



Equipment preparedness for neonatal resuscitation in neonatal intensive care unit in resource limited setting: cross-sectional study

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Background: Adverse healthcare's events are a critical issue worldwide, neonatal intensive care unit adverse events are a considerable issue. It is important that we recognize the basic equipment needed to address these circumstances. The aim of this study is to assess equipment preparedness for neonatal resuscitation in the neonatal intensive care unit.

Method: A hospital-based, cross-sectional study was conducted on 210 neonates admitted to neonatal intensive care unit at comprehensive specialized hospital from 26/03/2022 to 26/05/2022. The data were collected using Checklist prepared from Neonatal resuscitation: current evidence and guidelines. The data obtained were summed up and presented as descriptive statistics using the Microsoft Excel and were analyzed using SPSS version 25. The result reported in text and table form.

Result: In this study there was 12.72% complete equipment preparation (without defect) in 210 cases. From the total, there was minor defect in 52.8% cases, and 34.45% cases had serious defect. Serious defects were more frequently detected in the equipment preparation (42.46%), resuscitation medications (12.5%), and radiant warmer set-up (40%).

Conclusion and recommendation: Overall equipment preparation for neonatal resuscitation was insufficient, and quality of equipment preparation for neonatal resuscitation and stabilization needs to be improved. To enhance equipment preparedness in the neonatal intensive care unit staff should establish uniform guidelines.

Keywords: equipment preparedness, neonatal and resuscitation stabilization, neonatal intensive care unit

Introduction

The neonatal period, typically lasts from birth to 28 full days of life, is considered as the most crucial phase of a newborn's life^[1]. The need of resuscitation and assistance during the immediate transition from foetal life is seen in up to 10% of all infants^[2].

Preterm infants, due to their anatomical and physiological characteristics, require more resuscitative interventions at birth and increased chance for developing major short-term and long-term morbidities. These morbidities might be modified by delivery room (DR) resuscitation procedures within the first minutes of life^[3].

HIGHLIGHTS

- Resuscitation is frequently implemented in neonatal settings.
- Neonatal intensive care unit should have high quality and safety standards, human and equipment accessibility was guaranteed to practice of neonatal resuscitation and stabilization.
- The overall equipment preparation for resuscitation and stabilization in neonatal intensive care unit was inadequate.

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Even though most newborns not require any stabilization measures, the most vulnerable groups require resuscitation at the time of delivery^[4].

Around 85% of newborns born at term will start spontaneous respirations within 10–30 sec of birth and the remaining 10% will react during drying and stimulation. In addition, three percent will start respirations after positive weight ventilation, two percent will require intubation, and 0.1% will require chest compressions and/or epinephrine^[5,6].

Advanced Cardio-pulmonary resuscitation (CPR) with respiratory or hemodynamic support performed within the delivery room and prognosis of these newborns depends generally on the quality of the CPR performed^[7–9]. neonatal intensive care unit (NICU) should have high quality and safety standards, human and equipment accessibility was guaranteed to practice of neonatal resuscitation and stabilization^[10,11].

WHO estimates that of the 130 million newborns born each year, 4 million of them die in the first 28 days of their lives. Three quarters of neonatal deaths happen within the first week, and more than one quarter of deaths happen within the first 24 h^[12,13]. The most common causes of neonatal deaths are preterm birth, birth asphyxia, sepsis, and pneumonia^[14,15].

Studies have shown that mistakes and deviations from the neonatal CPR guidelines are commonest cause of neonatal morbidity and mortality. In previous study the resuscitation team members committed an average error rate of 27.8% in CPR guidelines steps^[16], in 132 resuscitations, the error rate was 15.9–54.5%^[17].

To improve the quality and safety of resuscitation and stabilization arrangement of satisfactory preparing and preparation of the resuscitation team, pre resuscitation briefings and post resuscitation debriefings of the CPR procedures for high-risk newborns, or the progression and utilize of systematic checklists should fulfilled in delivery room stabilization areas^[17].

Rationale of the study

Several studies have illustrated that adverse events are a significant problem, and all possible efforts are being made to limit their occurrence in NICU^[18–20]. Critical unplanned events frequently happen in the NICU that support the occurrence of unfavourable events, and it is essential to distinguish the essential equipment needed to address the situations. Therefore assessing the readiness of equipment preparation in NICU is essential in clinical practice in order to assessing actual practice and the immediacy of feedback allows for immediate awareness and change in practice where necessary. If the quality of delivering is standardized and improved according to those standards, patients admitted to the NICU get standardized equipment stabilization for resuscitation. It is important that we recognize the basic equipment needed to address for neonatal resuscitation and stabilization in NICU^[21].

Methods

Ethical clearance obtained from Ethical Review Committee. Informed consent obtained from each study participant after clear explanation about the merits of the study after data collection. This study registered with the UIN research registry and reported in accordance with STROCSS criteria^[22].

Study population

All neonates admitted to neonatal intensive care unit in study area.

Sample population

All neonates admitted to neonatal intensive care unit from 26/03/2022 to 26/05/2022.

Consecutively data collected from 210 neonates that admitted to NICU during study period.

Data collection methods

Direct observation of NICU nurses, physicians, and residents during neonatal resuscitation with Neonatal resuscitation: current evidence and guidelines (Table 1). It has three components

Table 1

Neonatal resuscitation clinical guideline equipment checklist.

No	Neonatal Resuscitation Equipment	Yes	No	Slightly defect
	Radiant warmer (presets and correct operation)			
	Switch on			
	Clock			
	Oxygen/air connections			
	Aspiration			
	Heat/preheat			
	FiO2 preset (21%)			
	PIP preset (20–25 CMH2O)			
	PEEP preset (5 CMH2O)			
	Maximum aspiration preset (100 mmHg)			
	Automatic respiratory rate (40–60 BPM)			
	CPR materials (availability and correct operation)			
	Check expiration date, if necessary			
	Polyethylene bag			
	Stethoscope			
	Pulse oximeter (with sensors)			
	Aspiration probes (sizes, 10–12)			
	Meconium vacuum adapter			
	Self-inflatable bag			
	Face-masks (different sizes)			
	Nasogastric tubes			
	Laryngoscopes			
	Laryngoscope blades (sizes, 00–0-1)			
	Endotracheal tubes (sizes, 2, 5–3–3, 5 Fr).			
	Endotracheal tube stylets			
	Endotracheal tube fix			
	Umbilical catheter box			
	Umbilical catheters			
	Medication check expiration date			
	Epinephrine			
	Physiological saline ampoules			
	Sodium bicarbonate			
	Double-distilled water			
	Physiological saline (bags or bottles)			
	Syringes (different sizes)			

PEEP, positive end-expiratory pressure; PIP, peak aspiratory pressure.

equipment preparation, radiant warmer set-up, and resuscitation medication.

Operation definition

Without defects: Completely correct preparation.

Minor defects: There was at least one preparation error which could have potentially been detected by a simple inspection when using the resuscitation area or easily correctable.

Serious defects: which were not easily detectable or not easily correctable problems (the absence of equipment).

Data quality management

To ensure quality of data, pre-testing of the data collection standard checklist tool (the questionnaire) conducted on 10 neonates admitted in NICU who were not included in the main study. Data collected prospectively and it blinded to clinician who works in NICU are not aware of the study. The collected data checked for the completeness, accuracy, and clarity before entre in to the database.

Data processing and analysis procedures

The data were entered using Microsoft excel by the principal investigator and then exported, cleaned and analyzed using SPSS version 26. Descriptive statistics such as percentage, frequency and table's used to present the result.

Results

Sociodemographic characteristics

From 210 resuscitated neonates 140 (66.7%) were males, 60 (28.6%) were preterm and 13 (6.1%) had congenital abnormality.

From 35 healthcare providers involved in neonatal resuscitation and stabilization in NICU 15 (42.8%) were nurses, 8 (22.8%) were sinour paediatricians and 12 (34.3) were residents.

Frequency of stabilization and resuscitation of neonates

From 210 case of this study, there was 12.72% complete equipment preparation (without defect). From the total, there was minor defect in 52.83% cases, and 34.45% cases had serious defect. Regarding the three factors analyzed at resuscitation area, compared with the availability and readiness for use of the resuscitation materials or medications. Serious defects frequently detected in the equipment preparation (42.46%), resuscitation medications (12.5%), and radiant warmer set-up (40%). Minor defects were also frequently detected in the equipment preparation (24.2%) compared to radiant warmer set-up (5.7%). The radiant warmer did not have the ventilator parameter presets like including positive end-expiratory pressure (PEEP), peak aspiratory pressure (PIP) presets and setting of automatic respiratory rate (Table 2).

Discussion

Current protocols state that particular staff members at each centre ought to audit equipments and medications accessible to guarantee the adequacy of the radiant warmer set-up, the availability of sufficient spare parts for each instrument, and periodic confirmation of the expiration date of disposable materials and medications. However, this study shows quality of equipment preparedness for neonatal resuscitation was insufficient. It might be due to delays to detect, communication problems, equipment failures, and non-standard clinical practices^[23]. In addition individual should change each position after utilize to ensure it is cleared out in optimal conditions for future use^[18,24]. One potential enhancement might be using written checklists on a regular basis to ensure strict adherence to the material preparation methods. This would ensure that the materials used for both general audits and post-stabilization zone use.

Out of multiple lists used in the same environment, equipment checklist used by the clinicians working in newborn hospitals deemed the most crucial. The employment of such checklists is additionally rapidly adopted by work teams since these staff individuals quickly see their usefulness^[25].

The WHO also recommends using such checklists at a global level to improve the safety of mothers and newborns during the birth process^[26]. With respect to the materials available, the most frequent cause of severe defects was the absence of any of the range of laryngoscope sizes and End tracheal tube. The study also

Table 2
Frequency and percentage of stabilization and resuscitation of neonates in neonatal ICU (n = 210)

Radiant warmer (presets and correct operation)	No, N (%)	Yes, N (%)	Slight defect, N (%)
Switch on	0	210 (100)	0
Clock	210 (100)	0	0
Oxygen/air connections	0	210 (100)	0
Aspiration	0	210 (100)	0
Heat/preheat	0	210 (100)	0
FI02 preset (21%)	0	210 (100)	0
PIP preset (20–25 CMH20)	210 (100)	0	0
PEEP preset (5 CMH20)	210 (100)	0	0
Maximum aspiration preset (100 mm Hg)	0	210 (43)	210 (57)
Automatic respiratory rate (40–60 BPM)	210 (100)	0	0
Result continuou....			
CPR materials (availability and correct operation)			
Polyethylene bag	0	210 (100)	0
Stethoscope	0	210 (100)	0
Pulse oximeter (with sensors)	78 (37)	0	132 (63)
Aspiration probes (sizes, 10–12)	0	0	210 (100)
Meconium vacuum adapter	210 (100)	0	0
Self-inflatable bag	0	210 (100)	0
Face-masks (different sizes)	0	210 (100)	0
Nasogastric tubes	0	210 (100)	0
Laryngoscopes	210 (100)	0	0
Laryngoscope blades (sizes, 00–0-1)	210 (100)	0	0
Endotracheal tubes (sizes, 2, 5–3–3, 5 Fr.)	210 (100)	0	0
Endotracheal tube stylets	210 (100)	0	0
Endotracheal tube fix	210 (100)	0	0
Umbilical catheter box	0	0	210 (100)
Umbilical catheters	0	0	210 (100)
Result continuou....			
Medication check expiration date			
Epinephrine	0	210 (100)	0
Physiological saline ampoules	0	210 (100)	0
Sodium bicarbonate	210 (100)	0	0
Double-distilled water	0	210 (100)	0
Physiological saline (bags or bottles)	0	210 (100)	0
Syringes (different sizes)	0	210 (100)	0
Needles to load medication	0	210 (100)	0
Three- way cocks	0	210 (100)	0

CPR, Cardio-pulmonary resuscitation; PEEP, positive end-expiratory pressure; PIP, peak aspiratory pressure.

revealed substantial problems with pulse oximeter alarm settings. The pulse oximeter only found in the hand of residents and it is difficult to monitor the neonate continuously. In terms of medications, the most common defect we found was the absence of bicarbonate at the NICU. The lack of bicarbonate at different stabilization areas was the most frequent serious defect found during the medication review. The aim of this audit is to improve the quality of equipment preparation required for the stabilization and resuscitation of newborns in the NICU. Medical errors in neonatal intensive care unit were a critical issue. However, it is difficult to detect by traditional reconnaissance methods due to delays to detect, communication problems, equipment failures, and non-standard clinical practices^[11,23,24]. Therefore, it is using standards checklist is crucial to easily detect errors and best

quality of care in intensive care unit. Therefore, routine implementation of guideline in neonatal units should be the norm to establish preventive and proactive measures that can help to avoid possible safety incidents at the time of resuscitation in newborns.

Limitation of the study

This study focused only on evaluating the degree of equipment readiness for newborn stabilization and resuscitation; it did not assess the medical personnel' expertise, attitudes towards neonatal stabilization and resuscitation, or the obstacles and enablers of neonatal resuscitation in NICUs.

Conclusion and recommendation

Overall equipment preparedness for neonatal resuscitation in NICU's was insufficient, and quality of equipment preparation for neonatal resuscitation and stabilization needs to be improved. To enhance the level of equipment preparation in the NICU and standardize the NICU equipment preparation process and staff should establish uniform guidelines.

Ethics approval and consent to participate

Ethical clearance was obtained from the institutional ethical review committee. The aim of the study was explained to the participant, and informed consent was obtained. Anyone not volunteering for participation was informed that they had the full right not to participate or stop at any time.

Consent for publication

Not applicable.

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Not applicable.

Author contribution

This work was carried out in collaboration among all authors. A.E.H. contributed to the conception, the review, and interpreted the result. B.A.A., B.M.A., M.M.T. and A.F.A. in commenting from conception till manuscript preparation.

Conflicts of interest disclosure

The authors declared that they have no competing interests.

Research registration unique identifying number (UIN)

Research registry used, Unique Identifying number or registration ID: 9072, Hyperlink to your specific registration (must be publicly accessible and will be checked): <https://www.researchregistry.com/browse-the-registry#home/>.

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Availability of data and materials

All data generated or analyzed during this study were included in this published article and available on request.

Provenance and peer review

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