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# Strengthening Neonatology in Ethiopia: From Survey Data to System Improvement

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**Keywords**
Survey · Delivery room · Neonatal intensive care · Low-income countries · Newborn infants

**Abstract**
***Introduction:*** Neonatal care in low-resource settings is hindered by shortages of trained staff, inadequate infrastructure, and limited equipment and medications that compromise the management of common neonatal conditions and reduce the quality of care. Our aim was to describe the collaborative efforts between the Italian Agency for Development Cooperation (AICS), the Union of European Neonatal and Perinatal Societies (UENPS), Doctors with Africa Collegio Universitario Aspiranti Medici Missionari (CUAMM), the Ethiopian Pediatrics Society (EPS), and the Ethiopian Federal Ministry of Health (FMoH) to assess resuscitation and respiratory care practices in Ethiopian neonatal intensive care unit (NICU)s, identify gaps, and guide targeted interventions. ***Methods:*** A 50-item survey was distributed to 48 Ethiopian NICUs. Based on the survey results, a national workshop in Addis Ababa and a neonatal resuscitation "Train the Trainers" course were scheduled. In parallel, funds were allocated to initiate renovations and equipment upgrade at two selected sites. ***Results:*** The survey showed that most units lacked essential resuscitation equipment. Noninvasive respiratory support mainly relied on homemade continuous positive airway pressure systems; mechanical ventilators were available in <40% of units. Caffeine was rarely used, and

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surfactant was unavailable. The national workshop led to a document shared with the FMoH outlining priorities for subsequent training and resource strengthening. Newly trained instructors conducted four local neonatal resuscitation courses, training 150 healthcare providers. Facility upgrades addressed water, power, medical gas systems, and refurbishment of deteriorated areas. ***Conclusions:*** The survey revealed major gaps in neonatal care in Ethiopia. Collaborative efforts by AICS, UENPS, CUAMM, EPS, and FMoH helped reinforce key infrastructures and promote delivery room and respiratory care.



## Introduction

Sub-Saharan Africa (SSA) bears the world's highest burden of neonatal mortality, accounting for 43% of all neonatal deaths. In SSA, the pooled neonatal mortality rate is 27 per 1,000 live births, with a 16.5% mortality rate among neonatal intensive care unit (NICU) admissions. A newborn in SSA is ten times more likely to die in the neonatal period than one in a high-income country [1, 2].

Although Ethiopia is a key demographic and economic force in SSA, it remains among the world's poorest countries despite its recent economic growth. In Ethiopia, neonatal mortality has declined from 59.4/1,000 live births in 1990 to 27 in 2020, with projections to be 19.8 in 2030 [3], still far from the United Nations' Agenda 2030 for Sustainable Development of mortality of ≤12/1,000 live births [4]. Key predictors of neonatal mortality include gestational age, sepsis, respiratory distress syndrome, and place of residence [5], while key contributors include limited trained staff for resuscitation [6–8], inadequate infrastructure and equipment [9], weak referral pathways [10], poor infection control, and insufficient health data systems limiting implementation of effective improvements [11].

In May 2023, the President of UENPS (Union of European Neonatal and Perinatal Societies) (C.M.) and a member of its Scientific Committee (G.L.) visited Addis Ababa upon invitation of the Italian Embassy and the Italian Agency for Development Cooperation (AICS). During the mission, meetings with the Federal Ministry of Health (FMoH) and the Ethiopian Pediatrics Society (EPS), together with visits to major hospitals, highlighted the need for a national assessment of delivery room (DR) and neonatal respiratory care. In response, UENPS proposed conducting a survey in Ethiopian NICUs to generate baseline data and establish direct links with clinicians, laying the foundation for a national neonatal network. The survey was completed in January 2024, and its preliminary findings were discussed with Ethiopian counterparts. Following the survey results and the identification of priority needs, Doctors with Africa CUAMM (Collegio Universitario Aspiranti Medici Missionari, Padua, Italy) was involved as an operational partner, given its consolidated experience in health system strengthening in Ethiopia. UENPS and CUAMM jointly developed a proposal approved by AICS as the project "*Strengthening Neonatology in Ethiopia*" (AID012958), officially launched in Addis Ababa in September 2024. This 27-month initiative (August 2024–October 2026) aims at advancing healthcare workers' capacity through training of clinical and biomedical staff, exchange visits, and international workshops, as well as rehabilitating the NICUs of two public hospitals: Suhul General Hospital (Shire) and Tikur Anbessa Specialized Hospital (Addis Ababa).

Upon project approval, UENPS, EPS, and CUAMM planned a mission to Addis Ababa in January 2025, including a national workshop with European experts and a neonatal resuscitation "Train the Trainers" course. Meanwhile, CUAMM conducted the needs assessment in the two target hospitals, which informed the allocation of funds to initiate renovations and equipment upgrades.

## Methods

The survey questionnaire was originally developed by experts from UENPS and the Italian Society of Neonatology (C.M., C.G., D.T., O.D.S., G.L., L.G.) for previously published European surveys [12–15]. For the Ethiopian project, the same group adapted it to a low-income context based on the initial on-site assessment. The draft was reviewed for content validity and contextual relevance by heads of major Ethiopian NICUs (D.A., G.M.), FMoH and EPS representatives (A.L., W.B.) and CUAMM staff (F.M., L.G.) before final approval; however, no formal validation was conducted in the Ethiopian setting. Explicit criteria guiding domain and question selection included clinical relevance, alignment with evidence-based standards, and applicability to the Ethiopian context. Each domain was designed to explore predefined aspects of neonatal respiratory care across the continuum of care. The FMoH identified 48 public Level II–III NICUs nationwide (Table 1) – selected based on case volume, referral role, and availability of essential equipment – representing

**Table 1.** NICU classification in Ethiopia

- Level I (basic NICU): located in *district hospitals*, providing essential neonatal care such as oxygen therapy, intravenous fluids, antibiotics, thermal regulation, and basic resuscitation.
- Level II (specialty NICU): located in *general or regional hospitals*, offering continuous monitoring, noninvasive respiratory support, phototherapy, and care for moderately preterm or sick neonates.
- Level III (subspecialty NICU): located in *tertiary or teaching hospitals*, equipped for advanced life support including invasive mechanical ventilation, blood transfusion, and management of preterm or critically ill neonates.

Sources: Ministry of Health Ethiopia – Operational Standards for Neonatal Intensive Care Units, 2021; Clinical Reference Manual for Advanced Neonatal Care in Ethiopia, 2022; Federal MoH website, and Newborn and Child Health Program.

approximately 60% (48/80) of all Level II–III neonatal units in the country, and authorized UENPS to distribute the questionnaire. The FMoH involvement ensured alignment with national priorities and access to key institutions. The 50-item questionnaire covered five domains: general information; DR practices; NICU respiratory practices; drugs for respiratory diseases; and available facilities. A combination of multiple-choice, yes/no, and fill-in questions was intentionally used to ensure standardization and contextual flexibility. While multiple-choice and yes/no formats facilitated quantitative analysis, fill-in questions allowed respondents to specify local practices or equipment not captured by predefined options, thus accommodating the heterogeneity of Ethiopian NICU settings. The survey was distributed via SurveyMonkey, with a PDF backup (online suppl. File 1; for all online suppl. material, see https://doi.org/10.1159/000550774), to the heads of NICUs, designated as primary respondents because they were expected to have the most comprehensive knowledge of unit organization, equipment, and clinical practices. This choice was intended to ensure the accuracy and completeness of information reported at the institutional level rather than reflecting individual opinions. When the unit head was unavailable, the questionnaire was completed by a staff member formally designated by the unit head, with direct knowledge of clinical activities and resource availability. The questionnaire was initially open for 4 weeks and subsequently extended to just over 2 months to accommodate variable internet connectivity across centers. Participants were informed of the study aims and anonymized data handling, and survey completion constituted informed consent.

The January 2025 mission included a 2-day national workshop in Addis Ababa, bringing together representatives from all participating centers to review and discuss the survey results through plenary presentations and group discussions. This was followed by a 2-day neonatal resuscitation Train the Trainers course aimed at strengthening local instructional capacity. Based on a format approved by the Italian Society of Neonatology, the course prepared new trainers through simulation and case discussions, with content adapted in collaboration with EPS to local priorities, regulations, and ethical considerations. The CUAMM needs assessment identified major infrastructural challenges in the two target NICUs, including water supply problems, inadequate medical gas systems, unreliable power, insufficient outlets, deteriorated finishes, and spaces requiring redesign. Organizational issues included faulty or unused equipment, stock-outs of essential and some third-level drugs, and limited bioengineer support.

*Statistical Analysis*

All the data obtained through the survey were examined via descriptive analysis. Categorical data were expressed as counts and percentages while continuous data were expressed as median and interquartile range (IQR).

EPS gave permission to publish the survey data (Approval No. EPS-01-5342-25). The study did not meet the criteria for human subject research and is in line with the principles of the Declaration of Helsinki.

## Results

*Survey*

The survey was first sent out in October 2023 and closed by December 2023. It was distributed to 48 hospitals: 43 completed the questionnaire, 1 submitted a partial response, and 4 did not respond. The overall response rate was 89.6% (43/48). Figure 1 shows the distribution of the responding hospitals.

General Information

Among the responding NICUs, 41 (95%) were birth centers, 22 (51%) were academic hospitals, and 21 (49%) were Level II general hospitals. The number of NICU

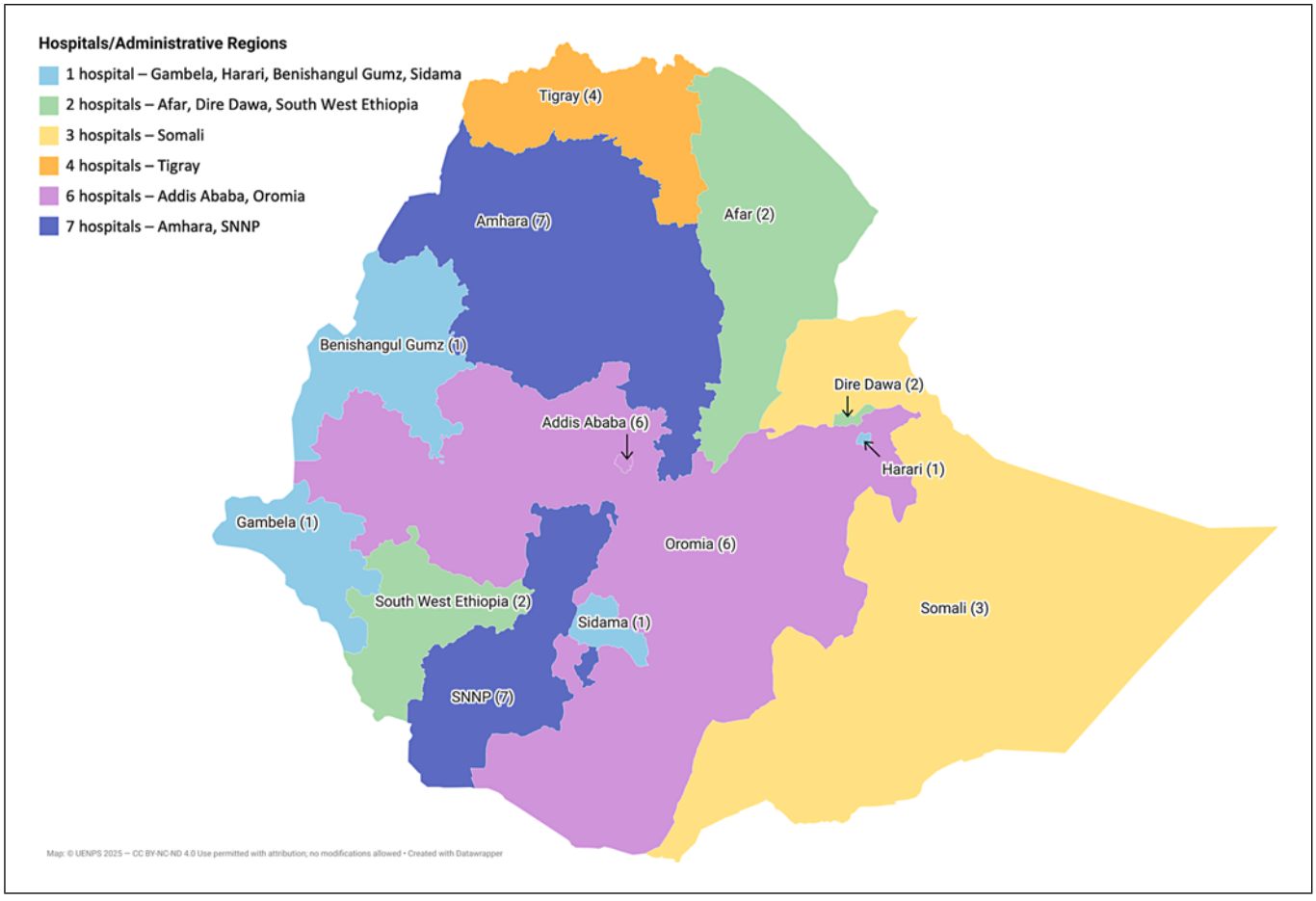


**Fig. 1.** Distribution of the responding hospitals.

beds ranged from 5 to 75 (median 29, IQR: 16–43). In 2022, annual births ranged from 960 to 10,800 (median 4,000, IQR: 2,486–5,340), while NICU admissions ranged from 237 to 4,600 (median 1,120, IQR: 663–1,660). A patient-to-nurse ratio ≥5:1 was reported by 16 (37%) centers.

DR Practices

Delivery room practices are reported in Table 2. A checklist for preparing materials and equipment is lacking in 15 (35%) DRs, and midwives or nurses, who usually act as the primary caregivers during birth, rarely receive specialized training. In 23 (53.5%) centers, neonatal resuscitation courses are not routinely conducted and in 24 (55.8%), a skilled neonatologist is not consistently available at high-risk deliveries, including prematurity, perinatal distress, and recognized obstetric risk factors [16]. Ethiopian guidelines previously classified births <28 weeks as abortions, but about 50% of hospitals now start resuscitation at 28 weeks, reflecting a progressive change in practice. Notably, 27 (62.8%) units lack air-oxygen blenders, and none have heated, humidified medical gases. The high rate of missing responses on initial $FiO_2$ (Table 2) likely reflects this limited availability.

NICU Respiratory Practices

NICUs respiratory practices are reported in Table 3. In Ethiopian NICUs, the most widely used noninvasive ventilation strategy is bubble continuous positive airway pressure, often delivered using locally assembled, improvised systems. The predominant interface is the short binasal prongs. Nasal high-flow therapy and nasal IPPV (Intermittent Positive Pressure Ventilation) are rarely used. Invasive synchronized IPPV is the preferred first-line treatment for severe acute neonatal respiratory distress syndrome, but most units lack the necessary equipment. In 23 (53.5%) centers,

**Table 2.** The modes, devices, and strategies employed in the DR

| | |
|---|---|
| Umbilical cord management in vaginally delivered term infants | |
| ICC <1 min | 17 (39.5) |
| Milking | 2 (4.6) |
| DCC | 24 (55.8) |
| Total | 43 (100) |
| Umbilical cord management in term infants born through C-section | |
| ICC <1 min | 20 (46.5) |
| Milking | 1 (2.3) |
| DCC | 22 (51.1) |
| Total | 43 (100) |
| When is arterial cord blood gas analysis performed in the DR? | |
| Routinely | 0 (0.0) |
| In asphyxiated infants | 4 (9.3) |
| Never | 39 (90.7) |
| Total | 43 (100) |
| Which algorithm for neonatal resuscitation does your institution follow? | |
| ERC | 0 (0.0) |
| AAP | 10 (23.3) |
| ILCOR | 1 (2.3) |
| HBB | 11 (25.6) |
| National guidelines | 19 (44.2) |
| I don't know | 0 (0.0) |
| Other | 2 (4.6) |
| Total | 43 (100) |
| Who is responsible for preparing the material and the equipment?[a] | |
| Pediatrician/neonatologist | 6 (13.9) |
| Obstetrician | 8 (18.6) |
| Anesthesiologist | 6 (13.9) |
| Midwife | 39 (90.7) |
| Nurse | 18 (41.8) |
| Other | 6 (13.9) |
| What is the lowest GA at which you initiate resuscitation? | |
| 23 weeks | 0 (0.0) |
| 24 weeks | 3 (7.0) |
| 25 weeks | 4 (9.3) |
| 26 weeks | 8 (18.6) |
| 27 weeks | 2 (4.6) |
| 28 weeks | 0 (0.0) |
| Other | 22 (51.2) |
| Total | 43 (100) |
| What devices are available for noninvasive respiratory support?[a] | |
| Self-inflating bag | 27 (62.8) |
| Flow-inflating bag | 7 (16.3) |
| T-piece resuscitator | 6 (13.9) |
| Oxygen flow | 37 (86.0) |
| Bubble CPAP | 36 (83.7) |
| Mechanical ventilator | 6 (12.9) |
| Which device is routinely used for noninvasive respiratory support? | |
| Self-inflating bag | 3 (7.0) |
| Flow-inflating bag | 2 (4.6) |
| T-piece resuscitator | 0 (0.0) |
| Oxygen flow | 22 (51.1) |
| Bubble CPAP | 16 (37.2) |
| Mechanical ventilator | 0 (0.0) |
| Total | 43 (100) |

**Table 2** (continued)

| | |
|---|---|
| Which interface is routinely used for respiratory stabilization? | |
| $O_2$ head box | 0 (0.0) |
| Facial mask | 5 (11.6) |
| Short binasal prongs | 33 (76.7) |
| DILC | 4 (9.3) |
| Single nasopharyngeal tube | 1 (2.3) |
| Total | 43 (100) |
| How is newborn's HR detected and monitored during resuscitation?[a] | |
| Palpation of the UC | 17 (39.5) |
| Palpation of peripheral pulses | 12 (27.9) |
| Stethoscope | 35 (81.4) |
| 3-lead ECG monitor | 2 (4.6) |
| Pulse oximeter | 34 (79.1) |
| I don't know | 0 (0.0) |
| Which initial $FiO_2$ do you set for term infants who need resuscitation? | |
| 0.21 | 12 (66.7) |
| 0.22–0.3 | 3 (16.7) |
| 0.3–0.4 | 0 (0.0) |
| 0.4–0.5 | 0 (0.0) |
| >0.51 | 1 (5.6) |
| 1 | 2 (11.1) |
| Total | 18 (100) |
| Missing | 25 (58.1) |
| Which initial $FiO_2$ do you set for a <32 GA infant who needs resuscitation? | |
| 0.21 | 4 (22.2) |
| 0.22–0.3 | 3 (16.7) |
| 0.3–0.4 | 5 (27.8) |
| 0.4–0.5 | 2 (11.1) |
| >0.51 | 0 (0.0) |
| 1 | 4 (22.2) |
| Total | 18 (100) |
| Missing | 25 (58.1) |
| Which initial $FiO_2$ do you set for a 32–36 GA infant who needs resuscitation? | |
| 0.21 | 6 (33.3) |
| 0.22–0.3 | 7 (38.9) |
| 0.3–0.4 | 3 (16.7) |
| 0.4–0.5 | 1 (5.6) |
| >0.51 | 0 (0.0) |
| 1 | 1 (5.6) |
| Total | 18 (100) |
| Missing | 25 (58.1) |
| Which strategies do you use in your DR to keep a preterm infant warm?[a] | |
| Increasing DR temperature | 21 (48.8) |
| Preheating the radiant warmer | 36 (83.7) |
| Using a servo-controlled probe | 14 (32.5) |
| Pre-warmed towels | 19 (44.2) |
| Polyethylene bag | 13 (30.2) |
| Hat | 16 (37.2) |
| Thermal mattress | 1 (2.3) |
| Heated, humidified gases | 0 (0.0) |
| Immediate skin-to-skin | 34 (79.1) |
| What monitoring technologies are available? | |
| Pulse oximeter | 43 (100) |
| ECG monitor | 12 (27.9) |
| $CO_2$ detector | 0 (0.0) |
| Mechanical ventilator | 6 (13.9) |
| Total | 43 (100) |

**Table 2** (continued)

| | |
|---|---|
| Time limit to discontinue resuscitation for severely asphyxiated infants | |
| 20 min | 16 (37.2) |
| 10 min | 1 (2.3) |
| No time limit | 13 (30.2) |
| I don't know | 0 (0.0) |
| Other | 13 (30.2) |

Data are expressed as counts and percentages. Total sample = 43 hospitals. ICC, immediate cord clamping; DCC, delayed cord clamping; ERC, European Resuscitation Council; AAP, American Academy of Pediatrics; ILCOR, International Liaison Committee on Resuscitation; HBB, Help Babies Breath; GA, gestational age; DILC, double inspiratory loop cannulas; UC, umbilical cord; DR, delivery room; CPAP, continuous positive airway pressure. [a]Multiple-choice questions.

medical gases for ventilation are not heated or humidified, and therapeutic hypothermia is not available in the country.

Drugs Used for Respiratory Diseases

Forty-two (97.7%) units use methylxanthines, primarily aminophylline. None of the NICUs is equipped with nitric oxide, and surfactant is currently unavailable. Twenty-nine (67.4%) units do not use postnatal corticosteroids.

Facilities Available in the NICU

Many responding centers reported shortages in respiratory care equipment (Table 4), with 39 (90.7%) considering it insufficient to provide adequate care for all infants in need. In addition, 41 (95.3%) reported that disposable respiratory supplies were not consistently available in appropriate quantities and sizes, and only 18 (41.9%) centers had a standardized protocol for respiratory device maintenance.

*National Workshop*

Building on the survey results, the January 2025 mission dedicated the first 2 days to a national workshop in Addis Ababa, held at the Italian Cultural Institute "Galileo Galilei," with contributions from European experts and the participation of doctors, nurses, and midwives from all surveyed NICUs, together with representatives of AICS and the FMoH. Day 1 began with a morning plenary session dedicated to presenting and discussing the survey results. In the afternoon, participants were divided into working groups. Local facilitators summarized the notes from each group and conducted a thematic analysis to identify needs and priorities. Further contextual information on equipment availability, environmental conditions in DRs and NICUs, and perceived gaps in clinical practice emerged during the workshop. This information was used to support the interpretation of the survey results. Structured notes were collected by UENPS and EPS facilitators to summarize these insights and delineate priority needs. The identified challenges were then collectively reviewed, leading to the development of an action plan document subsequently shared with the FMoH. Day 2 featured a workshop with lectures on DR and respiratory care delivered by European neonatologists, along with case-based neonatal clinical discussions led by Ethiopian neonatologists.

*The Train the Trainers Course*

Days 3 and 4 were focused on a Train the Trainers course on neonatal resuscitation, held at Tikur Anbessa Hospital and conducted by certified European instructors (C.G., D.T.). The course was designed to train the most motivated Ethiopian neonatologists, selected by the EPS, to become neonatal resuscitation instructors, with the goal of enabling them to subsequently train other healthcare professionals. The Train the Trainers course aimed at promoting a more harmonized approach to neonatal care in Ethiopia, while remaining adaptable to the resources and constraints of the different facilities. All the participating neonatologists were awarded certificates upon completion.

*Facilities Renovations*

Beyond the structural rehabilitation initiated at the two target sites in February 2025, the intervention included key infrastructure and supply chain-strengthening actions, such as repair or replacement of obsolete biomedical equipment, establishment of maintenance protocols with dedicated training for 12 biomedical engineers/technicians, and measures to ensure the availability of essential and third-level medications.

**Table 3.** The modes, devices, and strategies employed in the NICU

| | |
|---|---|
| How are infants usually ventilated during transport from the DR to the NICU? | |
| Manual ventilation | 22 (51.1) |
| Mechanical ventilator | 0 (0.0) |
| Spontaneous breathing | 11 (25.6) |
| Nasal HFT | 2 (4.6) |
| Nasal CPAP | 8 (18.6) |
| Total | 43 (100) |
| What noninvasive ventilation modes are available in your unit?[a] | |
| Conventional ventilator CPAP | 7 (16.3) |
| Bubble CPAP | 33 (76.7) |
| Infant-flow CPAP | 8 (18.6) |
| Nasal BiPAP | 0 (0.0) |
| NIPPV/NIMV | 2 (4.6) |
| Handmade CPAP | 28 (65.1) |
| Nasal HFT | 12 (27.9) |
| What noninvasive ventilation is routinely used for acute moderate RDS? | |
| Conventional ventilator CPAP | 3 (7.0) |
| Bubble CPAP | 26 (60.5) |
| Infant-flow CPAP | 2 (4.6) |
| NBiPAP | 0 (0.0) |
| NIPPV/NIMV | 0 (0.0) |
| Handmade CPAP | 10 (23.3) |
| Nasal HFT | 2 (4.6) |
| Total | 43 (100) |
| What noninvasive interfaces are available?[a] | |
| $O_2$ headbox | 8 (18.6) |
| Facial mask | 30 (69.7) |
| Short binasal prong | 37 (86.0) |
| DILC | 10 (23.3) |
| Single nasopharyngeal tube | 9 (20.9) |
| Which noninvasive interface is routinely used for acute moderate RDS | |
| $O_2$ headbox | 1 (2.3) |
| Facial mask | 6 (13.9) |
| Short binasal prong | 28 (65.1) |
| DILC | 8 (18.6) |
| Single nasopharyngeal tube | 0 (0.0) |
| Total | 43 (100) |
| What invasive ventilation mode is the first choice for acute severe RDS in preterm infants? | |
| Non-synchronized conventional ventilation | 1 (2.3) |
| Synchronized conventional ventilation | 8 (18.6) |
| Synchronized conventional ventilation + VT | 5 (11.6) |
| HFOV | 3 (6.9)[b] |
| I do not have devices for invasive ventilation | 26 (60.5) |
| Total | 43 (100) |

Data are expressed as counts and percentages. Total sample = 43 hospitals. CPAP, continuous positive airway pressure; BiPAP, bilevel positive airway pressure; NIPPV/NIMV, nasal intermittent positive pressure ventilation/nasal intermittent mandatory ventilation; HFT, high flow therapy; DILC, double inspiratory loop cannulas; VT, volume target; HFOV, high-frequency oscillatory ventilation; DR, delivery room; NICU, neonatal intensive care unit; RDS, respiratory distress syndrome. [a]Multiple-choice questions. [b]This response proved to be inaccurate during the discussion of the survey results at the workshop, as no center reported using this ventilation mode.

## Discussion

The survey highlighted several priority gaps across the continuum of neonatal care in Ethiopia, with important implications for improving outcomes. High nursing workload was a key concern due to its association with missed or delayed care and adverse neonatal outcomes [17], underscoring the need to address staffing ratios. DR practices showed substantial resource limitations. Reliable access to medical gases and air-oxygen blenders is essential, as the ability to titrate oxygen markedly influences survival and neurodevelopment [18]. Similarly, providing heated, humidified gases is critical for preventing hypothermia among preterm infants [19]. According to the 2025 ILCOR recommendations, T-piece resuscitators, which ensure controlled pressures and are associated with better outcomes, should become standard equipment, with a self-inflating bag available as backup [20, 21]. In this regard, UENPS provided two T-piece resuscitators (GINEVRI S.r.l., Albano Laziale, Rome, Italy), which were used as training equipment during the Train the Trainers course and subsequently donated by GINEVRI to Tikur Anbessa Hospital. Ethiopian clinicians unanimously recognized delayed cord clamping as a simple, cost-free intervention improving anemia, neurodevelopment, and survival [22]. Umbilical cord milking, an alternative for non-vigorous term and late preterm infants (≥35 weeks), is rarely used and may further improve outcomes [22]. Finally, strengthening the skills of midwives and nurses, who manage equipment and provide first-line care at birth, remains a priority. In the NICU, respiratory support practices also reflected resource constraints. Many units still lack mechanical ventilators and heated, humidified blended gases, both essential for safe invasive and noninvasive ventilation.

Subsequently, the national workshop served as a structured platform to interpret survey results and translate them into priority actions, identifying key needs such as training in neonatal ventilation, strengthened biomedical engineering support, and equipment standardization. Survey-documented shortages of disposable consumables and essential supplies, compounded by limited access to disinfectants, antibiotics, and running water, were further contextualized during the workshop with direct input from FMoH representatives. Regarding respiratory medications, the introduction of caffeine in 2025 represents a major advance for Ethiopia as a safer alternative to aminophylline [23]. Overall, the official consensus document, endorsed by UENPS, CUAMM, and EPS and

**Table 4.** Facilities available in the NICU

| | |
|---|---|
| Available facilities at your hospital[a] | |
| Wall oxygen supply | 4 (9.3) |
| Oxygen cylinder | 43 (100) |
| Oxygen concentrator | 42 (97.7) |
| Wall air supply | 2 (4.6) |
| Air cylinder | 0 (0.0) |
| Air compressor | 5 (11.6) |
| Pulse oximeter | 39 (90.7) |
| Blood gas analyzer | 1 (2.3) |
| Nasal CPAP | 38 (88.4) |
| Nasal HFT | 1 (2.3) |
| Mechanical ventilators | 16 (37.2) |
| HFOV | 0 (0.0) |
| Nitric oxide | 0 (0.0) |
| Therapeutic hypothermia | 2 (4.6)[b] |
| Other | 2 (4.6) |
| Which of the following equipment items are insufficient in your NICU?[a] | |
| Neonatal resuscitation beds | 22 (71.0) |
| Incubator | 21 (67.7) |
| Blender | 21 (67.7) |
| Humidifier | 23 (74.2) |
| Nasal CPAP | 28 (90.3) |
| Mechanical ventilator | 24 (77.4) |
| Pulse oximeter | 22 (71.0) |
| Total responders | 31 (100) |
| Missing | 12 (27.9) |

Data are expressed as counts and percentages. Total sample = 43 hospitals. CPAP, continuous positive airway pressure; HFT, high flow therapy; HFOV, high-frequency oscillatory ventilation; NICU, neonatal intensive care unit. [a]Multiple-choice questions. [b]This response proved to be inaccurate during the discussion of the survey results at the workshop, as no center reported using therapeutic hypothermia.

submitted to the FMoH, represents the outcome of this process, ensuring that identified gaps were framed within evidence-based standards while remaining feasible and locally owned.

In response to the Train the Trainers program, the newly trained neonatologists led four advanced neonatal resuscitation courses over the following 6 months, three in Addis Ababa and one in Shire. A total of 150 healthcare professionals, mainly midwives and nurses, were trained, demonstrating the feasibility of a scalable capacity-building model.

The most recent course, held in Addis Ababa, was supervised by C.M., C.G., and D.T. during a second mission in July 2025, which also provided an opportunity to assess progress and implementation challenges. The structural rehabilitation of Suhul and Tikur Anbessa Hospitals marked a key project milestone, resulting in safer neonatal environments, improved power supply reliability, and more efficient care organization. Together with equipment replacement and functional space reorganization, these interventions optimized workflow and resource use. Following renovation, the NICU at Suhul Hospital opened in November 2025, while the NICU at Tikur Anbessa Hospital is expected to be opened in April 2026.

Despite providing valuable insights, this project has some limitations. The survey relied on self-reported data without external validation and did not capture clinical outcomes; therefore, findings should be interpreted as descriptive. The workshop and Train the Trainers activities involved a limited number of participants, and their long-term effects on clinical practice and competency retention will require further assessment. Similarly, the document shared with the FMoH was based on descriptive gap analysis and stakeholder consensus, without formal prioritization or direct linkage to outcomes. Finally, although infrastructural rehabilitation was initiated and early progress assessed in 2025, the sustainability and broader impact of these interventions will need ongoing follow-up and systematic evaluation.

In conclusion, these activities mark important progress in strengthening neonatal care in Ethiopia and expanding nationwide training. Continued training, exchange visits, and scientific collaboration, supported by EPS's Associate Membership in UENPS, may help reduce preventable neonatal mortality by addressing key competency, infrastructure, and training gaps, in line with global targets [24].


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## Statement of Ethics

The survey was approved by the Ethiopian Federal Ministry of Health and by the Ethiopian Society of Pediatrics, which also granted permission for data publication (Approval No. EPS-01-5342-25). Written informed consent to participate was not directly obtained but inferred by completion of the questionnaire.

## Conflict of Interest Statement

Prof. Assoc. Daniele Trevisanuto and Prof. Ola Didrik Saugstad were members of the journal's Editorial Board at the time of submission.

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## Author Contributions

Corrado Moretti and Camilla Gizzi contributed to the study concept, preparation of the survey, data interpretation, and writing the initial draft. Daniele Trevisanuto, Gianluca Lista, Virgilio Carnielli, and Ola Didrik Saugstad contributed to the study concept, preparation of the survey, and data interpretation. Luigi Gagliardi and Giulia Vertecchi contributed to data analysis and writing the initial draft. Amanuel Lelisa, Demtse Asrat, and Gesit Metaferia contributed to preparation of the survey and critical review of the manuscript. Luisa Gatta, Fabio Manenti, Dante Carraro, and Worku Bogale contributed to data curation, project administration, and resources and provided relevant expertise. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

## Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request, due to privacy concerns and ethical considerations.

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