

The infectious diseases vaccines R&D financing landscape

An Industrial perspective



The Novo Nordisk Foundation
Initiative for Vaccines and Immunity

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Presentation Overview

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SCOPE: All infectious disease prophylactic vaccine R&D targets (emerging, endemic, epidemic & pandemic; including commercially viable)

1. **Landscape** for infectious disease vaccine R&D financing
2. **Pharmaceutical Industry perspective** for R&D funding
3. **Novo Nordisk Foundation approach** to vaccine R&D funding

Landscape for infectious disease vaccine R&D financing

The cost of vaccine research and development

❖ Precise Vaccine R&D private sector costs are NOT frequently disclosed

ca. 70% of cost is in late development

Cost Category	Cost examples
Overall R&D	❖ Capitalized mean development cost, incl. Ph3 \$887M NOT incl.Mfg ¹ over a mean 15.3 years.
Overall R&D (includingMfg)	❖ R&D \$200 to \$500M & for building and maintaining the manufacturing facilities at scale \$500M to \$1B ³
Overall R&D (includingMfg)	❖ Sanofi's Dengvaxia vaccine cost \$1.5B R&D and Manufacturing over 20 years
Development	❖ Moderna received \$955M from BARDA for development (and later \$1.53B for mfg & delivery of 100M doses ⁴)
Clinical Dev	❖ Gardasil4 Clinical Development costs range \$540-594 million
Clinical Dev	❖ Gates Foundation & Wellcome- \$550 million to fund a Ph3 trial for M72/AS01E TB vaccine candidate.
Facilities &Mfg	❖ Sanofi Singapore Facility (2025) \$595 million mfg facility for 4 vaccines or biologic, French Expansion (2020) \$700 million new mfg site and a research center, Val de Reuil Site (2017) €170 million expansion vaccine manufacturing ⁷ .

1. Sertkay et al. 2024 (US ASP estimate adjusts for the cost of capital (the opportunity cost of using funds for R&D instead of other investments)).
2. Sanofi's Dengvaxia launch rocked by turmoil in Latin America, Fierce Pharma, 2016
3. Bloom et al., 2020, IMF
4. Statement from NIH and BARDA on the FDA Emergency Use Authorization of the Moderna COVID vaccine, 2020
5. Songane and Grossman 2021
6. Nasdaq The Daily Upside 2023
7. Pharmaphorum & BioPharma Dive

The ‘universe’ of vaccine R&D financing sources

❖EXAMPLES of R&D funding sources globally NOT exhaustive

PRIMARY FUNDERS

Public sector
Government



Private sector
Pharma, Biotech, VCs & Investors



Philanthropic
NFP & charitable foundations



INTERMEDITARY FUNDERS

Public sector
Multilateral agencies



PPP/PDPs
Innovative funding mechanisms

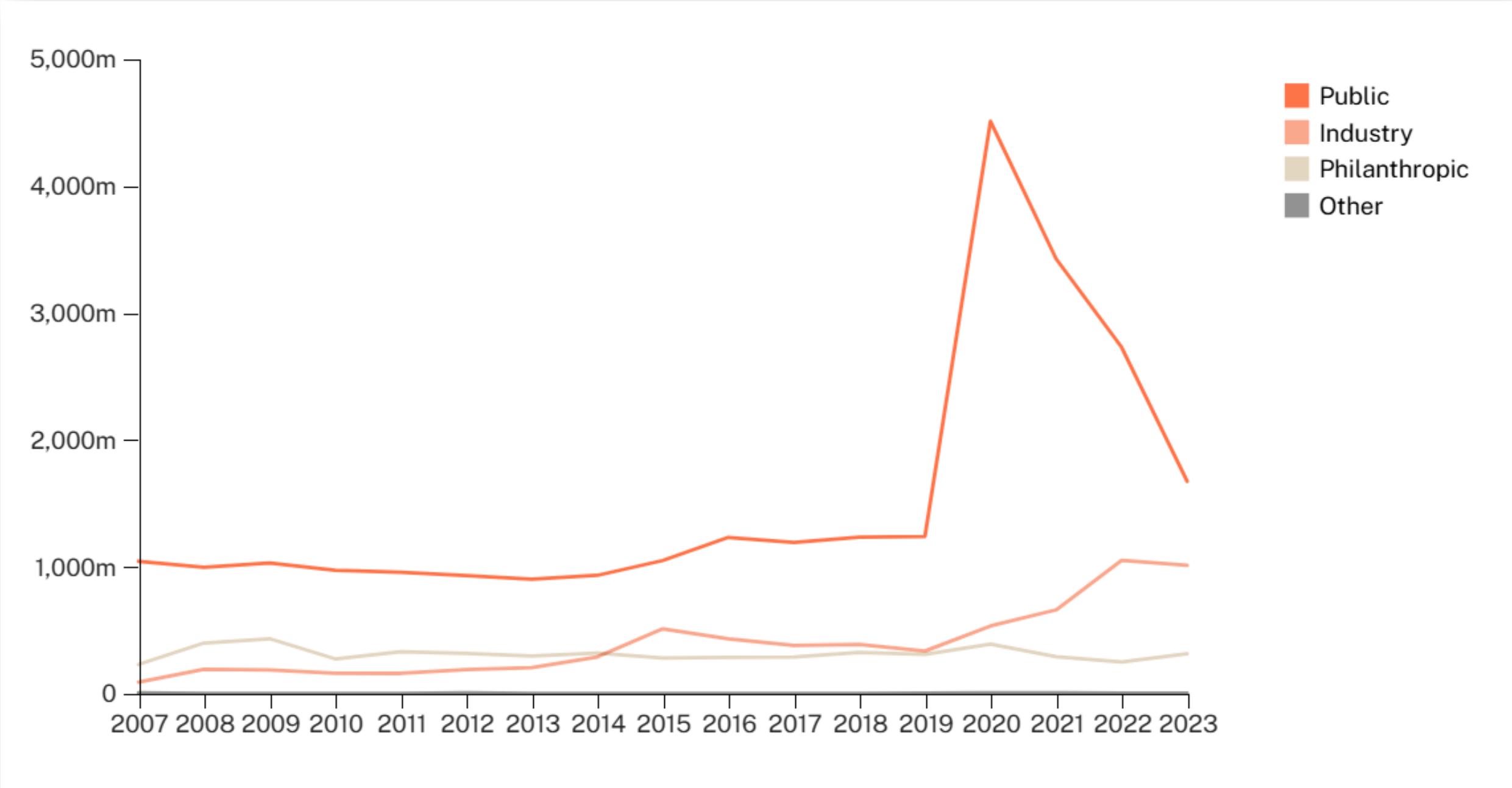


Academic & Research
Universities & Research Institutes



Public donors represent the largest share of all vaccine R&D funding for neglected endemic diseases, emerging disease, and sexual & reproductive health.

❖ Total vaccine R&F funding by sector 2007-2023; \$M



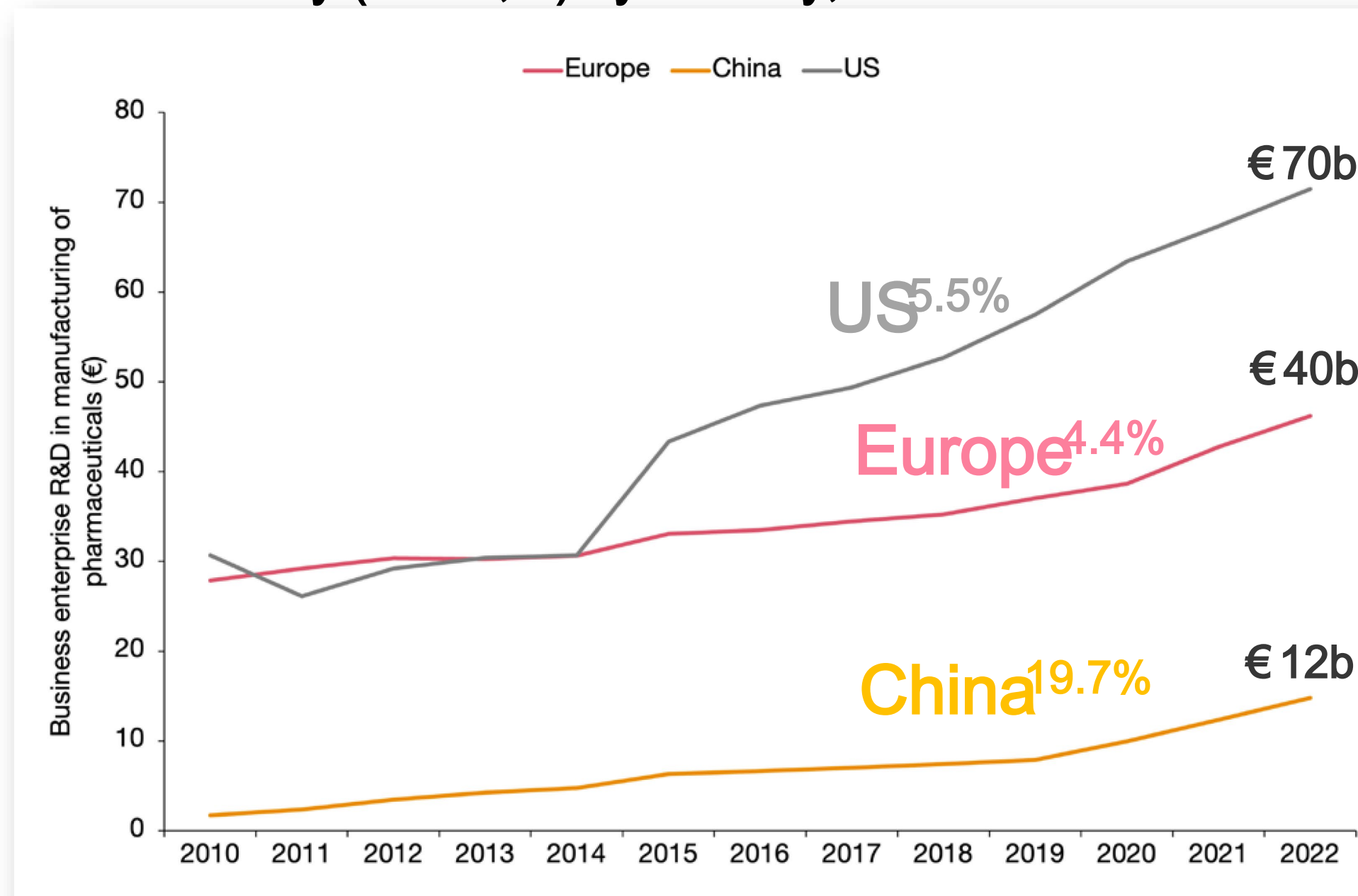
2024 GFINDER REPORT

*Includes neglected endemic diseases, emerging diseases, sexual & reproductive health (and COVID, and Disease X)

Estimates for global *total*/ID vaccine R&D expenditure are not available

❖ Proxy private sector view based on total pharma

R&D investment in the pharmaceuticals industry (billion, €) by territory, from 2010 to 2022

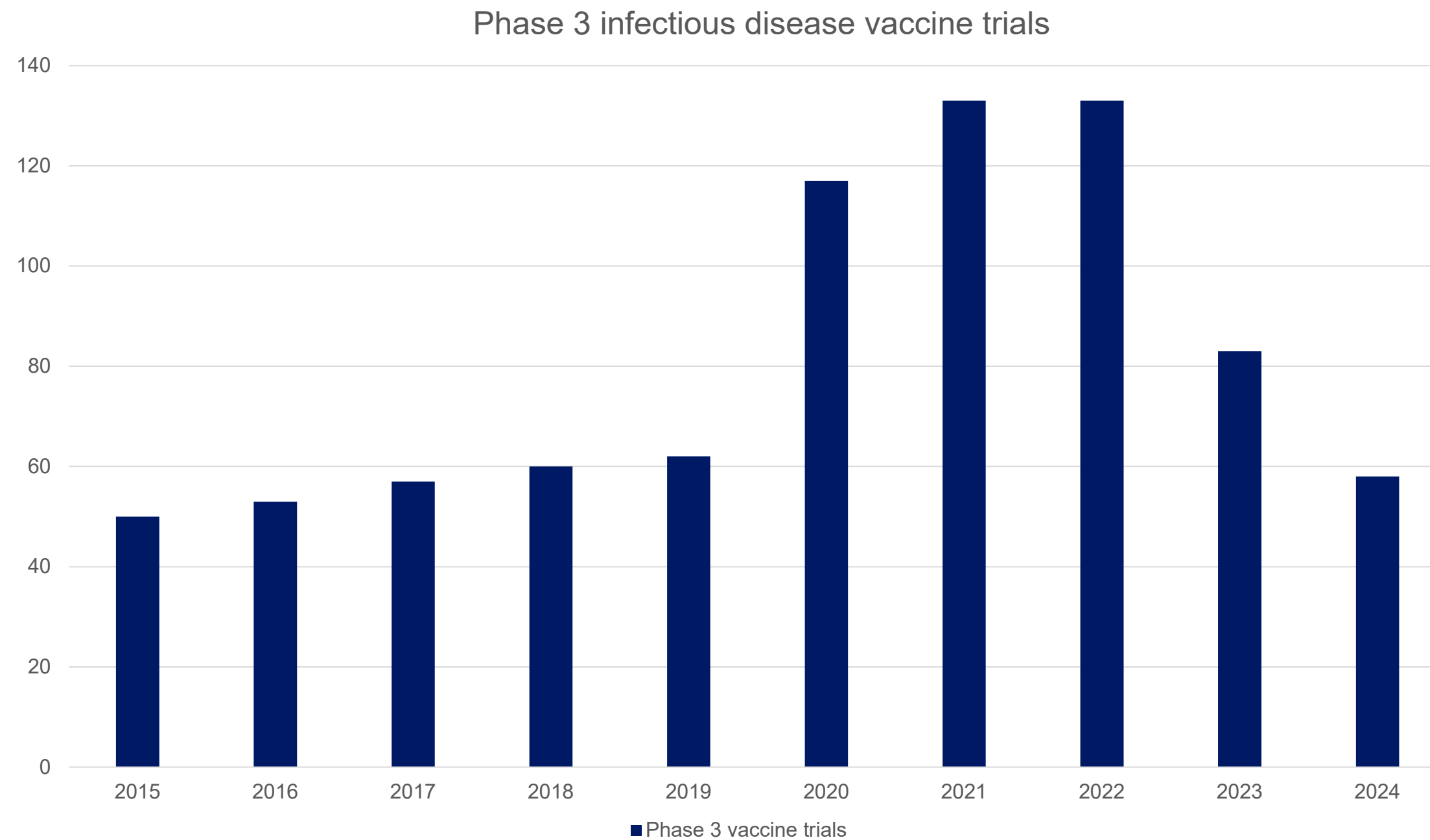


VACCINES typically account for 25% of the total global pharmaceutical R&D budget (\$5 billion to \$12 billion annually)

PWC, Economic footprint of the pharmaceutical industry in Europe, November 2024
EFPIA member associations, PhRMA, China Statistical Yearbook, 2024

Phase 3 vaccine study initiations by year (globally reported Clintrials.gov)

❖ All forms of Phase 3 (L2L consistency, efficacy, label extensions, variations, combination immunobridging, special populations) *Private & Public sponsors*



Private sector perspective for vaccine R&D financing

Companies have to address the *opportunity cost* of an investment

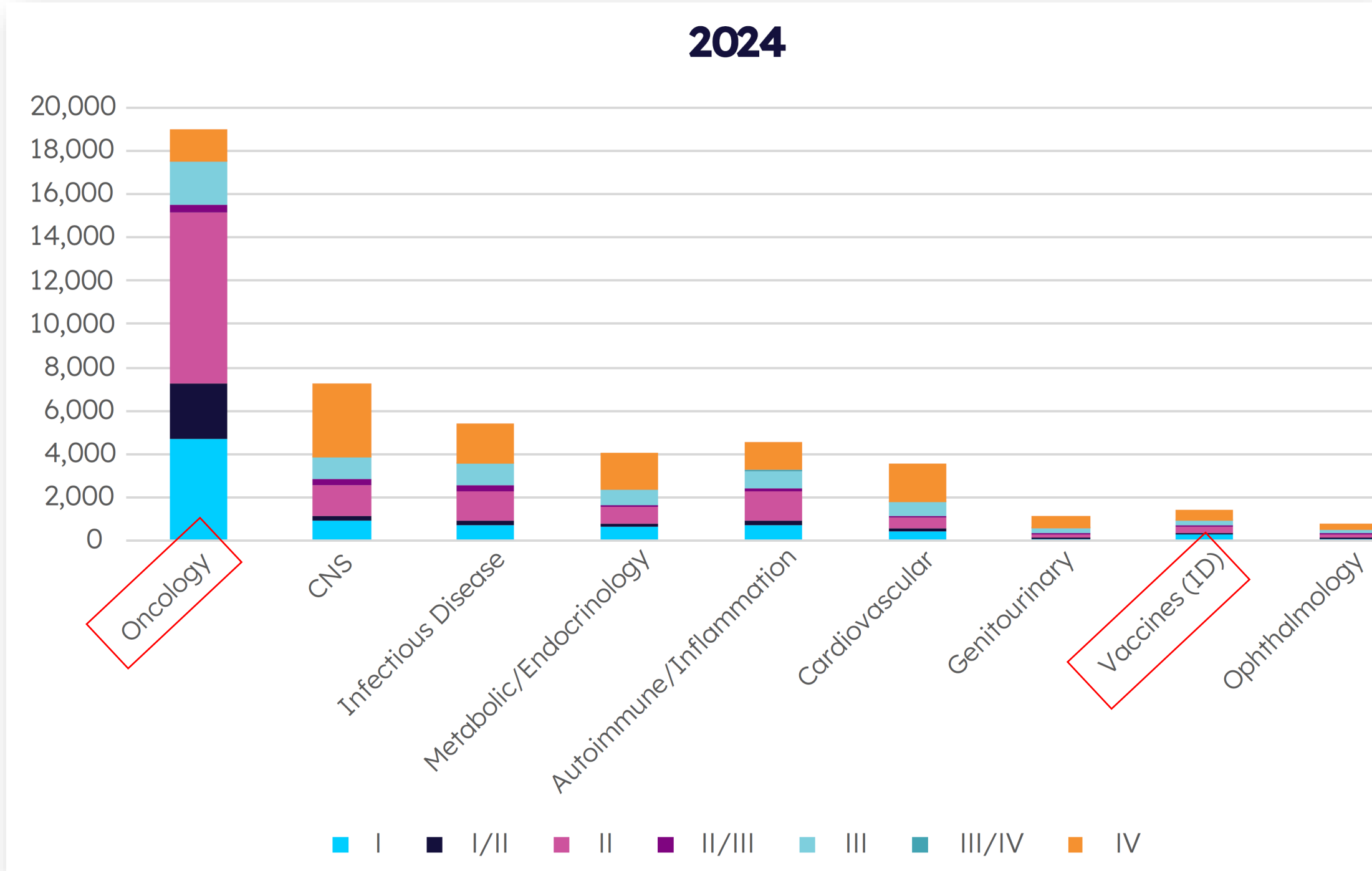
❖ Vaccines vs Immunoncology (generally US/EU perspective)

Business considerations	Vaccines	Immuno-oncology therapies
Development timelines	10-15 years ¹	5-6 years ²
Estimated development cost	\$1.5 billion	\$1 billion
Manufacturing	High complexity, higher CMC burden, inspections & batch consistency High right offs; High CAPEX investment required early.	Generally less burden; patient specific requiring careful identity controls.
Probability of technical & regulatory success (Ph1 asset)	30-40% ³	3-5% ⁴
Clinical development N	Thousands to tens of thousands	Hundreds to thousands ⁵
Approval requirements	Typically phase 3 efficacy, safety and immunogenicity	Sometimes Phase 2 data or surrogate endpoints (with post licensure commitments)
Approval timelines	Full BLA process; 6-month priority FDA review ⁶	Often rolling submissions; mean of 89 new Tx (2010-2019) mean 200 days FDA review
Label variations	Several years	Couple of years ⁷
Post licensure	Substantial costs; FDA, EMA and MHRA RMPs/PV	Risk Evaluation & Mitigation Strategies (REMS) for certain high risk therapies
Pricing	Commodity – premium range (private US PCV \$200 dose)	Premium+ (Keytruda US \$150,000/yr EU \$80,000/yr, Yeroy+Opdivo\$256,000/yr)
Blockbuster potential	Few (Gardasil \$8.9 billion in 2023, Prevnar-\$5 billion)	More common (Keytruda \$20.9 billion in 2022)
Global market / projections	\$35-45 billion annually (forecast \$159 billion by 2032) CAGR 78% through 2030	\$135 billion annually (forecast \$237 billion by 2030) CAGR of 10-20% from 2025 to 2034.

1: Timings outside of a pandemic; Gardasil over 11 years, Dengvaxia 20 years, subunit vaccines 8-12 years platform based approaches can shorten the timelines
2: Anti-PD-1 checkpoint inhibitors from Ph1 to licensure in 5 years. PDblocker for melanoma 3 years.
3: Vu et al.,The Challenging Economics of Vaccine Development in the Age of COVID-19 and What Can Be Done About It
4: Vu et al.,The Challenging Economics of Vaccine Development in the Age of COVID-19 and What Can Be Done About It
5: CAR T therapies approved on 50 to 100 patients
6: Atezolizumab, Durvalumab, Avelumab the rapid succession of approvals often just 2-3 years apart was aided by companies running parallel trials in different countries and regulators allowing expansion of indications quickly as data emerged.
7: HPV and Varicella vaccines
8: Lythgoe MP, Desai A, Gyawali B, Savage P, Krell J, Warner JL, Khaki AR. Cancer Therapy Approval Timings, Review Speeds and Pivotal Registration Trials in the US and Europe, 2010-2019. JAMA Netw Open. 2022 Jun 1;5(6):e2216183.

Pharma R&D investment is heavily focused on Oncology indication

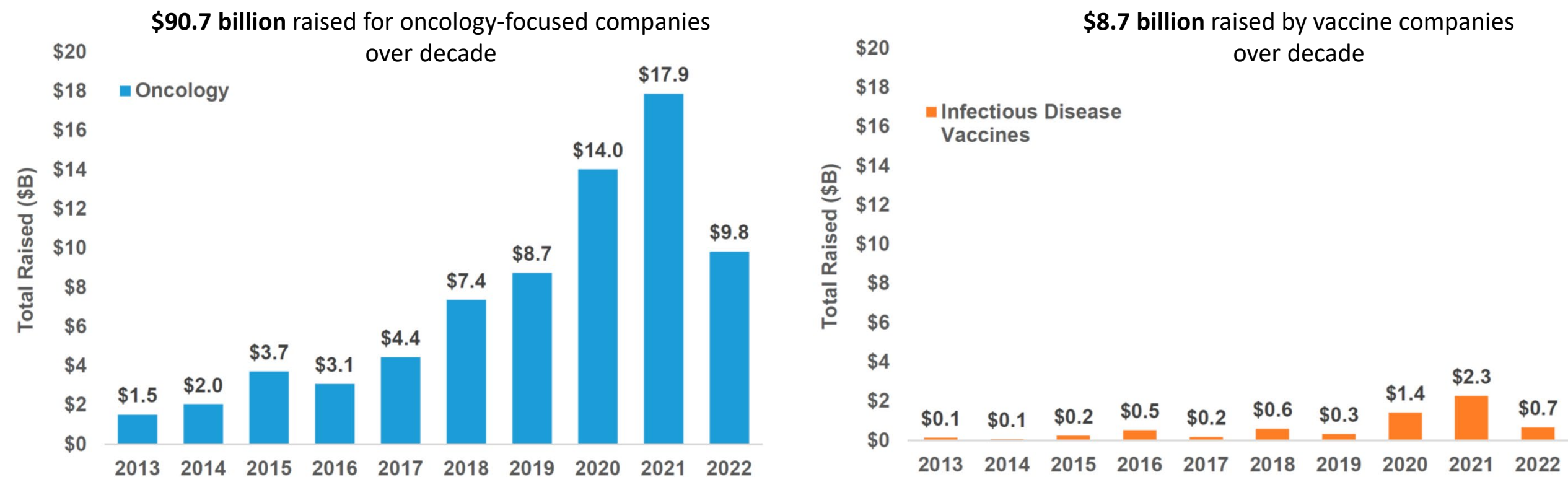
❖ Ongoing N clinical trials, by therapeutic area



Trialtrove®, January 2024

Global Venture Investment: Vaccines vs Oncology

❖ Global Venture investment into companies 2013-2022

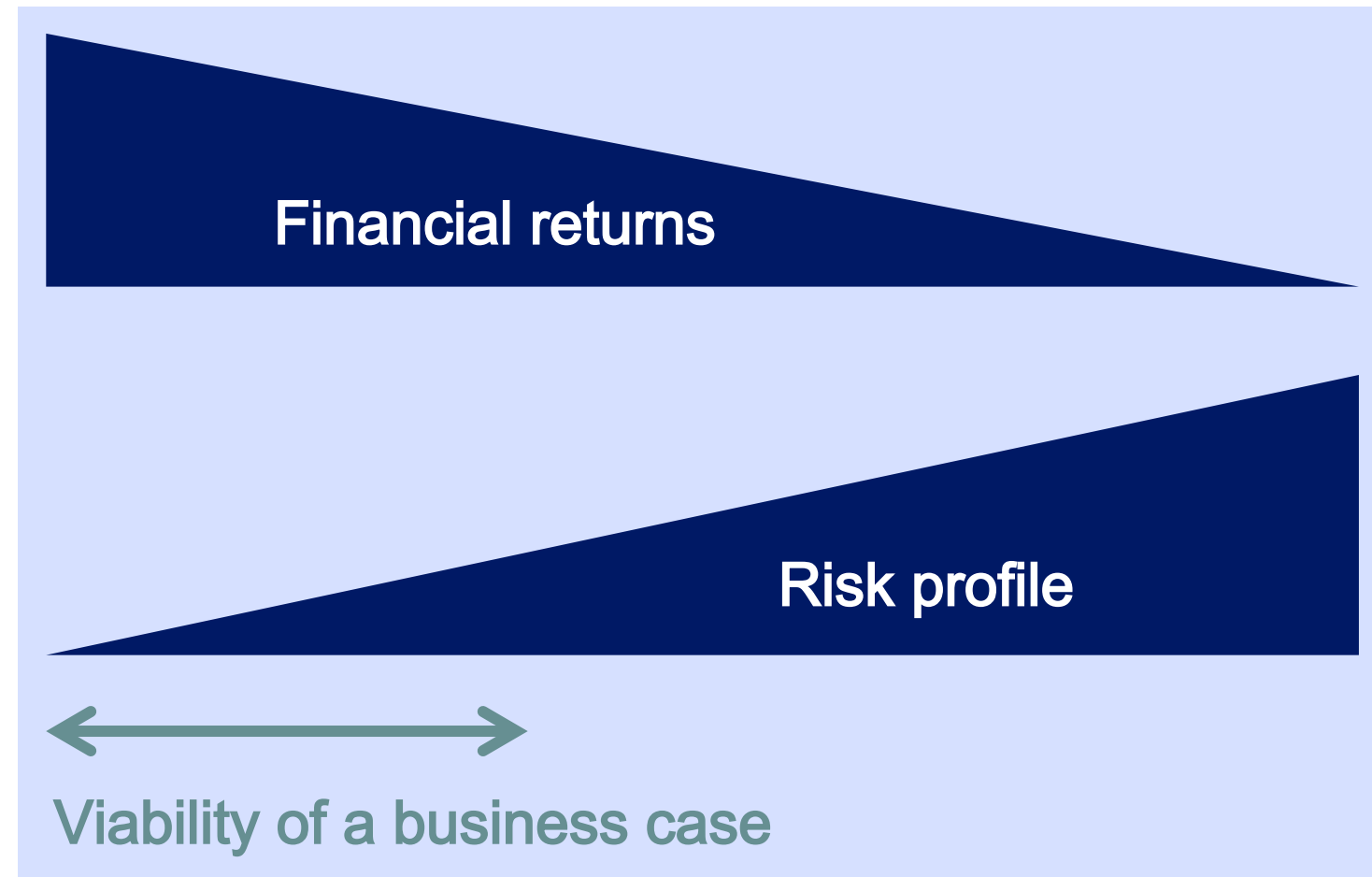


- ❖ The peak year for both types of companies was during the COVID-19 pandemic in 2021, with oncology companies raising \$17.9 billion and vaccine companies raising \$2.4 billion
REF: Thomas & Wessel, Bio Industry Analysis 2023

- ❖ VC investment into companies with vaccines from 2013 to 2022 totaled **\$2.2 billion** in the U.S. and **\$6.5 billion** worldwide (=3.4% of total worldwide venture capital raised for pharma field).
- ❖ Oncology drug development companies raised **\$90.7 billion** worldwide over the last decade, *12-fold more than vaccines*

Incentivizing vaccine R&D in the private sector (for first in class vaccines)

❖ How can the opportunity cost and the dilution of management time/HC be incentivized ?



Companies with **aviable business case** will NOT dilute returns and thus self fund

Companies with **no/questionable business case** may pursue incentives *if minimal* impact on interests (e.g. stock price, ability to raise capital elsewhere, capacity)

Incentives

New Regional Incentive Hubs

Hybrid Push+Pull Mechanisms
“Progressive Commitment”

Outcome-based pull funding

Milestone Bonds

Patent Vouchers

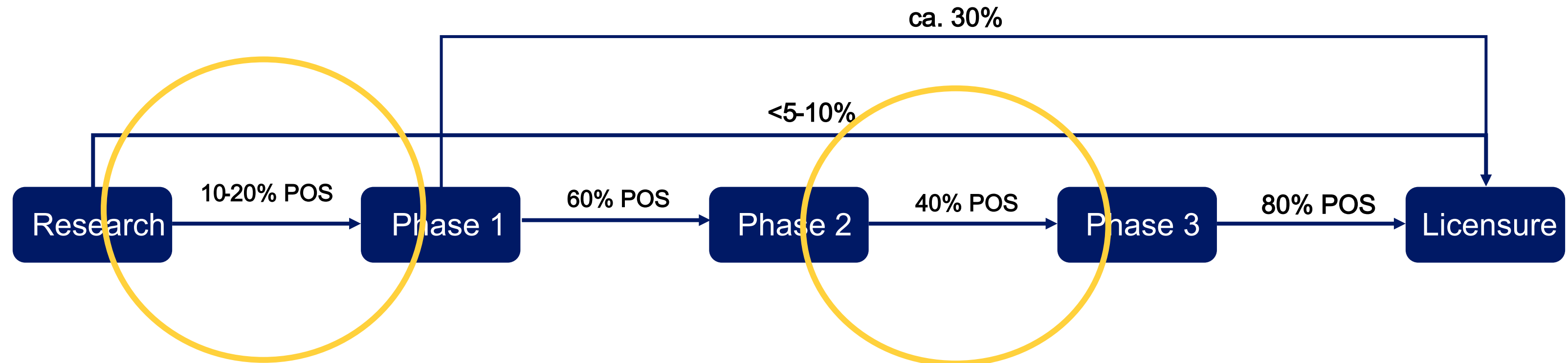
Reducing liability burden

Expanding market sizes

Novo Nordisk Foundation approach to Vaccine R&D funding

Vaccine attrition

❖ Probability of success between stages and two “drop off points”



Although references were used for these POS figures, the figures should be considered a composite range of estimates and varying significantly between industry or non industry sponsored (publications used, Wong et al. 2020, MacPherson et al., 2020, Struck 1996, Thomas & Wessel 2023).

NIVI – Novo Nordisk Foundation Initiative for Vaccines & Immunity

❖ NIVI comprises two entities

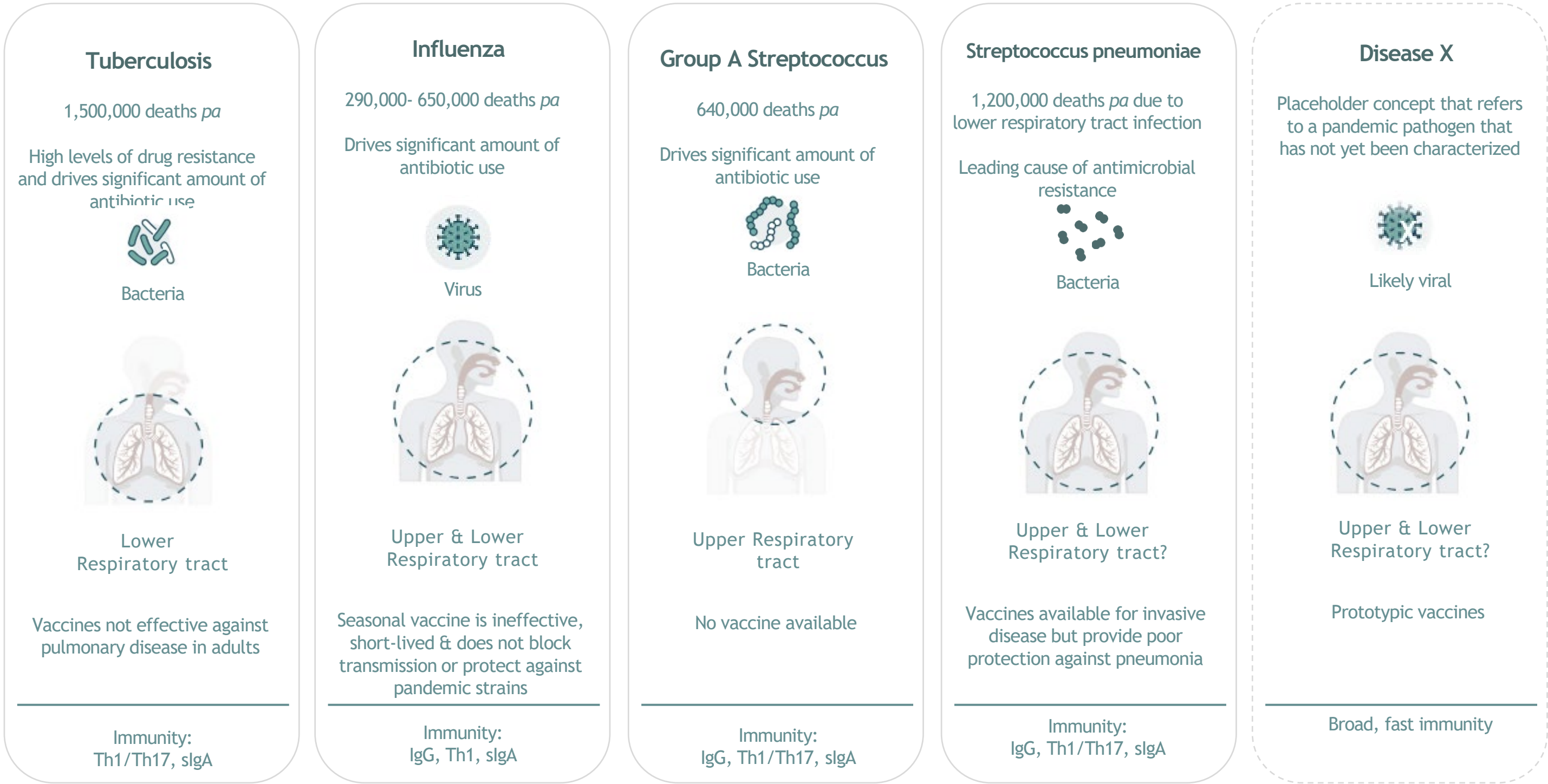
1) Large NNF funding to UCPH

2) NNF-owned Vaccine company

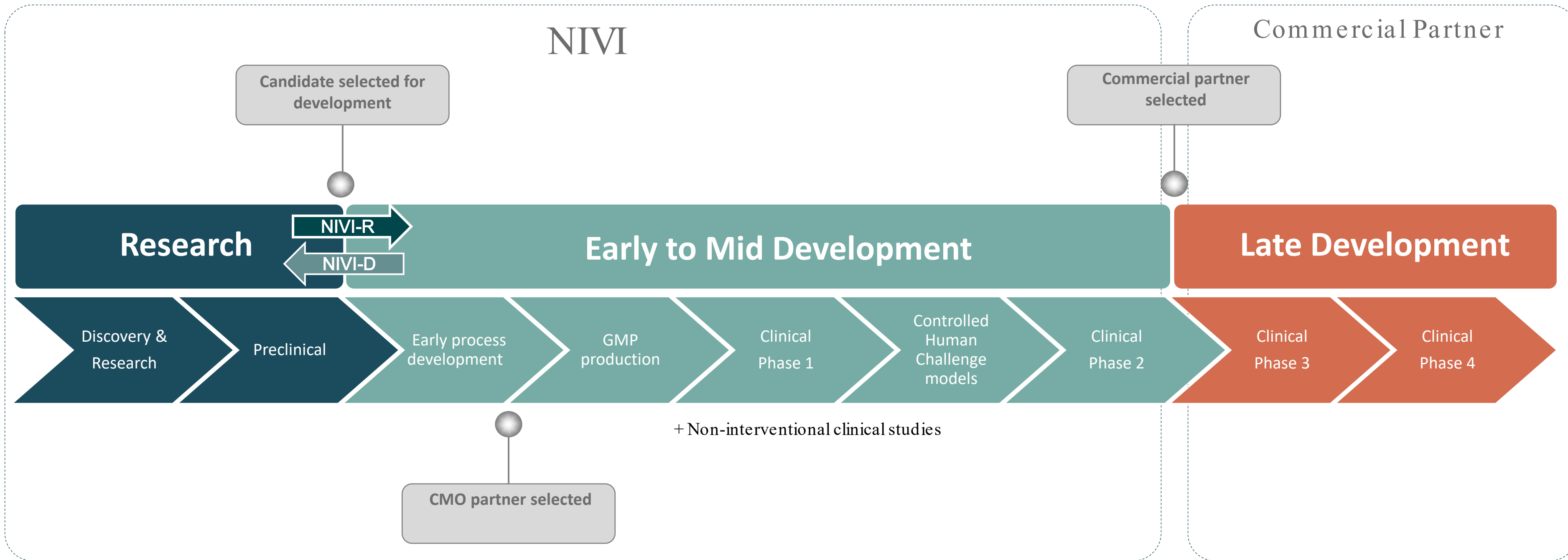


Harnessing Airway Immunity through innovative vaccine R&D to prevent airborne pathogens

❖ 4 targets within NIVI's portfolio, as well as prototypic approaches to Disease X



The NIVI-D company will provide translational and development capabilities



NIVI-D will provide key capabilities (either directly, or via external strategic partnerships) to ensure the full value chain from exploratory research to Phase II translational development can be achieved.

❖ Summary

- ❑ R&D capitalized cost, including CMC, for a first-class vaccine with global label claims **estimated at over \$1.5b** (ca. 70% on late development).
- ❑ Vaccine ID R&D expenditure globally & including ALL targets **are NOT available** Proxy's can be used to have a sense on expenditure in the private sector.
- ❑ The **opportunity cost** for a new vaccine R&D project are high within Pharma compared to other stronger business cases.
- ❑ Incentivizing vaccine R&D in the private sector is **challenging** especially for the larger developers.
- ❑ Novo Nordisk Foundation's financing model for NIVI **attempts to bridge attrition gaps and ensure research knowledge is pulled through rapidly into development & seek sustainability.**