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Oxygen Systems Strengthening

Supply, Logistics, and Implementation Challenges and Innovations

Meredith K. Dyson, MSPH
Health Systems Strengthening Specialist
UNICEF Regional Office for South Asia

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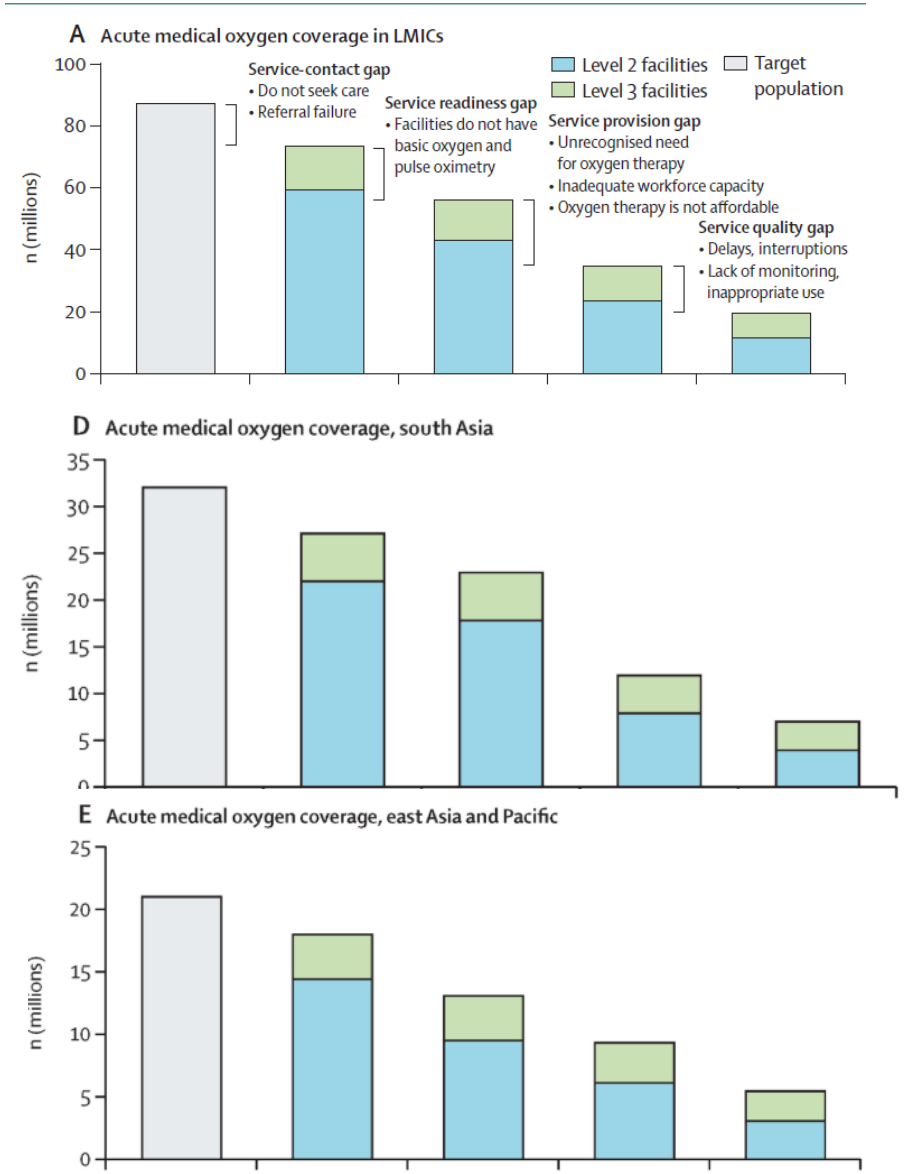
Unmet need for oxygen is high, particularly in LMICs, and especially Asia and the Pacific[1]

- **364 million people in need** of oxygen therapy for acute medical and surgical conditions[2] globally in 2021
- **82% living in LMICs** of people with acute medical or surgical need
- **51% of global need** - 186.2 million people - *in South and East Asia and the Pacific*
- **70% coverage gap** in medical oxygen services for acute medical and surgical conditions across LMICs
  - **76%** gap across Asia (74% in East Asia and Pacific; 76% in South Asia)
  - **Fewer than half** of all health facilities in LMICs have uninterrupted access to medical oxygen
- Increased needs driven by severe respiratory illnesses (COVID-19, SARS)



[1]Source: *Reducing global inequities in medical oxygen access: the Lancet Global Health Commission on medical oxygen security. Graham, Hamish R et al. The Lancet Global Health, Volume 13, Issue 3, e528 - e584*

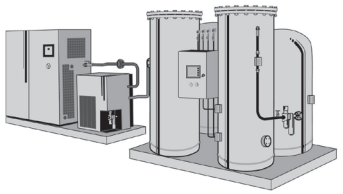
[2]*children and adults with respiratory tract infections, traumatic injury, neonates, people undergoing surgery; excluding COVID-19*

Oxygen Supply and Logistics Components at the center of early COVID-19 response

Oxygen source	Distribution	Regulation & conditioning	Patient delivery	Patient monitoring
• Plant • Concentrator • Cylinder • Liquid oxygen	• Piping (high pressure) • Tubing (low pressure) • Transport (for cylinders)	• Regulator • Flowmeter • Humidifier • Blender • CPAP • Ventilator	• Nasal cannula • Nasal catheter • Masks • Tubing	• Pulse oximeter • Multiparameter monitor • Clinical guidelines

Oxygen Therapy in Response to COVID-19

UNICEF channeled **over $69 million in oxygen equipment and supplies** between 2020 and 2025 **across 35 countries** in South Asia, East Asia and the Pacific



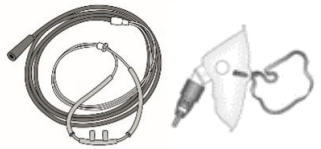
17 Pressure Swing Absorption (PSA) Plants across **10** countries **$7 million**

24,173 Concentrators across **33** countries **$23 million**

25,416 Pulse Oximeters across **32** countries **$8.2 million**

Medical gas pipeline system (MGPS)

308 CPAP Machines across **12** countries With additional accessories and consumables **$1.66 million**



Oxygen delivery interfaces, including nasal cannula and O2 masks

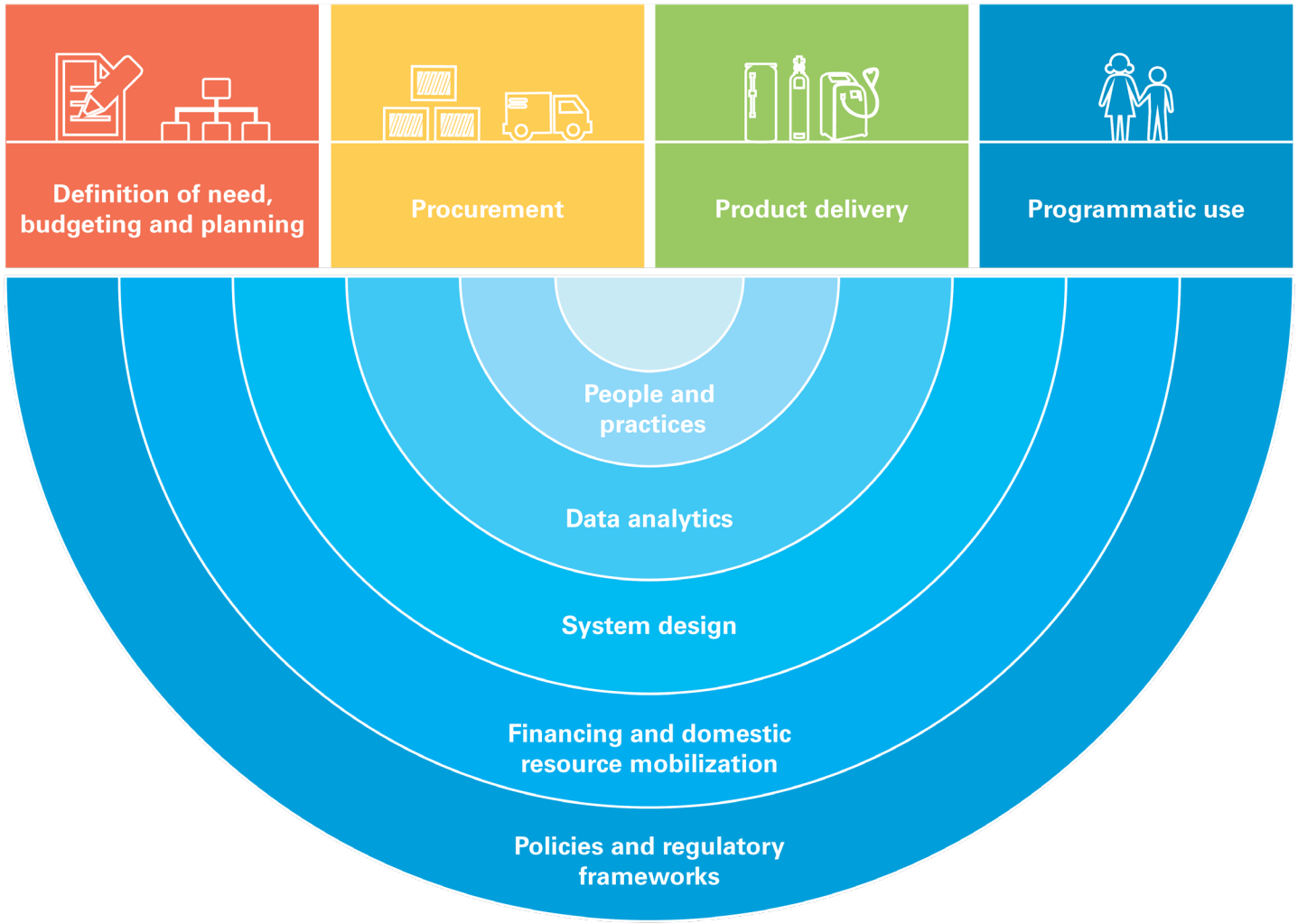
Other equipment, including oxygen cylinders, voltage stabilizers, and UPS

Operations, Maintenance, and Tracking:
Challenges and gaps identified in SAR and EAPR

Oxygen source	Distribution	Regulation & conditioning	Patient delivery	Patient monitoring
• Lack of oxygen supply at secondary, primary, referral levels • **Lack of BME capacity for effective operation of oxygen plants**	• Absence of oxygen distribution network within hospitals for patient usage	• Unavailability of equipment • **Shortage of skilled staff**	• Irregular supply and stockout of oxygen delivery interfaces • **Lack of planning for consumable needs and stock management**	• Lack of pulse oximeters • **Inadequate adherence to guidelines**

Power supply	**Lack of reliable power supply to ensure uninterrupted operation of oxygen equipment**
Maintenance	**Lack of equipment maintenance and repair systems, including BME capacity**
HR	**Shortage of clinical staff with the skills to provide oxygen therapy**
Financing	**Insufficient financing in domestic budgets, declining donor interest post-COVID**
Governance & Management	**Lack of coordination, lack of oxygen system operation guidelines, lack of safety measures and practices, weak private sector engagement, poor monitoring, data capture, and evidence-based planning**

UNICEF's Oxygen Scale-up Framework
developed in response to COVID-19



Outcomes

Strengthened Primary Health Care (PHC) with:

- efficient and effective supply planning
- safe use of oxygen in maternal, newborn and child health programming.

Impact

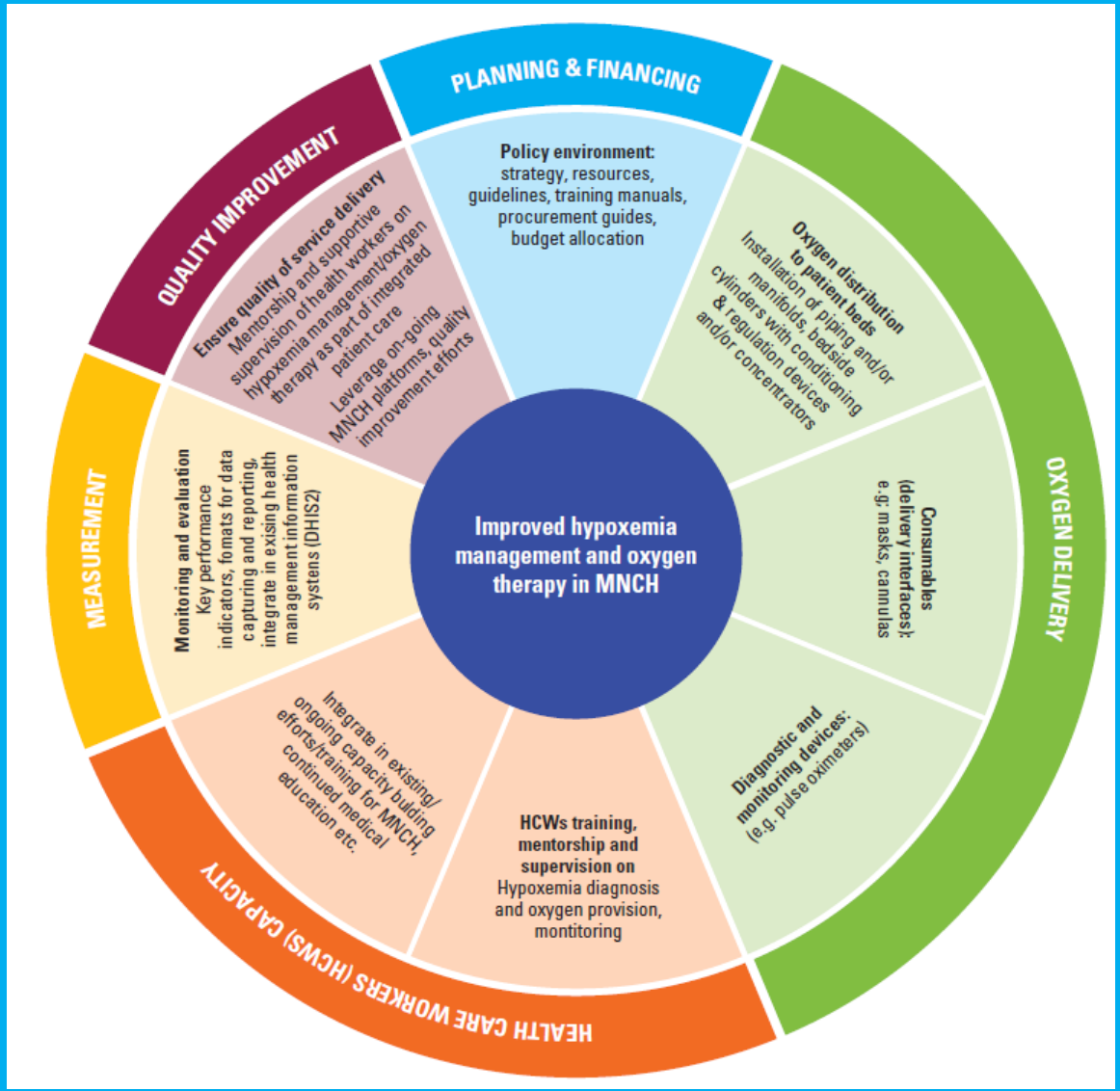
Improved maternal, newborn and child survival

Improved pandemic preparedness and response.

Converting oxygen supplies into effective oxygen therapy requires a comprehensive systems approach

Our work emphasises that provision of oxygen is an essential public service, not just a commodity or commercial product, and that achieving equitable oxygen access will require a systems approach addressing multiple domains (production, storage, distribution, supply, clinical use, coordination, regulation, and financing) across the health, education, energy, industry, and transport sectors. Previous efforts, including major investments in response to the COVID-19 pandemic, largely focused on the delivery of equipment to produce more oxygen, but did not invest in the systems and people required to ensure equipment is distributed, maintained, and used safely and effectively. Key findings from this Commission show how future investment in strengthening oxygen systems could have a huge impact by saving millions of lives, accelerating progress towards the Sustainable Development Goals (SDGs), and preparing the world for future pandemics.

Reducing global inequities in medical oxygen access: the Lancet Global Health Commission on Medical Oxygen Security



Bangladesh Case Study

Infrastructure and Equipment

30 LMO systems in hospitals: **infrastructure and pipeline installation**

81 oxygen monitoring devices

1,000+ oxygen concentrators

70 oxygen manifolds in 60 UHCs

Pulse oximeters (120 adult, 120 pediatric)

Oxygen cylinders, flowmeters, gas analyzers

Fire extinguishers in 30 LMO hospitals and 70 UHC manifolds

Guidelines and Training

Developed **pediatric guidelines** for the rational use of oxygen and related training modules

Conducted **training on rational use** of oxygen in SCANUs

Landscape analysis

SOP and Facilitator handbooks for the medical gas system

Medical gas system booklet

Capacity building for facility managers.

Training on **fire safety** and produced related guidelines.

Systems and Process Improvements

Initiated and invested in the **Oxygen Management Information System (OMIS)**

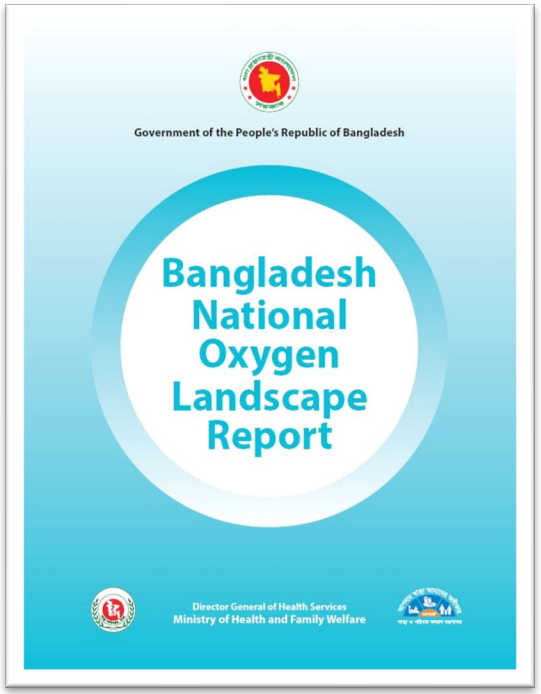
Integrated OMIS indicators into the **HMIS** (DHIS2)

Assessed quality in the nationwide SCANU, leading to **quality improvements**

Enhanced capacity on NEMMEW & TC for the overall medical gas system.

Rational use of oxygen training for healthcare professionals (HCP).

Oxygen landscape analysis and development of a roadmap for Bangladesh



- Develop oxygen landscape
- Develop oxygen security and fire safety system
- Develop costed plan and implementation framework
- Develop advocacy and communication plan/strategy
- Develop a comprehensive oxygen MIS and dashboard
- Develop SOP, Guidelines for supply chain/procurement and maintenance
- Capacity building for hypoxemia management and rational use of oxygen
- Develop quality assurance and M&E system

Pakistan Case Study

Planning: Comprehensive Biomedical Engineering Capacity Building Program

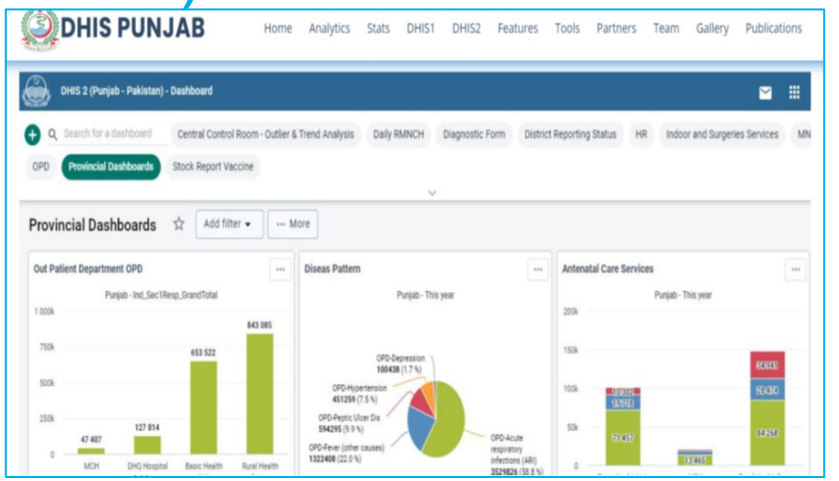
5 on-site PSA [illegible] Generation Plants [illegible] District Headquar[illegible] Hospitals (DHQs) to enhance timely provision of oxygen and prevent Pneumonia deaths among children

Challenge: Power is Expensive!

Hybrid solar power system (Each 250 kW capacity, 200 kW on-grid & 50kW hybrid with 50 kWh batteries) at **3** DHQs

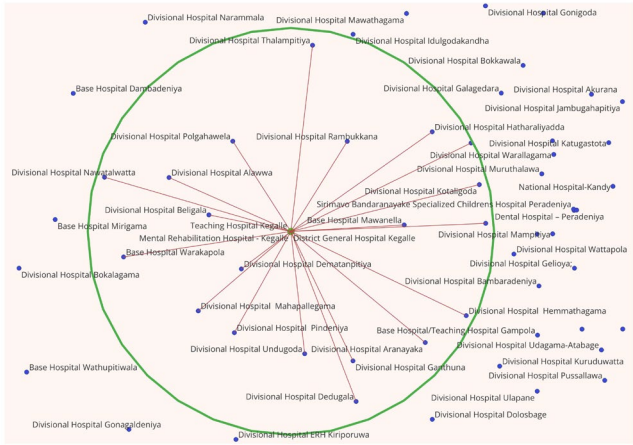
Scaling Pneumonia Responsive Interventions (SPRINT)

- Oxygen **indicators embedded in HMIS**, including mobile entry at service delivery point
- Implementation of **Oxytherapy Guidelines** for MNCH, focus on QA of hypoxemia management
- Sustainability concerns and considerations



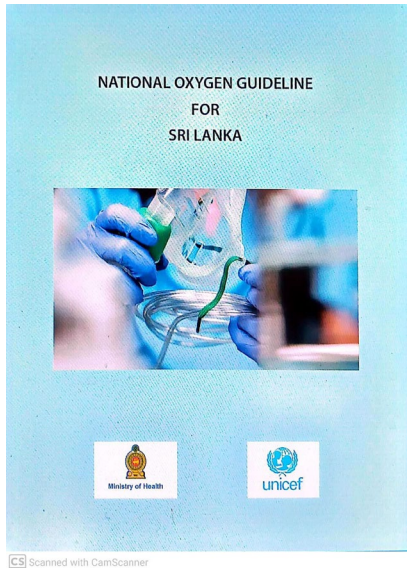
Sri Lanka Case Study

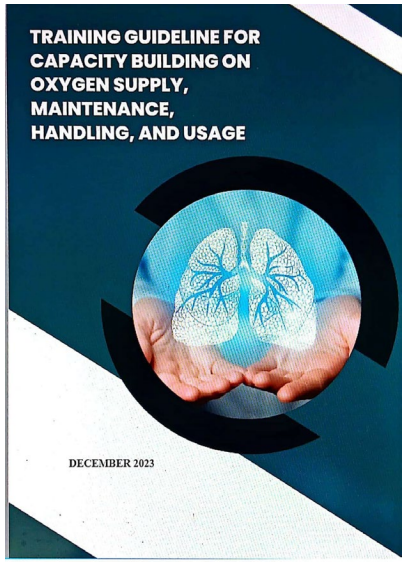
UNICEF supported PIB site	Estd pop	Catchment facilities to receive oxygen	
		Base hospitals	District hospital
1 BH Udugama	90,000	2	21
2 BH Thissamaharama	900,000	3	16
3 TH Kehalle	900,000	3	16
4 DGH Awissawella	800,000	2	11
Total	2.69 mn	10	64

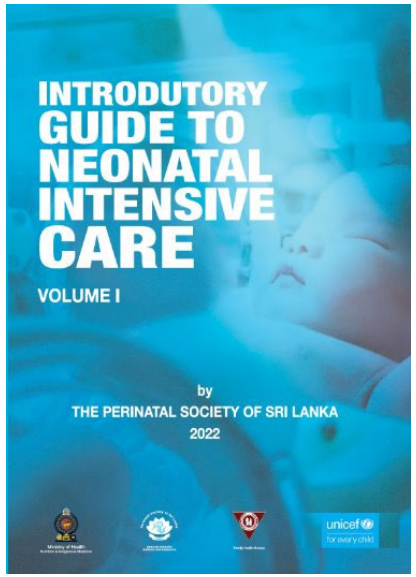


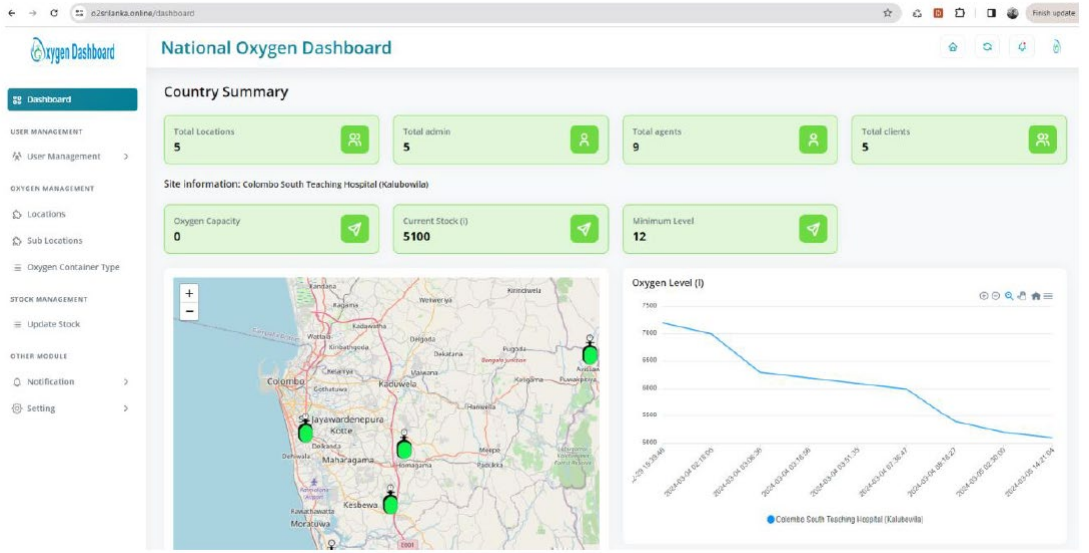
Hospitals supply by TH Kegalle oxygen plant


Neonatal advanced life support training including hypoxemia detection and management









Cambodia Case Study

New oxygen plant saves children's lives in rural Cambodia | UNICEF Cambodia

- Oxygen plant installed at 16 Makara Provincial Hospital, Preah Vihear Province, to treat patients with pneumonia, COVID, and other respiratory diseases
  - Provincial child mortality rate (79 / 1,000) higher than national average (16 / 1,000)
  - First oxygen plant in the province; nearest facility with oxygen therapy 4 hours away
- Procurement and distribution of additional oxygen therapy supplies for all 35 oxygen plants in public hospitals in Cambodia, including oxygen concentrators, patient monitors and other essential accessories
- Training of oxygen plant operators

"I think we will see much better outcomes, particularly in situations where we have to intervene, as with some Caesarian sections. Every second can count when it comes to oxygen, so I'm certain this oxygen plant will save lives."
- Kan Phirun, nurse and oxygen plant operator

Common Challenges in Oxygen Systems Strengthening across South Asia

National oxygen guidelines, Oxygen training materials and an oxygen dashboard were developed. But introduction of all three components across the country has not happened. It is still ***challenging to establish a system*** *and identifying necessary* ***funding sources*** *for the same.*
- Sri Lanka

Sustainability *remains challenging—insufficient* ***maintenance*** *budgets, limited rural vendor networks, and* ***quality monitoring gaps*** *persist. While functionality improved to 95-100% in supported facilities, systemic infrastructure weaknesses continue threatening long-term oxygen security nationwide.*
- Nepal

Sustainability issues*. Due to the government changes, there is a* ***gap in the leadership*** *of the Ministry of health and family welfare and also all the operation plans are on hold…. The support includes the* ***capacity building of biomedical technicians****, who are mainly responsible for regular and on-call maintenance of all medical devices within the health facilities. However, due to* ***recent funding cuts****, these activities are put on hold as well.*
- Bangladesh

Sustaining oxygen systems *in Afghanistan faces multiple challenges, including an acute* ***shortage of biomedical engineers and technicians*** *compounded with…* ***[u]nreliable power supply, complex logistics****, and delays in spare part delivery…. Additionally, a* ***lack of clear ownership and accountability*** *at system levels leads to poor oversight, ultimately compromising critical care delivery.*

Lessons Learned and Recommendations

Takeaways:

1. Embed a systems approach from the beginning of emergency response
2. Integrated support: Equipment, training, and maintenance that are contextually adapted
3. Integrated management of oxygen assets with other medical equipment and supplies (e.g. CCE, SNCUs, waste management)
4. Evidence-based planning and implementation – landscape analysis, build integrated information systems
5. Local capacity building
6. Leadership and ownership of national and local authorities
7. Strategic global partnerships, such as GO2AL, for advocacy, technical assistance, and resource mobilization
8. Availability and use across the continuum of care (e.g. PHC, referral transport)

Investment case

Global Oxygen Alliance

Costs and cost-effectiveness

- Closing the gap will require **$6.8br**
  $34bn over the next 5 years
- **Comparable to other vital interv**
  vaccines and breastfeeding in low-
- Each dollar invested delivers estim
- Estimated to cost **$168 / DALY av**
  $23 in highest-burden countries

Embed a Systems Approach, even

- Considering all **systems compon**
  sustainability from the beginning
  inefficiencies, and ensure crisis inv
  transformed into long-term benefits
  and populations.
- Policy, evidence-based planning, i
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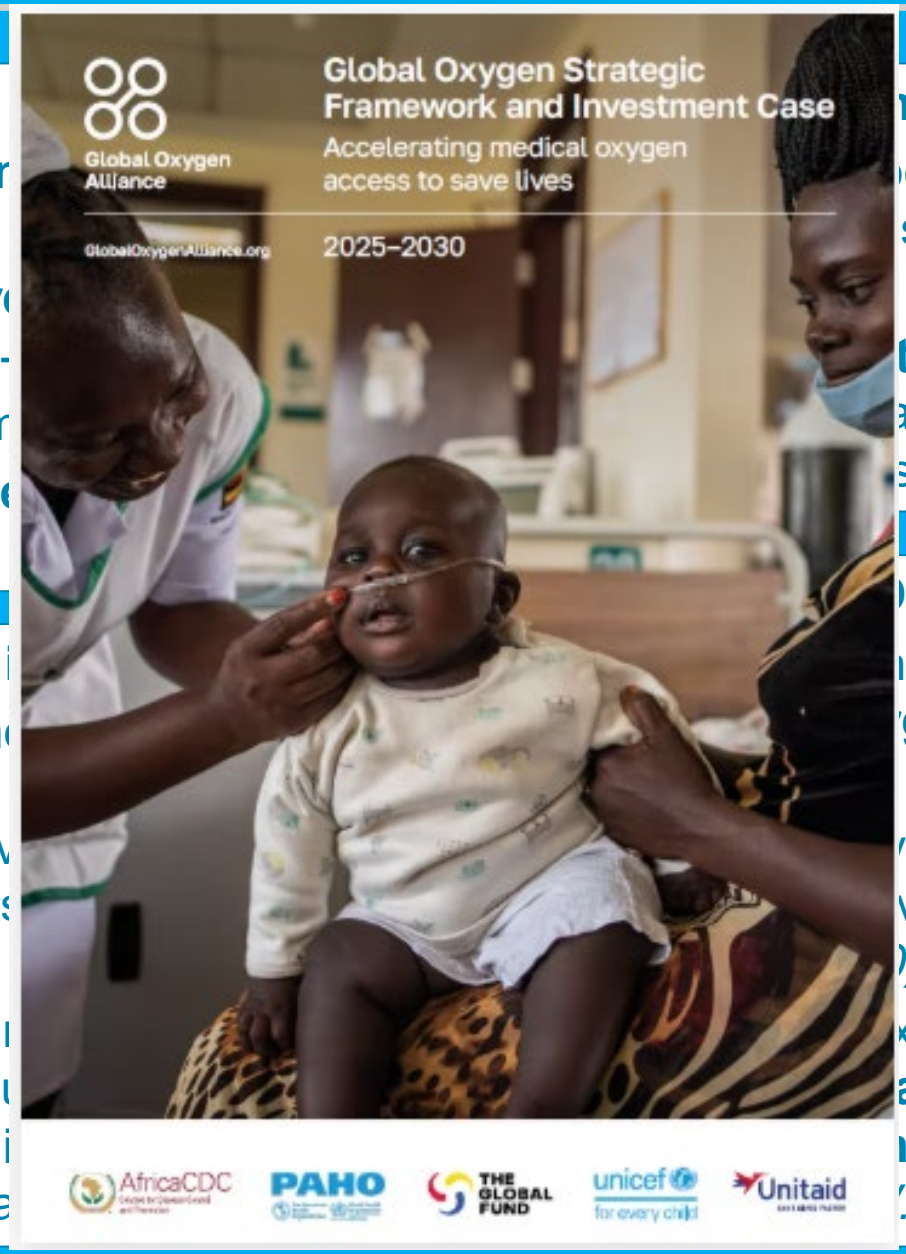

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gets, especially for maternal and

es overall, including 331,000
ve *(Global Oxygen Investment*
)

xygen systems **significantly**
al-based pneumonia mortality
under five. *(Lam, F., Stegmuller,*
., 2021)

Thank you

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