Delivering vaccines for emerging infectious diseases: Harnessing the power of innovative partnerships

Mark Feinberg, MD, PhD

NASEM Forum on Microbial Threats

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Delivering vaccines for emerging infectious diseases: Harnessing the power of innovative partnerships

Convenes at an **extraordinary time**, when the COVID-19 pandemic has

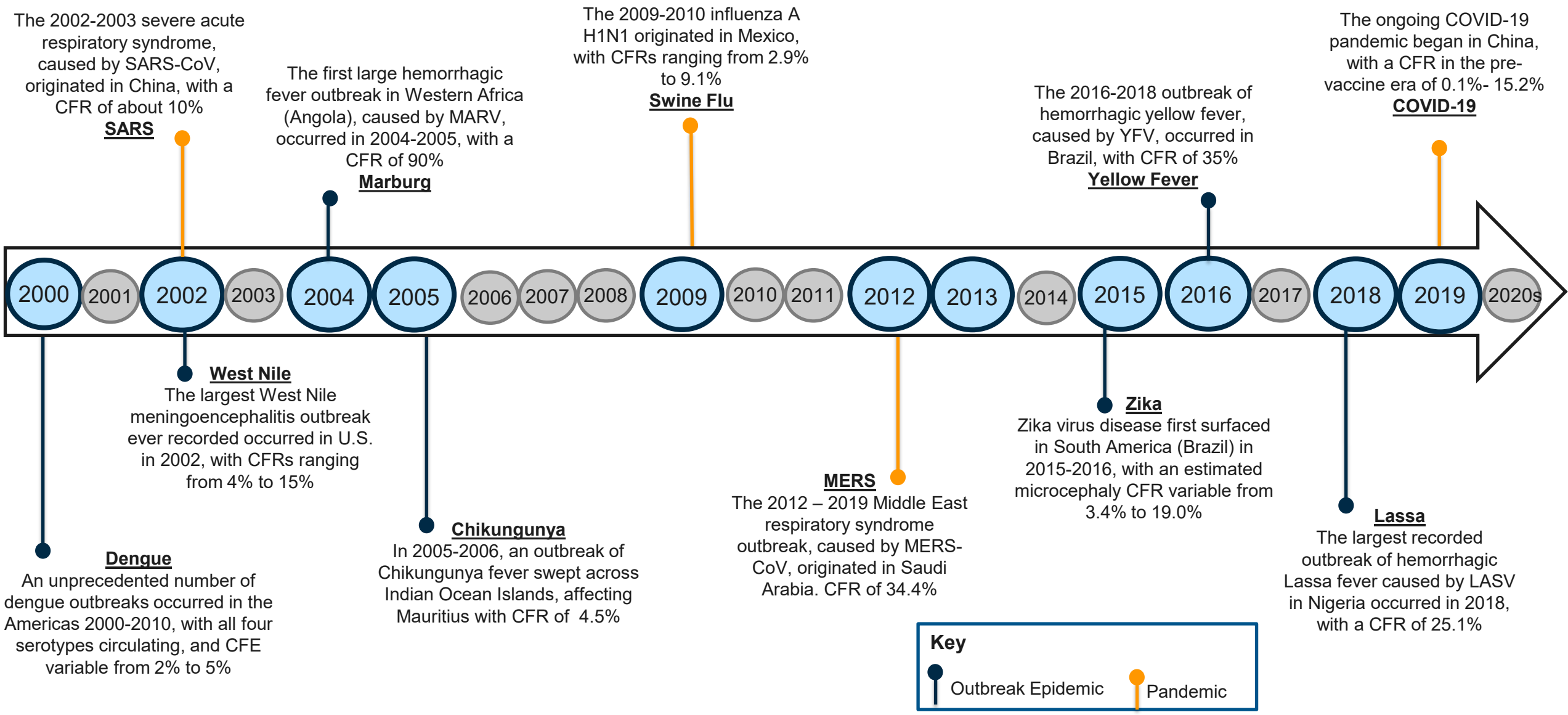
- Generated tremendous attention to **global health and vaccine innovation**
- Vividly reinforced the need to ensure **prompt, equitable and affordable access**
- Demonstrated that **nationalism and misinformation are continuing threats**
- Expanded and reshaped the **R&D environment, including the potential of novel partnership models**
- Highlighted needs and opportunities for **alignment in global health agendas**
- Requires that we proactively prepare, via both scientific innovation and creation of new models of multisector collaboration, to address **future emerging infectious disease threats**

"Who would have predicted that the end of the last millennium would see the emergence of new pathogens and epidemics, when the medical world thought it had it all under control—at least in the wealthier part of the world? …The story of new viruses is also not over, and it is safe to predict that more pathogens will emerge and affect us in always faster and more global ways."

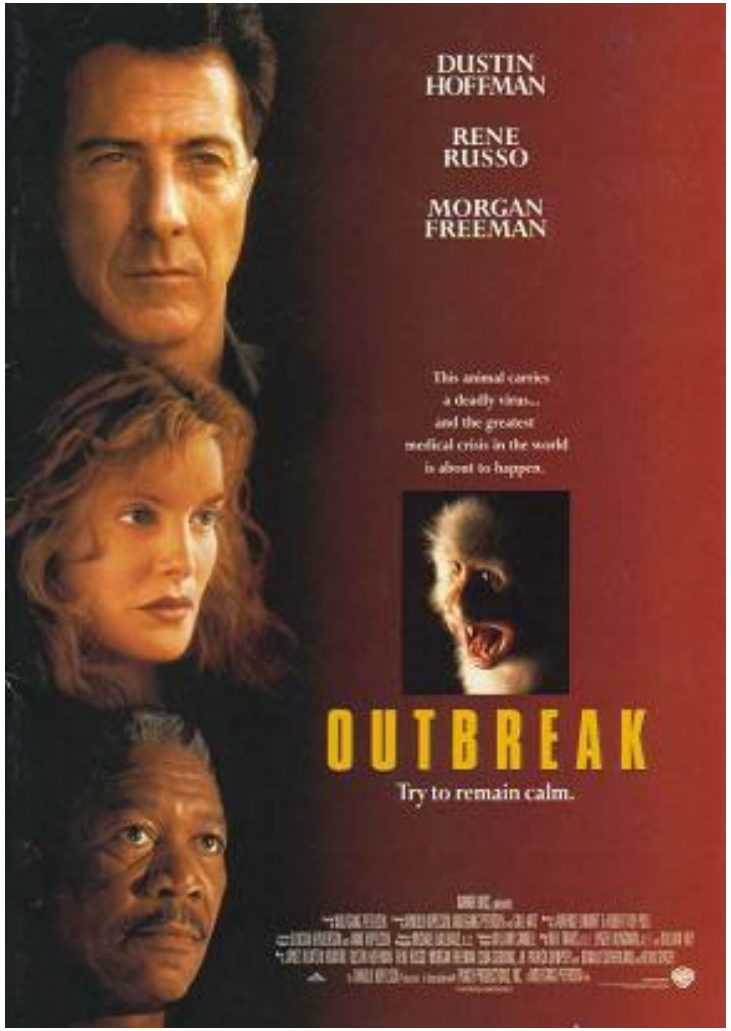
--Peter Piot*

**No Time to Lose: A Life in Pursuit of Deadly Viruses, 2012*

Outbreaks and pandemics over the last 20 years



Popular depictions of the pace and process of vaccine development targeting emerging pathogens



Challenges of developing products for global health threats

Small Markets

The prevailing business model prioritizes vaccine candidates with consistent, large markets

Scientific Complexity

The scientific complexity of targets may also require further investment in novel approaches to demonstrate safety and effectiveness.

Limited / Inconsistent Resourcing

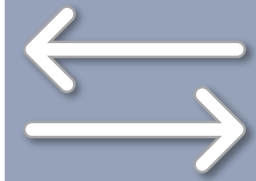
Vaccines compete with other pharmaceutical products for limited development resources. Resource are often correlated with global attention and imminent danger of the threat.

Investment Risk

Uncertainty of the public health priority and demand for some targets may be unclear, which increases the uncertainty of the potential return on investment for industry.

Nationalism

COVID-19 has shown that global vaccine access is impeded by high-income country priorities to vaccinate their own populations.



Reactive Vaccine Research

To date, vaccine research efforts for EIDs have been spurred by outbreaks and little, if any, focus has been on Disease X planning.

Source: https://www.hhs.gov/sites/default/files/encouraging_vaccine_innovation_2018_final_report.pdf

The critical importance of alignment and integration in vaccine development (an “end-to-end” view)

- Successful vaccine development depends on a highly iterative, integrated system predicated on a bi-directional flow of information (an “end-to-end view”).
- Successful product development and implementation is hard enough when pursued within a single company, and when well-defined accountability, tracking and incentive models are in place.
- Successfully defining and reaching the desired “end” is even harder when it involves contributions and hand-offs between different public and private partners (who each have different capacities, resources, constraints, levels of experience in product development, risk profiles and incentives).
- ***No one sector or organization can address these challenges by themselves. Our collective success will depend upon the extent to which we can develop effective new partnership models and mobilize requisite investments to prepare and respond effectively.***

“The only real expertise in the world to make these vaccines in a quantity and a safety environment is in the private sector. If the private sector isn’t fully engaged and involved, it’s a show stopper.”

- Michael Osterholm, Director, Center for Infectious Diseases Research and Policy

The case for change and innovation in product development partnership models

- Traditional grant and donor funding mechanisms are ill-suited to support end-to-end product development programs where a multitude of diverse, but integrated, activities must be accomplished and investments made *well in advance and at-risk*

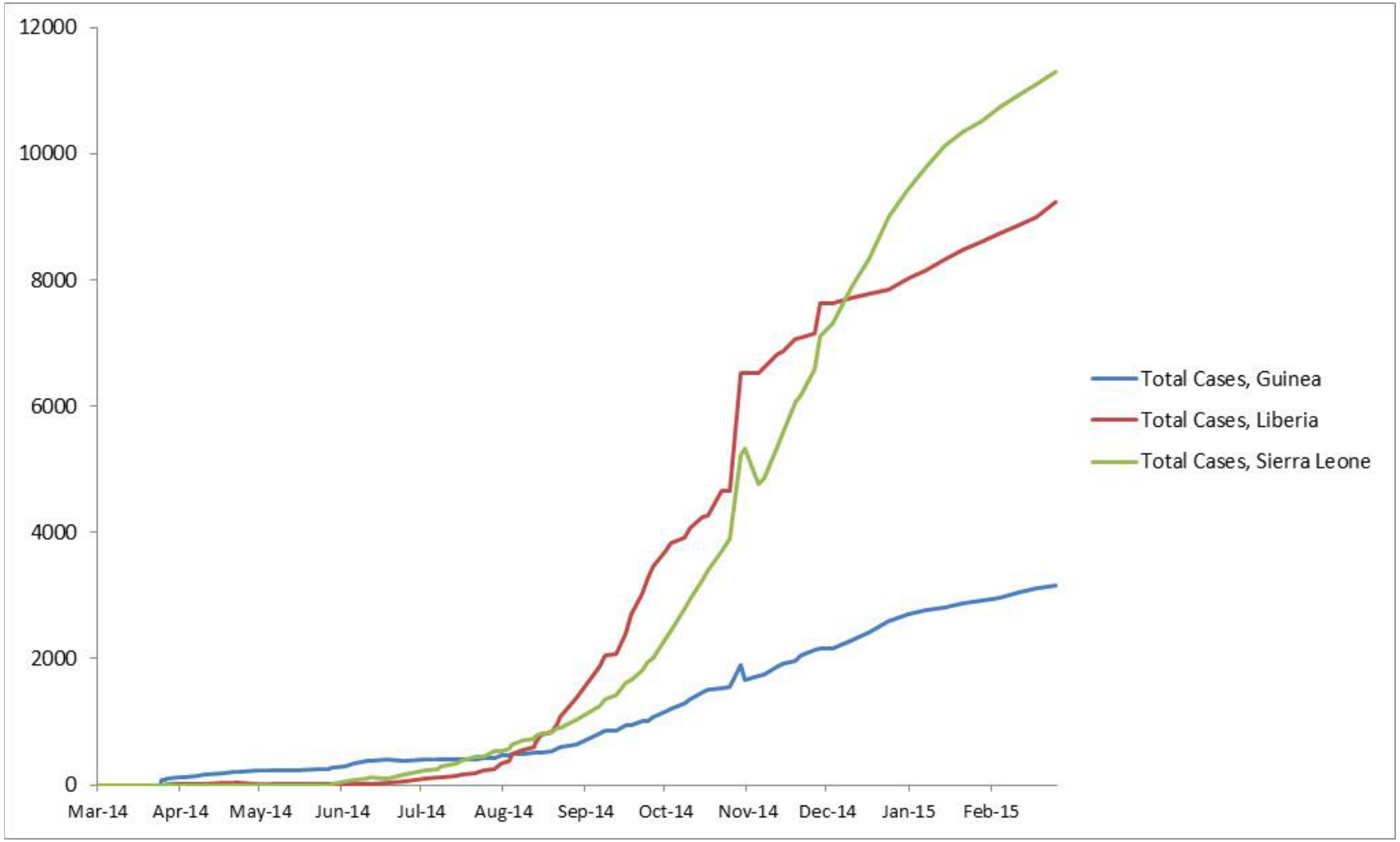
- Lack of alignment between public and private sector stakeholders, along with their distinctive priorities, impedes execution of the most efficient and effective programs to deliver global health innovations whose product profiles, price points, sustainable/scalable supply solutions can deliver the greatest public health impact

- Private sector concerns about distraction from core programs and opportunity costs constrain their willingness to engage in R&D programs targeting diseases that disproportionately impact low income countries…and this challenge may be increasing of recent

In an ideal world, a new model(s) can be defined and implemented that leverages the most valuable contributions of each sector and from all partners to deliver products optimized for maximal, predictable and sustainable impact. Moving forward, success will depend on both scientific innovation and partnership model innovation.

Ebola Zaire virus outbreak in West Africa (2014-2016)

Total suspected, probable and confirmed cases of Ebola virus disease in Guinea, Liberia and Sierra Leone, March 25, 2014- February 22, 2015



WHO Situation Report, 02/22/15

Enablers of Merck's Decision to Engage in Ebola Vaccine Development

- Appreciation of public health imperative and opportunity for Merck to contribute in a valuable, and in some ways unique, manner to the accelerate development of a promising vaccine candidate

- Highly promising preclinical data supporting the rVSV-ZEBOV candidate and the availability of clinical supply to promptly initiate and expedite clinical evaluation

- Recognition and ready acceptance of the fact that Ebola vaccine development is not an attractive commercial opportunity

- Expectation that vaccine development efforts would be advanced in collaboration with public sector partners to pool expertise, to share costs and risks, and to manage uncertainties

- Stated commitment of donor/funding organizations (eg, GAVI, UNICEF) to procure and deliver an Ebola vaccine should it prove efficacious and safe

Partnerships and Alliances to Develop V920 (Ervebo)

Public Health Agency of Canada

Public Health Agency of Canada (PHAC)

NewLink Genetics (Bio-Protection Systems Corporation)

I

Phase I studies

WHO Clinical Consortium/ Wellcome Trust

Switzerland: University Hospitals of Geneva

Germany: University Medical Center Hamburg/Clinical Trial Center North

Gabon: Centre de Recherches Medicales de Lambarene/University of Tuebingen

Kenya: Kenya Medical Research Institute Marburg Laboratory

- **CCV** – Halifax, Canada
- US Department of Defense (**WRAIR**, JVAP, USAMRIID, DTRA)
- **NIAID/NIH**
- **NewLink Genetics**
- BARDA

II/III

Phase II/III studies

Liberia (PREVAIL): Liberia – NIH Partnership (NIAID)

Sierra Leone (STRIVE): CDC/Sierra Leone Medical School/BARDA

Guinea (Ebola ça suffit): WHO/Norwegian Institute of Public Health/MSF/HealthCanada

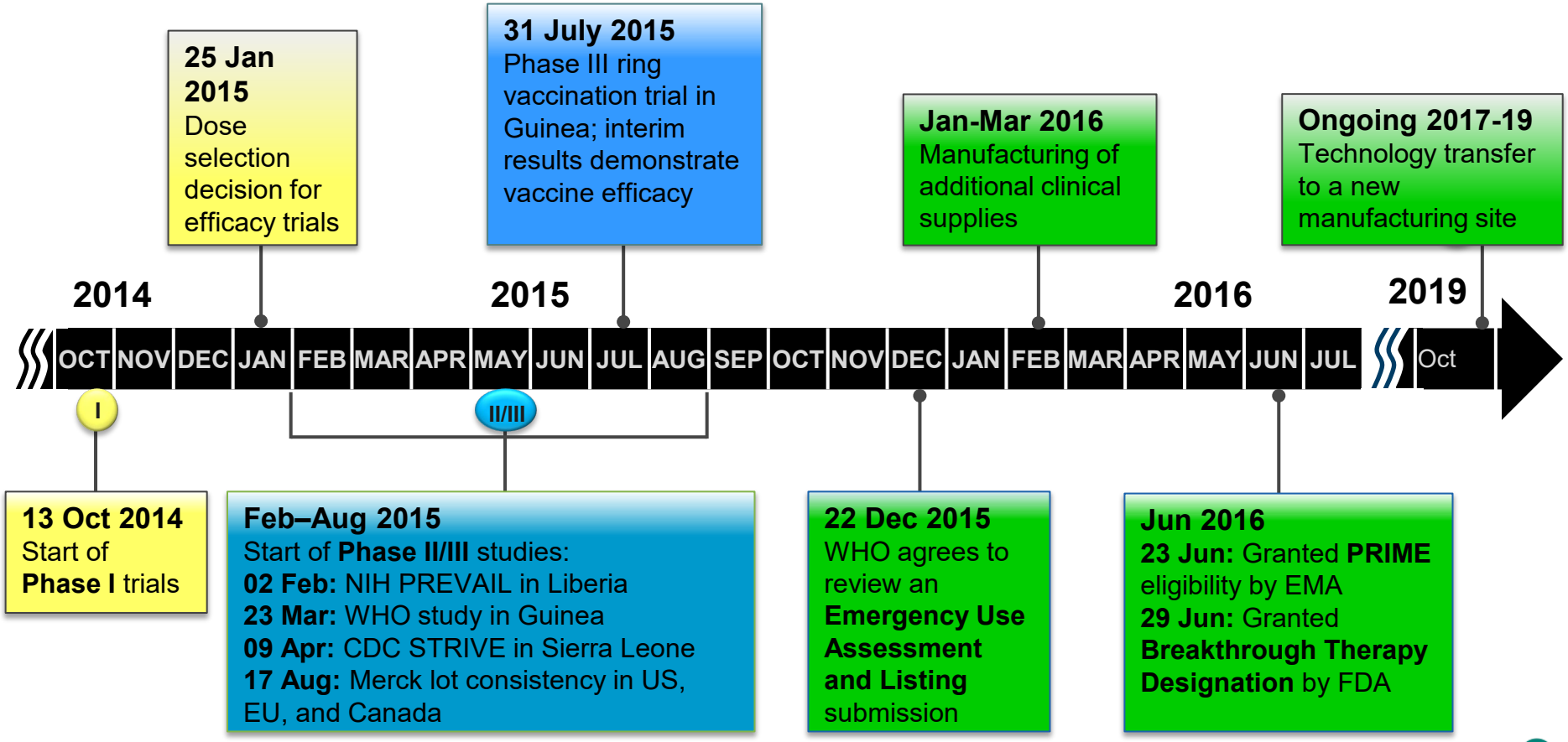
US/Canada/Spain (V920-012): Merck/BARDA

Additional funding and support: US Department of Health and Human Services (BARDA)

US Department of Defense (DTRA, JVAP)

Vaccine Milestones: 2014-mid 2019

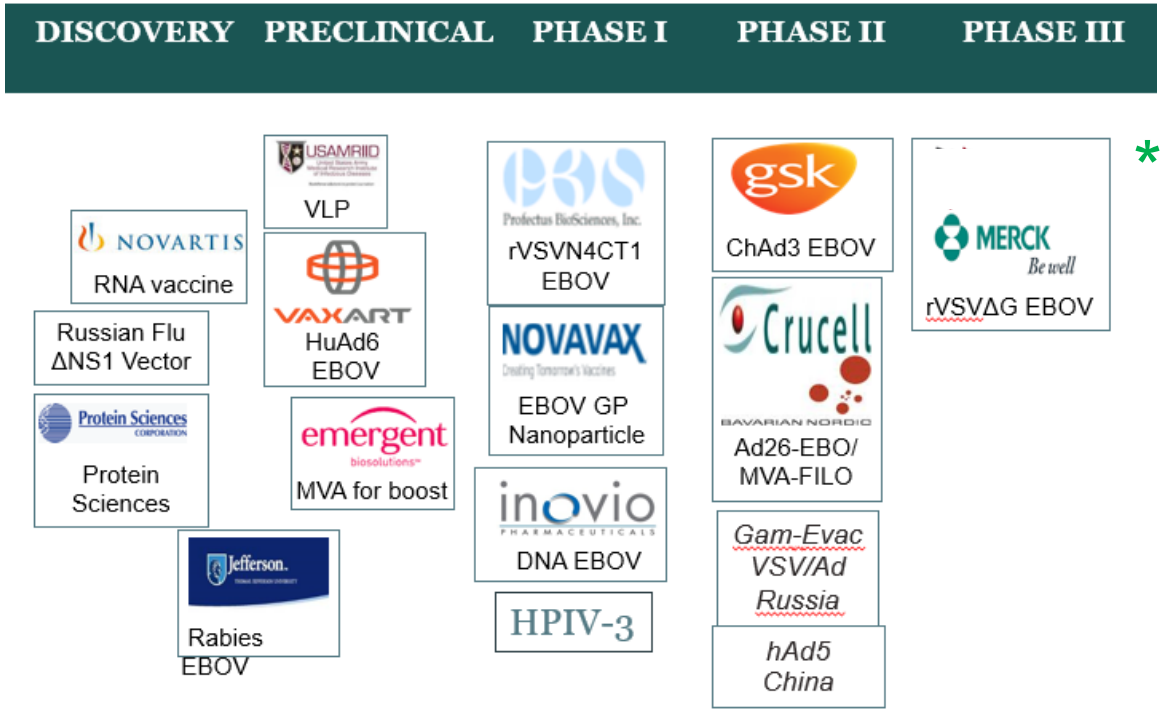
Accelerated timeline to develop the Merck Ebola vaccine



Gupta et al, Expert Review of Vaccines, 2018

The Ebola Vaccine Development Experience - An unprecedented response to a global health emergency

- Magnitude of private sector engagement and commitment, including both multinational vaccine companies and biotechnology companies
- Speed of vaccine development response--although enabled by earlier investments by key organizations (eg, BARDA, NIH, US Department of Defense, Public Health Agency of Canada, etc)
- Number of partners included in multi-sector product development collaborations, with many partners directly collaborated with each other for the first time
- Significant investments by both public sector and private sector partners



Yet, it also demonstrated that reactive, non-strategic efforts do not deliver results in time to impact an outbreak, extract enormous opportunity costs for private sector partners and are not sustainable

*** The importance of being first to demonstrate efficacy***

Lessons Learned and Calls to Action

Will Ebola change the game? Ten essential reforms before the next pandemic. The report of the Harvard-LSHTM Independent Panel on the Global Response to Ebola

Suerie Moon, Devi Sridhar, Muhammad A Pate, Ashish K Jha, Chelsea Clinton, Sophie Delaunay, Valnora Edwin, Mosoka Fallah, David P Fidler, Laurie Garrett, Eric Goosby, Lawrence O Gostin, David L Heymann, Kelley Lee, Gabriel M Leung, J Stephen Morrison, Jorge Saavedra, Marcel Tanner, Jennifer A Leigh, Benjamin Hawkins, Liana R Woskie, Peter Piot

World Health Organization

Report of the

Ebola Interim Assessment Panel

Preparing for the Next Outbreak

Public Views on Global Infectious Diseases and Health Security

July 2015

WORLD BANK GROUP

Establishing a Global Vaccine-Development Fund

Stanley A. Plotkin, M.D., Adel A.F. Mahmoud, M.D., Ph.D., and Jeremy Farrar, M.D., Ph.D.

The Neglected Dimension of Global Security

A Framework to Counter Infectious Disease Crises

February 2015

Recommendations for Accelerating the Development of Ebola Vaccines

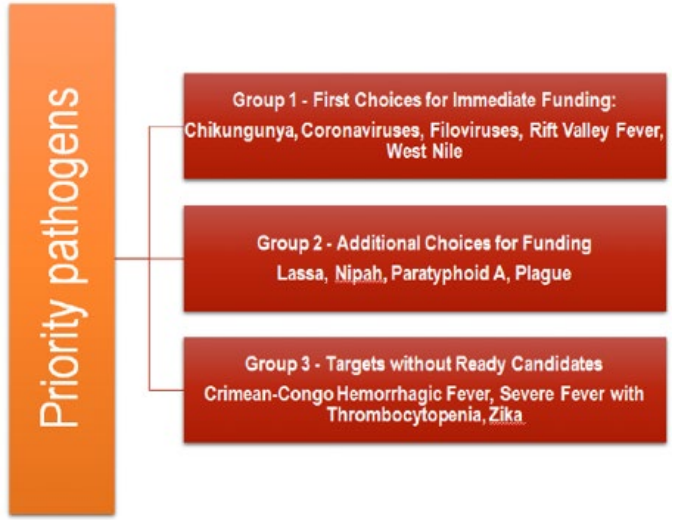
REPORT & ANALYSIS

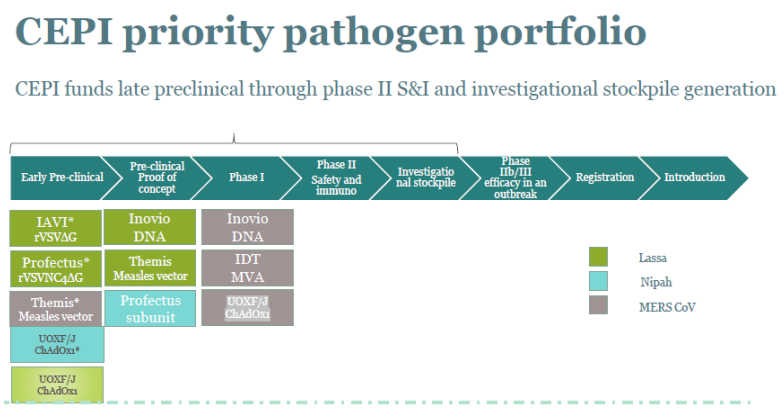
wellcome trust

CIDRAP

Initiatives to Address Key Lessons Learned through Ebola outbreaks

The establishment of the Coalition of Epidemic Preparedness Innovations (CEPI)





Partnership for Innovation for Infections of Epidemic or Pandemic Potential (PEPP)

Leadership Group Update
April 2016

CEPI | New vaccines for a safer world
Coalition for Epidemic Preparedness Innovations

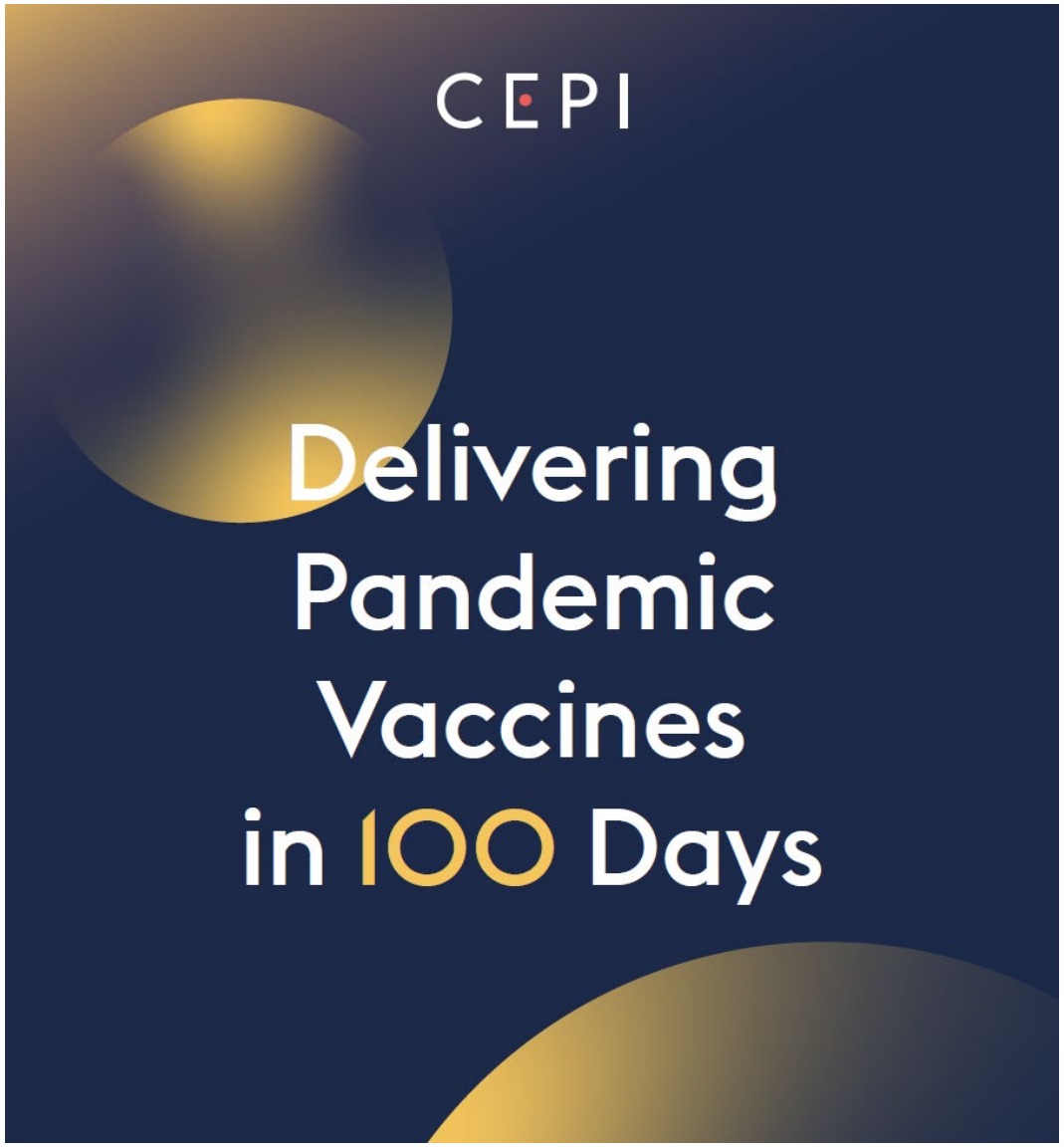
May 2016 — May 2019

New Vaccines against Epidemic Infectious Diseases

John-Arne Røttingen, M.D., Ph.D., Dimitrios Gouglas, M.Sc., Mark Feinberg, M.D., Ph.D., Stanley Plotkin, M.D., Krishnaswamy V. Raghavan, Ph.D., Andrew Witty, B.A., Ruxandra Draghia-Akli, M.D., Ph.D., Paul Stoffels, M.D., and Peter Piot, M.D., Ph.D.

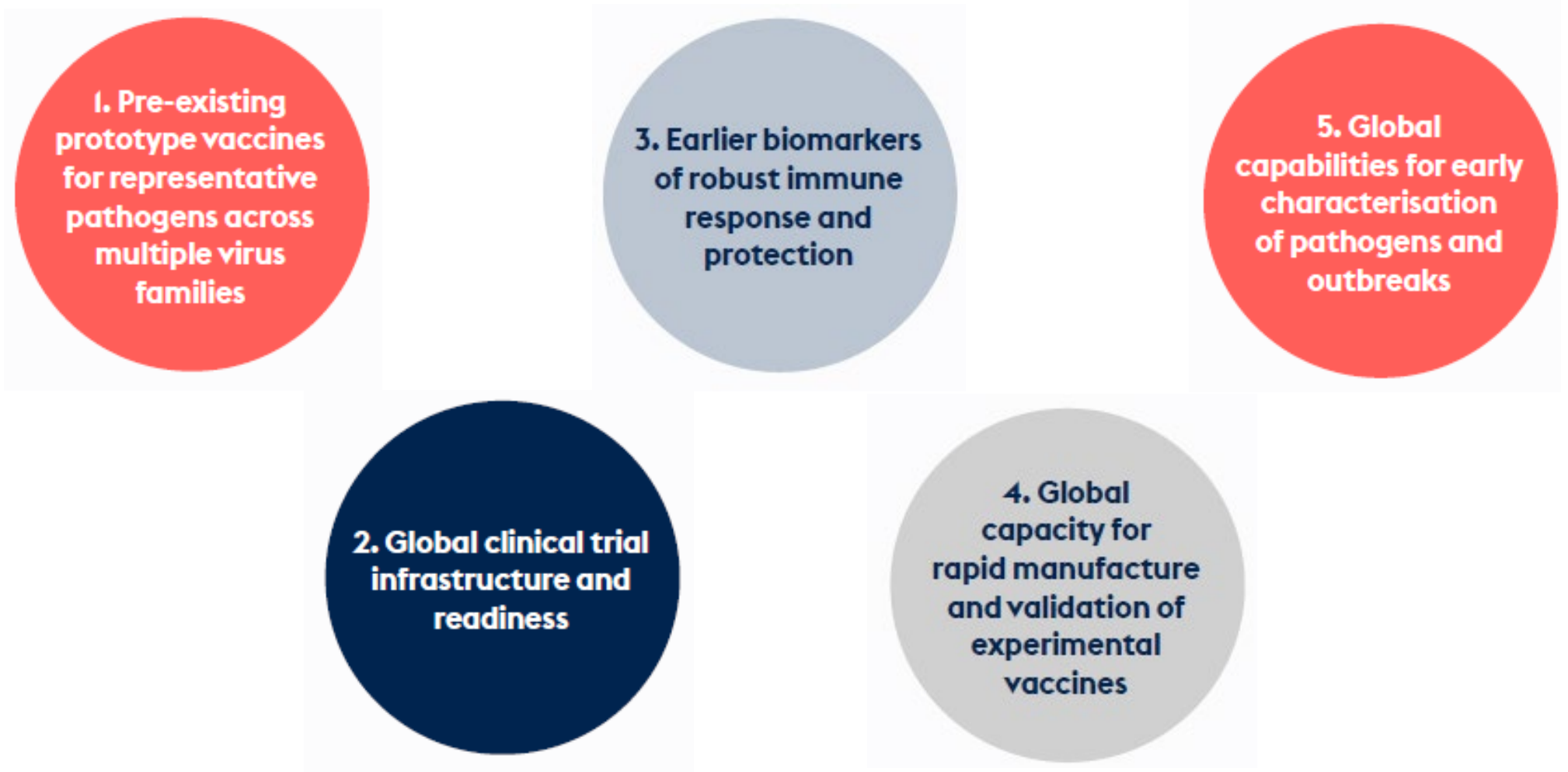
NEJM 376, 610-613. February 16, 2017

CEPI's 100 Day Vaccine Development Vision



See yesterday's presentation by In-Kyu Yoon or at CEPI.net

Key scientific and technological prerequisites underpinning a fundamental shift towards preparedness



Key areas of innovation contributing to accelerated development and authorization of COVID-19 vaccines

1. Leveraging pre-existing insights about pathogens and platforms

2. Supporting innovation in the vaccine development model

3. Using operational excellence to accelerate development and manufacturing

4. Promoting collaboration among stakeholders

5. Enabling continuous generation and review of evidence to support rapid approval

Some Open Questions for Achieving the 100 Day Vision

- Who leads?
- Who decides?
- Who funds?
- Who executes?
- Who assumes risk (both development and liability)?
- Who produces?
- Who is product sponsor for regulatory approval?
- Who decides distribution priorities?
- Who is accountable for achieving equitable and sustainable access?

No matter how compelling CEPI's vision is, they can't accomplish the 100 day goals without the alignment of a wide range of public and private sector partners. Further, this alignment needs to be achieved in advance of when an outbreak materializes.

The real threat of complacency

How can science help us prevent the next pandemic? I think we can do a whole lot better in rapid response and there are a lot of clever ideas I'm excited about, yet I feel like we've kicked back into that lackadaisical mode. We have a lull now. In surfing, when there's a lull in between the big set waves, that's when you paddle out. But we tend to paddle out when the waves are crashing. We wait for crisis.

JON COHEN

Author and senior correspondent with Science magazine

IAVIReport

The challenge of waning urgency….

The diminished sense of urgency once the threat of Ebola waned in 2016 had a consequent impact on funding and responsiveness: new outbreaks will gain renewed attention, but the global response will risk being delayed (with attendant public health and reputational consequences)


STAT Sections Topics Multimedia Popular STAT Plus Job

POLITICS

Millions in Ebola funding, a casualty of Zika virus, may not be replenished

- 21/10/2016

The costs of complacency are real

Following the Ebola Zaire outbreak in 2014-2016 and the demonstration of efficacy of VSV-ZEBOV, both CEPI and WHO had prioritized "finishing the job on Ebola" wherein vaccines would also be developed and stockpiled to address future outbreaks of Ebola Sudan and Marburg viruses. Unfortunately, this effort has languished as the memory of the tragedy of 2014-2016 faded.

- Outbreak of Marburg Virus in Ghana in June 2022 (the first time seen in this country)

- Outbreak of Ebola Sudan in Uganda in September 2022

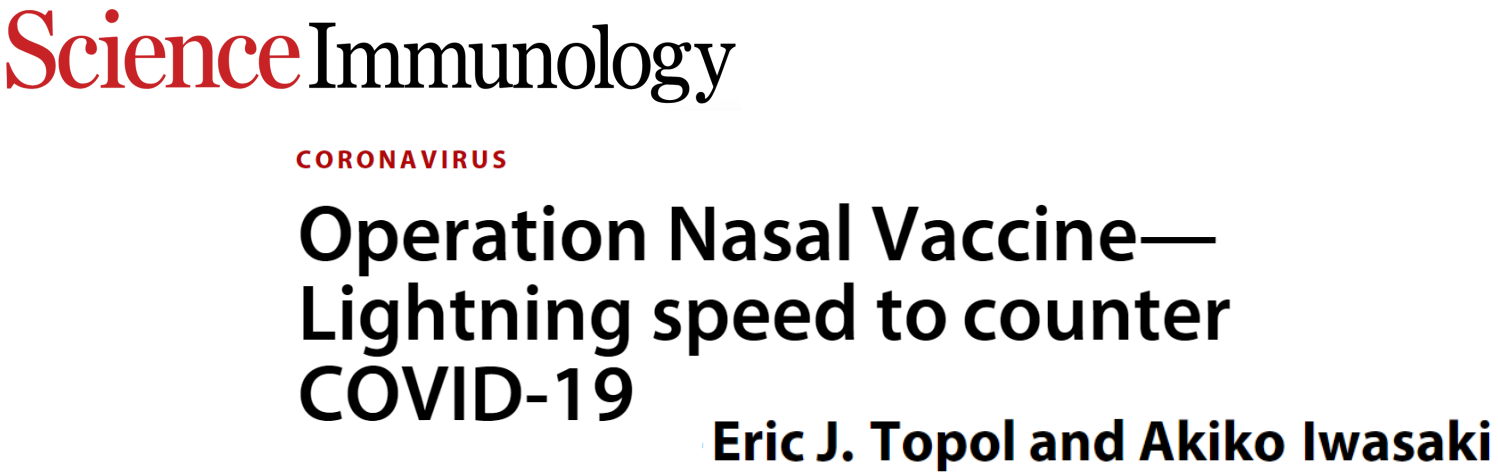
STAT

WHO, Uganda plan to test three candidate Ebola vaccines in outbreak

By Helen Branswell Nov. 16, 2022

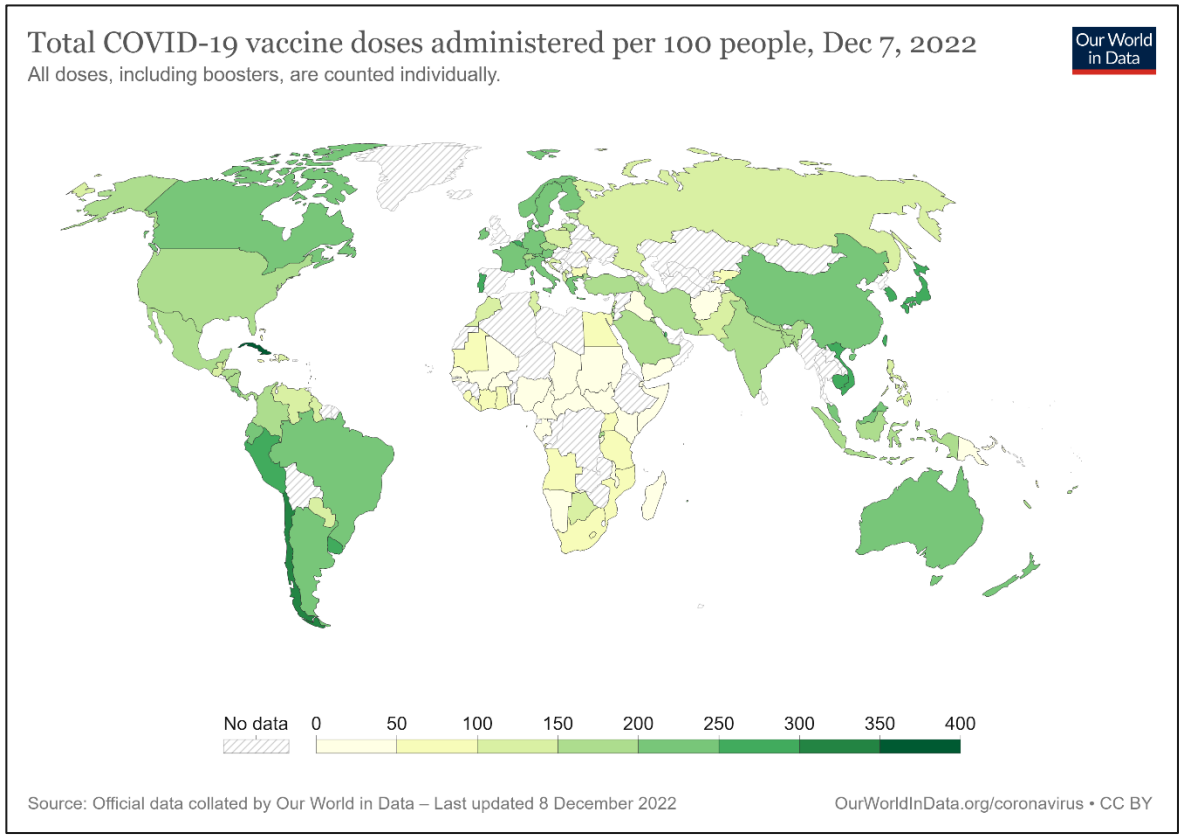
Complacency also impedes continued scientific innovation

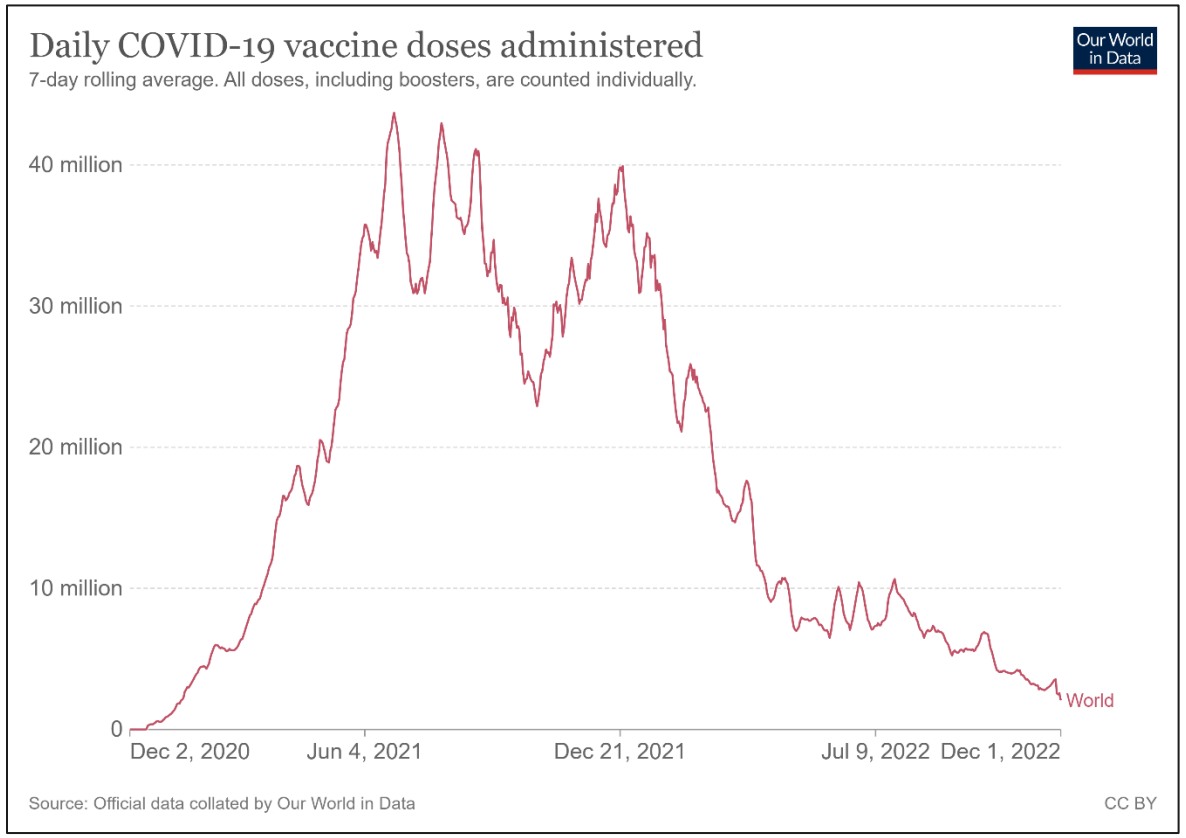
Waning government support and declining vaccine utilization will stifle ongoing R&D efforts to develop vaccines that are more efficacious, have broader VoC coverage, are more durable, are better tolerated and better able to block SARS-CoV-2 infection and transmission



Science Immunology 7.74 (2022): eadd9947.

Global Inequities in COVID-19 Vaccine Access Persist





An equitable solution to affordable global vaccine access remains elusive

With the impending potential dissolution of Covax, what, if any, solution for global access will take its place?

The Washington Post
Democracy Dies in Darkness

Organization leading Covax could end the vaccine-sharing initiative

By Claire Parker

December 7, 2022 at 8:54 p.m. EST

Optimizing partnership models to accelerate product development and achieve equitable access moving forward

When the world is facing a pandemic threat, is it reasonable to have the magnitude and effectiveness of the vaccine and therapeutic development response depend primarily on the decisions of individual companies about whether or not to engage? If not, is the best alternative approach:

- A public sector solution?
- A new more strategic public-private partnership model?
- A new model that includes private-private partnership (along with public sector support)?

When the world seeks solutions to ensure prompt, equitable and affordable global access to live-saving countermeasures:

- Is a new global compact that overcomes nationalistic inclinations achievable?
- Is local manufacturing a viable and sustainable solution (everywhere, all at once)?
- Can a new approach that is strategically designed to deliver results and that works for both public and private sector constituencies (and where IP is not viewed as a barrier to access)?

We need to develop a new "science of partnerships" to develop optimal solutions to maximize effectiveness and impact of epidemic responses

A new model is needed for accelerating global health innovation and impact

Where **private and public partners** are aligned in a manner that:

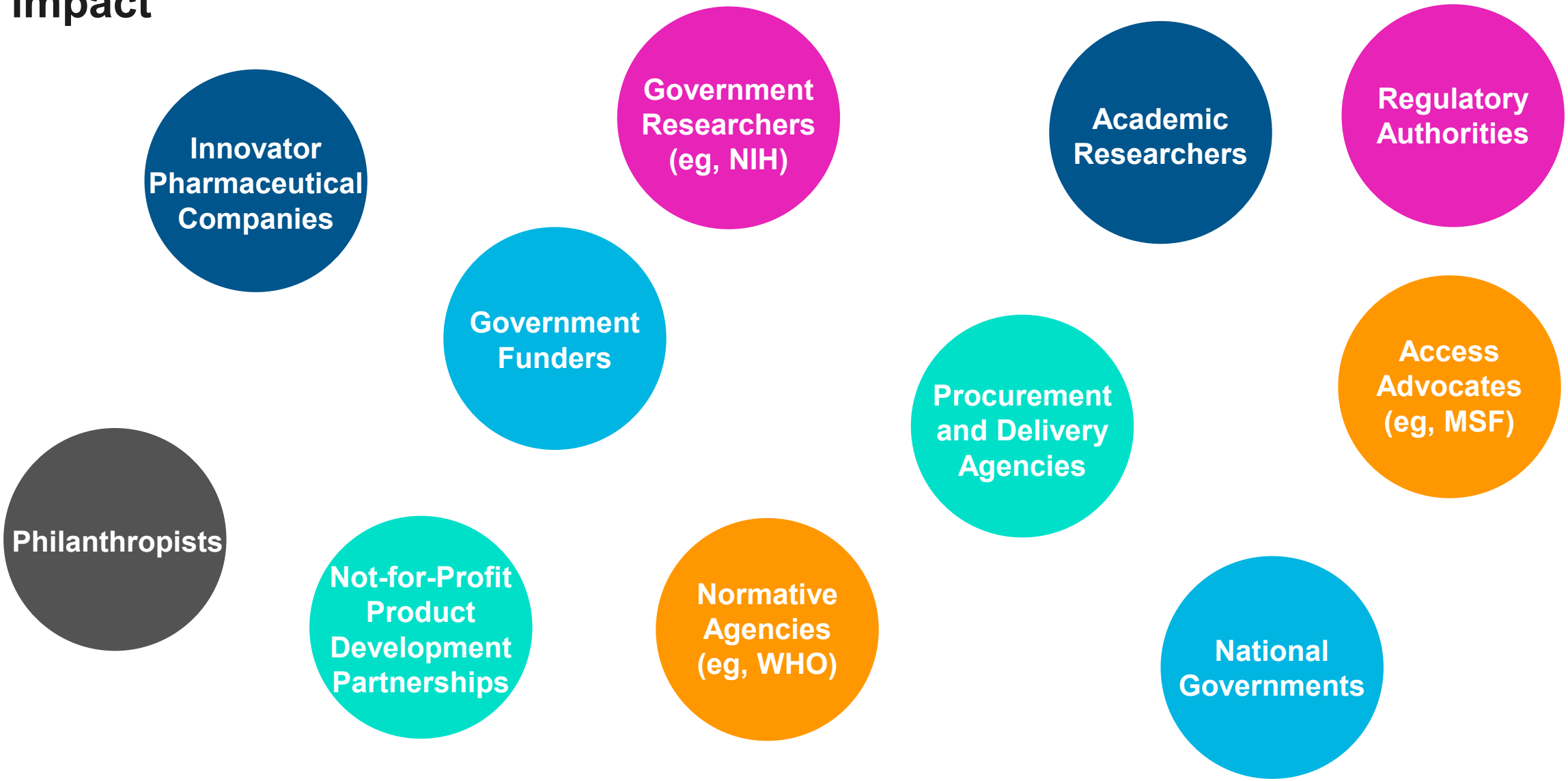
- Proactively defines roles and responsibilities, and the model for collaboration to be implemented
- Specifies key data that need to be generated to inform future policy decisions
- Secures up-front commitments to procurement and implementation should defined product performance criteria be met
- Shares risks in a fair and reasonable manner

The **product development program**:

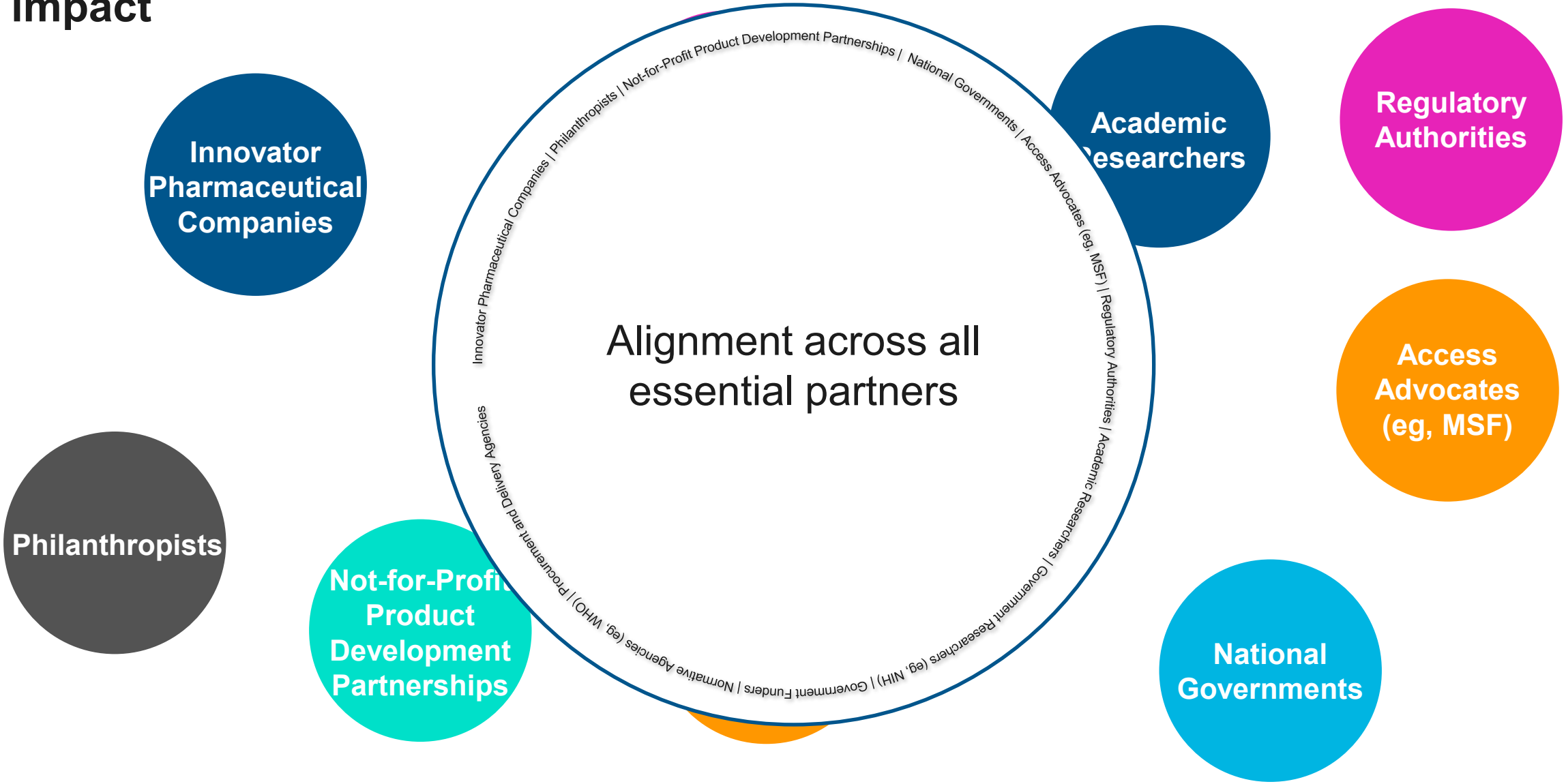
- Effectively and efficiently utilizes each partner's unique skills and assets
- Optimizes development to hasten the availability of vaccines with profiles and price points that maximize the probability for **prompt, widespread, effective, and sustainable adoption** to achieve the desired public health impact
- Prioritizes equitable vaccine distribution and access

Defined Program Leadership is needed to ensure that key stakeholders that can **fill the product development gaps** are engaged and that all stakeholders including funders and regulators are convened

Aligning all essential partners to maximize preparedness, response and impact



Aligning all essential partners to maximize preparedness, response and impact



Applying Lessons Learned from COVID-19 R&D to Future Epidemics

- Optimizing partnerships and collaboration
- Continued scientific innovation for preparedness and response
- Define optimally effective and sustainable approaches to ensure prompt and equitable access
- Do the needed work during “peacetime”….from continued scientific innovation to effective ongoing public education and engagement
- Pursue a global collaboration framework that counters nationalistic tendencies

The time to act is now and everyday thereafter!

Cecilia Kamura, Age 6, Robertsport, Liberia

Photo: Alphanso Appleton