readings within1 minute. Although the onset of functionality may bevariable, oximeters remain useful for monitoring thesubsequent care of infants and are essential if clinicianswish to use a blender and to provide 100% oxygen. Inthe delivery room, the ideal pulse oximeter should be set to its lowest averaging time and highest sensitivity; one manufacturer has developed a probe that adjusts theoximeter to these settings automatically (LNOP Hi-FiTrauma; Masimo Corp, Irvine, CA).

Using blenders :

Initial oxygen administration with just room airthat is practised routinely in ou DRis efficacious, especiallyfor near-term and term infants, and may beassociated with lower mortality rates.Butour trials excluded infants of <1000 g; therefore, moreinformation is required for very preterm infants. However, a compressedair source and a blender are required to deliverranges of oxygen between 21% and 100%.When blendersand a compressed air source are available, teams canuse pulse oximeters to adjust the amount of oxygendelivered to an appropriate level for the condition of theinfant. Our experience in evaluating neonatal resuscitationsuggests that infants spend far more time in theresuscitation area than is anticipated, and the use of blenders and oximeters in such circumstances can reduce unnecessary exposure to excessive oxygen levels,with associated toxicity.

Positive Pressure Ventilation :

For the delivery of positive pressure breaths, 51% ofprograms according to a survey on neonatal resuscitation in Spain use flow-inflating bags and 40% use self-inflatingbags. More than 1 device is available for resuscitationin 30 programs (7%). In an international survey of resuscitationpractices, O'Donnell et al determined that a T-pieceresuscitator was used in 30% of centers. In our survey,a self-inflating resuscitator was used most frequently,possibly reflecting the World Health Organization guidelines and the lack of an available gas source.

2 mannequin-based evaluations have been performed of neonatal resuscitation devices, comparing flow-inflatingbags, T-piece resuscitators, and, most recently, selfinflating bags. Our observations from these studies came up with the conclusion that the T-piece resuscitator delivers the desiredpressures most consistently and that both T-pieceresuscitators and flow-inflating bags are capable of deliveringend expiratory pressure as well as prolongedinflations. Self-inflating bags have a greater tendency topermit excessive pressures. Previous observations from International Surveys confirmthat the T-piece resuscitator delivers desired pressuresmore consistently and may be easier to use for a variety of operators.

All infants who require assisted ventilation should receive PEEP during mechanical ventilation, and should be treated for respiratory distress with variousforms of CPAP. We couldn'tget an evaluation of the efficacy of CPAP or PEEP in our study. When it was determined that 70% of neonatologistsused CPAP in Spain. This survey did not distinguish specificallybetween the use of CPAP and PEEP. Although our findings indicate that 93% of respondents target a pressure of 5 cmH2O, theoptimal level of CPAP has not been determined andrequires additional research.

Cardon dioxide detector :

Current NRP guidelines recommend the use of a carbondioxide detector if there is any doubt about theplacement of an endotracheal tube. Our survey revealedthat 32% of programs use carbon dioxide detectors forconfirmation of intubation. Interestingly, only 48% ofprograms that use carbon dioxide detectors do so routinelyfor every intubation. Previous studies by Repetto et al and Aziz et al demonstrated clearly that the useof carbon dioxide detectors reduces the amount of timerequired to determine that an endotracheal tube is in anincorrect location.

CONCLUSION

The successful transition from intrauterine to extrauterine life is dependent upon significant physiologic changes that occur at birth. In almost all infants (90 percent), these changes are successfully completed at delivery without requiring any special assistance. However, about 10 percent of infants will need some intervention, and 1 percent will require extensive resuscitative measures at birth.

We discussed the physiological changes that occur in the transition from intrauterine to extrauterine life and we reviewed the indications and principles of neonatal resuscitation.

Neonatal resuscitation contributes to a better care of newly born infants. This thesis revealed that many important issues concerning neonatal resuscitation, have to be answered in the future, such as the outcome of preterm infants treated with occlusive plastic wrapping, the percentage and timing of additional oxygen in newborns not responding initially, the use of continuous positive airway pressure during neonatal resuscitation, the most efficacious intravenous dose of epinephrine in newborns with an asystole and the outcome of infants treated with hypothermia. In addition, implementation and training of the new guidelines in Neonatal Life Support Programmes will further contribute to the improvement in the care of newborn infants.

We think that the results of this survey will be useful in

What Is Already Known on This Topic : Adequate resuscitation at birth has a major role in improving morbidity and mortality of neonates, especially preterms. The guidelines are repeatedly revised; last revision in NRP based on ILCOR has been published on 2015, thus, updating the practice among our teams, inside our DR needs to be done regularly to improve birth outcomes.

What This survey Adds : The contemporary knowledge of current neonatal resuscitation guidelines can’t be effective without the necessary equipement.

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ANNEXE

Nouveau-Né N°   Age :   Poids :   Sexe : Masculin ☐ Féminin ☐

Mère	GN	GP	GG	INF	MED	DIABETE	HTA	AVH	AVB	Autre

Apgar	1mn	5mn	10mn	
Coloration				
Cris				
FC				
FR				
Tonus				
RCIU				
Malformations visibles				
LA Clair				
LA Teinté				
Méconium – Bon état				
Méconium – Mauvais était				
	Oui	Non	PM	Notes, Remarques et Précisions
1. Manœuvre :				
Position neutre de la tête : LVAS				
Respiration +FC à l'auscultation				
Essuyer/Sécher				
Réchauffement – contrôle de la T°				
Sac en polyéthylène (Préma)				
26°c en Salle /Préma				
Hypothermie /EAI à 35°C				
Désobstruction de l'oropharynx				
Aspiration oropharyngée				
Intubation pour Aspiration EndoT				
Pièce T				
Ventilation au masque VPP				
SpO2 susductale droite				
O2 : air ambiant				
O2 : mélangeur				
Intubation				
Capnographie				
Respirateur				
MEC/Ventilation3/1				
Cathéter veineux ombilical				
Voie Trachéale				
Adrénaline IV 0.01-0.03mg/kg				
Remplissage SSI : 10mL/kg				
Remplissage Culot Globulaire ORh-				
Mesure extemporanée du taux Hg				
Naloxone				
Glucose				
Arrêt de la Réa après 10mn sans AC				
2. Quelques règles :				
Évaluations à chaque 30 secondes				
Rapidité des gestes				
Coordination				
Asepsie				
Douceur des manipulations ++/Préma				
Calibre des sondes				
Table chauffante				

PEDIATRICIAN SURVEY

1. Pour respecter l'asepsie vous portez lors de la prise en charge d'un nouveau-né :

a. Blouse/Tenue de bloc
b. Gants stériles
c. Masque

d. Charlotte (bonnet)
e. Autre :

2. Pensez-vous être prêt(e) à prendre en charge une détresse respiratoire ?

3. Comment et pouvez-vous dépister et anticiper une situation à risque ?
4. Le matériel nécessaire à une réanimation néonatale est-il disponible ? Détaillez
5. Accueil et mise en route de la réanimation du nouveau-né présentant un Apgar bas, (détresse respiratoire) :
6. Problèmes vous empêchant de réaliser vos objectifs en réanimation néonatale :
7. A quel moment appelez- vous le pédiatre ?
8. Est-ce que vous assistez le pédiatre ? Comment ?
9. Votre formation concernant la réanimation néonatale est-elle suffisante pour répondre aux exigences de la prise en charge du nouveau-né ?
10. Veuillez remplir le tableau ci-dessous :

	Jamais vu	Vu	Jamais fait	Fait assisté	Fait seul
Cotation d'Apgar					
Séchage/ Stimulation					
Aspiration					
Ventilation					
Intubation					
Massage cardiaque					
Pose d'un cathéter					
Adrénaline					
Stage en unité de Réa					

11. Quels supports pédagogiques utilisez-vous pour garder vos aptitudes ?
12. <u>Suggestions/Remarques :</u>

MIDWIVES SURVEY

Class of Recommendation and Levels of Evidence for the 2015 Guidelines Update: Demonstrating the Gap in Resuscitation Science						
Class of Recommendation	**LOE A**	**LOE B-R**	**LOE B-NR**	**LOE C-LD**	**LOE C-EO**	**Total**
I	0	8	17	27	28	80
IIa	0	12	12	40	10	74
IIb	0	23	11	80	26	140
III: No Benefit	2	3	0	0	0	5
III: Harm	0	1	4	3	7	15
Total	2	47	44	150	71	314
Legend: LOE, Level of Evidence; NR, non-randomized; R, randomized;						