Novel technical solutions for vaccine manufacturing

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BATAVIA biosciences

Accelerate biotechnology

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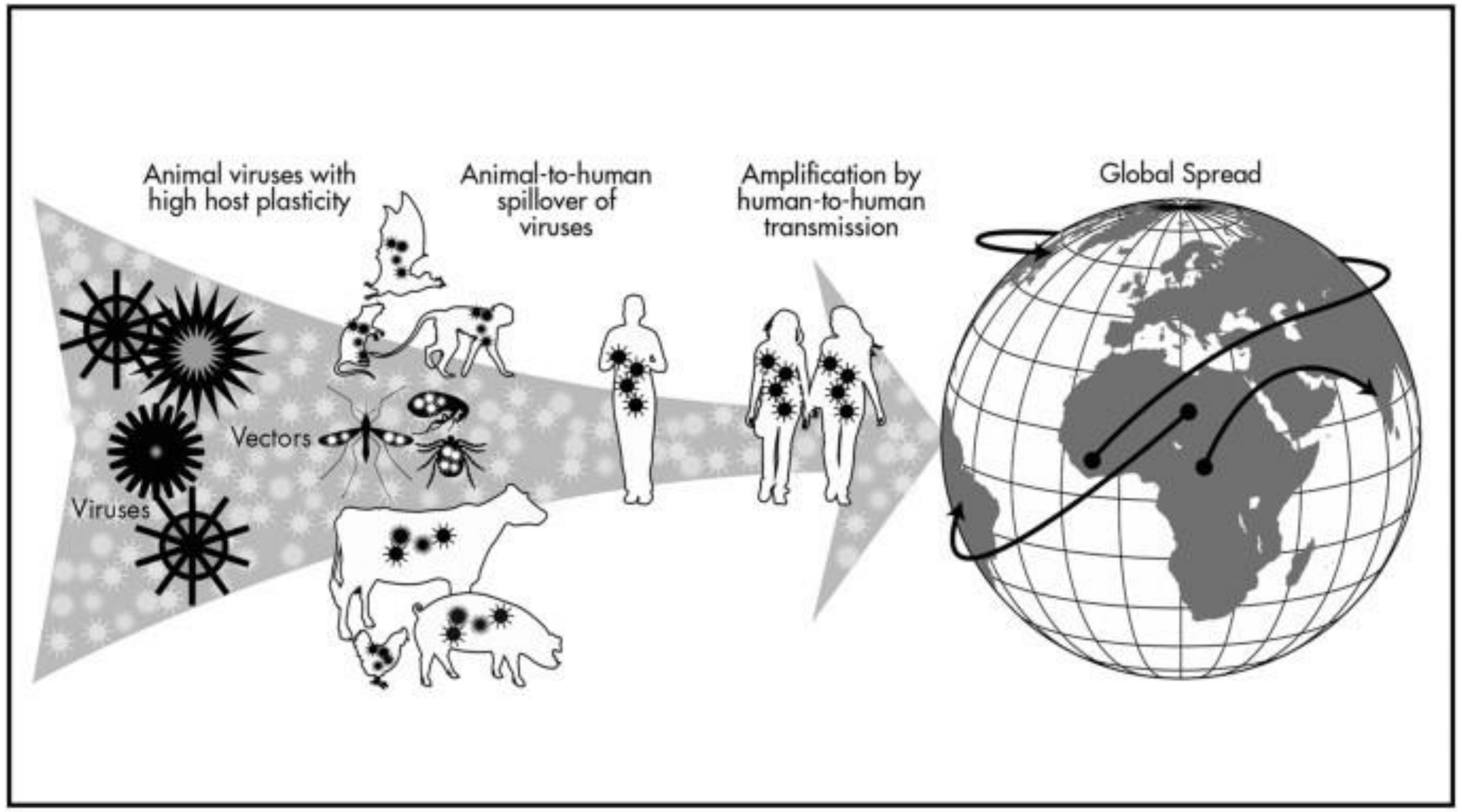
The next pandemic: not if, but when

A startling reminder of the empty streets of Amsterdam and the Keukenhof Gardens without any visitors during the Covid-19 pandemic

New emerging disease rate accelerating. Will we be ready?

“We estimate there are around **1.5 million viruses** in wildlife that we don’t yet know about. Any one of those could be spilling over into human population right now…We know of some pretty lethal ones, but we expect there are others out there that are more lethal, that are better at being transmitted, where we have no drugs and no vaccines.”

-Dr. Peter Daszak, Ecohealth Alliance, President

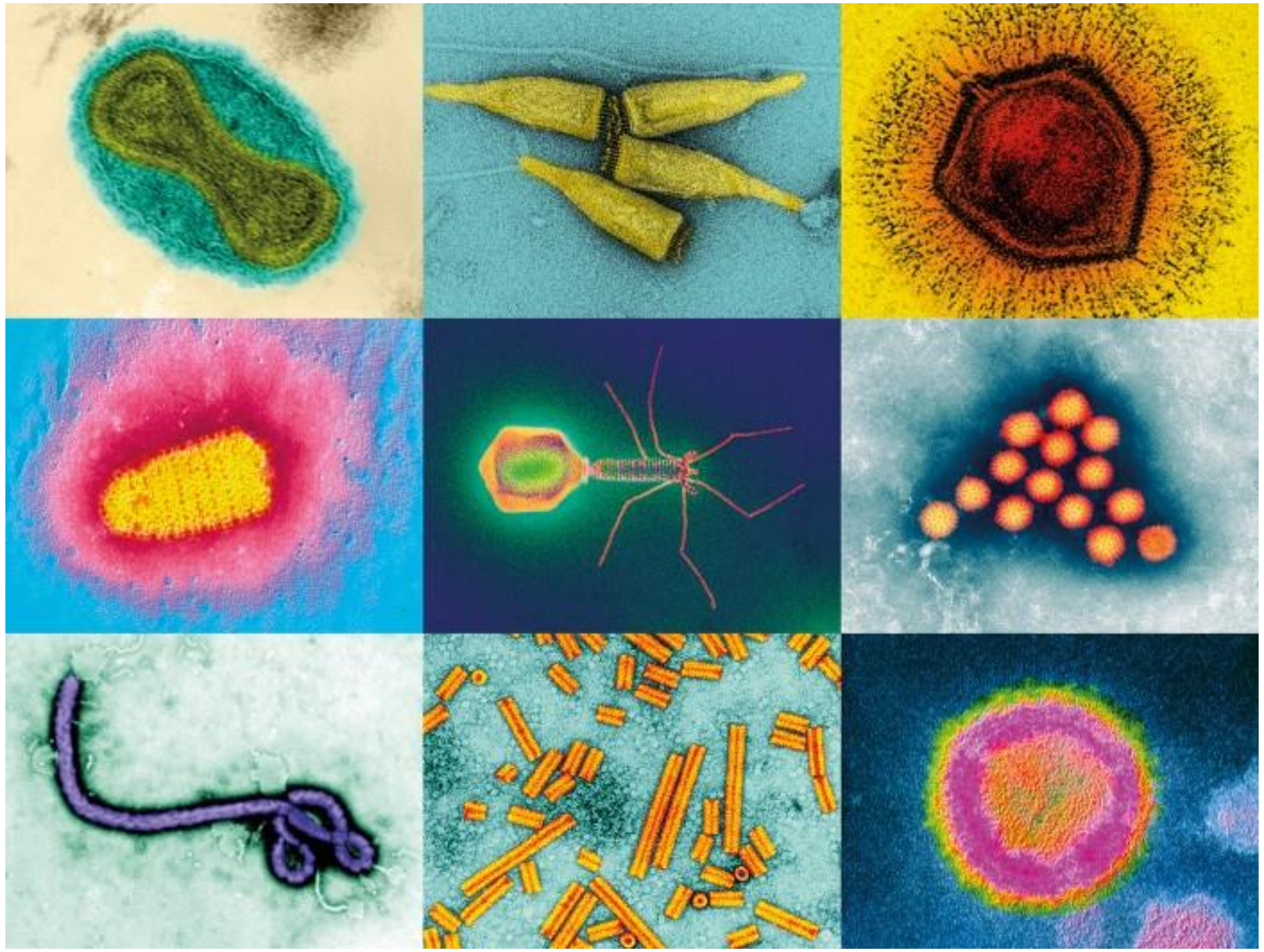


A breakdown of our needs

1) We need to improve **affordability** and **accessibility** of vaccines for viruses we know about.

Everyone worldwide, not just some, should have equitable access to these vaccines.

2) We need vaccines developed quickly for inevitably new pandemics.



Accelerate biotechnology

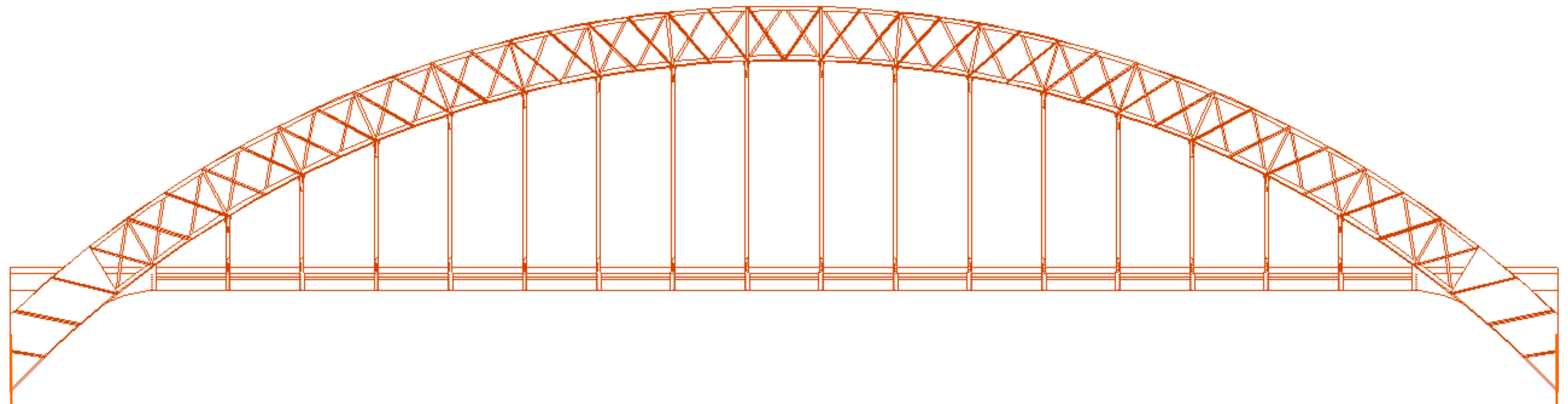
Vision:

To reduce human suffering
from infectious disease and cancer

Mission:

Recognized as Center of Excellence
in Biopharmaceutical R&D
and clinical manufacturing

Batavia Biosciences “bridges the gap” as a partner



Batavia Biosciences

Early discovery
- University, Academia
- Biotech
- Big pharma
- (N)GOs

Process Development

Clinical Manufacturing Phase I and II

Late stage & Commercial Manufacturing
- Manufacturer

Critical interface

Critical interface

Transformational change needed in vaccine and virotherapy manufacturing

Major factors affecting the global availability of life-saving therapies

1. Manufacturing capacity - Insufficient due to large capital investment to build commercial manufacturing facility
2. Commercial supply - Insufficient due to low process yields & manufacturing capacity
3. Cost-of-Goods - High due to capital and operational facility costs & low yielding manufacturing processes

CAPEX

Large investment for facility construction

Relatively low output per m^2 floorspace

OPEX

Labor intensive processes

Large, costly to operate facilities

Cost of Goods

Low process yields

Long bioprocessing times and many process steps

Improving current vaccines

Vaccines have a major economic impact: example

2008 Measles outbreak in Southern California – 11 cases of measles in unvaccinated children

Sugarman et al, Pediatrics 2010; 125. 747-755

What it cost to stop the outbreak:

11 cases of measles **X $10,376** per case
48 children quarantined **X $775** per child

$151,336

What it would have cost to vaccinate all 11 children:

$20 – $60
(approximately)

For every **$1.00** the U.S. spends on childhood vaccinations

$10.20 is saved in disease treatment costs.

Global Health collaborations aimed at reducing manufacturing costs

Product	Funding agency	Partners	Status
Lassa vaccine (VSV)	CEPI	IAVI	GMP (manufactured 2021)
Rubella vaccine	Gates Foundation	BioFarma, UNVC	R&D (manufactured Q1 2022)
Measles vaccine	Gates Foundation	BioFarma, UNVC	R&D (GMP manufacture scheduled Q2 2022)
Inactivated polio vaccine	Gates Foundation	BioFarma, UNVC	R&D (GMP manufacture scheduled H2 2022)
Oral polio vaccine	Gates Foundation	BioFarma, UNVC	R&D
Nipah vaccine (MV)	CEPI	UTokyo, EVI, Stanford	R&D
Marburg vaccine (VSV)	DTRA	IAVI	R&D (manufactured Q4 2021)

HIP-Vax® All of these projects are developed using our HIP-Vax platform

Track record HIP-Vax® platform

HIP-Vax®

- Established for viral & vector vaccines using $60m in grants and contracts since 2016 from Gates Foundation, CEPI, DTRA
- Proven successful in cGMP production of clinical trial material VSV-vector based Lassa vaccine candidate
- Proven successfully scalable from pilot scale to clinical and commercial scale in more than 50 runs

Benefits of HIP-Vax® platform

Delivers low CoGs : <$1 per dose for vaccines

- Reduced facility footprint (CAPEX)
- Reduced labor and consumables (OPEX)
- Reduced process times (increased output)

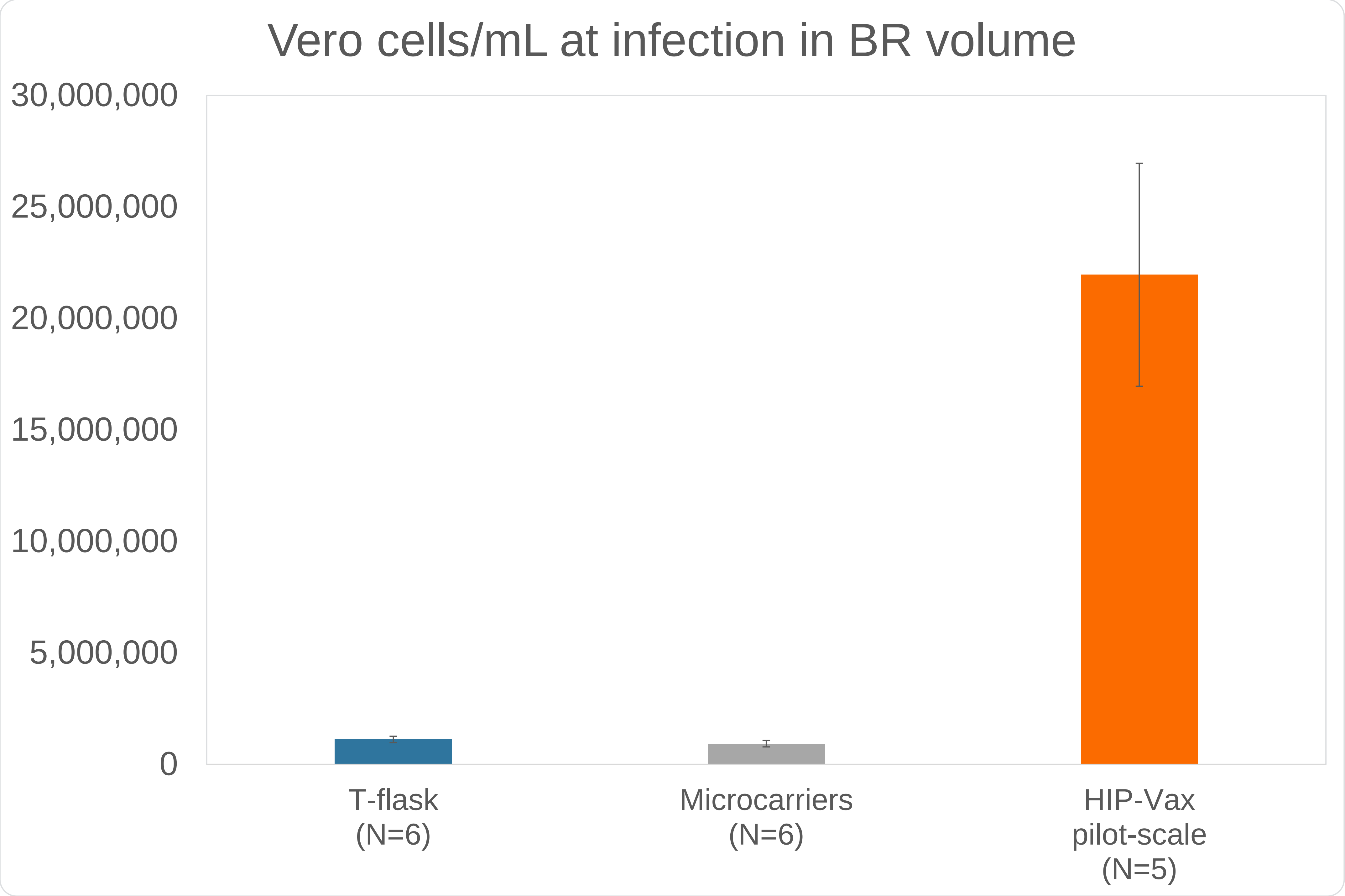
Applicable to multiple product modalities

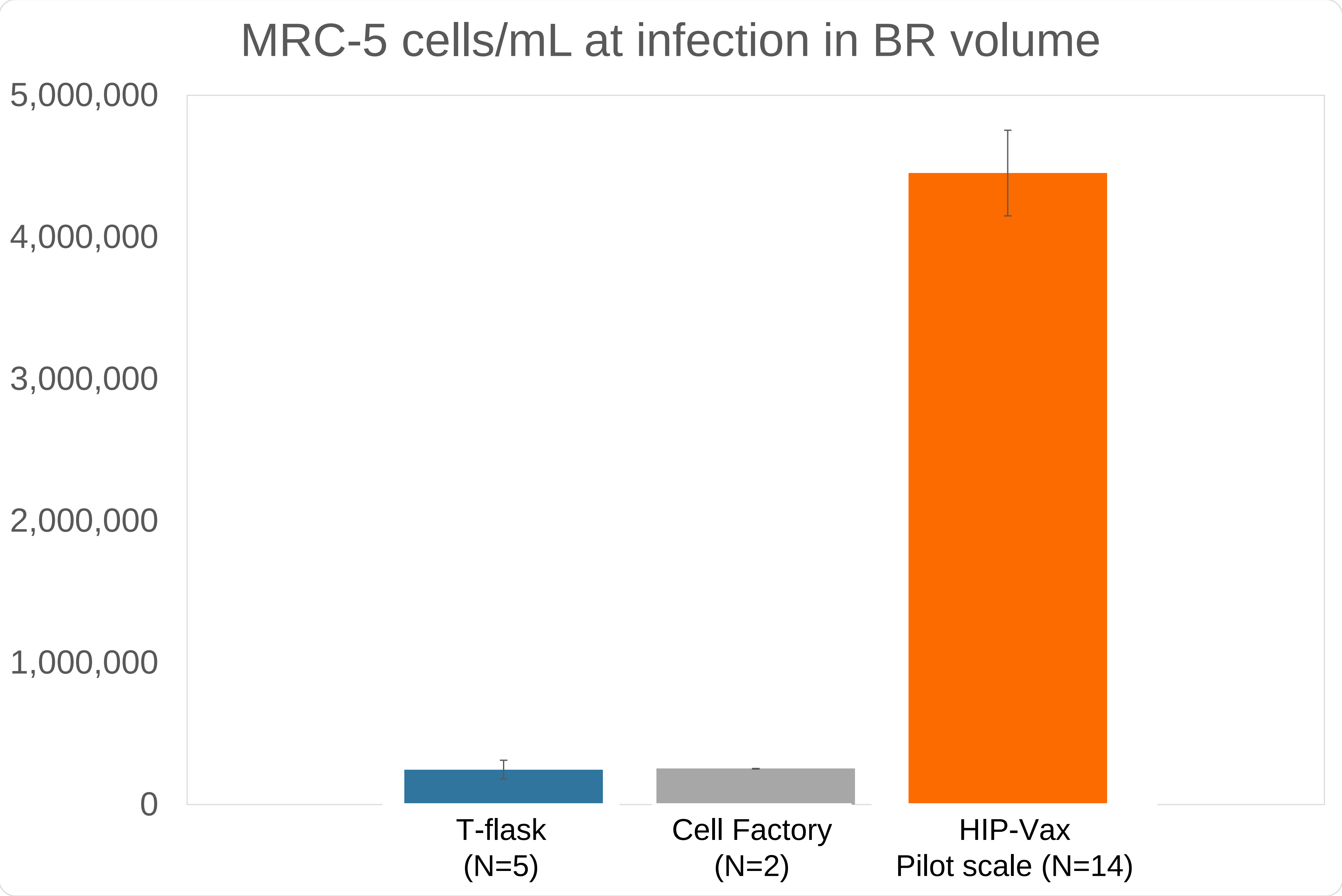
- Viral & vector vaccines (e.g.: based on Vero and MRC-5)
- Virotherapies, such as gene therapy or oncolytic vectors (e.g.: based on HEK293)
- Recombinant proteins (based on CHO)

Commercial manufacturing at lab scale

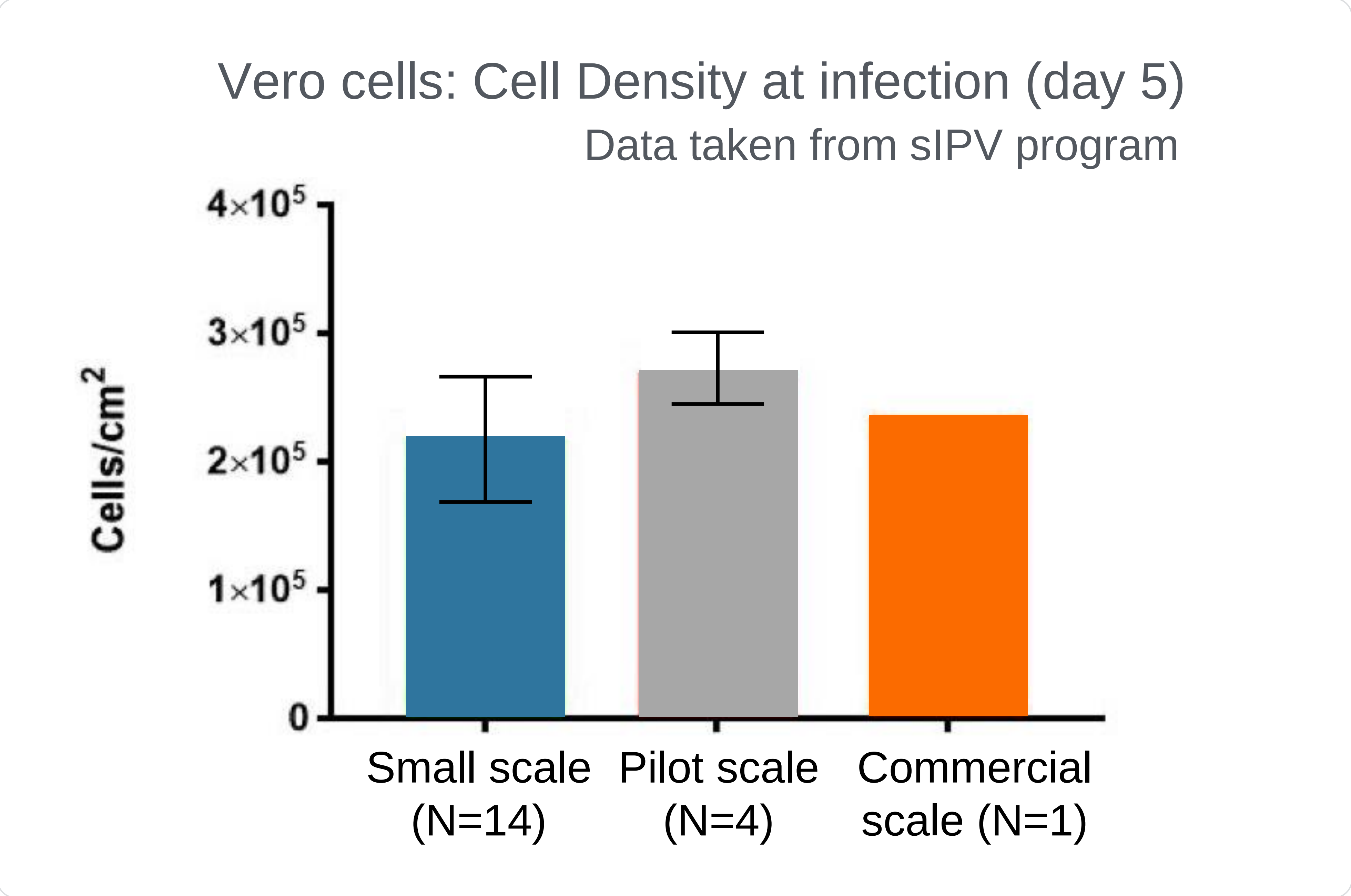
- High yield from small footprint
- 1000L output in 50-100L harvest volume

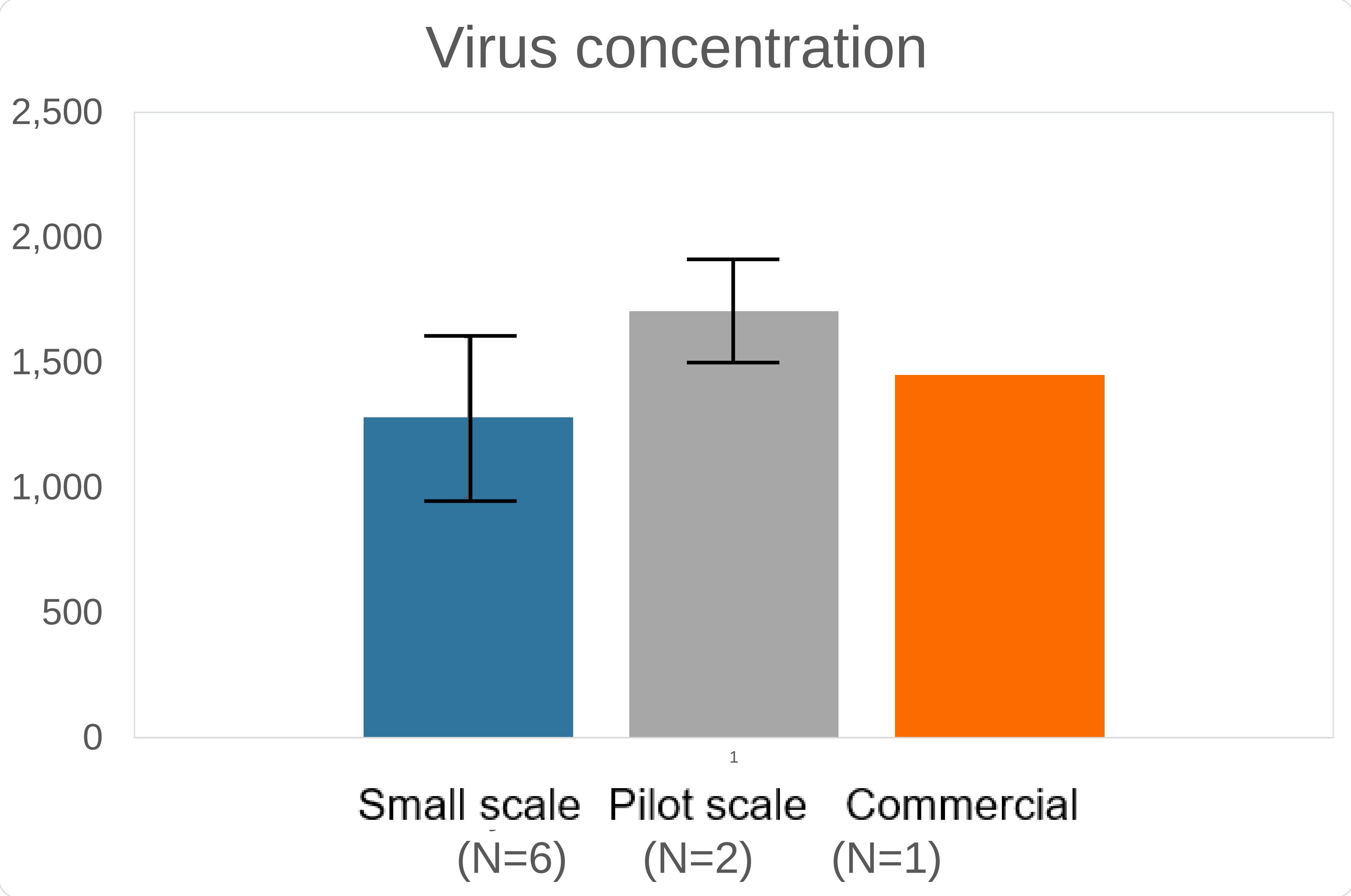
HIP-Vax® delivers 10 to 20-fold higher cell densities





Scalability: Equal upstream performance across all production scales



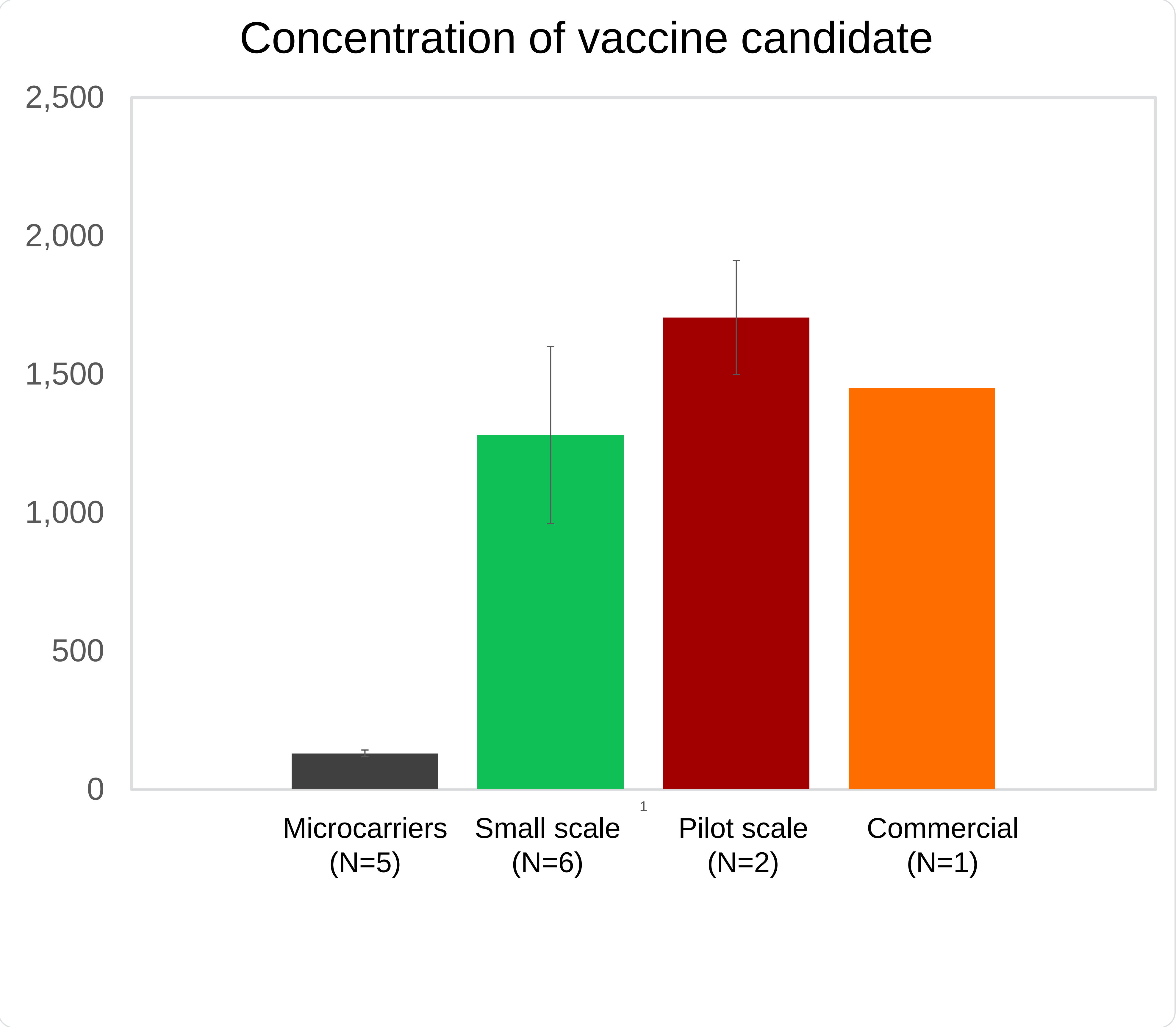


HIP-Vax	Phase	Surface area	Harvest
Small scale	Early development	2.4 m^2	240 mL
Pilot scale	Clinical development	10-30 m^2	1-3 L
Commercial scale	Commercial development	200-600 m^2	20-60 L

HIP-Vax at commercial scales equals a 1,000L microcarrier process

HIP-Vax delivers about 10-fold more concentrated harvest

HIP-Vax®



HIP-Vax delivers low CoGs and high product output

HIP-Vax®

CAPEX

Based on the results of scalability, increased cell density

Relatively low output per m^2 floorspace

OPEX

Labor intensive processes

Large, costly to operate facilities

Cost of Goods

Low process yields

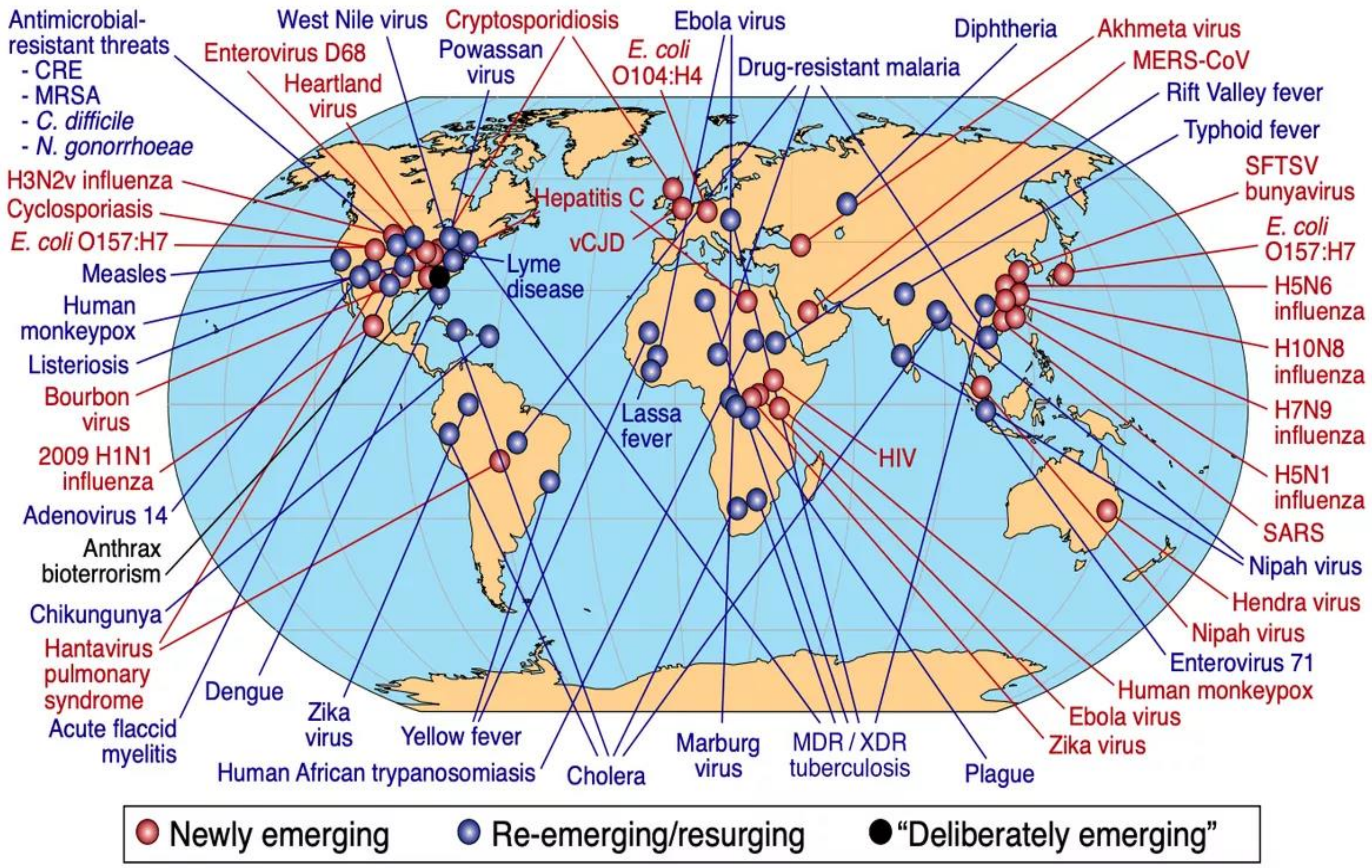
Long bioprocessing times and many process steps

With current process yields, full commercial manufacturing process **at 600 m^2** delivers a fully loaded cost:

- **sIPV = $0.40 per dose**
- **MR = <$0.15 per dose**
- **VSV-vector = <$0.70 per dose**

2) Need for rapid vaccine development

Emerging and re-emerging diseases exert a significant global threat



- Globalization
- Migration
- Armed conflicts
- Increasing population
- Climate change
- Urbanization

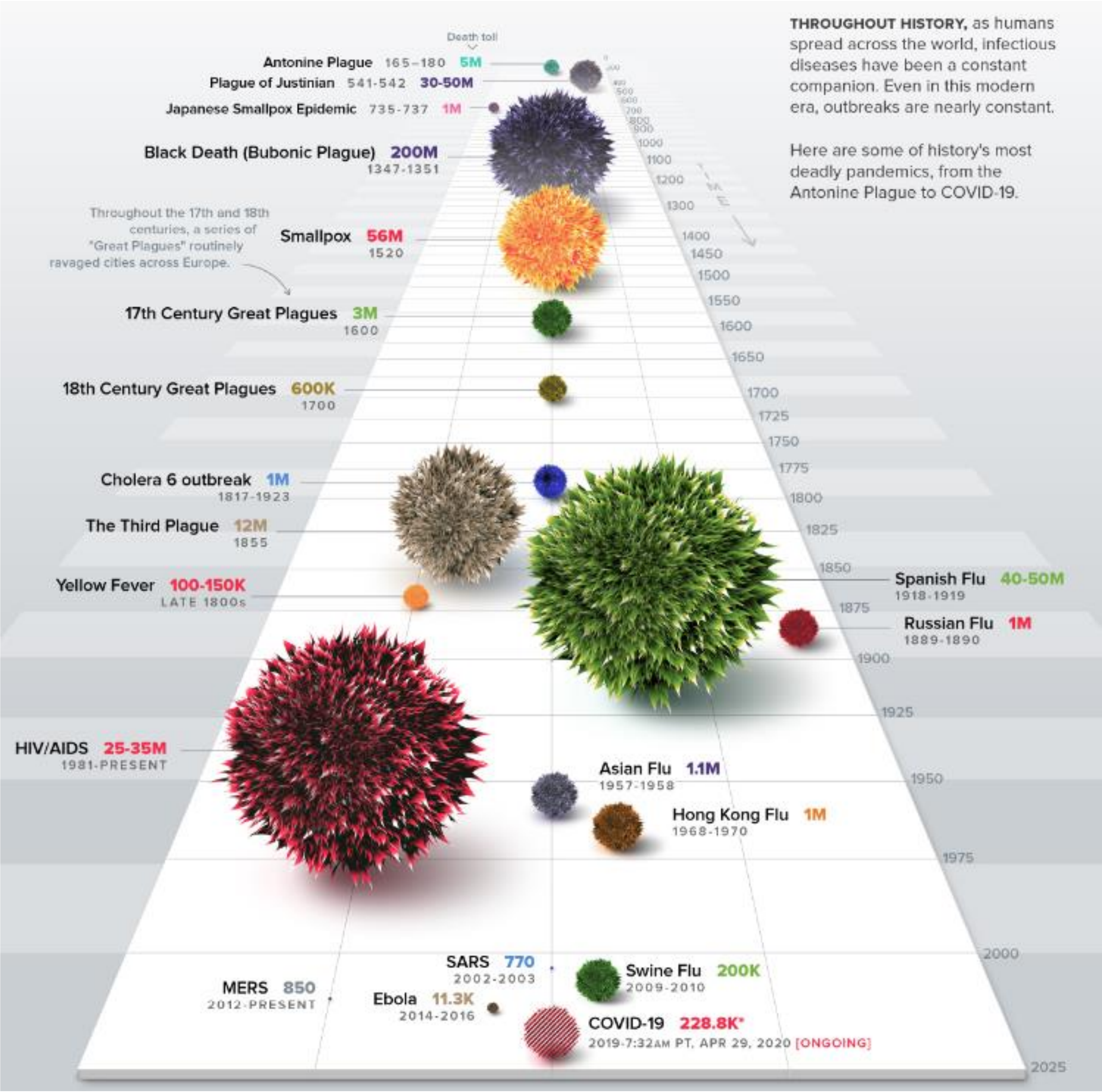
- Chikungunya Dec 2013 - Mar 2015 (Americas)
- >1.3 million cases in 44 countries

- Ebola 2014 (W.Africa)
- 20,206 cases, 7905 deaths

- MERS-CoV 2012 - 2017 (Global)
- Affecting >212 countries and territories

- COVID-19 (Global)
- >488 M cases, >6.1 M deaths

Outbreaks becoming more frequent and costly



Source: visualcapitalist.com

Costs of recent outbreaks

- $16 Trillion for COVID-19
- $53 Billion for Ebola

- Estimates indicate it's roughly 500 times more costly as what it would take to invest in proposed preventative measures

- "Typically, it would take 4-5 years to come up for a vaccine against an emerging disease and new technologies might shorten those times…"

 - Bill Gates

Manufacturing needs for epidemic preparedness

Flexibility

Respond to small regional threats (e.g.: Nipah and Lassa) and major global outbreaks (e.g.: COVID-19, Ebola, etc.), stockpiles from <1M to >250M doses

Low-cost

Many disease threats are prevalent in developing economies, low COGs critical

Broad applicability

High diversity of disease threats means multiple vaccine modalities used, platform solutions needed

Business model

Lack of commercial market for many epidemic disease threats (including sporadic use) means novel business model needed for manufacturers

The next pandemic

CEPI has expressed that for the next pandemic, vaccines should be ready in **100 days** after the declaration of a pandemic by the WHO.

To be able to reach this important milestone, it is important to have:

1) a worldwide surveillance system in place to be able to detect the next pandemic threat in time, &

2) a worldwide manufacturing system in place in the developed and developing countries to manufacture the required number of vaccine doses.

CEPI

A production platform is needed to meet the 100-day vaccine delivery requirement

Batavia's platform approach

- Vaccine vector system will be applied, generate vector within 2 months
- No development required, initiate GMP manufacturing directly when vector is available
- Phase 1 clinical material (pilot scale) available 18 weeks after receiving the vector
- Phase 3 clinical material (commercial scale) available 39 weeks after receiving the vector

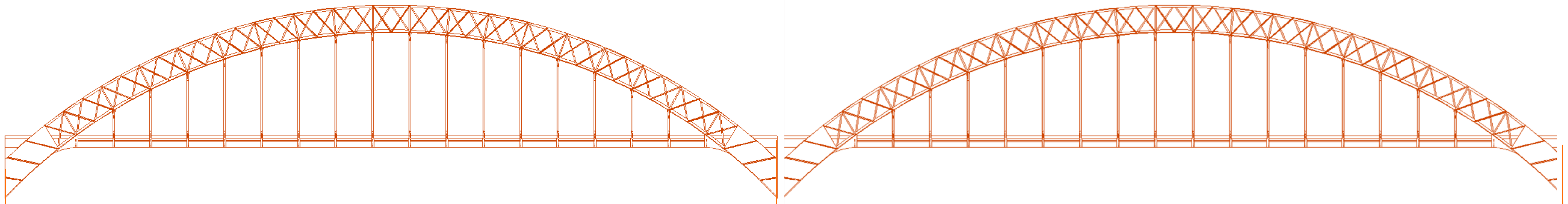
Higher speed

Benefits of platform approach

- Low-cost manufacturing
- Small footprint
- Flexible and mobile

Lower cost

Batavia Biosciences “building new bridges”



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The investment by CJ CheilJedang gives Batavia the possibility to build further

Building a commercial manufacturing facility in Leiden

Multi-product, combined clinical & commercial manufacturing facility

6 upstream, 2 downstream, 1 formulation suites for DS production

1 filling line, inspection and packaging area for DP production

Q3 2024

10,000 m2

Plans for potential duplication of facility in USA

Summary

Batavia Biosciences is a product developer with in-depth know-how on biopharmaceuticals such as vaccines

Our technologies aim to increase success and reduce timelines and production costs

Our HIP-Vax technology will better help vaccine manufacturing to make access more affordable and equitable to people worldwide

We need to be prepared for the next pandemic and being prepared means investing in new technologies, like HIP-Vax, that will speed up production, accelerate tech transfer, and provide equitable access.

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