J Afric Neonatal 2025;3: 120 - 129

ORIGINAL



# Service levels and infrastructure in 14 African Neonatal Network hospitals

**Pamela Henderson**
**Alexander G. Stevenson**
**Veronica Moses**
**Benenia Muzuva**
**Mahlet Abayneh**
**Olufunke Bolaji**
**Melissa Muparamoto**
**Tendai Mutema**
**John Baptist Nkuranga**
**Victoria Nakibuuka**
**Helina Selam**
**Misrak Tadesse**
**Redeat Workneh Tadesse**
**Erika M. Edwards**
**Danielle E.Y. Ehret**
**Iyabode Olabisi Florence Dedeke**

https://dx.doi.org/10.4314/jan.v3i3.9

Received: 1st July 2025
Accepted: 7th July 2025

Pamela Henderson (✉)
Alexander G. Stevenson
Veronica Moses
Tendai Mutema
African Neonatal Network, Kigali, Rwanda and Harare, Zimbabwe
Email: ann.zimbabwe@gmail.com

Benenia Muzuva
Mbuya Nehanda Maternity Hospital, Harare, Zimbabwe

Mahlet Abayneh,
Redeat Workneh Tadesse
St Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia

Olufunke Bolaji
Federal Teaching Hospital, Ido-Ekiti, Nigeria

Melissa Muparamoto
Mbuya Nehanda Maternity Hospital, Harare, Zimbabwe

John Baptist Nkuranga
University of Rwanda/African Health Sciences University, Kigali, Rwanda

**Abstract:** *Background:* Hospitals across Africa are diverse in terms of infrastructure, available medical technology, and the range of services provided. Many hospitals in Africa face ongoing challenges related to inadequate equipment, frequent breakdowns due to poor maintenance, and irregular supplies of commodities.
*Methods:* Fourteen hospitals in the African Neonatal Network responded to an annual facility survey and a health facility survey co-developed by faculty in the African Neonatal Network and Vermont Oxford Network. All analyses use descriptive statistics.
*Results:* The hospitals varied in service level and included a mix of public, private, and faith-based institutions mostly located in cities or large towns. The median total bed capacity was 34. The median annual deliveries across the hospitals were 3583 (Q1:1800, Q3:4369).All hospitals reported being able to provide continuous positive airway pressure, supplemental oxygen via nasal cannula, essential newborn care and neonatal resuscitation at delivery, kangaroo mother care, intravenous antibiotics, prevention of mother-to-child HIV transmission, and supplemental feeds via cup or nasogastric tube.
*Conclusions:* The 14 hospitals reported experiencing shortages of necessary equipment, beds, technicians, medications, and tests, similar to other hospitals in low- and middle-income countries. Reducing neonatal mortality to meet the United Nations' Sustainable Development neonatal mortality goal of 12 per 1,000 live births by 2030 will require significant investment in neonatal units, as it is likely that the demand for services will only continue to grow.

**Keywords:** Infant, Newborn; Infant, Premature; Neonatal Intensive Care Units; Hospitals / organization and administration; Health Facilities/standards; Health Resources; Health Equipment and Supplies; Medical Equipment; Africa South of the Sahara; Global Health

**Résumé:** *Contexte:* Les hôpitaux à travers l'Afrique presentment unegrande diversité entermes d'infrastructures, de technologies médicales disponibles et de services offerts. De nombreux établissements doivent faire face à des défis persistants liés à un équipement insuffisant, à des panes fréquentes dues à un manque d'entretien, ainsi qu'à une fourniture irrégulière des consommables.

Victoria Nakibuuka
St. Francis Nsambya Hospital, Kampala, Uganda

Helina Selam
Vermont Oxford Network, Burlington, Vermont, USA

Misrak Tadesse
Vermont Oxford Network and Johns Hopkins School of Medicine, Baltimore, Maryland, USA

Erika M. Edwards
Danielle E.Y. Ehret
Vermont Oxford Network and University of Vermont, Burlington, Vermont, USA

Iyabode Olabisi Florence Dedeke
Federal Medical Centre, Abeokuta, Nigeria

*Méthodes:* Quatorze hôpitaux du Réseau Néonatal Africain ont répondu à une enquête annuelle sur les établissements, ainsi qu'à une enquête sur les structures de santé, co-développées par des membres du corps professoral du Réseau Néonatal Africain et du Vermont Oxford Network. Toutes les analyses ont été réalisées à l'aide de statistiques descriptives.
*Résultats:* Les hôpitaux présentaient des niveaux de service variés et comprenaient un mélange d'établissements publics, privés et confessionnels, situés principalement dans des villes ou grandes agglomérations. La capacité-médiane totale enlist était de 34. Le nombre median d'accouchements annuels dans ces établissements était de 3 583 (Q1 : 1 800 ; Q3 : 4 369). Tous les hôpitaux ont indiqué être enmesure de fournir les soins suivants : pression positive continue (CPAP), oxygène complémentaire par canule nasale, soins essentiels aux nouveau-nés et reanimation néonatale à la naissance, method kangourou, antibiothérapie intraveineuse, prévention de la transmission du VIH de la mère à l'enfant, et alimentation complémentaire par tasse ou sonde nasogastrique.
*Conclusions:* Les quatorze hôpitaux ont signalé des penuries d'équipements essentiels, de lits, de techniciens, de médicaments et d'examens diagnostiques, à l'instar d'autres hôpitaux situés dans des pays à revenue faible ou intermédiaire. Pour atteindre l'objectif de développement durable fixé par les Nations Unies en matière de mortalité néonatale — soit 12 décès pour 1 000 naissances vivantes d'ici 2030 —, des investissements majeurs dans les unites néonatales seront indispensables, d'autant plus que la demande en services continuera probablement d'augmenter.

## Introduction

The provision of and quality of neonatal care in Africa is of critical importance given the continent's high rates of infant mortality and the contribution of neonatal complications to these rates.[1] Meeting the United Nations' Sustainable Development neonatal mortality goal of 12 per 1,000 live births by 2030 will require cooperative efforts that cross borders and combine resources, knowledge, and expertise.

Hospitals across Africa are diverse in terms of infrastructure, available medical technology, and the range of services provided. Facilities typically offer a spectrum of neonatal services, from basic care for healthy newborns to more advanced care for small and sick newborn infants requiring neonatal intensive care. However, the level of care provided can vary significantly due to differences in available resources, trained healthcare personnel, geographical factors.[2]

In neonatal care, the availability of appropriate equipment and supplies is paramount to ensuring the survival and well-being of newborns.[3,4] The first few hours and days of life are crucial for newborns, especially those born prematurely or with medical complications.[4,5] Specialized equipment such as incubators, ventilators, phototherapy units, and monitoring devices play critical roles in stabilizing these infants and providing the essential care they need. The consistent supply of medical consumables, such as sterile syringes, intravenous (IV) fluids, medications, and oxygen, is equally critical.[6,7] These supplies are used daily in the treatment of neonatal conditions and in managing the delicate health of newborns in critical care settings. Access to essential medicines such as antibiotics to treat infections, or surfactants to aid in preterm lung function, can mean the difference between life and death for many newborns.[8] Interruptions in the supply chain, which can be common in low-resource settings, often lead to delays in treatment and influence the development of complications and likelihood of survival. Many hospitals in Africa face ongoing challenges related to inadequate equipment, frequent breakdowns due to poor maintenance, and irregular supplies of commodities.

This study provides an overview of the service levels, infrastructure, and consumables availability at hospitals in the African Neonatal Network (ANN), a collaborative of hospitals in Ethiopia, Nigeria, Rwanda, Uganda, and Zimbabwe.

## Methods

Data collection was conducted in 14 African Neonatal Network (ANN) member hospitals across five countries: Ethiopia, Nigeria, Rwanda, Uganda, and Zimbabwe.

Vermont Oxford Network (VON) conducts an annual survey for members that was co-developed with ANN faculty members, which includes information on the hospital setting, number of beds and admissions, staffing, obstetric service, follow-up clinic, resuscitation and essential newborn care, transfers and transport, family

centred care, services provided by the neonatal unit, guidelines in the neonatal unit, quality assurance/ continuous quality improvement, and level of neonatal care. Participation in the membership survey is mandatory. The responses used for this manuscript are from 2023.

In October 2023, the ANN conducted a health facility assessment to collect more detailed information on buildings and facilities, medications, diagnostics and consumables, equipment, staffing, governance, thermal regulation and foetal transition, nutrition, family-centred care and kangaroo mother care, infection prevention and control, and perceived priorities.
Tables of hospital-level measures include data from both the membership survey and the health facility assessment. All analyses are descriptive.

The collaborative QI project and subsequent assessments received individual and hospital institutional research and ethics review approvals at the start of the collaborative and learning initiative.

## Results

The neonatal units in the 14 hospitals varied in service level provision and included a mix of public, private, and faith-based institutions (Table 1). The majority (78.6%) were located in cities or large towns servicing a population of over 49,999 people. The median total bed capacity of the neonatal units was 34, with a median of six intensive care and nine step-down care beds. Ten hospitals had kangaroo mother care (KMC) beds with a median of five. The median annual deliveries across the hospitals were 3583 (Q1:1800, Q3:4369). There were substantially more inborn than outborn admissions to the neonatal units with an average of 84 monthly neonatal admissions.

All 14 hospitals reported being able to provide continuous positive airway pressure (CPAP) and supplemental oxygen via nasal cannula, essential newborn care and neonatal resuscitation at delivery, KMC, intravenous antibiotics, prevention of mother-to-child HIV transmission, and supplemental feeds via cup or nasogastric tube (Table 2). Other services, such as general or subspecialty paediatric surgery, were available less frequently.

The availability of equipment and consumables varied widely among the 14 hospitals (Table 3). Most hospitals reported almost always having enough consumables necessary for critical neonatal procedures, including IV infusions (79%), blood transfusion (71%), and sterile feeding tubes that can be used as improvised umbilical vein catheters (79%). Cots, glucometers, and oxygen nasal prongs were sufficiently available in 64% of the health facilities. Transcutaneous bilirubinometer, air-oxygen blenders, mechanical ventilators, and cardiorespiratory monitors were available in one to three health facilities.

Thirteen hospitals (93%) reported that broken equipment was mostly not fixed or slow to be fixed and returned to the ward. The reasons cited for equipment not being fixed included the technician being unfamiliar with the equipment (82%), paucity of funds to purchase spare parts (70%), and unavailability of spare parts locally (94%). The majority of hospitals (59%) reported that although technicians were available at the hospitals, they were generally slow to respond to repair requests.

Table 4 lists the medications that were reported to be "almost always available" either in the neonatal unit or from the hospital pharmacy in less than two hours. Almost all the hospitals had antiretroviral medications on the wards or hospital pharmacy. Six hospitals had intravenous caffeine or aminophylline, while four hospitals had surfactant and one had oral caffeine.

Eight of the 14 hospitals (57%) had a pharmacist on duty 24 hours/day. Only one hospital supplied all medications free of charge, seven hospitals charged for all medications and 6 provided some free and charged for some. Pathology tests were free in only three hospitals, while all tests were charged for in eight hospitals and a mix of free and charged in three hospitals. Nine hospitals (64%) reported that the need for parents to purchase medicines and/or consumables resulted in noticeable delays in providing necessary treatment.
Tests reported to be "always available in the last month" are in Table 5. The top three consistently available tests, reported in 86% of hospitals, were blood grouping, syphilis screening for mothers, and ultrasound and x-ray in radiology departments. HIV-related tests (antibody rapid test and viral load) and bedside ultrasound were available in 71%–79% of hospitals. Other essential tests like full blood count, blood cultures, and cerebrospinal fluid cultures were available in 64% of hospitals. Nine hospitals (64%) reported either occasional or frequent stockouts for blood cultures. Less commonly available tests, such as CT scans, Coomb's test, and CRP, were offered by only 36%–43% of hospitals, while advanced tests like MRI, blood gas analysis, and inborn error of metabolism screening were available in one or two hospitals.

Eleven hospitals reported water outages of varying frequency where they had at least occasional water cuts, with six hospitals reporting no water coming out the taps in the NNU, labour ward and theatre at least once a month (Fig 1). Two hospitals had power outages lasting longer than 30 minutes. Eleven hospitals reported water outages of varying frequency where they had at least occasional water cuts, with six hospitals reporting no water coming out the taps in the NNU, labour ward and theatre at least once a month.

**Table 1:** Characteristics of 14 in African Neonatal Network hospitals

| | # | % or Median (Q1, Q3) |
|---|---|---|
| *Setting, %* | | |
| Rural (population <5,000) | 1 | 7 |
| Peri-urban (population 5,000-49,999) | 2 | 14 |
| Urban (population >49,999) | 11 | 79 |
| *Hospital Ownership, %* | | |
| Government (public) | 8 | 57 |
| Non-government, not for profit | 2 | 14 |
| Private for-profit | 3 | 21 |
| Other | 1 | 7 |
| *Type of Hospital, %* | | |
| Primary (district) hospital | 1 | 7 |
| Secondary (referral or general) hospital | 5 | 36 |
| Tertiary (specialized) hospital | 8 | 57 |
| Academic Hospital, % | 7 | 50.0 |
| *Number of Referring Health Centers, %* | | |
| <5 | 1 | 7 |
| 5-10 | 1 | 7 |
| 11-20 | 3 | 21 |
| >20 | 6 | 43 |
| Unknown | 3 | 21 |
| *Number of Referring District Hospitals, %* | 3 | 21 |
| <5 | 2 | 14 |
| 5-10 | 2 | 14 |
| 11-20 | 5 | 36 |
| >20 | 2 | 14 |
| Unknown | | |
| *Annual Deliveries, median (Q1, Q3)* | 14 | 3583 (1800,4369) |
| *Neonatal Unit Bed Capacity, median (Q1, Q3)* | 14 | 34 (20, 41) |
| Intensive care beds | 14 | 6 (6, 12) |
| Step down beds | 13 | 10 (8, 24) |
| Kangaroo mother care beds | 10 | 8 (4, 9) |
| Immediate kangaroo mother care beds | 5 | 4 (4, 7) |
| Isolation Rooms, median (Q1, Q3) | 10 | 1 (1, 1) |
| *Average Daily Census, median (Q1, Q3)* | 13 | 10 (5, 28) |
| *Average Admissions per Month, median (Q1, Q3)* | 13 | 84 (20, 130) |
| *Annual Admissions, median (Q1, Q3)* | | |
| Inborn | 14 | 851(144,1150) |
| Outborn | 14 | 134(80, 500) |
| *Infants Readmitted to Neonatal Unit from Home, %* | 10 | 71 |

**Table 2:** Services available at the hospital for 14 neonatal care units in African Neonatal Network

| | # | % |
|---|---|---|
| Continuous positive airway pressure (CPAP) | 14 | 100 |
| Essential newborn care | 14 | 100 |
| Intravenous antibiotics | 14 | 100 |
| Kangaroo mother care | 14 | 100 |
| Neonatal resuscitation at delivery | 14 | 100 |
| Prevention of mother to child HIV transmission | 14 | 100 |
| Supplemental feeds via cup or nasogastric tube | 14 | 100 |
| Supplemental oxygen via nasal cannula | 14 | 100 |
| Follow-up clinic for infants after discharge | 13 | 93 |
| Exchange transfusion | 10 | 71 |
| Formal neurodevelopment | 10 | 71 |
| Weight checks for kangaroo mother care | 10 | 71 |
| General pediatric surgery | 9 | 64 |
| Inotropes to support blood pressure | 8 | 57 |
| Compressed air | 6 | 43 |
| Exothermic mattresses for very-low-birth-weight infants | 6 | 43 |
| Anti-VEGF for retinopathy of prematurity | 4 | 29 |
| Subspecialty surgery | 3 | 29 |
| Therapeutic hypothermia | 3 | 21 |
| Inhaled nitric oxide | 2 | 14 |

**Fig 1:** Water and electricity availability at 14 African Neonatal Network hospitals

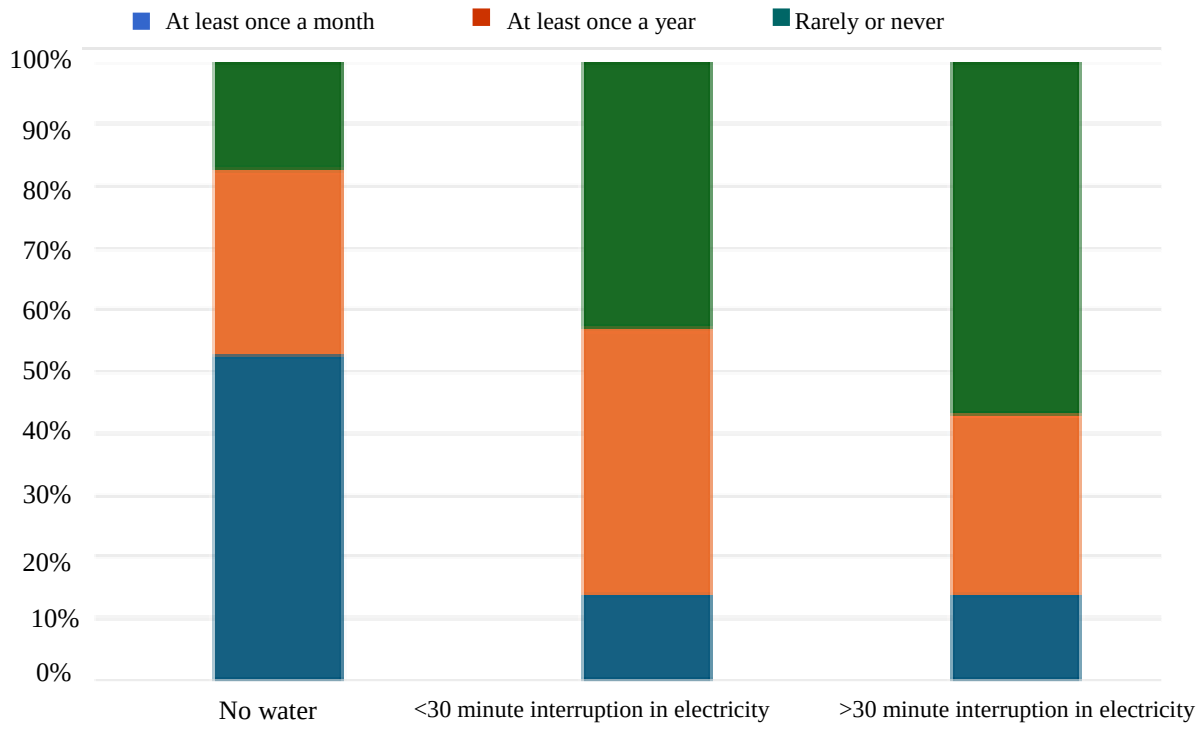

**Table 3:** "Almost always enough" equipment and consumables suitable for neonates available at 14 hospitals in African Neonatal Network

| | # | % |
|---|---|---|
| Tape or adhesive dressing for securing equipment | 12 | 86 |
| Sterile feeding tubes that can be used as improvised umbilical vein catheters | 11 | 79 |
| Consumables to give intravenous (IV) infusions | 11 | 79 |
| Latex non-sterile gloves | 10 | 71 |
| Sterile gloves | 10 | 71 |
| Thermometers to measure infant temperature | 10 | 71 |
| Consumables to give blood transfusion | 10 | 71 |
| Oxygen nasal prongs | 9 | 64 |
| Glucometers | 9 | 64 |
| Cots | 9 | 64 |
| Suction machines | 8 | 57 |
| IV cannulas | 8 | 57 |
| Open radiant warmers | 7 | 50 |
| Continuous positive airway pressure (CPAP) machines | 6 | 43 |
| Suction catheters | 6 | 43 |
| Sterile packs for procedures | 6 | 43 |
| Thermometers to measure room temperature | 6 | 43 |
| Clean linen provided by hospital | 6 | 43 |
| Pulse oximeter machines | 5 | 36 |
| Pulse oximeter probes | 5 | 36 |
| Incubators | 5 | 36 |
| CPAP nasal prongs | 5 | 36 |
| Phototherapy machines | 5 | 36 |
| Glucometer strips | 5 | 36 |
| Irradiance meter | 5 | 36 |
| Syringe drivers | 4 | 29 |
| Mechanical ventilators | 3 | 21 |
| Umbilical venous catheters | 3 | 21 |
| Air-oxygen blenders | 2 | 14 |
| Cardiorespiratory monitors | 2 | 14 |
| Transcutaneous bilirubinometer | 1 | 7 |

**Table 4:** "Almost always" available medications on ward or from hospital pharmacy in less than 2 Hours at 14 hospitals in African Neonatal Network

| | # | % |
|---|---|---|
| Zidovudine | 14 | 100 |
| Intravenous (IV) gentamicin, amikacin | 13 | 93 |
| Neviripine | 13 | 93 |
| Oral paracetamol | 13 | 93 |
| Water for injections | 13 | 93 |
| 5% dextrose solution | 12 | 86 |
| Adrenaline | 12 | 86 |
| Hydrocortisone | 12 | 86 |
| IV penicillin, amoxycillin, ampicillin | 12 | 86 |
| 50% dextrose solution | 11 | 79 |
| Antibiotic eye prophylaxis | 11 | 79 |
| Dexamethasone for neonatal use | 11 | 79 |
| Oral iron | 11 | 79 |
| Vitamin K | 11 | 79 |
| Atropine | 10 | 71 |
| 10% dextrose solution | 9 | 64 |
| Oral phenobarbitone | 9 | 64 |
| IV paracetamol | 8 | 57 |
| IV phenobarbitone | 7 | 50 |
| Vitamin D | 7 | 50 |
| IV aminophylline | 6 | 43 |
| IV caffeine | 6 | 43 |
| IV carbapenem | 6 | 43 |
| IV opiate | 6 | 43 |
| Ketamine | 5 | 36 |
| Supplemental oral phosphate | 5 | 36 |
| Pre-mixed neonatal maintenance fluids | 4 | 29 |
| Surfactant | 4 | 29 |
| IV amino acids | 3 | 21 |
| Human milk fortifier | 2 | 14 |
| IV muscle relaxant | 2 | 14 |
| Oral caffeine | 1 | 7 |

**Table 5:** Tests "always available in last month at this institution" at 14 hospitals in African Neonatal Network

| | # | % |
|---|---|---|
| Blood group | 12 | 86 |
| Syphilis screen for mother | 12 | 86 |
| Ultrasound in radiology | 12 | 86 |
| X-ray in radiology | 12 | 86 |
| HIV antibody (rapid) | 11 | 79 |
| HIV viral load | 11 | 79 |
| Bedside ultrasound | 10 | 71 |
| Echocardiography scan | 10 | 71 |
| Full blood count | 10 | 71 |
| HIV polymerase chain reaction (PCR) test | 10 | 71 |
| Blood culture | 9 | 64 |
| Cerebrospinal fluid culture | 9 | 64 |
| Alkaline phosphatase (ALP) | 7 | 50 |
| Cerebrospinal fluid protein level | 7 | 50 |
| Conjugated bilirubin | 7 | 50 |
| Lactate | 7 | 50 |
| Phosphate | 7 | 50 |
| Total serum bilirubin | 7 | 50 |
| Urea and electrolytes | 7 | 50 |
| Computed tomography (CT) scan | 6 | 43 |
| Coomb's | 6 | 43 |
| Syphilis diagnostic | 6 | 43 |
| Activated partial thromboplastin time (aPTT) | 5 | 36 |
| C-reactive protein (CRP) | 5 | 36 |
| International normalized ratio (INT) | 5 | 36 |
| Mobile x-ray | 5 | 36 |
| Thyroid function | 5 | 36 |
| Electroencephalogram (EEG) | 3 | 21 |
| Intestinal contrast | 3 | 21 |
| Magnetic resonance imaging (MRI) scan | 3 | 21 |
| Blood gas analysis | 2 | 14 |
| Cytomegalovirus PCR | 2 | 14 |
| Karyotype | 2 | 14 |
| Rubella serology | 2 | 14 |
| Amplitude integrated/continuous EEG | 1 | 7 |
| Inborn error of metabolism | 1 | 7 |
| Microarray | 1 | 7 |
| Placenta histology | 0 | 0 |

## Discussion

The diverse healthcare landscape in low- and middle-income countries (LMICs) is reflected in the variation in service levels across the ANN hospitals. Most hospitals serve urban populations with large numbers of deliveries and a high volume of neonatal admissions. These statistics are consistent with other studies of neonatal care in LMICs, which show that urban hospitals typically bear a larger burden of neonatal care compared with rural facilities due to higher population density, greater access to healthcare services, and the availability of specialized care.[9,10]

The median total bed capacity, intensive care beds and step-down care beds highlight a significant limitation in neonatal critical care capacity. A similar pattern has been observed in other LMICs where neonatal intensive care units (NICUs) are often undersized relative to the demand for services.[11] Although all ANN hospitals had beds for KMC, a practice widely endorsed for improving outcomes in preterm and low-birth-weight infants, the small number of KMC beds suggests that while the practice is supported, it may not be adequately scaled up.[11] This is in line with studies indicating that while KMC has been successfully implemented in many LMICs, challenges remain in making it available on a larger scale due to resource limitations. The provision of KMC beds should afford minimal separation of mother and infant for those born preterm or low birthweight. Where parents are supported, KMC provision would help reduce the need for expensive equipment, spare parts, and continual electricity supply as well as helping to reduce the potential for infection.[12]

Overall, 71% of hospitals reported readmitting babies to the NICU after initial discharge. This is an important area for further investigation, as readmission to the NICU may indicate underlying gaps in the continuum of care, particularly in the post-discharge follow-up of high-risk neonates. Studies have shown that earlier gestational age, lower maternal education attainment, inadequate follow-up and community-based care for neonates discharged from NICUs in LMICs often contribute to increased readmission rates and poor neonatal outcomes.[13,14] Readmission to NICU could also be based on hospital policy.

The issue of equipment maintenance exacerbates problems delivering care. Most hospitals reported that technicians were unfamiliar with the equipment, leading to delays in repair or failure to fix broken machines. This finding is consistent with other reports from LMICs where insufficient biomedical engineering capacity often results in long downtimes for critical equipment, thereby limiting the ability of health facilities to deliver life-saving care.[15,16] The unavailability of spare parts locally further complicates equipment repair and maintenance, pointing to a broader systemic issue in healthcare systems across LMICs where funding constraints, logistical

challenges, and workforce shortages impede the functionality and effectiveness of neonatal units.[17]
The availability of medications and tests in the ANN hospitals was variable. While most hospitals had access to antiretroviral medications, access to other medications such as caffeine and surfactant were limited. This implies there are notable gaps in the available medication compared to what is required in the essential medicine list, particularly for advanced therapies like surfactant. This finding is consistent with studies from other regions of Africa that report surfactant use as one of the most under-resourced interventions for managing neonatal respiratory conditions, particularly in premature infants.[18-20]

The availability of diagnostic tests in ANN hospitals showed a varied pattern, with more basic and commonly required tests available at most hospitals. This finding is consistent with findings from other LMIC neonatal units, where basic diagnostic capabilities are typically prioritized due to resource limitations.[8,17] Blood grouping and syphilis screening were widely available in these hospitals, aligning with global recommendations for essential antenatal and neonatal testing. HIV-related tests, including rapid antibody testing and viral load assessments, were available in 71%–79% of hospitals, which reflects global efforts to scale up HIV screening. However, more complex tests, such as cerebrospinal fluid (CSF) cultures and blood cultures, were only available in 64% of hospitals, which presents a significant limitation in diagnosing neonatal sepsis and other serious infections. This finding is consistent with other studies that highlight the diagnostic gap in managing neonatal sepsis in resource-limited settings.[21,22] Tests such as CT scans, Coomb's test, and C-reactive protein (CRP), available in only 36%–43% of hospitals, and are typically more resource-intensive. Limited access to these tests is frequently reported in LMIC settings, where the high cost and lack of technical expertise limit the availability of advanced diagnostic imaging and specific tests. Blood gas analysis and screening for inborn errors of metabolism were available in 14% or fewer hospitals. This mirrors findings from similar settings where such advanced diagnostics are almost non-existent outside of tertiary care centres. The lack of specialized diagnostic capabilities such as placenta histology, available in none of the hospitals, further emphasizes the diagnostic challenges faced by neonatologists in these settings, a gap that is well-documented in literature on neonatal care in low-resource environments.[8,17]

The availability of water was also unreliable, with 11 hospitals reporting water outages. Such interruptions can severely impact neonatal care, particularly during critical procedures such as resuscitation and surgeries. The World Health Organization advocates for any health facility performing the care of small and sick newborns to have an appropriate physical environment which includes running water and waste management, good sanitation, and a reliable power supply[13 Infection prevention is greatly facilitated by the presence of running water and hand soap.[17,23] Providing quality care for neonates requires sufficient resources and infrastructure. This basic infrastructure is still lacking in many hospitals. According to the WHO, globally, one in four health facilities still do not have basic water services, more than one in five have no sanitation service, and more than one in six have no basic hygiene service.[24] Water shortage can also contribute to a higher risk of hospital-acquired infections and higher mortality.

The inclusion of 14 hospitals in varied settings across five sub-Saharan countries strengthens this manuscript. The findings are limited by the self-reported nature of the data collection. Conducting such research through observation would be time- and resource-intensive. Neither survey asked whether the units had access to backup water (tanks) or power supply (solar, generators). Backup oxygen in the form of concentrators is a more sustainable solution than tanked oxygen which is expensive to supply. Provision of KMC beds where there is minimal separation of mother and infant for those born preterm or low birthweight and where parents are supported in its provision would go a long way to reducing the potential for infection and the need for expensive incubators. Incubators break down, require spare parts and a continual electricity supply. Use of high-quality standardized and adequate equipment that is easily repairable locally, as opposed to highly technical equipment that cannot be serviced/repaired locally, would help to ensure the units are adequately covered in terms of equipment. Strategic, prioritised, use of limited resources to fund essentials (consistent oxygen/water supply) rather than non-essentials would be beneficial in helping to provide quality neonatal care in LMIC settings.

## Conclusions

The 14 hospitals in the ANN reported experiencing shortages of necessary equipment, beds, technicians, medications, and tests, similar to other hospitals in LMICs. Reducing neonatal mortality to meet the United Nations' Sustainable Development neonatal mortality goal of 12 per 1,000 live births by 2030 will require significant investment in the infrastructure and commodity needs of African neonatal units, as it is likely that the demand for services will only continue to grow.

## Acknowledgments

We are indebted to our colleagues at the following hospitals who submit data to VON on behalf of infants and their families: St. Paul's Millennium Medical College, Addis Ababa, Ethiopia; Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia; Tirunesh Beijing Hospital, Addis Ababa, Ethiopia; Assosa Hospital, Asosa, Ethiopia; Hawassa Referral Hospital, Awassa, Ethiopia; Ayder Hospital, Mekelle, Ethiopia; Sacred Heart Hospital,

Abeokuta, Nigeria; Federal Teaching Hospital Ido-Ekiti, Ekiti, Nigeria; King Faisal Hospital, Kigali, Rwanda; Mengo Teaching Hospital, Kampala, Uganda; St Francis Nsambya Hospital, Kampala, Uganda; Lubaga Hospital, Kampala, Uganda; Murambinda Mission Hospital, Harare, Zimbabwe; Neocare Baby Hospital, Harare, Zimbabwe.

**Funding:** Bill and Melinda Gates Foundation
INV-042791

**References**

1. UN IGME. Levels & Trends in Child Mortality: Report 2023, Estimates developed by the United Nations Inter-agency Group for Child Mortality Estimation, United Nations Children's Fund. New York; 2024.
2. Edwards EM, Ehret DEY, Soll RF, Horbar JD. Vermont Oxford Network: a worldwide learning community. *Transl Pediatr. 2019; 8(3): 182-192*
3. Dickson KE, Simen-Kapeu A, Kinney MV, Huicho L, Vesel L, Lackritz E, et al. Every Newborn: health-systems bottlenecks and strategies to accelerate scale-up in countries. *Lancet. 2014 Aug 2;384 (9941):438–54.*
4. Moxon SG, Guenther T, Gabrysch S, Enweronu-Laryea C, Ram PK, Niermeyer S, et al. Service readiness for inpatient care of small and sick newborns: what do we need and what can we measure now? *Journal of Global Health. 2018 Jun;8(1):010702.*
5. World Health Organization. Survive and thrive: transforming care for every small and sick newborn [Internet]. Geneva: *World Health Organization; 2019 [cited 2024 Oct 17]. Available from: https://iris.who.int/handle/10665/326495*
6. Makene C, Plotkin M, Currie S, Bishanga D, Ugwi P, Louis H, et al. Improvements in newborn care and newborn resuscitation following a quality improvement program at scale: Results from a before and after study in Tanzania. *BMC pregnancy and childbirth. 2014 Nov 19;14:381.*
7. Tarus A, Msemo G, Kamuyu R, Shamba D, Kirby RP, Palamountain KM, et al. Devices and furniture for small and sick newborn care: systematic development of a planning and costing tool. *BMC Pediatrics. 2023 Nov 15;23 (2):566.*
8. World Health Organization. Equipment, Supplies, Drugs, and Laboratory Tests. In: Pregnancy, Childbirth, Postpartum and Newborn Care: A Guide for Essential Practice 3rd edition [Internet]. World Health Organization; 2015 [cited 2024 Oct 17]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK326669/
9. World Health Organization. Web Annex B. World Health Organization Model List of Essential Medicines for Children – 9th List, 2023. [Internet]. Geneva; 2023 [cited 2024 Oct 17]. (The selection and use of essential medicines 2023: Executive summary of the report of the 24th WHO Expert Committee on the Selection and Use of Essential Medicines). Available from: https://www.zotero.org/
10. Narayanan I, Nsungwa-Sabiti J, Lusyati S, Rohsiswatmo R, Thomas N, Kamalarathnam CN, et al. Facility readiness in low and middle-income countries to address care of high risk/ small and sick newborns. Maternal Health, *Neonatology and Perinatology. 2019 Jun 18;5(1):10.*
11. Herbert H, Lee A, Chandran A, Rudan I, Baqui A. Care Seeking for Neonatal Illness in Low- and Middle-Income Countries: *A Systematic Review. PLoS medicine. 2012;9:e1001183.*
12. Kinshella MLW, Hiwa T, Pickerill K, Vidler M, Dube Q, Goldfarb D, et al. Barriers and facilitators of facility-based kangaroo mother care in sub-Saharan Africa: a systematic review. *BMC Pregnancy and Childbirth. 2021;21 (1):176.*
13. World Health Organization. Standards for improving the quality of care for small and sick newborns in health facilities. Geneva; 2020. Available from:
14. Jarrett O, Gim D, Puusepp-Benazzouz H, Liu A, Bhurawala H. Factors contributing to neonatal readmissions to a level 4 hospital within 28 days after birth. *Journal of Paediatrics and Child Health. 2022;58(7):1251.*
15. Kaur E, Heys M, Crehan C, Fitzgerald F, Chiume M, Chirwa E, et al. Persistent barriers to achieving quality neonatal care in low-resource settings: perspectives from a unique panel of frontline neonatal health experts. *Journal of Global Health Reports. 2023;7:e2023004.*
16. NEST360. Newborn Essential Solutions and Technologies-Education – Technical Modules: *Point-of-Care Diagnostics: Glucometer. 2021.*

17. Diaconu K, Chen YF, Cummins C, Moyao GJ, Manaseki-Holland S, Lilford R. Methods for medical device and equipment procurement and prioritization within low- and middle-income countries: findings of a systematic literature review. *Globalization and Health. 2017;13:59.*
18. Gondwe MJ, Desmond N, Aminu M, Allen S. Resource availability and barriers to delivering quality care for newborns in hospitals in the southern region of Malawi: A multisite observational study. *PLOS Global Public Health. 2022;2(12):e0001333.*
19. WHO. Target product profile for aerosolized surfactant therapy in neonates with respiratory distress syndrome in low- and middle-income countries. Geneva: World Health Organization; 2023.
20. Okonkwo IR, Okolo AA. The scope and extent of exogenous surfactant utilization in Nigerian health care facilities: benefits of its regular use to outcomes of premature babies. *J Matern Fetal Neonatal Med. 2020;33(8):1276–81.*
21. Lategan I, Price C, Rhoda, Zar H, Tooke L. Respiratory Interventions for Preterm Infants in LMICs: A Prospective Study From Cape Town, South Africa. *Front Glob Womens Health. 2022;3:817817.*
22. Gleeson B, Ferreyra C, Palamountain K, Jacob ST, Spotswood N, Kissoon N, et al. A call to bridge the diagnostic gap: diagnostic solutions for neonatal sepsis in low - and middle-income countries. *BMJ Global Health. 2024;9(9):e015862.*
23. Milton R, Gillespie D, Dyer C, Taiyari K, Carvalho MJ, Thomson K, et al. Neonatal sepsis and mortality in low-income and middle-income countries from a facility-based birth cohort: an international multisite prospective observational study - The Lancet Global Health. *The Lancet Global Health. 10(5):E661–72.*
24. World Health Organization and the United Nations Children's Fund. WASH in health care facilities: *Global Baseline Report 2019. Geneva; 2019.*