murdoch children's research institute

THE UNIVERSITY OF MELBOURNE

Oxygen: do no harm

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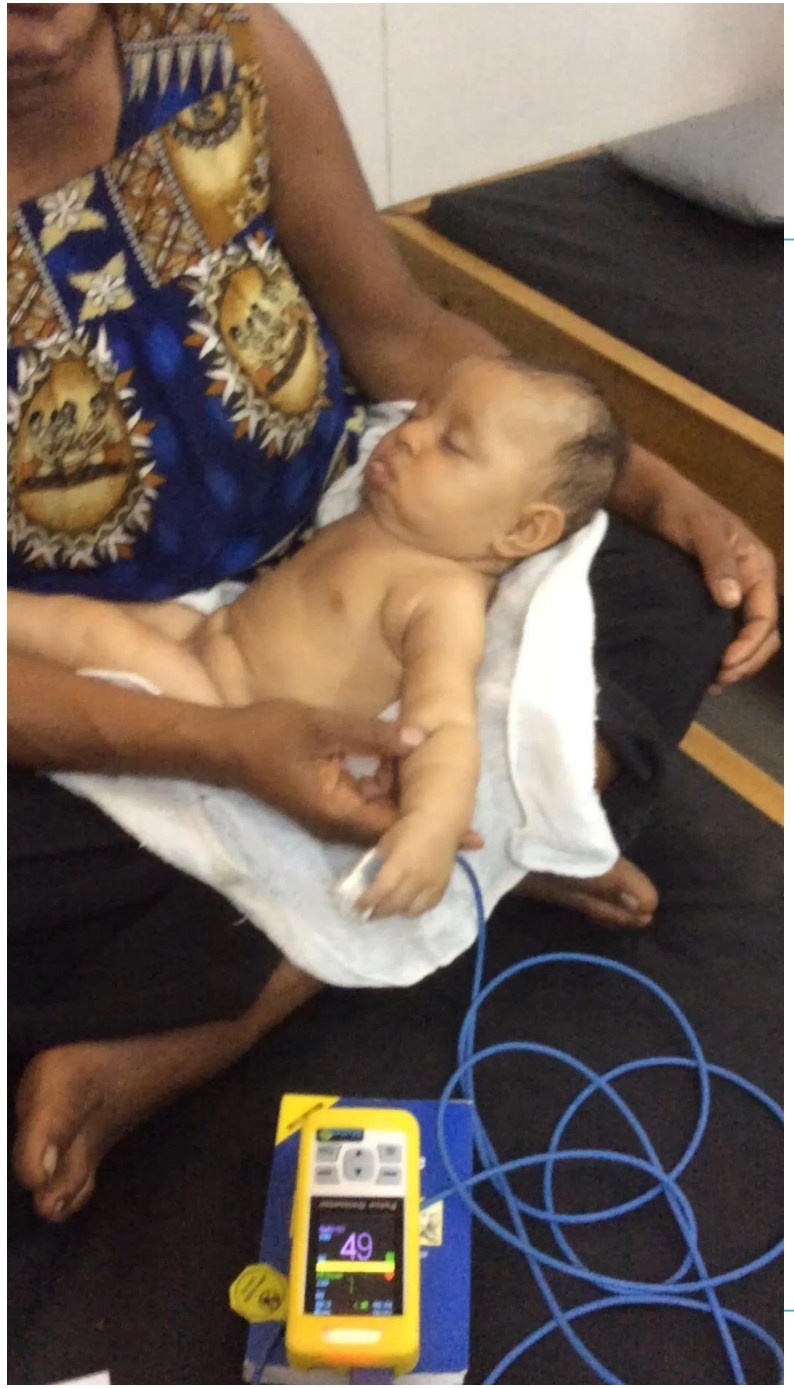
July 2020

Acknowledgments

Prof A.G. Falade, Dr Bakare, and the Oxygen for Life team.

Many other partners – WHO, UNICEF, CHAI, PATH, Save the Children, Hewatele, others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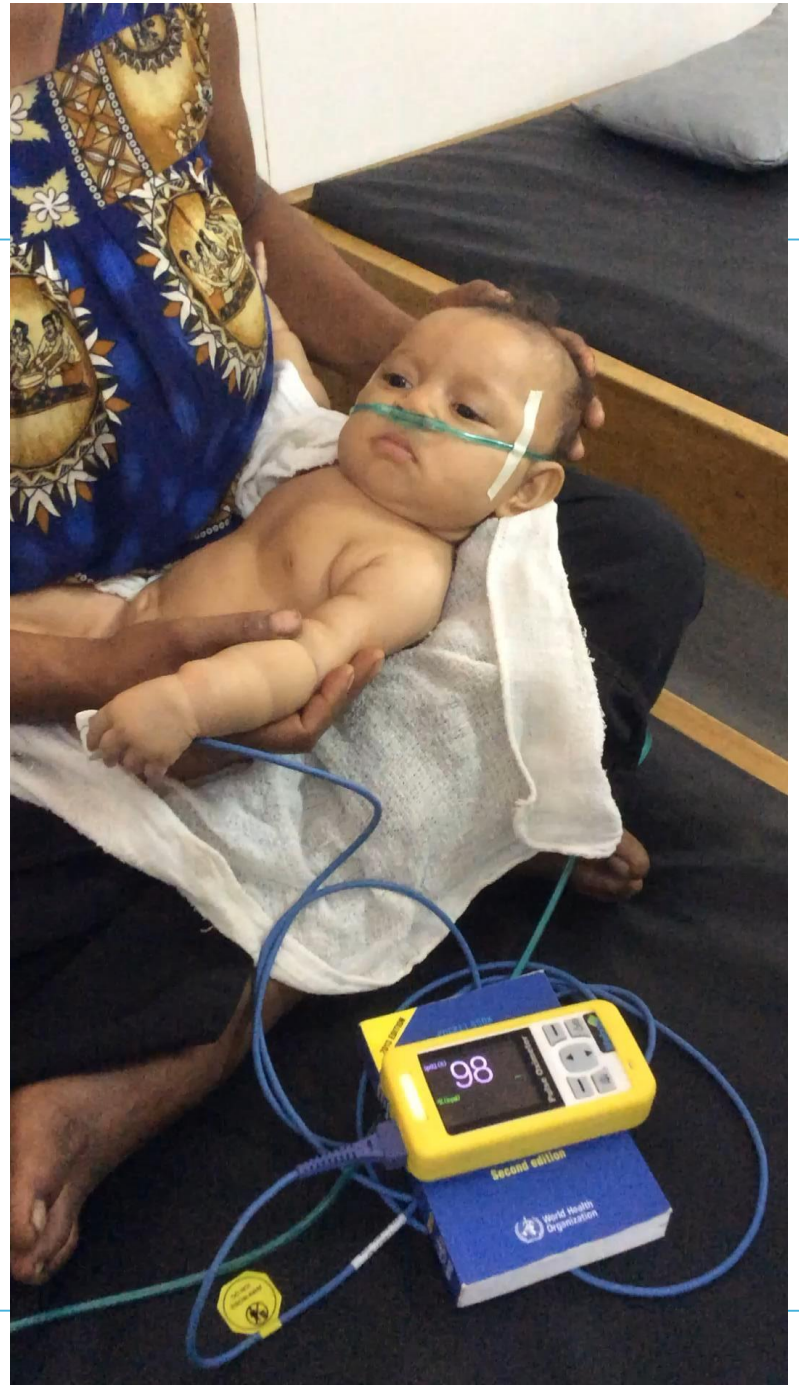
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Second edition
World Health Organization

Oxygen = O_2

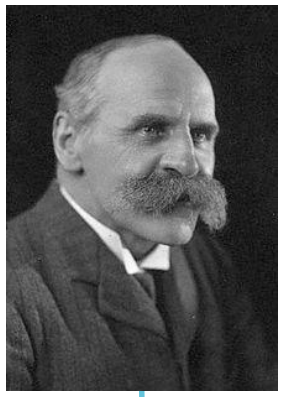
1770

Daily inhalation of oxygen for a young woman with TB

1783

1800s
Oxygen Dark Ages

"oxygenated water and bread"
"compound oxygen"
"cure-all"



1890

Continuous oxygen therapy for a woman with pneumonia

1917

Retinopathy of prematurity (ROP)

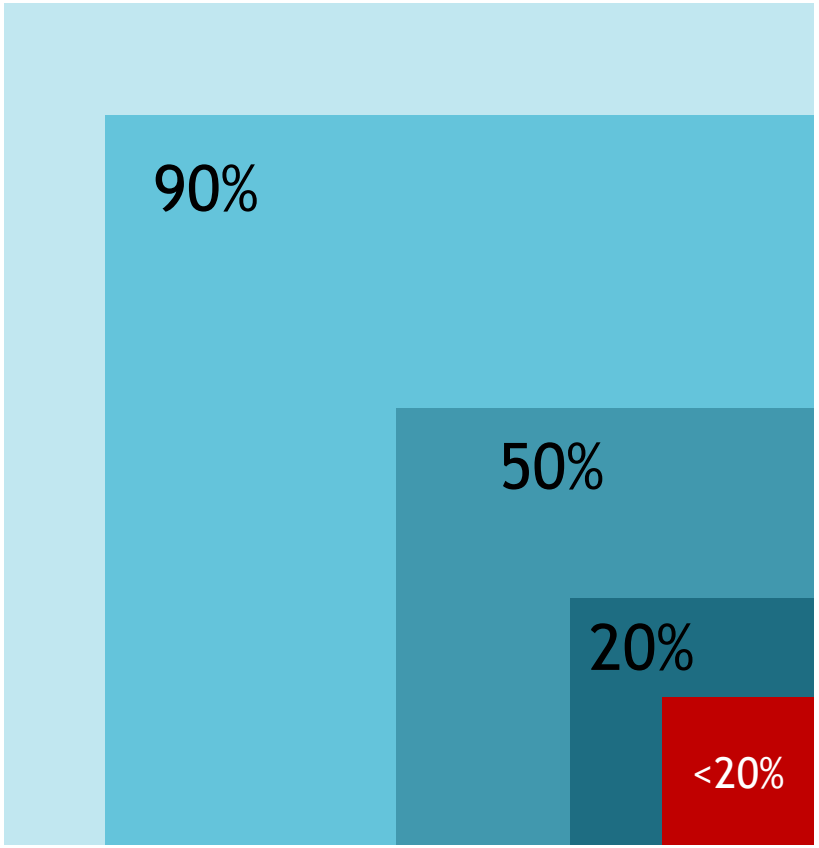
Pulse oximeter

1972

Every patient will receive oxygen when they need it – no exceptions

How good is oxygen access in your hospital?

How good is oxygen access in your hospital?



Do you have oxygen equipment?
(cylinders, concentrators)

Is it available and working in child and newborn areas?

Are staff trained & equipped appropriately?

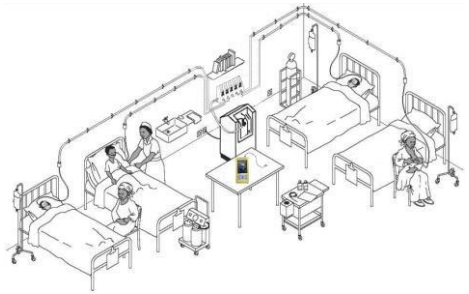
Do patients get oxygen when they need it?
(right time, right way, right duration, right cost)

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.

How do we ensure safe and effective oxygen for sick children?

How do we ensure safe and effective oxygen for sick children?

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**



Hypoxaemia

Is common!

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

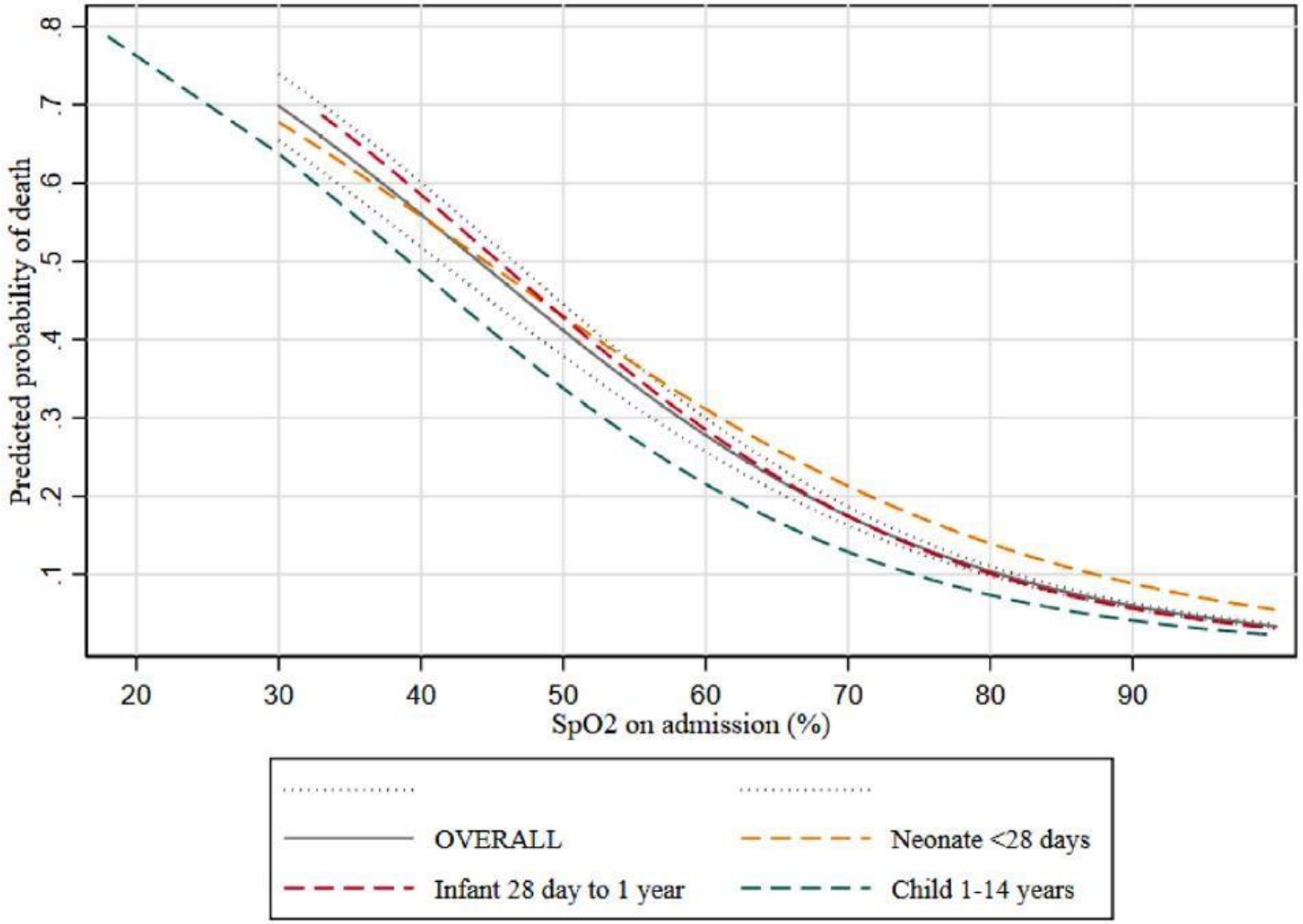
- 15% of sick infants
  >35% pneumonia

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

Hypoxaemia

Is deadly!

- Increases risk of death 7-fold
- Increasing risk with low SpO_2



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

Hypoxaemia ----> Pulse oximetry is essential!!

Here are 3 tips on <u>improving pulse oximetry adoption</u>:

#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.

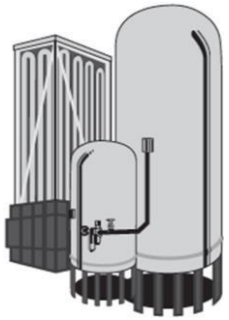
Oxygen supply

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

$

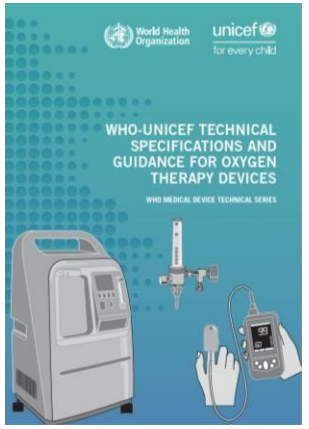
simple

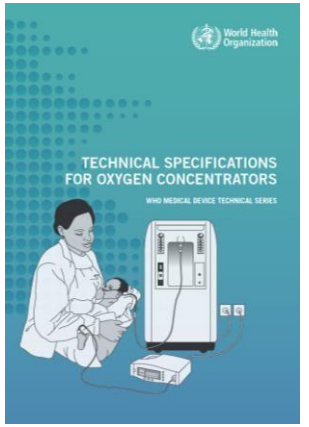
COMPLEXITY

complex

Oxygen supply

- What is medical grade oxygen?
  - >82%
  - Cylinders: typically 90-95% purity, (regulator) pressure 50psi
  - Concentrators: typically 90-95% purity, outlet pressure <20psi



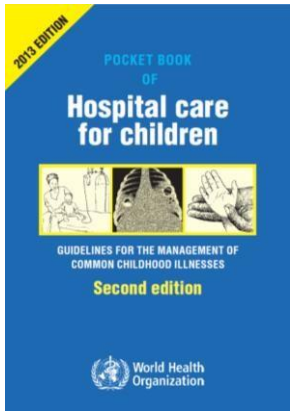


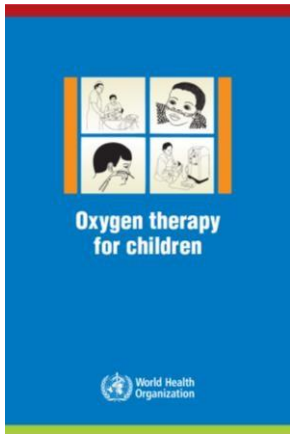
Method	Oxygen concentration achievable with 1 l/min in a 5 kg child
Nasopharyngeal catheter	45–60%
Nasal catheter	35–40%
Nasal prongs	30–35% up to 60% in neonates[6]
Oropharyngeal catheter	45–60%
Face mask	29%
Head box	Variable

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.

Clinical skills

- Pulse oximetry
- Clinical guideline
- Age-appropriate delivery equipment
- +/- air/oxygen 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.

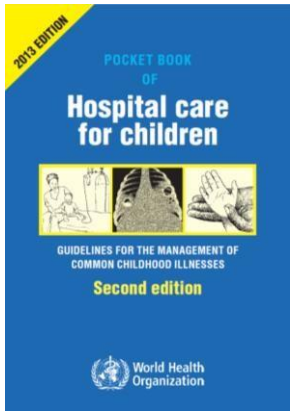
Clinical skills

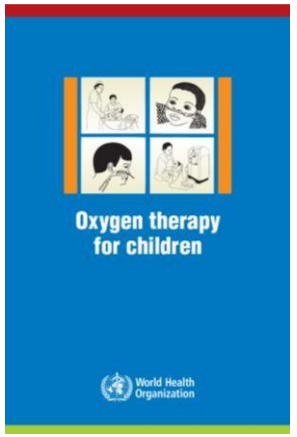
Oxygen safety

- Too little (hypoxaemia)
  - >90%

- Too much (oxidative stress)
  - Free radicals
  - 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”





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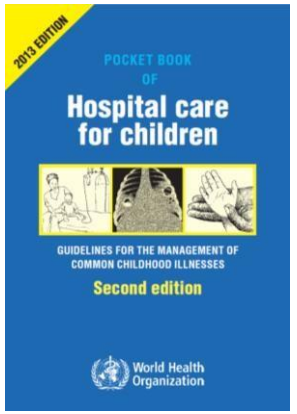
Clinical skills

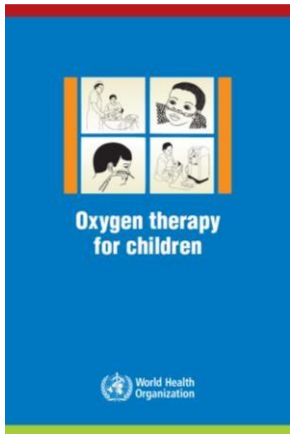
- Pulse oximetry
  - !!!

- 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.





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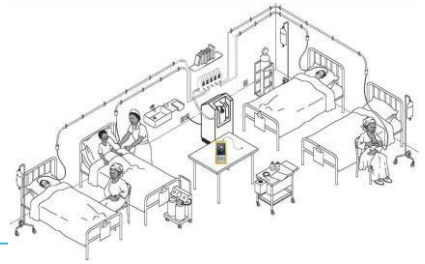
WHO (2016). Oxygen therapy for children. Geneva, World Health Organization.

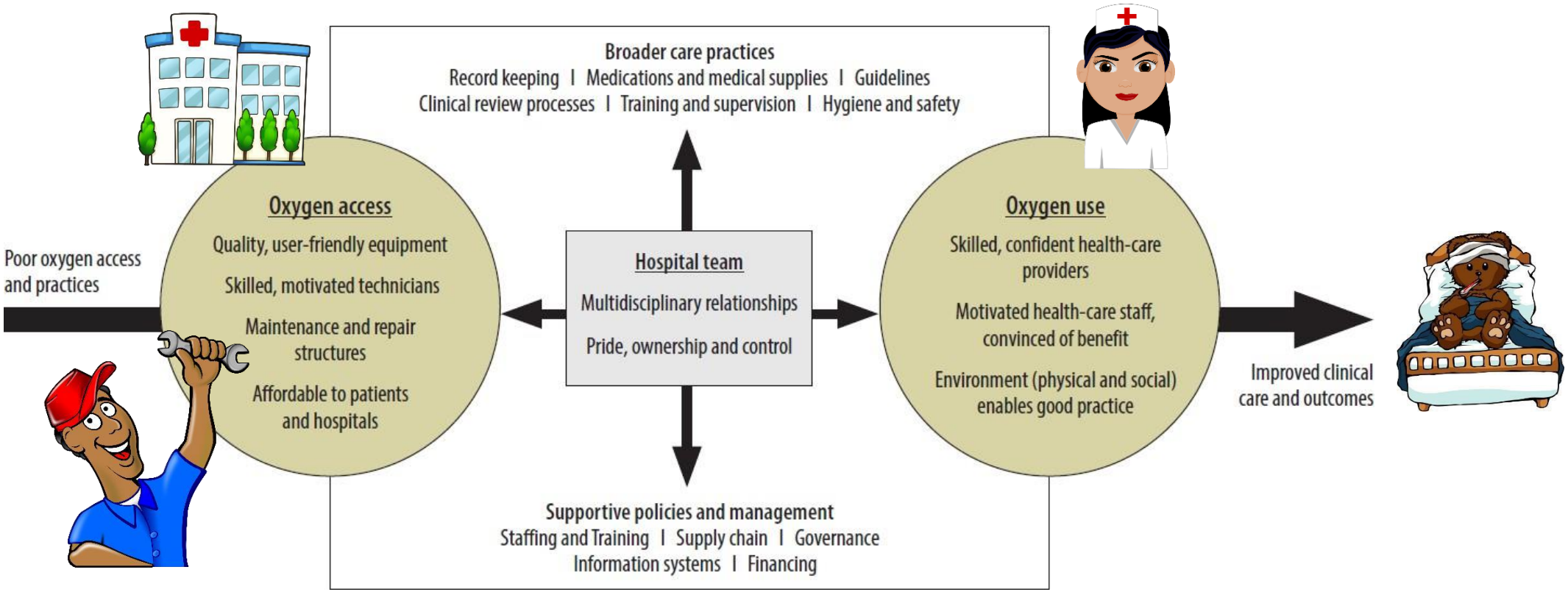
Technicians

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

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

Oxygen systems





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

Oxygen systems

OXYGEN FOR LIFE

Hewatele
Saving Lives, One Breath at a Time

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. **Use oxygen only as needed**. 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

- Other resources
  - Every Breath Counts
    https://stoppneumonia.org/latest/covid-19/

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Thank you