INGEGNERIA BIOMEDICA PER LA SALUTE GLOBALE E PER LO SVILUPPO SOSTENIBILE

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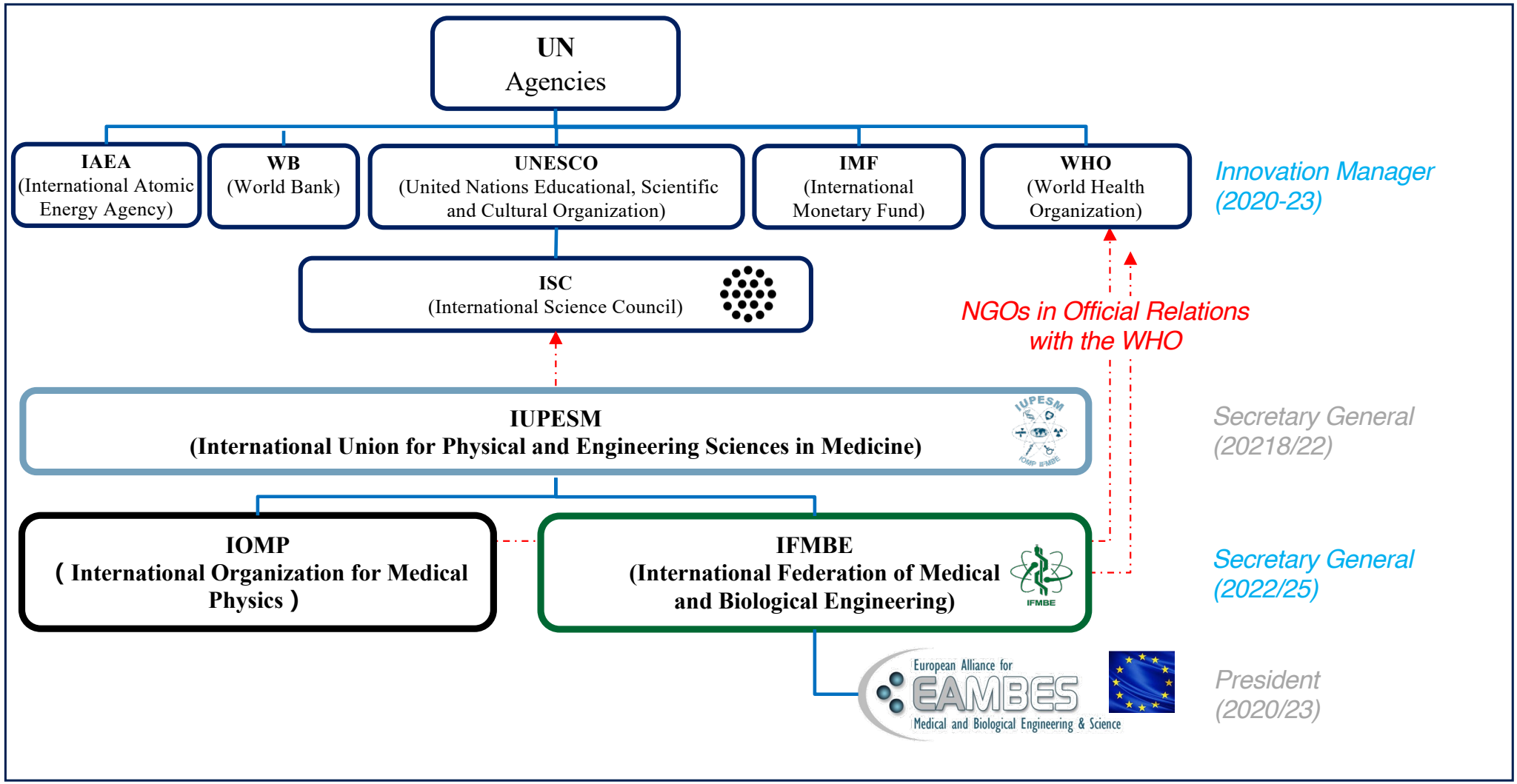
UN
Agencies
IAEA
(International Atomic Energy Agency)
WB
(World Bank)
UNESCO
(United Nations Educational, Scientific and Cultural Organization)
IMF
(International Monetary Fund)
WHO
(World Health Organization)
Innovation Manager
(2020-23)
ISC
(International Science Council)
NGOs in Official Relations
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IUPESM
(International Union for Physical and Engineering Sciences in Medicine)
Secretary General
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IOMP
(International Organization for Medical Physics)
IFMBE
(International Federation of Medical and Biological Engineering)
Secretary General
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EAMBES
Medical and Biological Engineering & Science
President
(2020/23)

How BME can we improve affordable health access in LMICs?

Many challenges:

- Hospital standard
- Lack of (specialised) staff
- Supply chain
- …and also budget

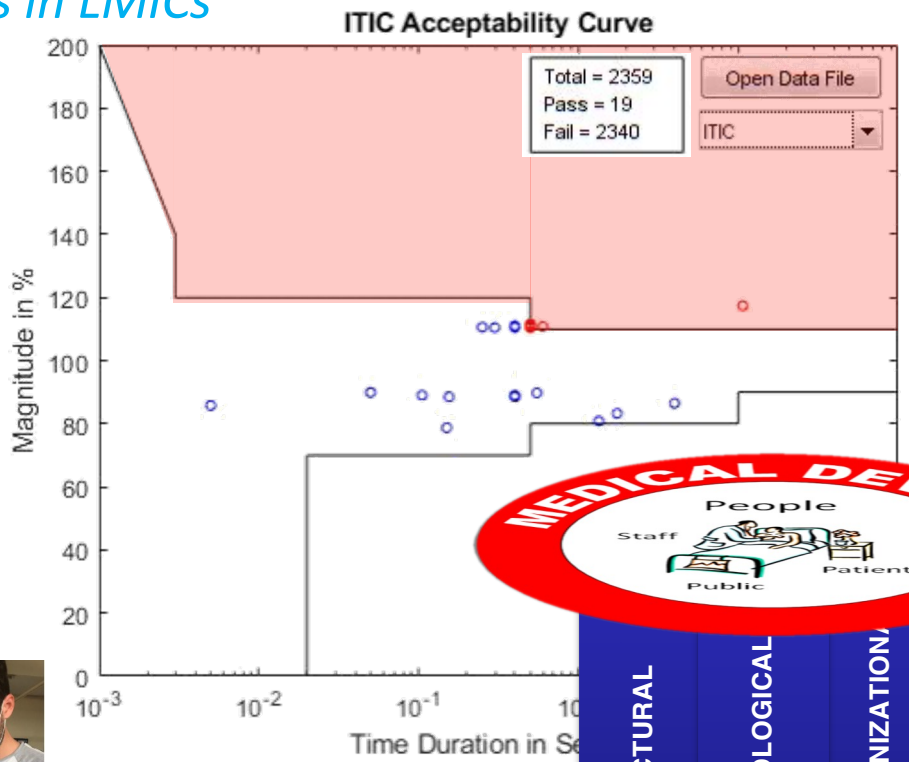
For improving medical device effectiveness and safety in LMICs we have to overcome the Cartesian Fragmentation of Knowledge (i.e., no silos).

Thus we must focus on:

- Design
- Regulation
- Management
- Assessment
- Environmental impact

8 field studies in 24 months: Benin, Ethiopia, South Africa, Nigeria, Uganda

Challenge 1: understand hospital standards in LMICs



...99%!

Challenge 1: understand hospital standards in LMICs

Country	Uganda	Uganda	Uganda	Benin	Benin	Benin
Hospital	**H1**	**H2**	**H3**	**H4**	**H5**	**H6**
Colonoscope	0	1	0	0	0	0
Mammograph	0	0	1	0	0	0
CT-scanner	0	1	1	0	0	0
Gastroscope	0	1	2	0	0	0
Infant reanimation centre	0	0	1	0	1	1
X-Ray Machine	1	3	1	1	1	1
Ambulance	0	3	1	2	0	2
Defibrillator	2	4	NA	3	2	0
Ventilator ICU	0	4	8	0	2	1
Hemocytometer	1	4	1	8	4	1
Ultrasound machine	0	8	2	4	2	3
Oxygen systems/cylinders	10	10	1	0	0	0
Syring pump	0	8	0	2	8	8
Autoclave for sterilisation	2	8	10	2	4	1
Operating theatre with basic equipment	3	8	3	8	3	2
Suction pump	1	8	10	0	8	1
Infant warmer	0	8	8	4	8	0
Anasthetic machine	1	10	8	0	2	8
Fetal monitor	1	8	10	0	8	2
Neonatal incubator	8	10	1	3	4	4
ECG machine	0	4	8	10	8	2
Patient monitor	1	10	10	10	8	10
Scale for adult	0	10	10	10	10	10
Scale for newborns	0	10	10	10	10	10
Pulsoximeter	2	10	10	10	10	10
Thermometer	8	10	10	10	10	10
Blood pressure machine/cuff	10	10	10	10	10	10

A Framework for Assessing Healthcare Facilities in Low-Resource Settings: Field Studies in Benin and Uganda, 2020, https://doi.org/10.1007/s40846-020-00546-3

Challenge 2: shortage of (specialized) healthcare professionals, PNEUMONIA

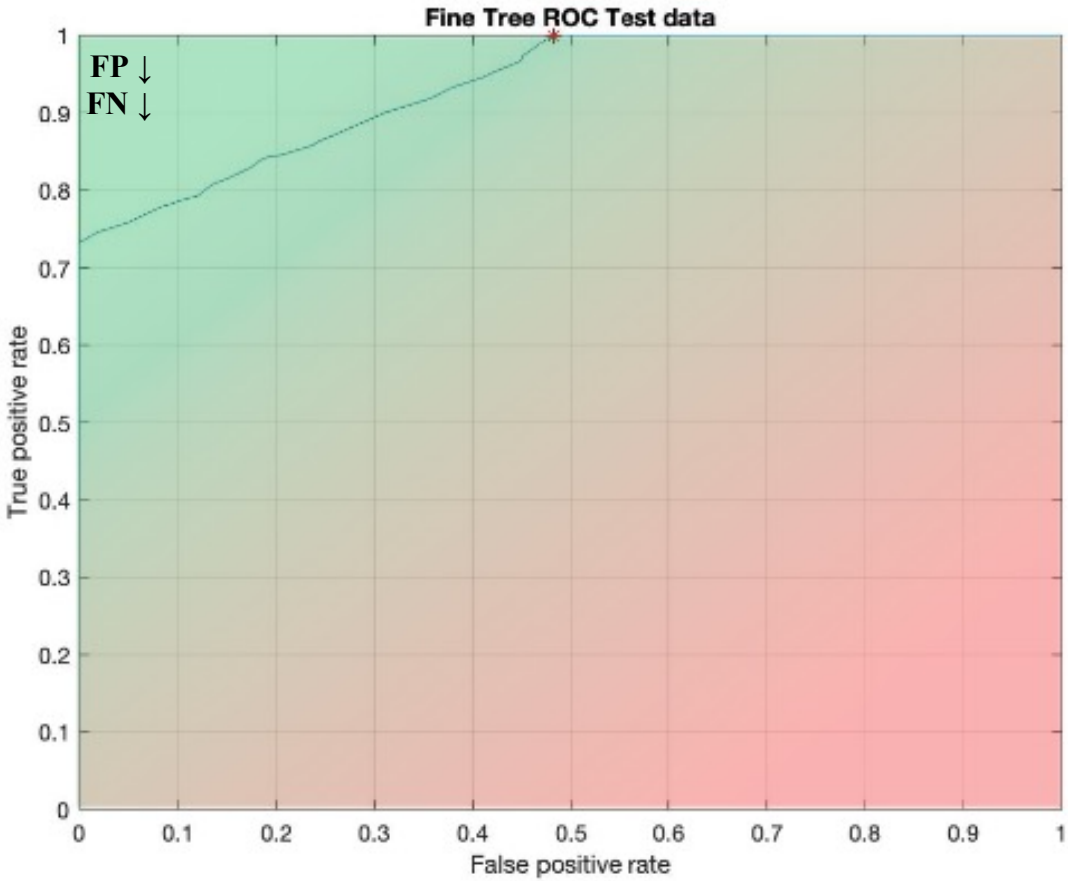
AIM: distinguish bronchitis vs pneumonia using easily recognised **symptoms and signs**, via AI

RESULTS:

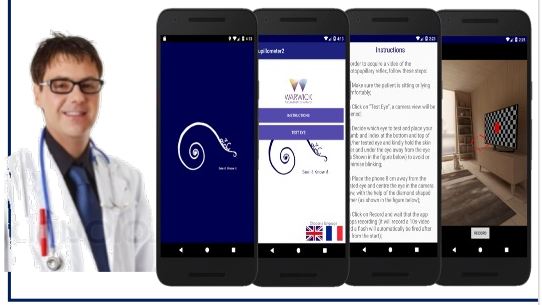
- 6 clinically relevant, easily interpreted symptoms were found to be best predictors of pneumonia.
- AI model with an AUC of 93%, sensitivity 80% and specificity 84%.

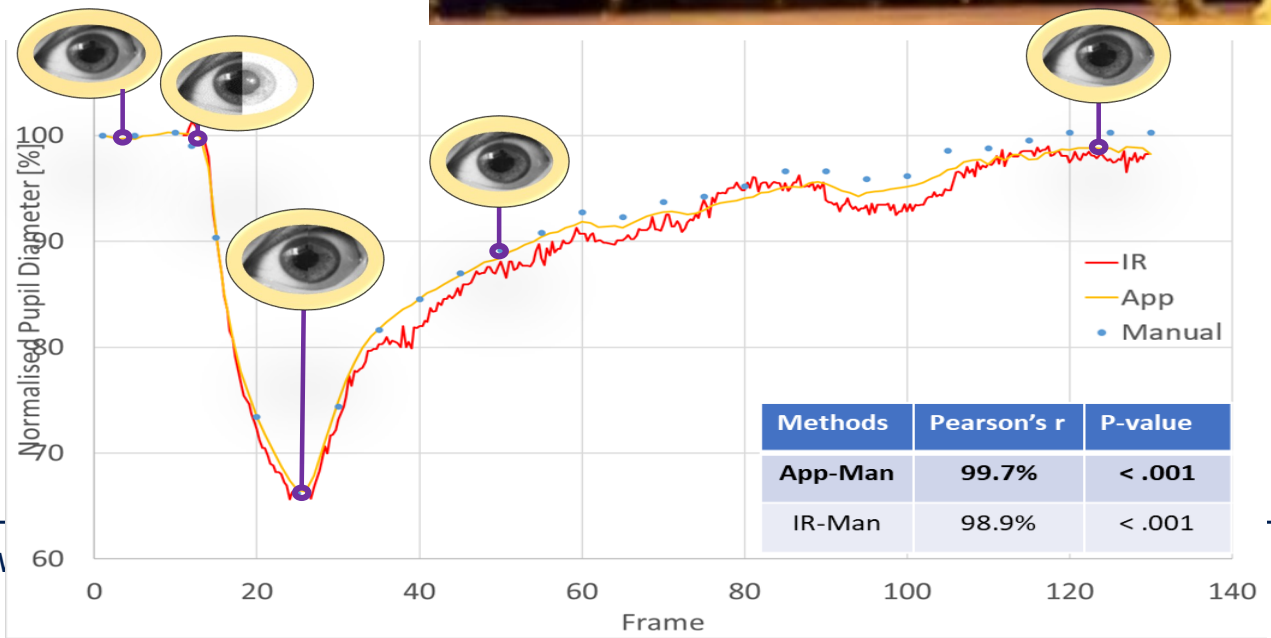
CONCLUSIONS:

- AI can support pneumonia referral in Africa, using symptoms and signs (i.e. no lab tests)



Challenge 2: shortage of (specialized) healthcare professionals, PUPILLARY REFLEX





Methods	Pearson's r	P-value
App-Man	99.7%	< .001
IR-Man	98.9%	< .001

Challenge 3: supply chain, OXYGEN CONCENTRATOR

A nurse from new-born unit noticed that the device was performing consistently (moving the control from 1 to 2, the output was not doubled as expected)

Pecchia, L., et al. "Health Technology Assessment and Biomedical Engineering: Global trends, gaps and opportunities." *Medical engineering & physics* 72 (2019): 19-26.

3D-printed activated charcoal inlet filters for oxygen concentrators: A circular economy approach, 2020, https://doi.org/10.1016/j.deveng.2022.100094

Challenge 3: supply chain, OXYGEN CONCENTRATOR

XR, CAD, 3D printing and DIY active coal, (wood and calcium chlorite)

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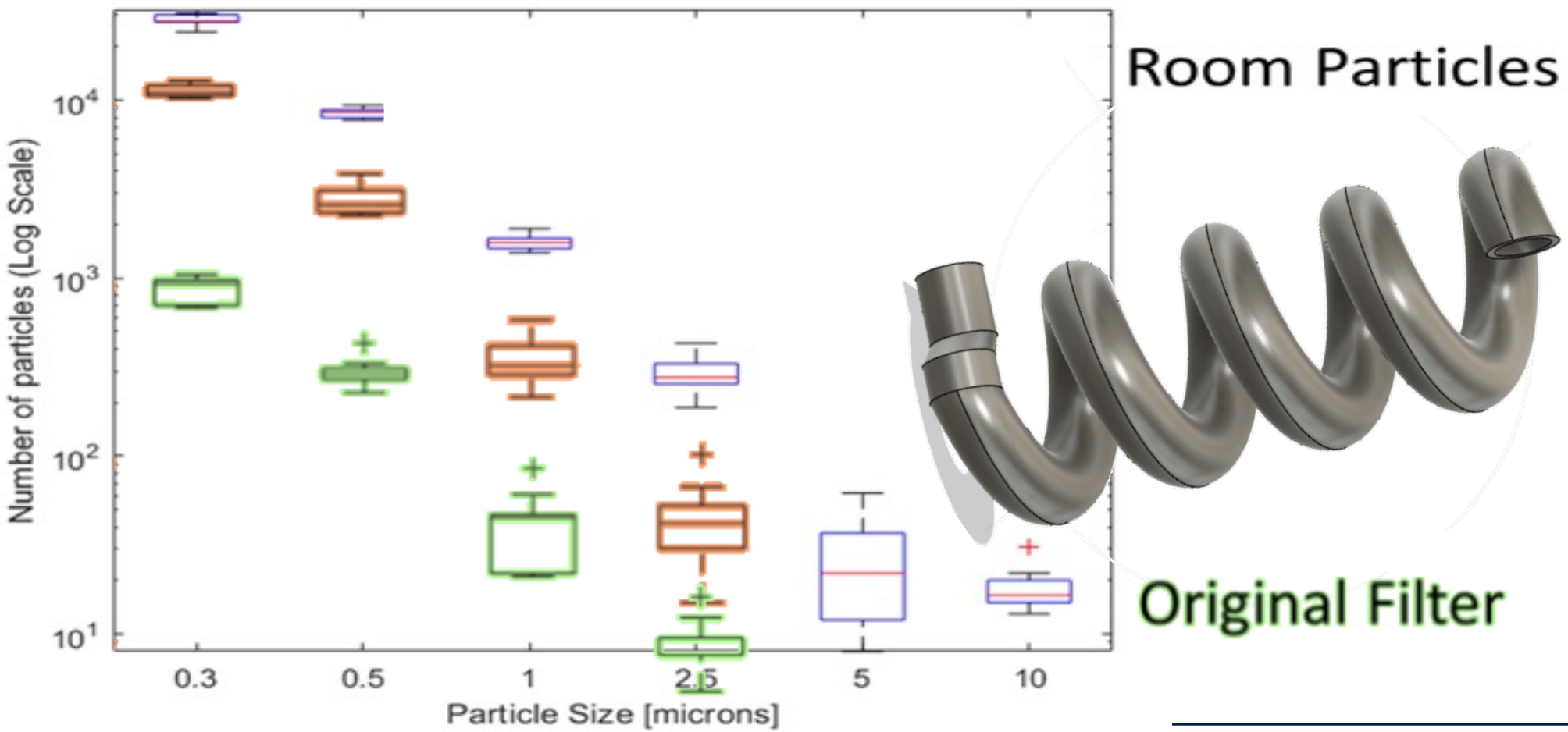
Challenge 3: supply chain, OXYGEN CONCENTRATOR



3D-printed activated charcoal inlet filters for oxygen concentrators: A circular economy approach, 2020, https://doi.org/10.1016/j.deveng.2022.100094

How the global community of BME is supporting Africa?

In the short term

- Evidence Based biomedical-engineering: factual evidence on medical settings & gap analyses
- Technology for compensating the shortage of specialised workers (HW and BMEs), e.g. AI
- Overcome supply chain bottleneck with environmental friendly manufacturing: circular economy, 3D printing, up-cycling, local-manufacturing.

In the long term

- Capacity ~~*building*~~ strengthening
- Support local high-quality research for inverting brain drain
- Dialogue with local/international authorities
- Bridge competent African Scholars and relevant policy makers
- Demonstrate the value of LMICs research and innovation for high-income countries

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9. A smartphone-based tool for screening **diabetic neuropathies**: a mHealth and 3D printing approach. Submitted to Biomedical Signal Processing and Control (Accepted)
10. **Personal protective equipment research and innovation in the context of the World Health Organization COVID-19** R&D Blueprint program. American Journal of Infection Control. 2022 Aug 1;50(8):839-43.Moon M, Pecchia L, Berumen AV, Baller A. Personal protective equipment research and innovation in the context of the World Health Organization COVID-19 R&D Blueprint program. American Journal of Infection Control. 2022 Aug 1;50(8):839-43.
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15. Biomedical engineering and **ethics**: reflections on medical devices and PPE during the first wave of COVID-19. BMC Medical Ethics. 2021 Dec;22(1):1-7