Sustaining and improving oxygen systems for children in the time of COVID

Dr Hamish Graham
Centre for International Child Health, MCRI, RCH, University of Melbourne, Australia

Prof Adegoke G Falade
Department of Paediatrics, UCH Ibadan/University of Ibadan, Oyo, Nigeria
Oxygen for Life Initiative
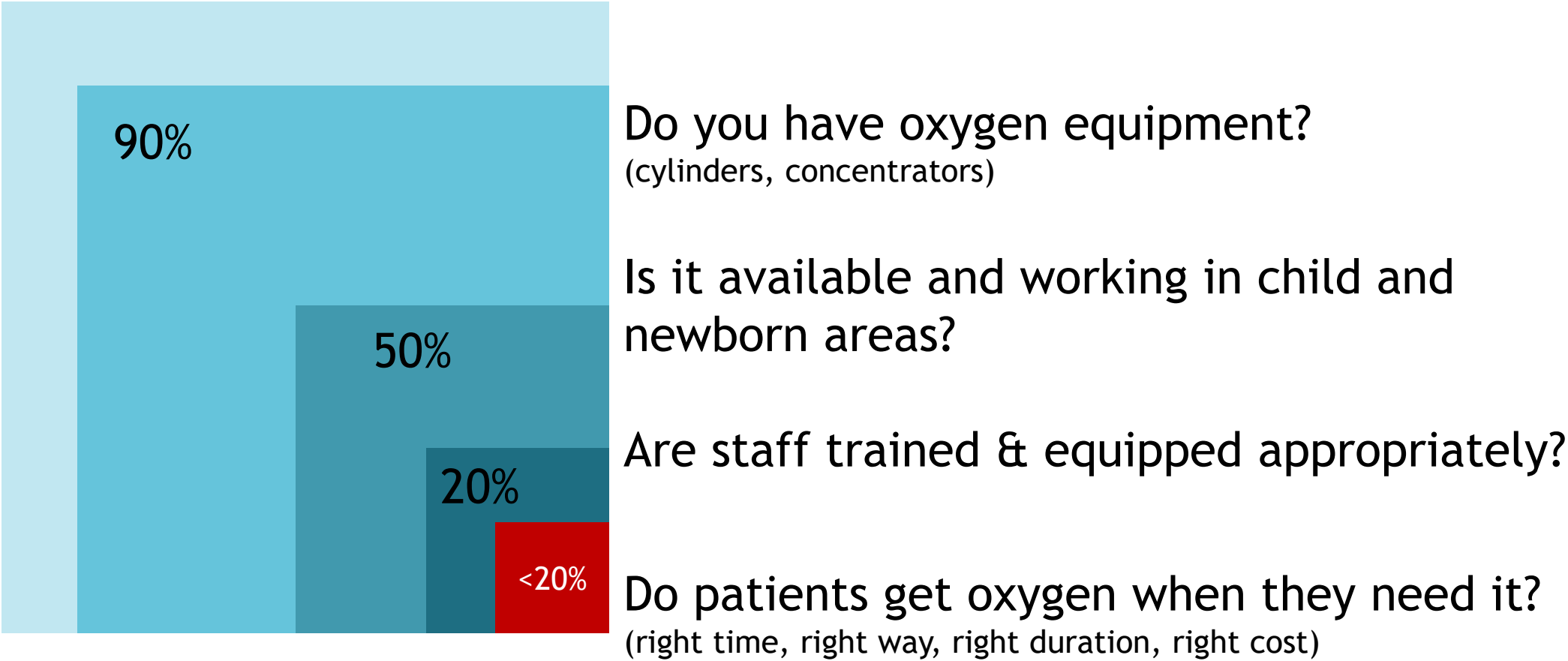
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Acknowledgments

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Partners – WHO, UNICEF, CHAI, PATH, Save the Children, Hewatele, ASSIST, many others

Patient-centred approach to oxygen access

90% Do you have oxygen equipment?
(cylinders, concentrators)

50% Is it available and working in child and newborn areas?

20% Are staff trained & equipped appropriately?

<20% Do patients get oxygen when they need it?
(right time, right way, right duration, right cost)

Bakare, A. A., et al. (2020). "Providing oxygen to children and newborns: a multi-faceted technical and clinical assessment of oxygen access and oxygen use in secondary-level hospitals in southwest Nigeria." International health.

Opportunities to "build back better"

Opportunities to "build back better"

1. Prompt and accurate identification of patients who need oxygen (specifically, **hypoxaemia**)

2. Reliable, continuous **supply** of medical-grade oxygen

3. **Healthcare workers** with the skills, equipment and motivation to use oxygen well

4. **Technicians** with the skills, equipment and motivation to maintain oxygen equipment well

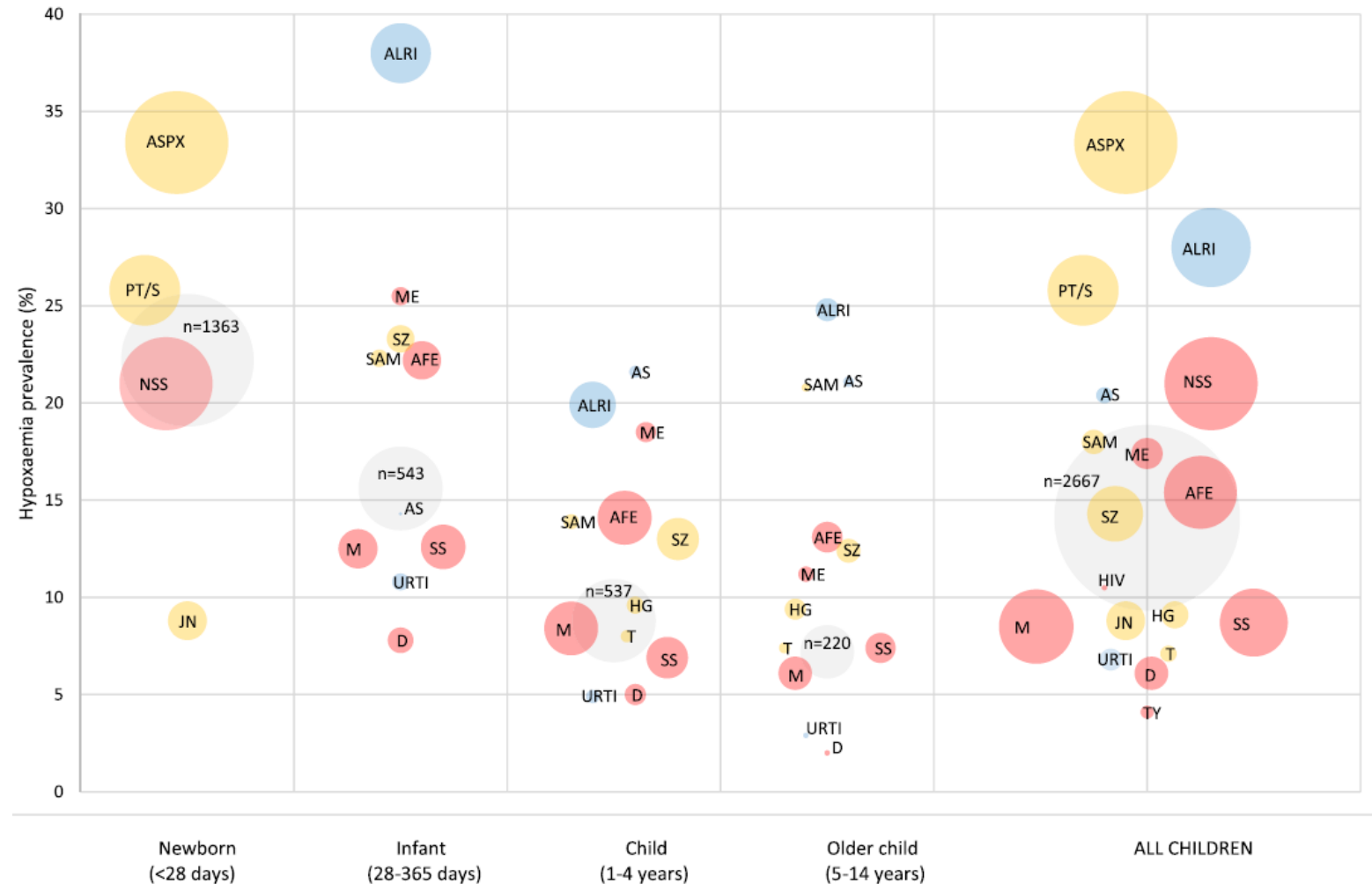5. Holistic approach to hospital **oxygen systems**

#1 - Pulse oximetry, pulse oximetry, pulse oximetry!

Hypoxaemia is...

Common!

- **22% of sick neonates**
  >30% neonatal encephalopathy
  >25% preterm/small

- **15% of sick infants**
  >35% pneumonia

Graham, H. R., et al. (2019). "Hypoxaemia in hospitalised children and neonates: a prospective cohort study in Nigerian secondary-level hospitals." EClinicalMedicine.

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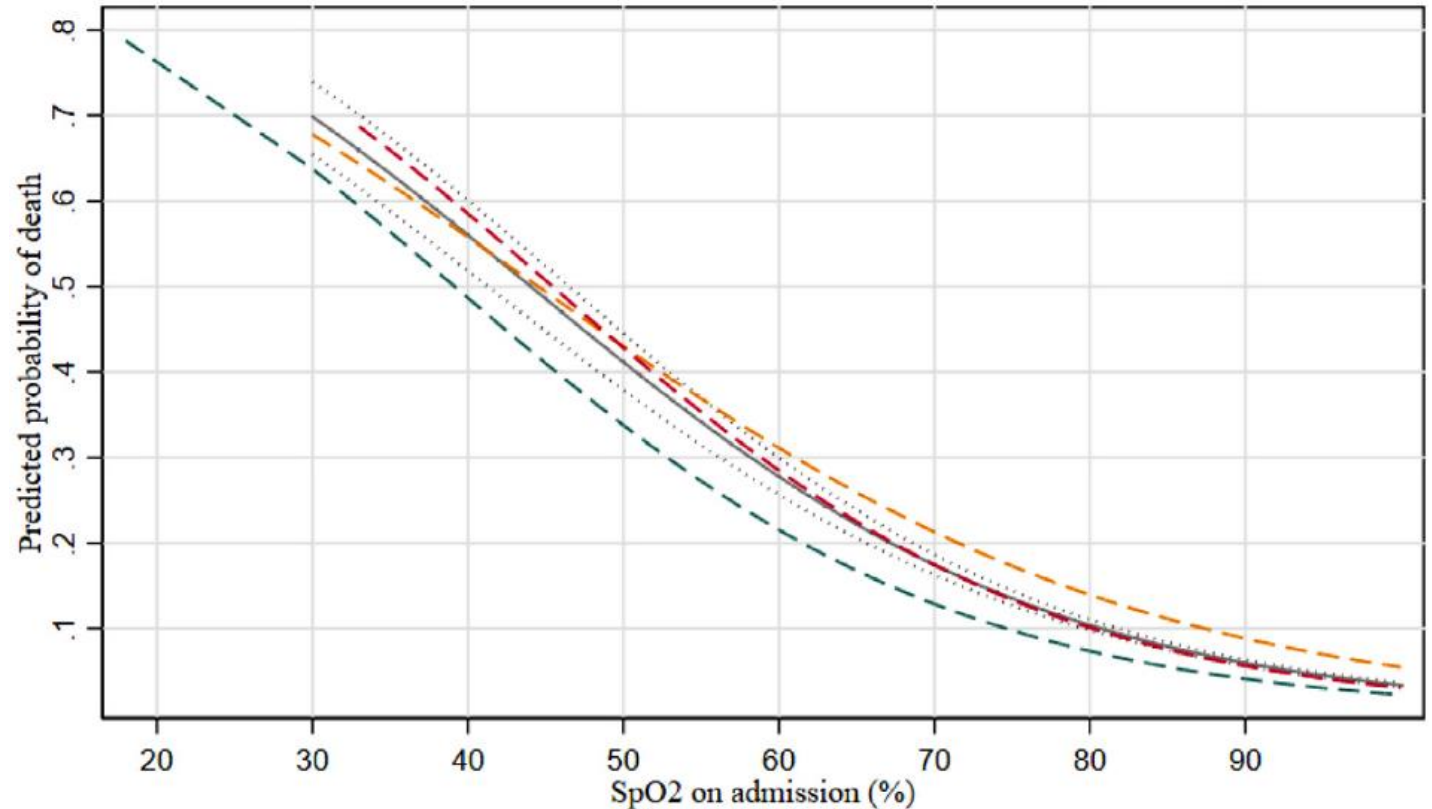
Hypoxaemia is...

Common!

- 22% of sick neonates
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Deadly!

- Increases risk of death 7-fold

- Increasing risk with low SpO_2

Difficult to detect clinically

Graham, H. R., et al. (2019). "Hypoxaemia in hospitalised children and neonates: a prospective cohort study in Nigerian secondary-level hospitals." EClinicalMedicine.

#1 - Pulse oximetry, pulse oximetry, pulse oximetry!

Here are 3 tips on improving pulse oximetry adoption:

#1. Make pulse oximetry a routine vital sign (temperature, HR, RR, SpO$_2$)

Nurses already do vital signs as part of routine practice. Help nurses embrace pulse oximetry as part of their existing practice (BONUS: you get both SpO2 and heart rate simultaneously)

#2. Promote pulse oximetry as a way "to help make nurses' work easier".

At first, pulse oximetry can feel like extra work. Nurses need to see the benefits first hand. These include clinical benefits (e.g. saving lives) and practical benefits (e.g. easy SpO2 monitoring and recognition of sick patients, build confidence and trust...).

#3. Support nurses to learn pulse oximetry and make it a habit.

Pulse oximetry is relatively easy, but it still takes time to become competent and make it routine. Provide practical assistance. Be patient and encouraging. Give gentle reminders.
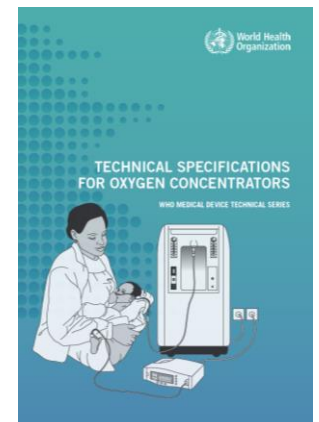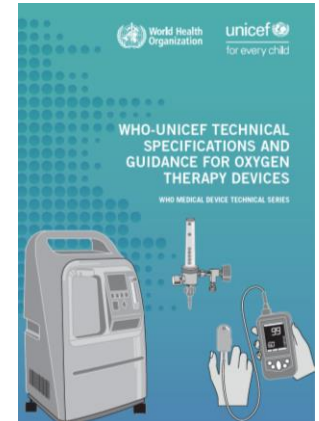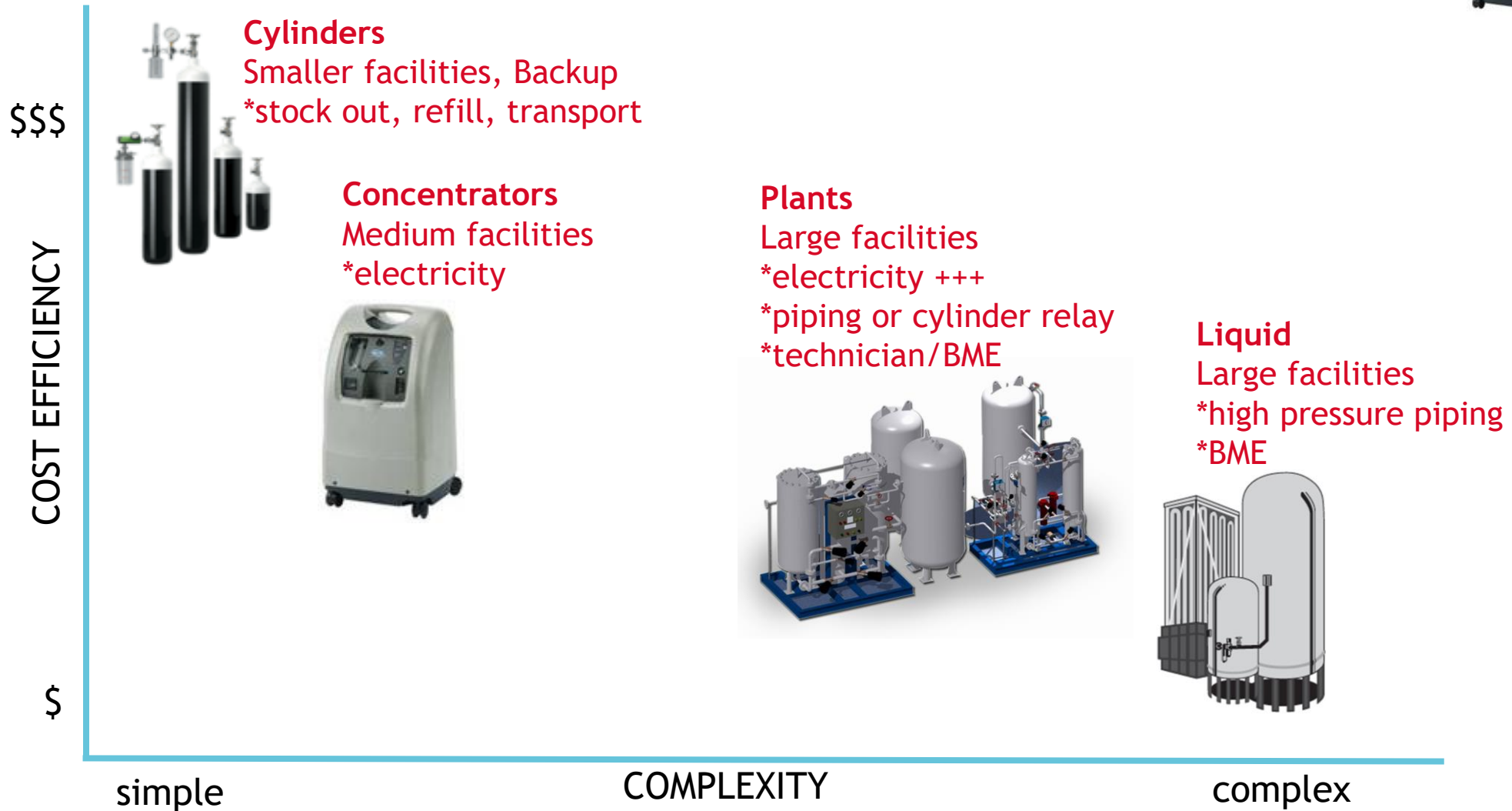
Graham, H. R., et al. (2018). "Adoption of paediatric and neonatal pulse oximetry by 12 hospitals in Nigeria: a mixed-methods realist evaluation." BMJ Glob Health 3: e000812.

#2 – Reliable oxygen supply

- **What is medical grade oxygen?**
  - **>82%**

  - Cylinders: typically **90-95%** purity, (regulator) pressure **50psi**
  - Concentrators: typically **90-95%** purity, outlet pressure **<20psi**

Method	Oxygen concentration achievable with 1 l/min in a 5 kg child
Nasopharyngeal catheter	45–60%
Nasal catheter	35–40%
Nasal prongs	30–35% up to 60% in neonates[6]
Oropharyngeal catheter	45–60%
Face mask	29%
Head box	Variable

WHO and UNICEF (2019). WHO-UNICEF Technical Specifications and Guidance for Oxygen Therapy Devices. Geneva, WHO.
WHO (2015). Technical Specifications for Oxygen Concentrators. WHO Medical Device Technical Series. W. H. Organization. Geneva, WHO.

#2 – Reliable oxygen supply

Cylinders
Smaller facilities, Backup
*stock out, refill, transport

Concentrators
Medium facilities
*electricity

Plants
Large facilities
*electricity +++
*piping or cylinder relay
*technician/BME

Liquid
Large facilities
*high pressure piping
*BME

COST EFFICIENCY
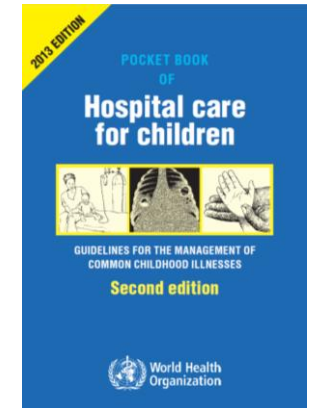
$$$

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COMPLEXITY

simple

complex

#3 - Clinical capacity

Oxygen safety

- Too little (hypoxaemia)
  - \>90%

- Too much (oxidative stress)
  - Retinopathy of prematurity (ROP), BPD
  - Preterm/small neonates 88-94% (or similar)

- Too variable
  - Scott Haldane: "like bringing a drowning man up to breathe then pushing him under again"

WHO (2013). Pocket Book of Hospital care for children: guidelines for the management of common childhood illnesses. Geneva, WHO.
WHO (2016). Oxygen therapy for children. Geneva, WHO.

#3 - Clinical capacity

- Pulse oximetry
  - !!!

- Clinical guideline
  - Editable WHO-based templates here: https://bit.ly/O2clinical

- Age-appropriate delivery equipment
  - Nasal prongs or catheter
  - Humidifier only if higher flow rates (>2-4LPM)

- +/- air/oxygen mixer
  - High-flow or CPAP – use air (21% oxygen), or mixer.

WHO (2013). Pocket Book of Hospital care for children: guidelines for the management of common childhood illnesses. Geneva, WHO.
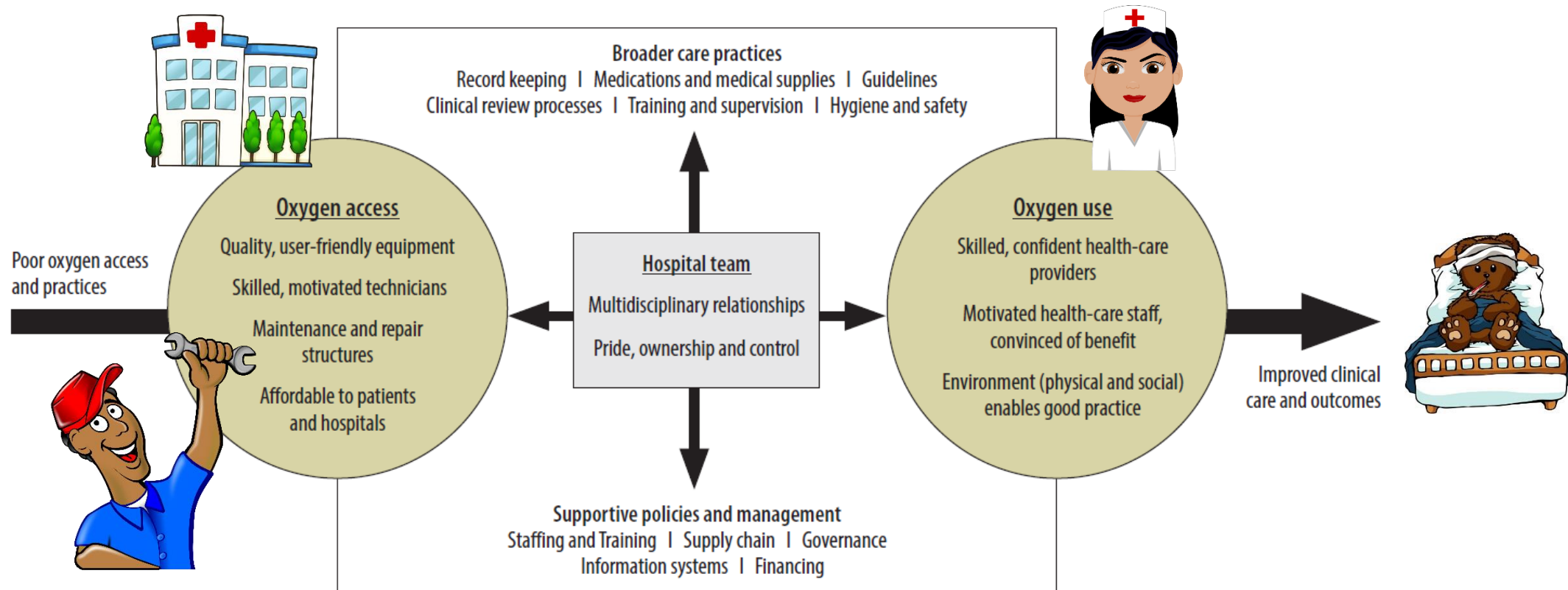WHO (2016). Oxygen therapy for children. Geneva, World Health Organization.
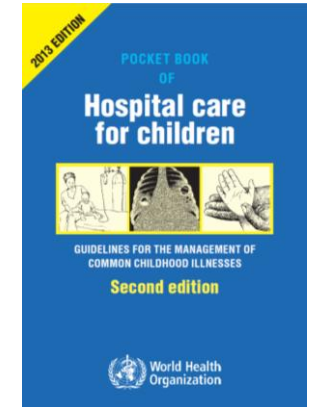
#4 – Involve technicians

- Most important people for providing oxygen safely to patients? (my opinion)
  1. Nurses
  2. Technicians
  3. Doctors

- Technician resources
  - https://bit.ly/O2install

#5 - Oxygen systems

Poor oxygen access and practices →

Oxygen access
- Quality, user-friendly equipment
- Skilled, motivated technicians
- Maintenance and repair structures
- Affordable to patients and hospitals

Broader care practices
Record keeping | Medications and medical supplies | Guidelines
Clinical review processes | Training and supervision | Hygiene and safety

Hospital team
- Multidisciplinary relationships
- Pride, ownership and control

Supportive policies and management
Staffing and Training | Supply chain | Governance
Information systems | Financing

Oxygen use
- Skilled, confident health-care providers
- Motivated health-care staff, convinced of benefit
- Environment (physical and social) enables good practice

→ Improved clinical care and outcomes

Graham, H., et al. (2017). "Providing oxygen to children in hospitals: a realist review." Bulletin of the World Health Organization 95(4): 288-302.

#5 - Oxygen systems

Planning

Financing & Procurement

Installation

Healthcare worker training & support

Technician training & support

Maintenance schedules & tools

Monitoring & feedback
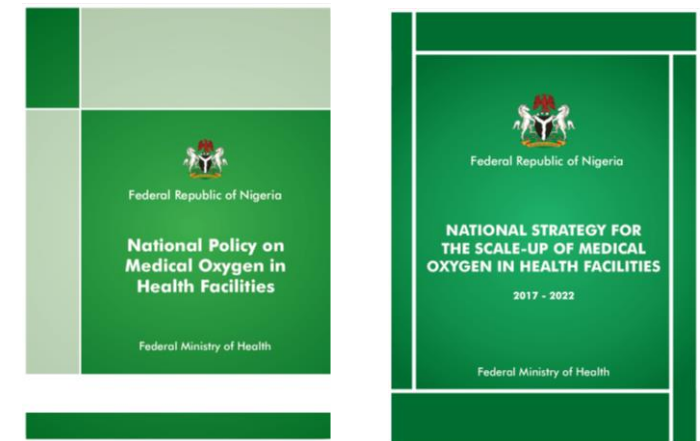

OXYGEN FOR LIFE

Hewatele
Saving Lives, One Breath at a Time

View from the ground - Nigeria

- Nigeria
  - Policies & Strategies
    - National Strategy for the scale up of medical oxygen in health facilities (2017)
    - National Policy on medical oxygen in health facilities (2017)
    - National Integrated Pneumonia Control Strategy and Implementation Plan (2020)
  - Financing
  - Responsible people/institutions
  - Implementing partners

Graham, H., et al. (2020). "Oxygen therapy for children: A key tool in reducing deaths from pneumonia." Pediatric Pulmonology 55(S1): S61-S64.

Summary

1. **Patient-centred thinking.** When we think about oxygen access, keep the patient at the centre.

2. **Pulse oximetry is essential.** If you are not already doing pulse oximetry routinely on all sick newborns and children, start doing it!

3. **Get to know your equipment.** Choose quality. Use it to its full capacity. Cost it over full life cycle.

4. **Encourage responsible oxygen use.** Right amount, right method, right patient, right duration.

5. **Involve technicians in everything.**

6. **Think of the whole system.**

"Do oxygen well, do infection control well, protect staff"

Resources

- Oxygen collection (curated by UNICEF)
  https://bit.ly/O2resources

  - Clinical protocols and training: https://bit.ly/O2clinical
  - Cleaning equipment: https://bit.ly/O2clean
  - Technician resources: https://bit.ly/O2technicians
  - Procurement and installation guide: https://bit.ly/O2install
  - WHO technical specifications
  - WHO clinical guidelines – oxygen, children, COVID-19
  - WHO oxygen planning documents and interim guidance

- Other resources
  - WHO medical devices: https://www.who.int/medical_devices/priority/COVID-19_medequipment/en/
  - Every Breath Counts: https://stoppneumonia.org/latest/covid-19/
  - ASSIST International - oxygen series: https://assistinternational.org/covid19resources/
  - USAID Do No Harm – oxygen brief: https://www.everypreemie.org/donoharmbriefs/

Thank you

Hamish.Graham@rch.org.au