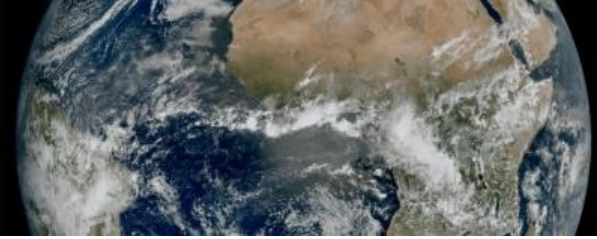
Global Health
Supply Chain Summit

ABSTRACT **86**
TRACK **6**
13 November 2024

LAGOS, NIGERIA ~ NOVEMBER 12-15 2024

# VALUE CHAIN INNOVATIONS FOR UNIVERSAL HEALTH COVERAGE



# Designing global vaccine stockpiles to achieve public health goals in Africa: Applied to cholera and ebola disease


Donovan Guttieres, Catherine Decouttere, Nico Vandaele

**Access-To-Medicines Research Centre**
**KU Leuven, Belgium**

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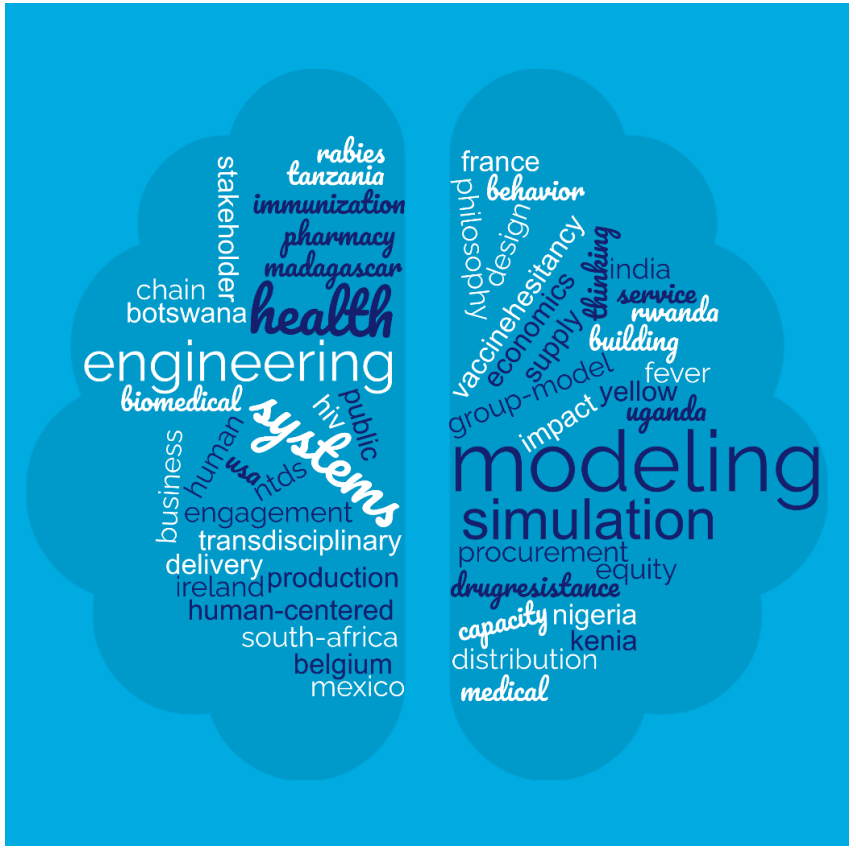
Faculty of Economics & Business
KU Leuven



**Funding support**:
Research Chair on
Pandemic Preparedness

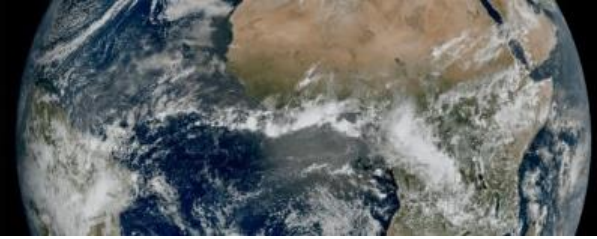
**Travel support**:
Research Foundation -
Flanders

# Access-To-Medicines Research Centre




**https://feb.kuleuven.be/atm**

# Outline



**Pathogens with epidemic potential**
- Priority lists
- Multi-dimensional risks
- Unhealthy vaccine markets

**Systems analysis of global vaccine stockpiles**
- Approach
- Drivers of behavior
- Case studies

**Dynamic understanding of market health**
- Conclusions
- Future work

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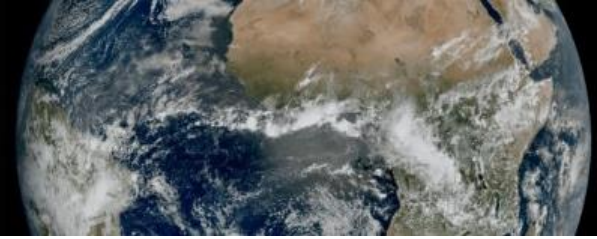

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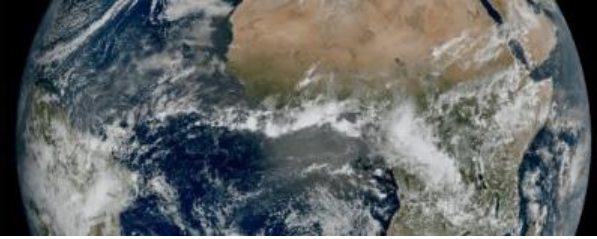
# Pathogens for which vaccines have been licensed continue to be a high priority for epidemic preparedness



**WHO only**

**Africa CDC only**

**Both WHO & Africa CDC**

**WHO pre-qualified vaccines**

## Comparing global and regional (Africa) priorities

| | |
|---|---|
| COVID-19 | 💉 |
| Crimean-Congo haemorrhagic fever | |
| Ebola Virus Disease | 💉 |
| Marburg Virus Disease | |
| Lassa fever | |
| MERS coronavirus & SARS | |
| Nipah and henipaviral diseases | |
| Rift Valley fever | |
| Zika | |
| Cholera | 💉 |
| Yellow fever | 💉 |
| Meningitis | 💉 |
| Measles | 💉 |
| Dengue fever | 💉 |
| Polio | 💉 |
| Rabies | 💉 |
| Mpox | 💉 |
| Chikungunya | |
| Disease X* | |

*WHO, 2023 & Africa CDC, 2024*

## Ranking regional preparedness and response priorities in Africa (2022)

| Disease | Risk score | Preparedness score |
|---|---|---|
| Ebola | 12.25 | 2.5 |
| Cholera | 10.50 | 2.3 |
| Covid-19 | 10.50 | 2.5 |
| Crimean-congo-haemorrhagic-fever | 9.00 | 1.5 |
| Yellow-Fever | 9.00 | 2.4 |
| unknown-agent | 9.00 | 1.3 |
| Marburg | 9.00 | 1.6 |
| Neisseria-Meningitis | 9.00 | 2.3 |
| Measles | 8.75 | 2.6 |
| Lassa-fever | 7.50 | 1.7 |
| Rift-valley-fever | 7.50 | 1.7 |
| Dengue-fever | 7.50 | 1.6 |
| Polio-virus | 7.50 | 2.4 |
| Rabies | 7.50 | 2.0 |
| Monkeypox | 6.25 | 1.6 |
| Anthrax | 6.25 | 1.6 |
| Plague | 6.25 | 1.4 |
| Chikungunya | 5.00 | 1.6 |

*Africa CDC, 2024*

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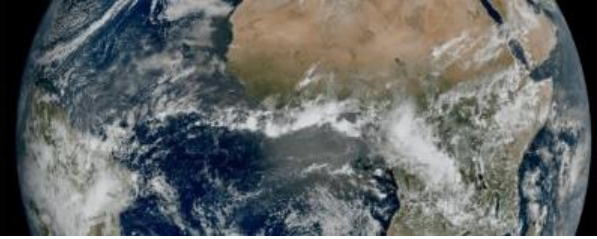
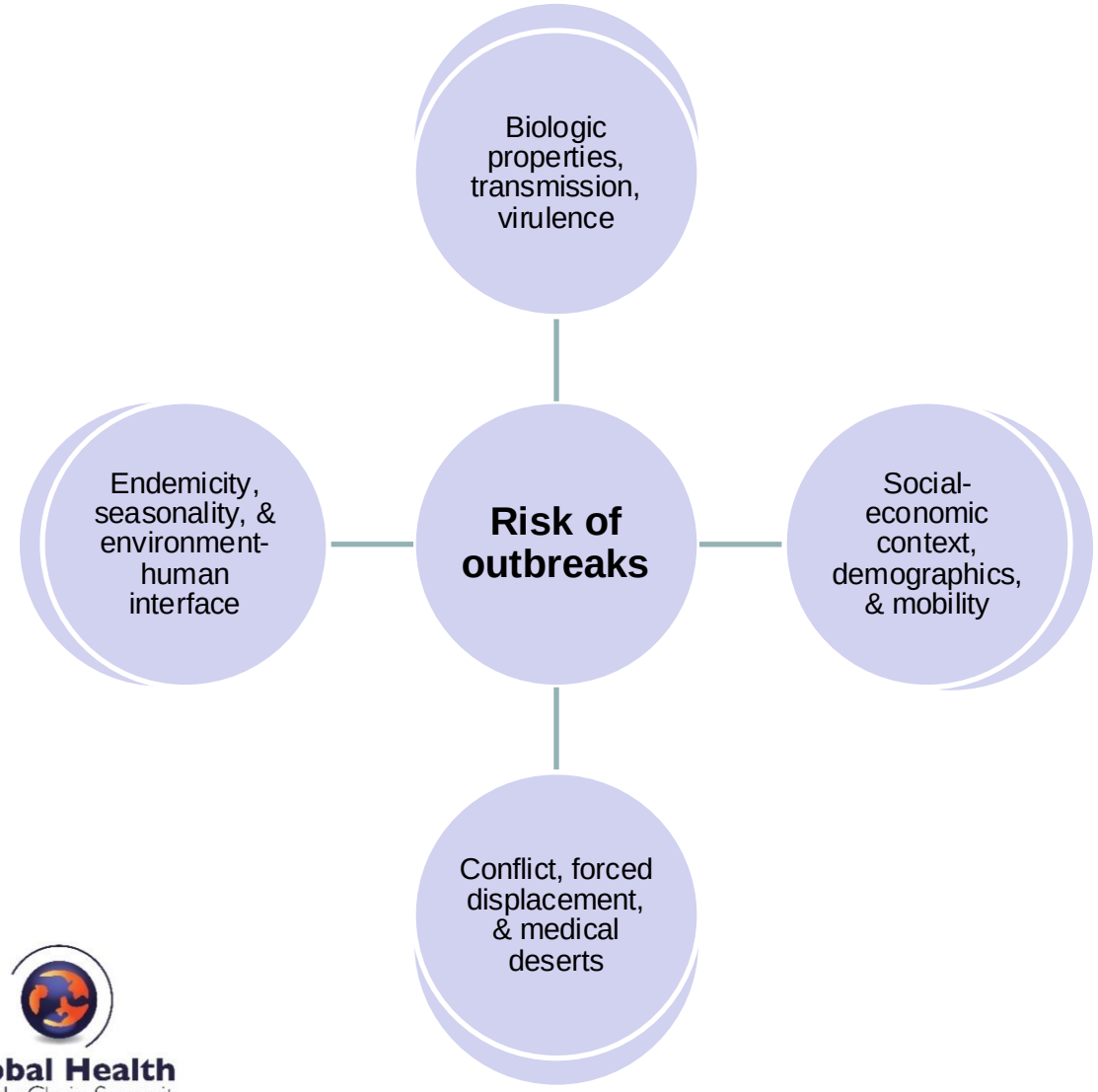
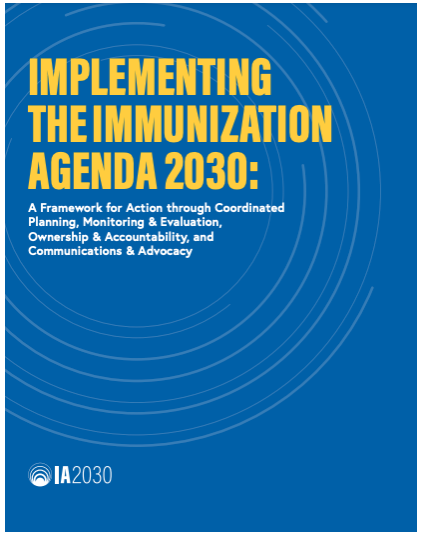
# Outbreaks are becoming more frequent and severe, especially in settings with multiple converging risks





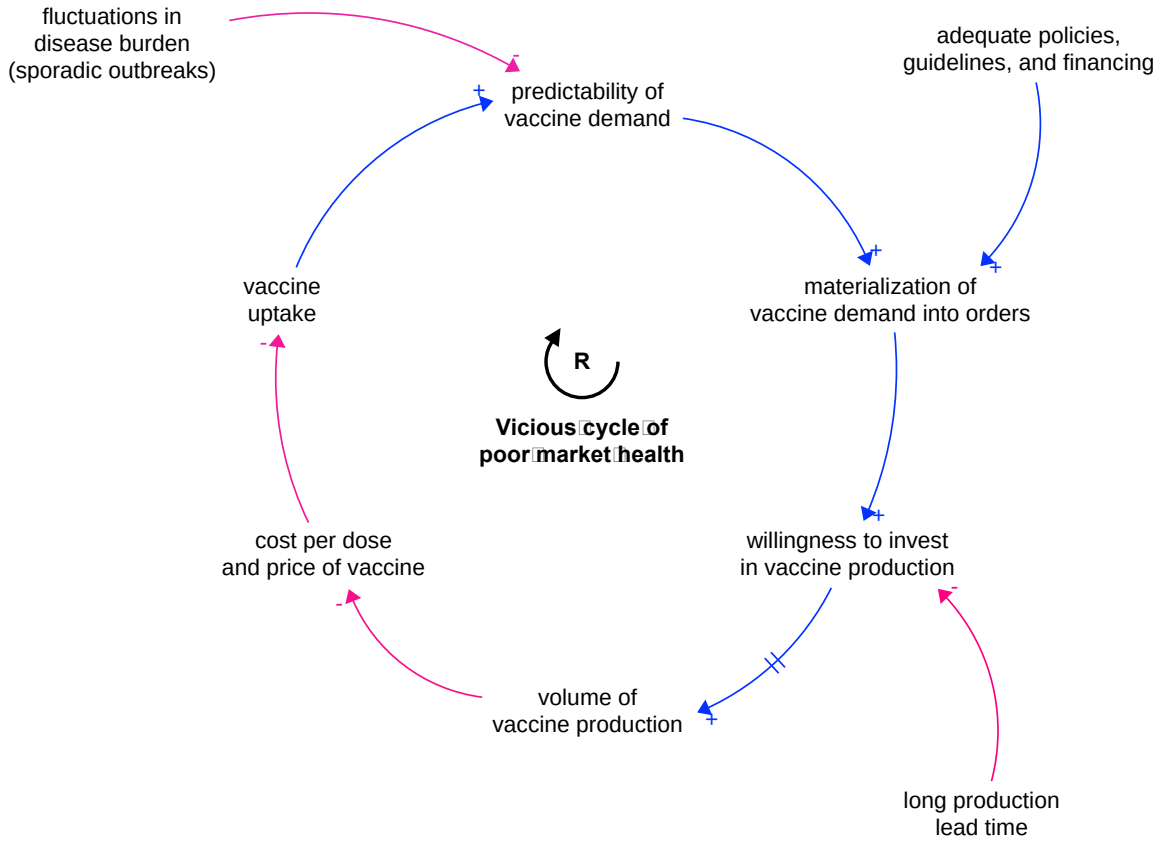

**Strengthening health systems for epidemic and pandemic preparedness**

- Surveillance & research
- National capacities
- Governance, coordination & financing
- Equitable supply of medical countermeasures




- Vaccines are cost-effective, preventing disruptions from outbreaks
- Vaccines available for ~20 life-threatening diseases (WHO, 2024)
- Success story: 150+ million lives saved in 50 years of routine immunization (GAVI, 2024)
- COVID-19: 20 million lives saved in the first year of use (Watson, 2022)
- **Extend benefits of vaccines to accelerate universal health coverage**

# Unhealthy vaccine markets lead to insufficient and delayed access




**Consequences of the vicious cycle:**

- Unclear *current* and *future* market needs
- Low market attractiveness (few suppliers)
- Limited geographic diversification of production
- Delayed and unmet demand

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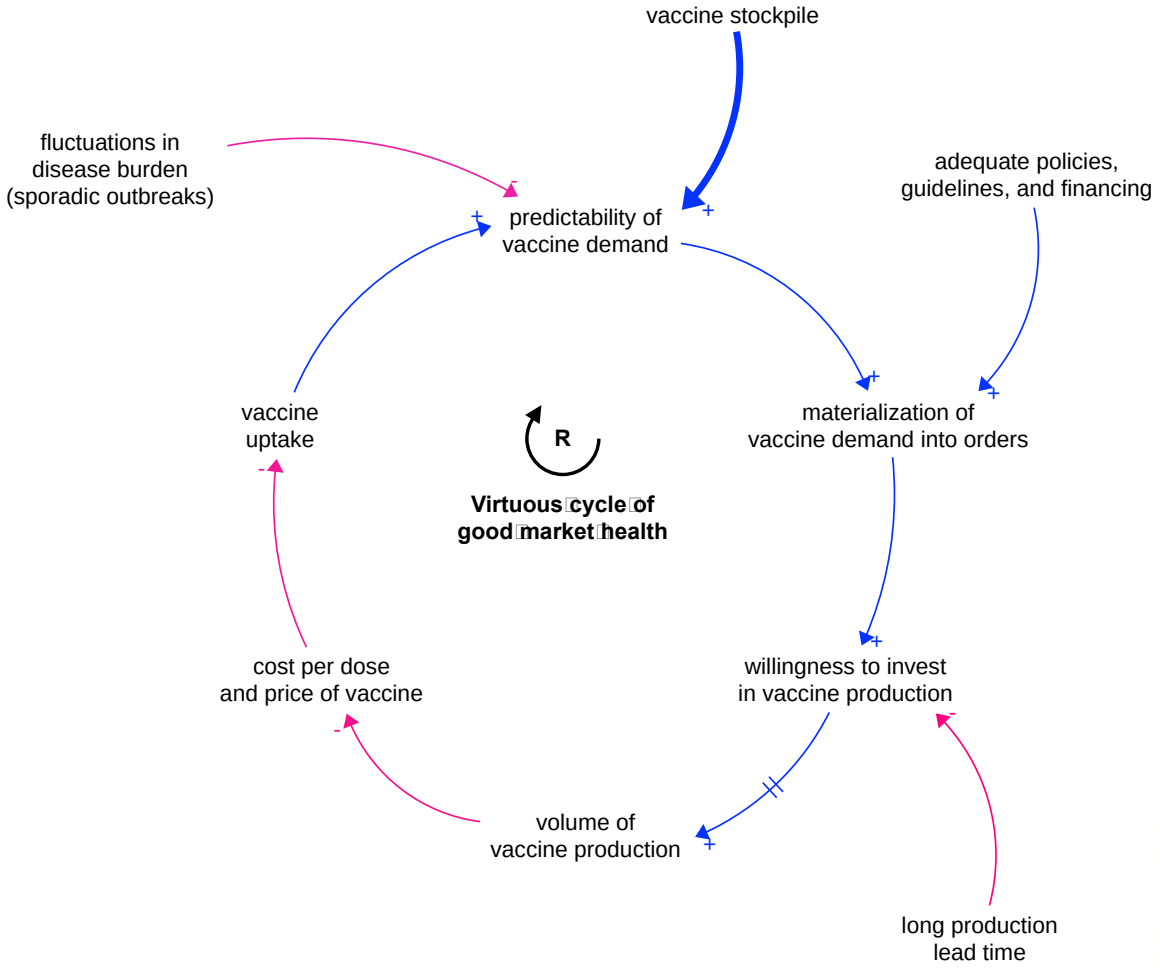


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**Emergency vaccine stockpiles**

- Managed by the International Coordinating Group on Vaccine Provision (WHO, UNICEF, IFRC, MSF)
- Meningitis (1997), Yellow Fever (2001), **Cholera** (2013), & **Ebola** (2021)
- For Cholera & Ebola, ~100% vaccines used are supplied from stockpiles

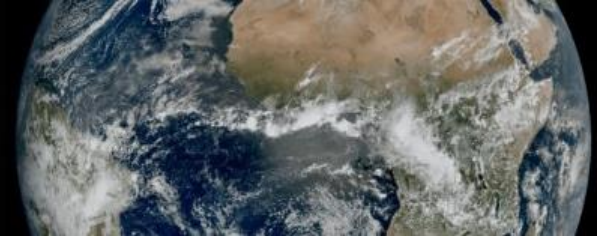

The ICG Ebola vaccine stockpile reached the goal of 500,000 doses in 2022 and, as of December 2023, holds 518,890 doses. In total, **208,390 (40%) doses from the current stockpile are scheduled to expire in 2024**. Apr 25, 2024

National Institutes of Health (NIH) (.gov)
https://pmc.ncbi.nlm.nih.gov › articles › PMC11065462

Use of Ebola Vaccines — Worldwide, 2021–2023 - PMC

***Turning a vicious cycle into a virtuous cycle: increased supply, lower cost, & more equitable access***

# Outline



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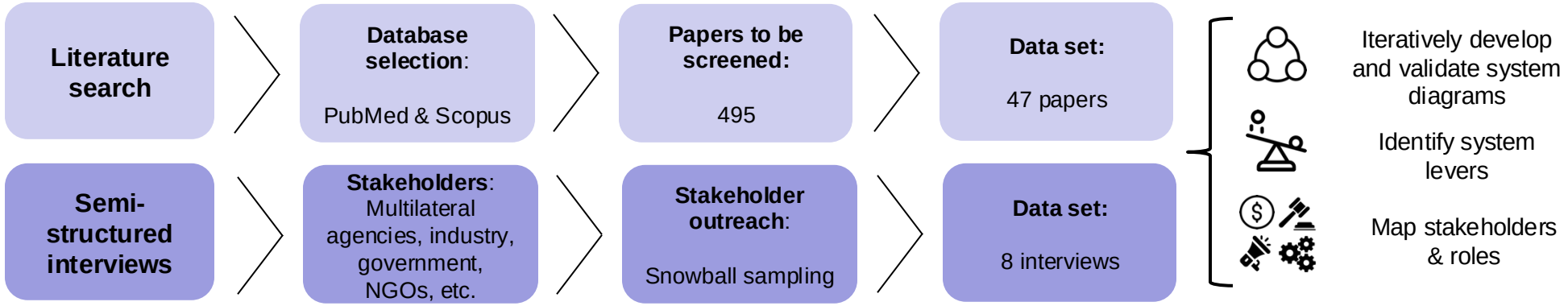
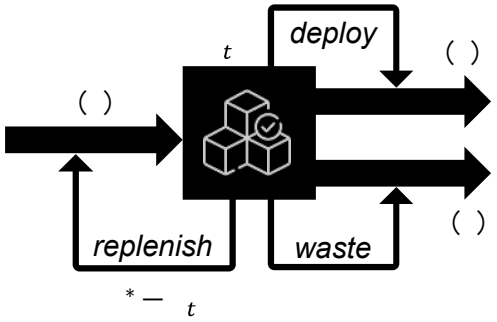
# Vaccine stockpiles serve as buffer mechanisms to overcome demand uncertainty

**Project goal**: Identify the underlying drivers of stockpile dynamics to inform their design

## Methodology:




**Considerations**:

- Stockpile decisions depend on numerous, interacting processes and stakeholders
- Perishable inventory with intermittent demand
- Difficult to assess value – relative costs and benefits – over long time horizons

# Growing unmet demand for oral cholera vaccines as outbreaks surge

Cholera now threatens 1bn people. It's time to finish what we began in the 19th century

*Hakainde Hichilema and Tedros Adhanom Ghebreyesus*

News

**Cholera: WHO rations vaccines to preserve stocks amid rising outbreaks**

*BMJ* 2022 ; 379 doi: https://doi.org/10.1136/bmj.o2528 (Published 21 October 2022)
Cite this as: *BMJ* 2022;379:o2528

NEWS · Volume 5, Issue 7, P632, July 2024 · *Open Access*

New measures to tackle the global cholera surge

Priya Venkatesan

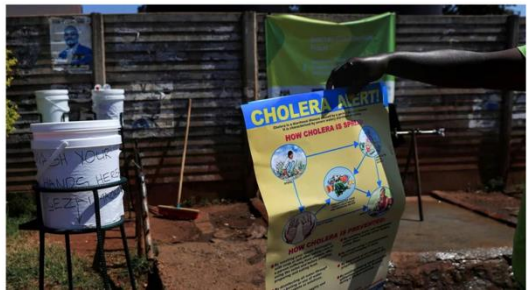
WORLD REPORT · Volume 403, Issue 10430, P891-892, March 09, 2024

The great cholera vaccine shortage

Talha Burki

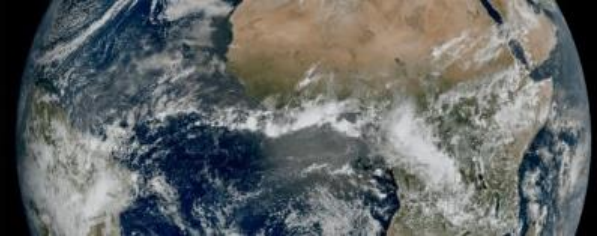
Cholera vaccine stocks 'empty' as cases surge

By Jennifer Rigby and Gloria Dickie
February 14, 2024 9:11 PM GMT+1 · Updated 8 days ago




***"Conflict, poverty, the climate crisis and global socioeconomic inequities** are all underlying reasons why outbreaks tend to be larger and deadlier..."*
**– WHO, DG, 2024**

# Complexity emerges from asynchronous supply and demand dynamics, with competing feedback mechanisms



**Replenishment dynamics:**

**Aim**: reduce the stockpile gap

Core dynamics ***r(t)***
- Number of suppliers
- Capacity allocation
- Scaling-up capacity
- Adjusting target stockpile level based on disease threat

Related mechanisms
- Programmatic funding
- Anticipating demand (forecasts)

**Deployment dynamics:**

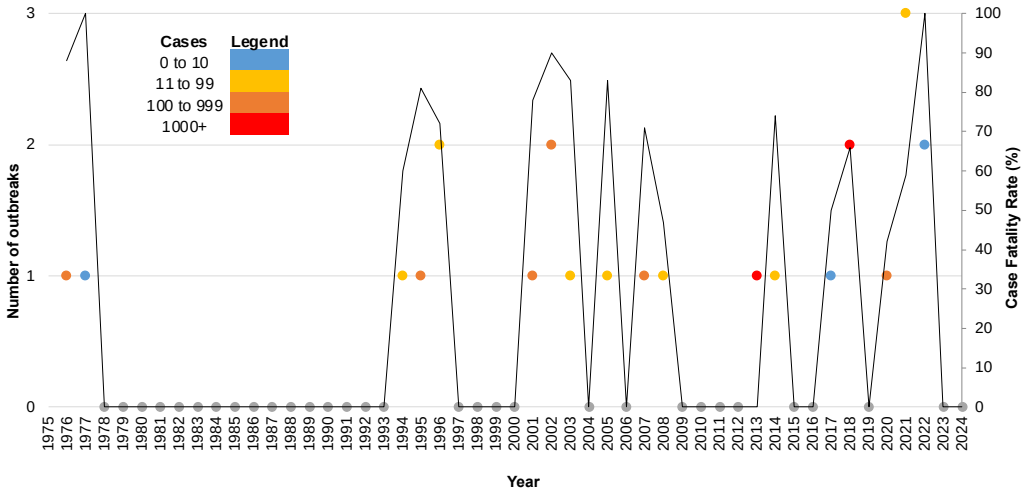
**Aim**: improve health outcomes

Core dynamics ***dt)***
- Surveillance and non-pharmaceutical interventions
- Current and future disease risks
- Vaccination strategy and vaccine-induced immunity
- Health system capacity
- Community perceptions

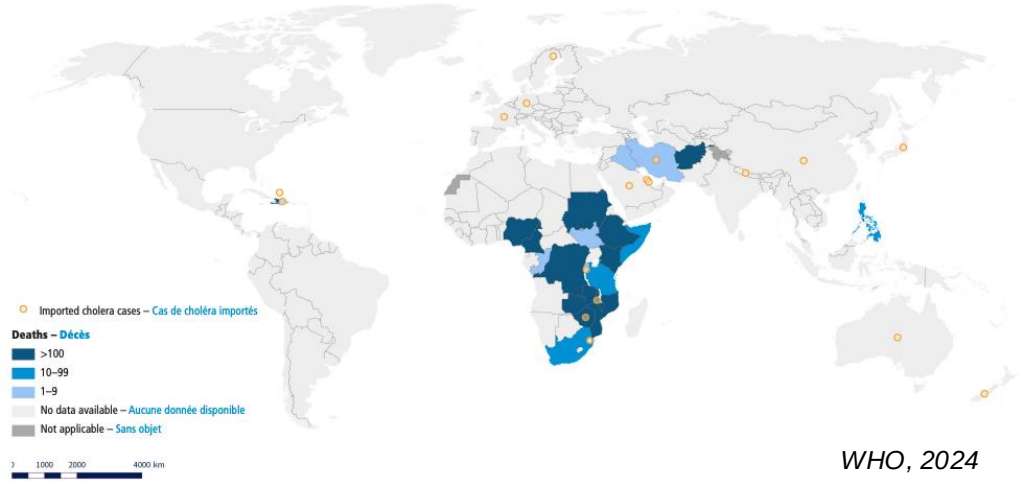
Related mechanisms
- Growing evidence on vaccine effectiveness
- Political and financial support

# Managing priority pathogens: contrasting examples of Cholera & Ebola

## New outbreaks & corresponding CFR, Ebola Virus - Zaire (1976-2024)



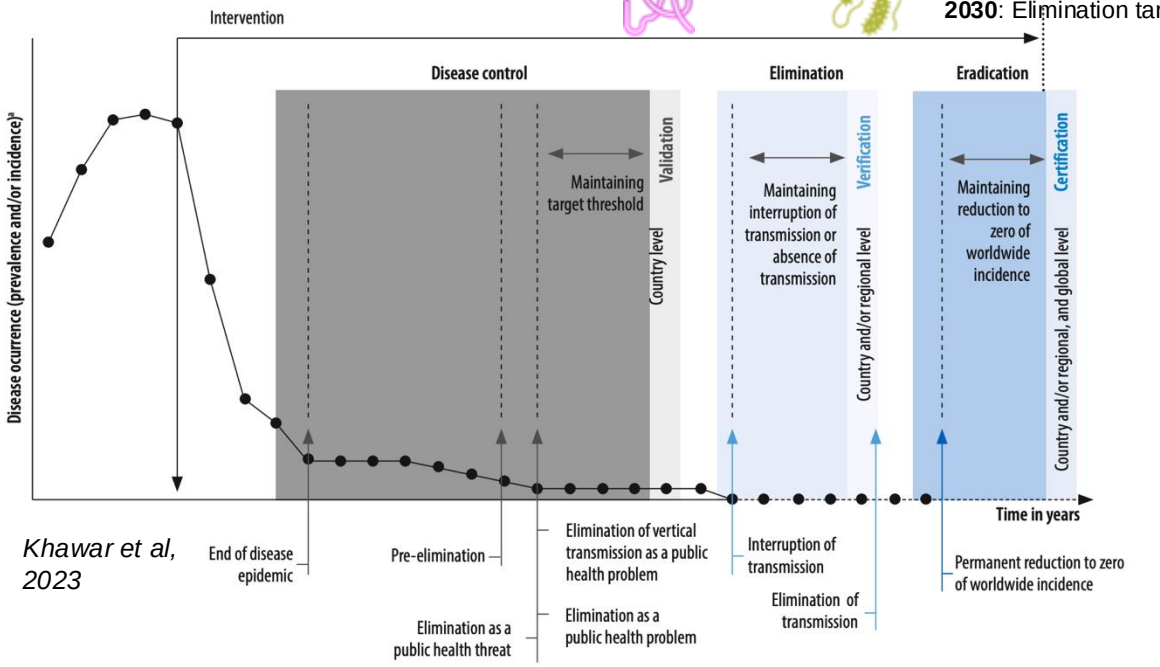

## Countries reporting cholera deaths (2023)




*WHO, 2024*

## Policy aim for disease management

**2017**: Roadmap launched
**2030**: Elimination target



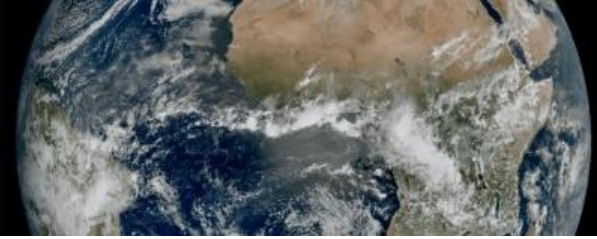

*Khawar et al, 2023*

## Vaccination strategy: global (SAGE) & national

**Reactive Immunization** (e.g., contact tracing & ring-based)

**Proactive Immunization** (e.g., annual birth cohorts)

# Outline



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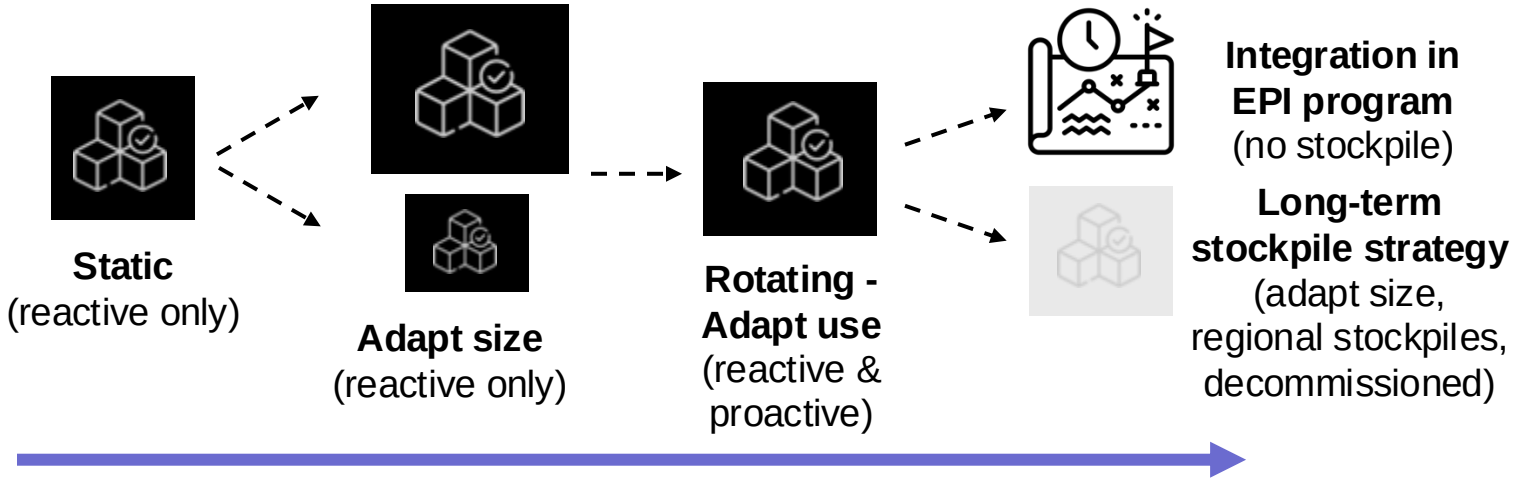
# Dynamic stockpile behavior promotes continuous learning and system re-design

## Stockpile performance serves as an indicator of market health

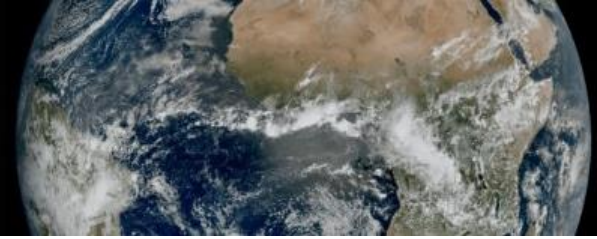
- Chronic stock-outs ~ scarcity of vaccine supply
- Chronic wastage ~ low visibility on vaccine demand, limited uptake
- Delayed order fulfillment ~ logistical, regulatory, and structural hurdles
- Capture how disease burden, vaccine demand, and supply evolve with time

## The role of stockpiles adapts to meet shifting public health goals




*Increasingly ambitious disease management strategy driven by policy aims*
*(relative value is **disease** and **vaccine** dependent)*

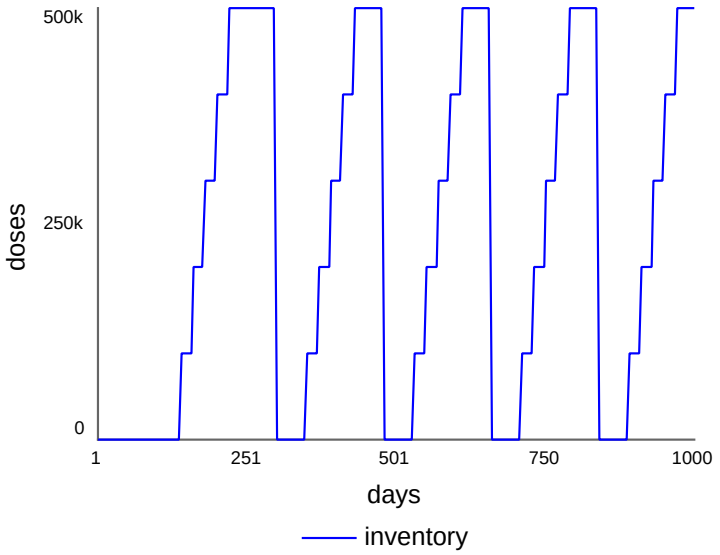
# Systems analysis provides a foundation for quantitative modeling and simulations

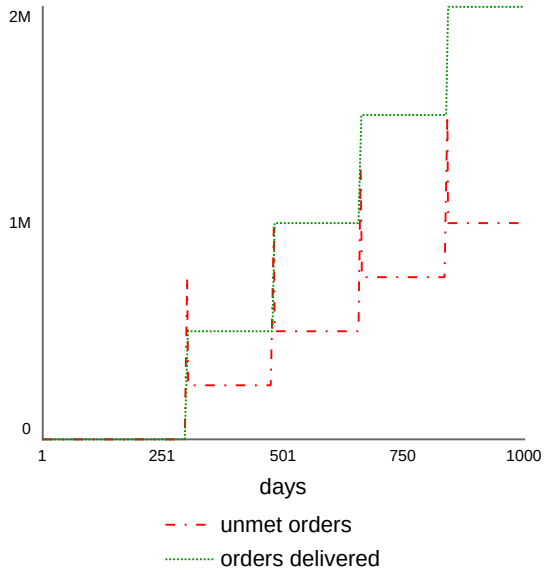


**There is a need for models that better integrate vaccine supply and demand dynamics**

- Requires active and frequent engagement stakeholders across disciplines/sectors
- Builds on deep understanding of historical behavior for model validation
- Allows users to define and explore relevant scenarios and interventions

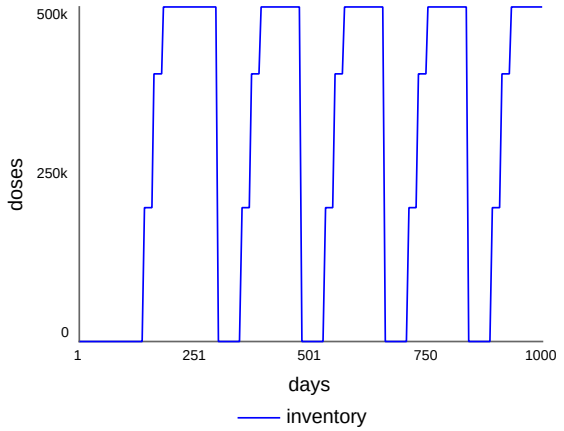
**Baseline: assuming 500k stockpile, with a demand of 750k doses every 6 months**



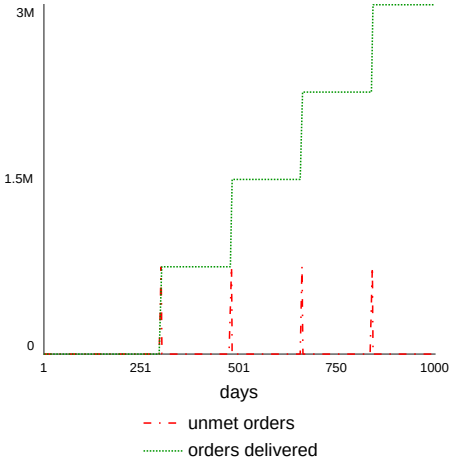

**Leverage point:** reducing replenishment time

*Increasing production capacity*

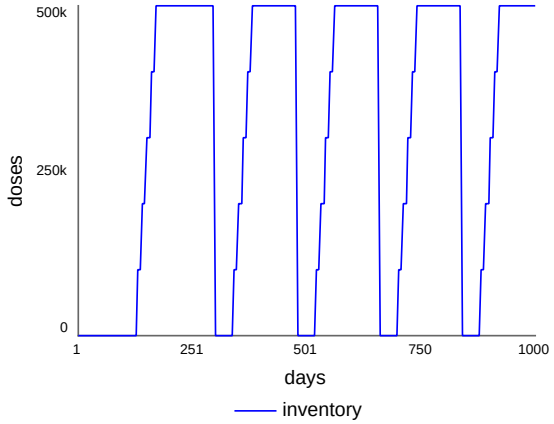



**Leverage point:** increasing buffer capacity

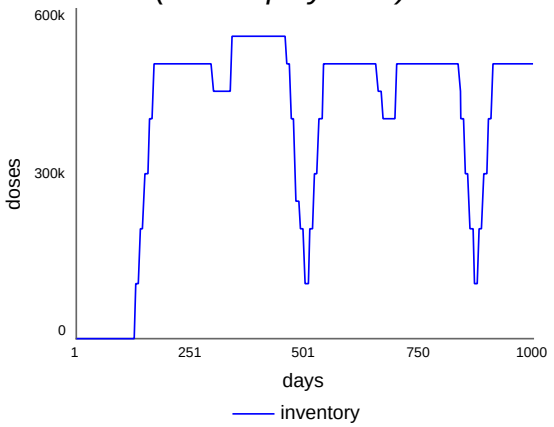
*Increasing stockpile size*



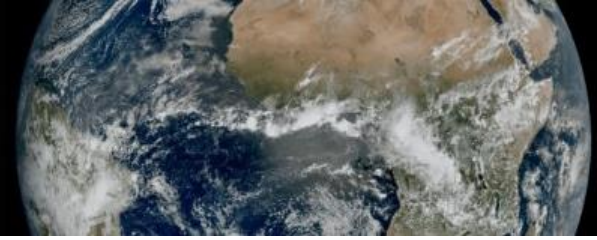

*Reducing process time (product innovation)*




*Prioritizing orders (limit deployment)*



# Q&A



| | | |
|---|---|---|
| | **1:45–3:45 pm**<br>*Live French translation is available. Un interpète est disponible..* | **Friday 15, Nov 2024** |
| **WORKSHOP: Systems Thinking – applied to Mpox and other public health emergencies**<br><br>Location:<br>Meeting Room 1 | Background: This workshop invites participants to apply various systems thinking tools to outbreak response and preparedness in Africa. In particular, the workshop focuses on Mpox (which has spread to 15+ African countries in 2024) and other priority pathogens with epidemic potential, including Ebola and Marburg. Sporadic outbreaks present a unique challenge for supply chains, as they are inherently difficult to anticipate and plan for. Furthermore, they lead to wide-ranging disruptions, including to routine health services. Systems thinking tools are particularly useful to identify the root-cause(s) of behavior and unintended consequences of interventions. The participatory nature of this workshop, bringing numerous stakeholders together, will be an opportunity to share insights and broaden perspectives.<br><br>Workshop objectives:<br><br>• To collectively build systems diagrams that reveal factors driving the behavior (e.g., disease epidemiology, delayed access to countermeasures) observed in the ongoing Mpox outbreak<br>• To identify leverage points and interventions that can lead to system change in both the short-term (outbreak control) and long-term (prevention)<br>• To apply system archetypes to the management of sporadic outbreaks and foresight thinking to imagine the impact of Africa's New Public Health Order<br>• To foster collaboration and shared understanding among stakeholders<br><br>**Session by: Access-To-Medicines (ATM) Research Centre, KU Leuven** | |