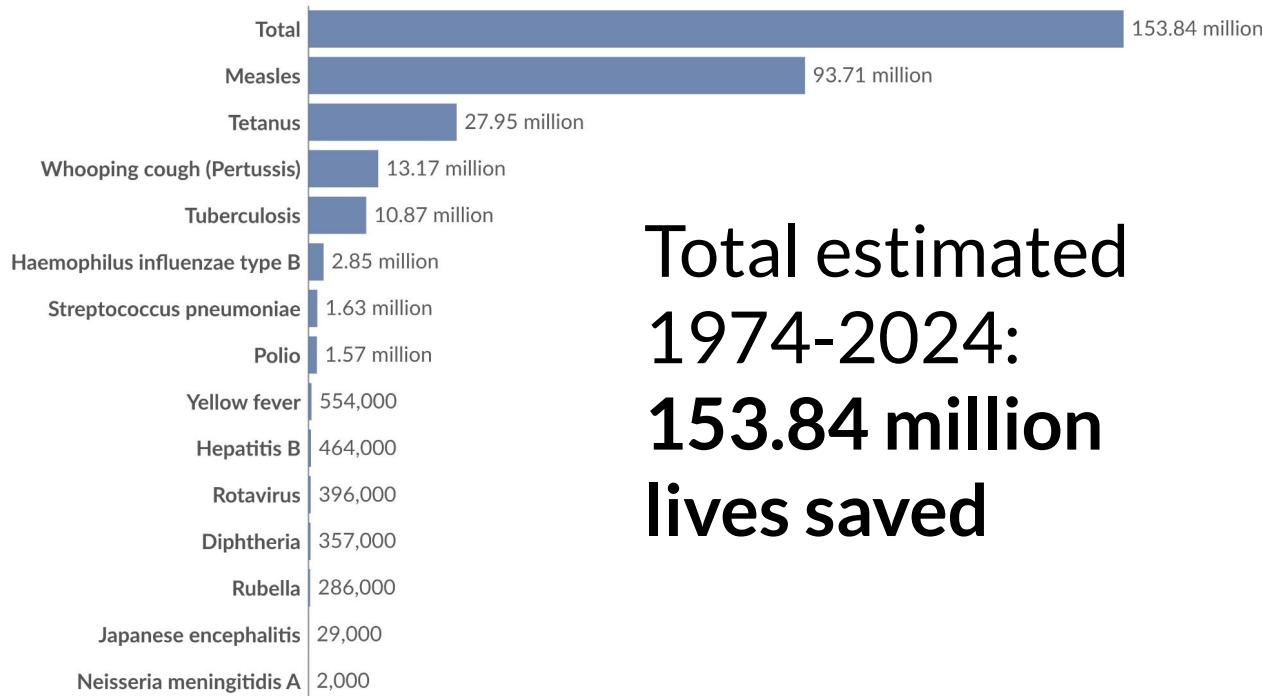


PopVax: Verifiable Open Source Vaccines to Save Millions of Lives from the Developing World Up

d/acc Discovery Day, Devcon SEA, November 2024

Number of lives saved by childhood vaccinations from 1974-2024 across the world



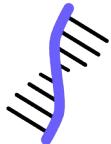
**Total estimated
1974-2024:
153.84 million
lives saved**

Data source: Shattock et al. (2024). Contribution of vaccination to improved child survival: modelling 50 years of the Expanded Programme on Immunization.

OurWorldInData.org/vaccination | CC BY

3 pathogens for which no effective vaccines exist take
>1.8 million lives across the world each year

Pathogen	Lives lost per year
Tuberculosis (in adults)	1M+
Strep A	500k
HCV	350k
(total)	>1.8M

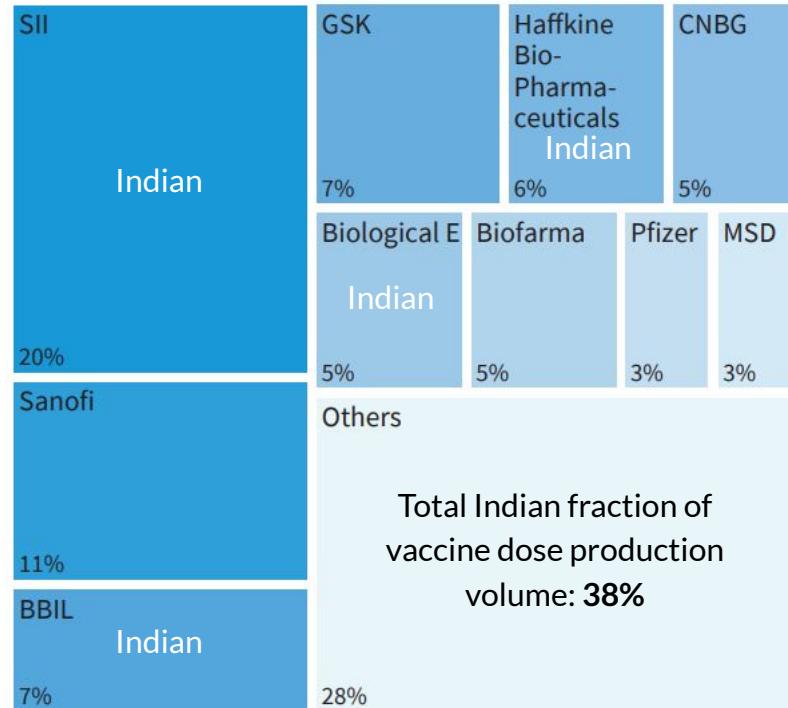


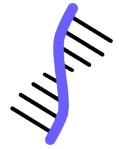
Vaccine development is *slowing down*:

- Malaria vaccines took 35 years from concept to licensure
- Vaccine development programs routinely cost 1 billion+ dollars end-to-end
- Vaccines are only dosed ~1-3 times, unlike eg. GLP-1 agonists like Ozempic, and cost less than many other therapeutic types
- Pathogens of particular relevance to developing countries (TB is the canonical example) considered low financial ROI



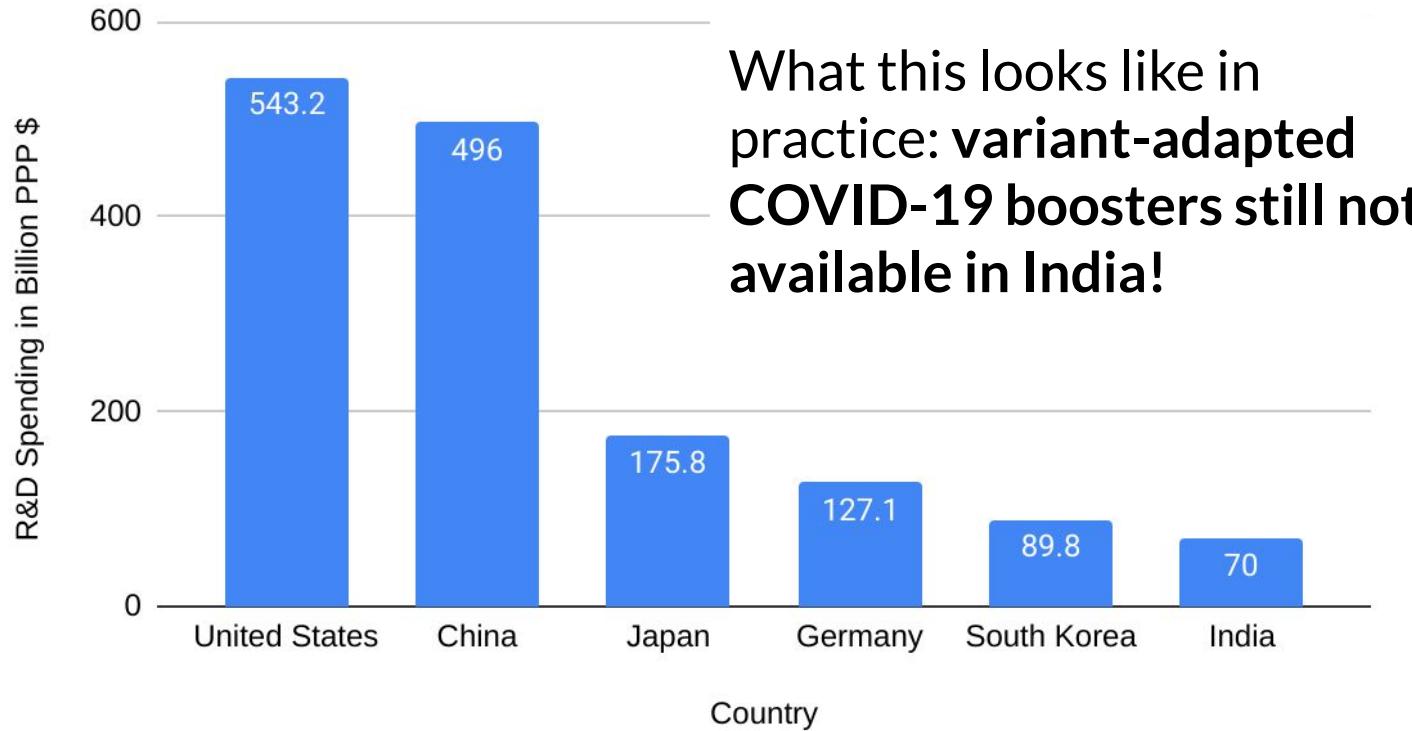
Top 10 Vaccine manufacturers by 2021 dose volume (excluding COVID-19)

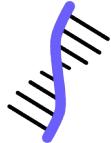




v/acc via 10x cheaper &
faster research in India

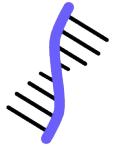
R&D Spending in Billion PPP \$ by Country





PopVax is solving longstanding vaccine design problems using mRNA and computational protein design in order to save millions of lives, leveraging the talent, cost, and speed advantages of operating in India.

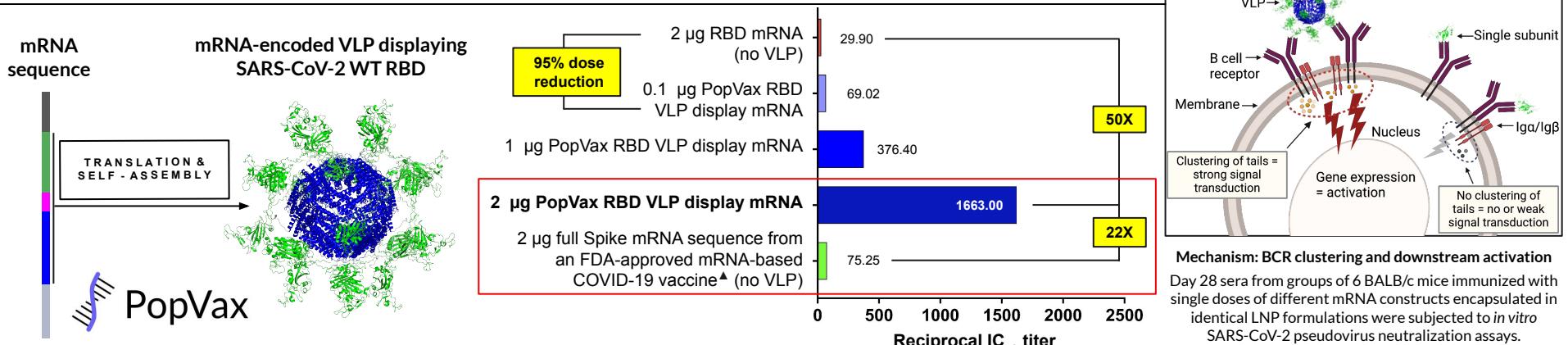




No one wanted to fund PopVax:

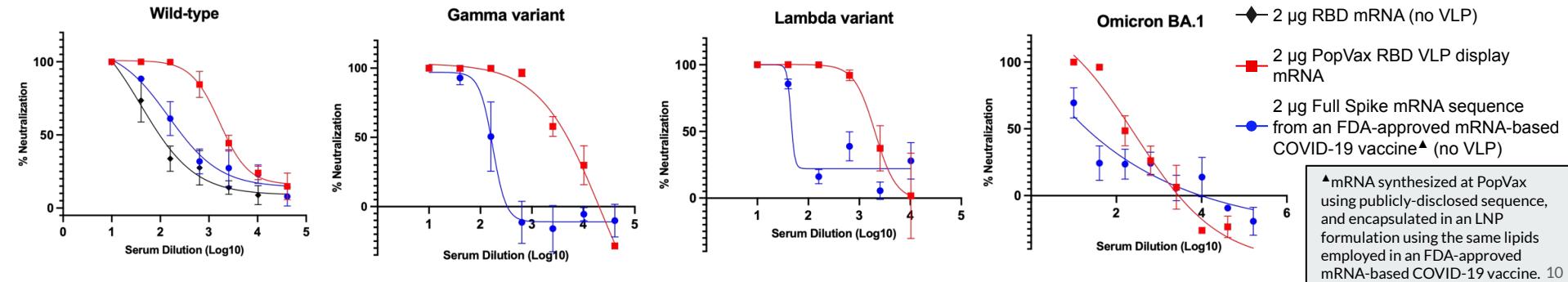
- VCs & nonprofits didn't believe the talent existed in India
- Gates Foundation took an early \$100k bet on us, but not enough to build an actual development platform and take something to clinic
- Good early data but company + me bankrupt
- Shiba Inu coin!
- Vitalik founded the biosecurity + public health org Balvi; funded us a cumulative \$15M+ over the past 2.5 years

PopVax's COVID-19 vaccine is 10-100x more potent than current vaccines



PopVax's immunogen display approach using mRNA-encoded VLPs results in a **>50x increase** in the elicited neutralizing antibody (nAb) titer *in vivo*, as well as a **>20x increase in nAb titer compared to the same dose of the mRNA sequence from a US FDA-approved COVID-19 vaccine.**

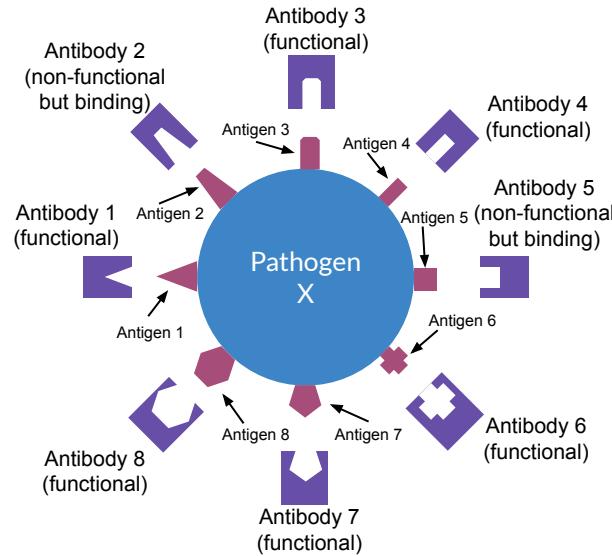
Our wild-type SARS-CoV-2 RBD-based VLP display construct was also able to elicit potent neutralization titer against the Gamma, Lambda, and Omicron BA.1 variants of COVID-19, while the FDA-approved mRNA-based COVID-19 vaccine comparator sequence at the same dose was not, demonstrating that the **VLP immunogen display approach results in the elicitation of antibodies that neutralize a greater breadth of variants.**



Structural reverse-vaccinology to solve challenging vaccine design problems

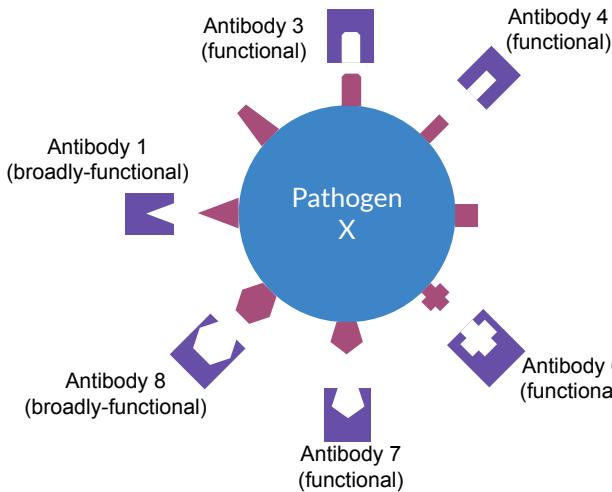
1

The immune response to a pathogen generates a wide variety of antibodies. Some only *bind*, while others are *immunologically functional* – they may neutralize, mediate effector function, or otherwise assist in clearing the pathogen.



2

Some of these functional antibodies are *broadly-functional antibodies* that have a potent effect against multiple variants of the pathogen and potentially even other related pathogens.



3

To develop first-in-the-world vaccines for pathogens against which naive vaccine design strategies have failed, we want to design immunogens capable of *focusing* the immune response towards these *broadly-functional* antibodies and away from non-functional antibodies.



TARGET SET OF ANTIBODIES to elicit with designed immunogen



Antibody 1 (broadly-functional) Antibody 8 (broadly-functional)

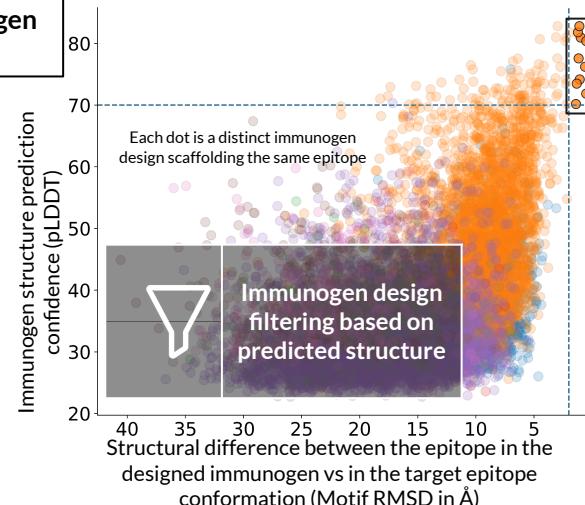
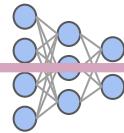


PopVax

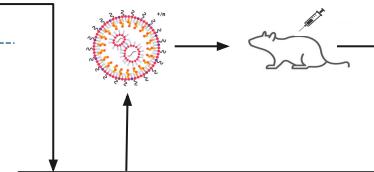
PopVax's immunogens are computationally designed, encoded in mRNA-LNPs & brought to life at scale in our wet lab

ML workflow for protein immunogen library design (example: HCV)

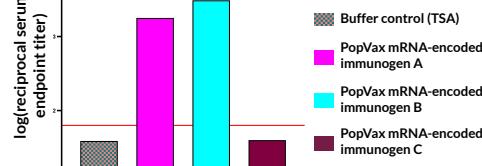
We use machine learning models conditioned on structure and sequence to generate scaffolds for target epitopes.



Each immunogen design is encoded in mRNA-LNP, then injected into mice



PVX141 Day 21 HCV IgG ELISA after a single mRNA-LNP injection in mice



Achieved in Years 0-3

SYNTHEZIZED

60+ unique novel ionizable lipids
including lipids engineered for targeted delivery

TESTED

2000+ unique LNP formulations
across *in vitro* & *in vivo* delivery experiments

SYNTHEZIZED

1000+ protein immunogen designs
encoded in mRNA & tested *in vitro*

INJECTED

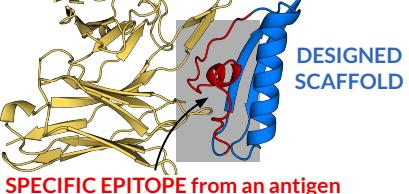
600+ unique vaccine constructs
into 5000+ mice to assess the immune response

PERFORMED

10000+ ELISA assays
to assess IgG response against specific antigens

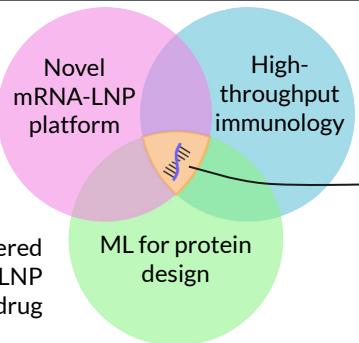
PERFORMED

1500+ PSV neutralization assays
to assess antibody functionality



PopVax's secret sauce: mRNA-LNP as a modality for designed proteins allows for unprecedentedly rapid design-build-test-learn cycles, not just *in vitro* but *in vivo*, while also ensuring that the final candidate can be smoothly transferred into GMP-grade production in months, not years.

A great protein design delivered via a bad mRNA architecture or low-efficacy LNP is a bad drug



A bad protein design delivered via an excellent mRNA-LNP platform is also a bad drug

Since founding, PopVax has built technical excellence at the intersection of these three areas, allowing to rapidly accelerate the development of vaccines against pathogens where existing design approaches have failed.

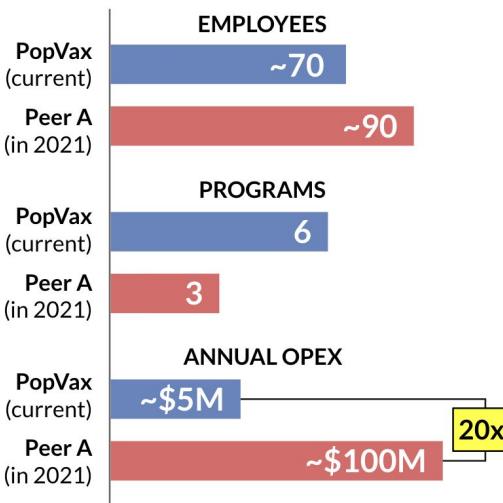
PopVax

vacc in India works!

In the course of our work on our next-generation COVID-19 vaccine, we have built out our mRNA-LNP, immunogen display, protein design, and GMP-capable manufacturing platforms end-to-end. We now intend to leverage these platforms to rapidly bring **best-in-class broadly-protective vaccines** and **computationally-designed first-in-the-world vaccines** to clinic.

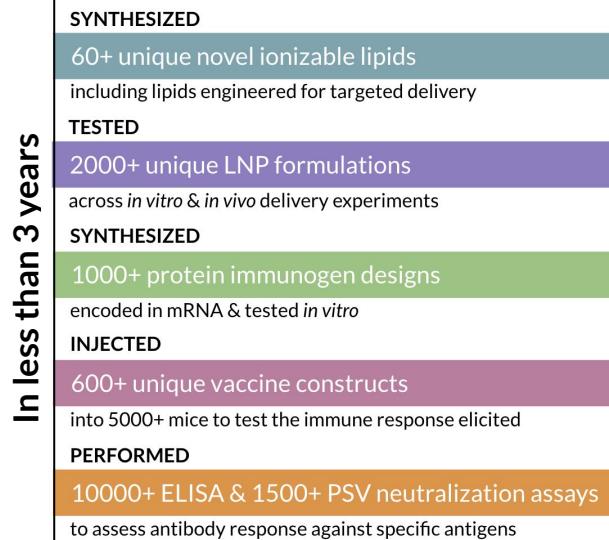
>10x efficiency in spending

PopVax is significantly cheaper operate than peer companies at the same stage and scale



>10x the testing throughput

Most vaccine design programs test on the order of 10^1 immunogens and a handful of delivery platforms or adjuvants. In contrast, PopVax has designed at 10^3 & tested *in vivo* at 10^2 scale.

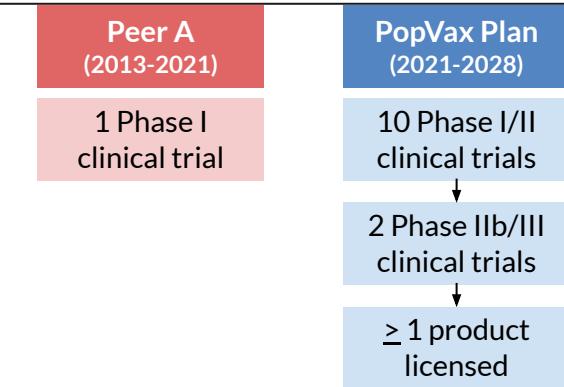


In less than 3 years

>10x the shots on goal

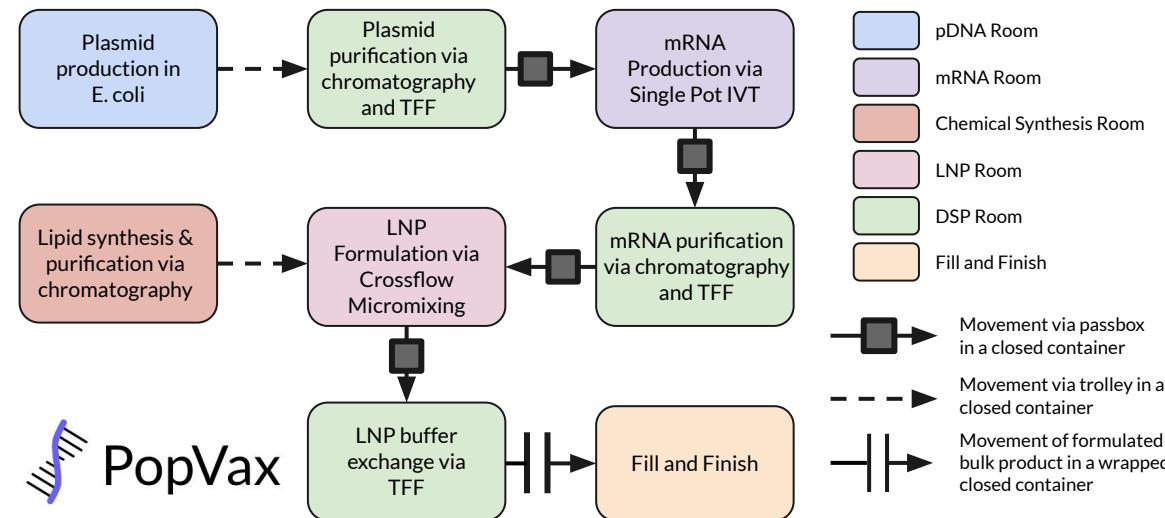
PopVax is singularly committed to advancing as many promising biomedicines to the clinic as quickly and efficiently as possible. We will take 10x more shots on goal than our peers for the same cumulative amount of funding, potentially saving 10x more lives.

After \$300M total funds spent



PopVax

In-house GMP mRNA-LNP manufacturing & QC allows us to rapidly and cheaply produce material for clinical trials



PopVax pDNA Room



PopVax Clean Corrido



Vax mRNA Room



PopVax DSP Room



PopVax | NP Room



PopVax OC Lab

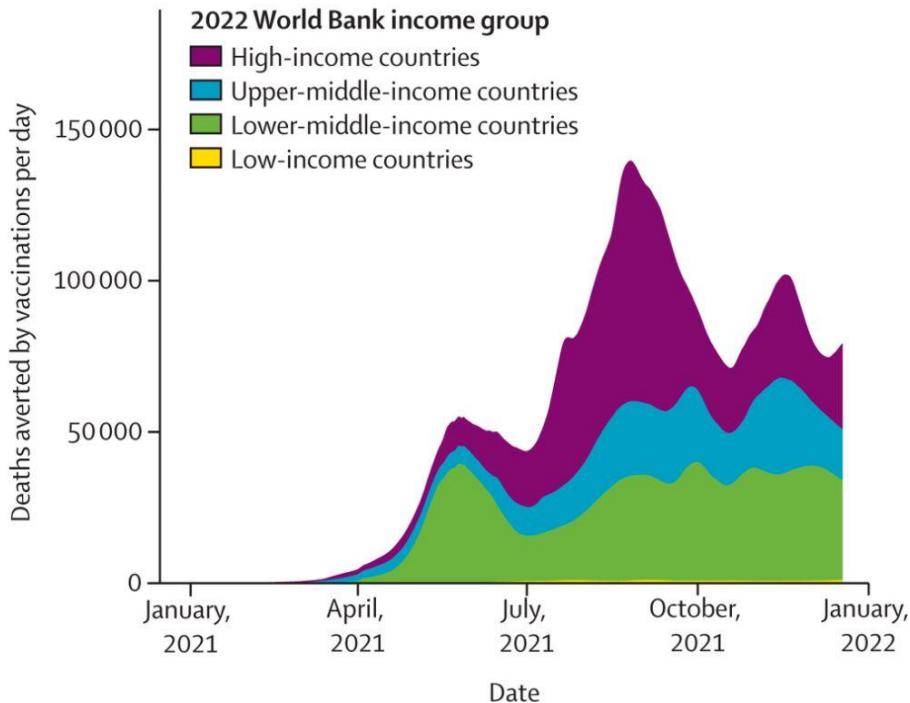
	PopVax's Key Release Assays
pDNA	Integrity and purity via SEC, AEX, and IP-RP HPLC; Host cell DNA via qPCR and host cell protein by ELISA; Total protein by BCA, Residual antibiotic content by ELISA.
mRNA	Integrity and purity via SEC, AEX, and IP-RP HPLC, as well as by Capillary Gel Electrophoresis; 5' capping efficiency and PolyA tail length by IP-RP-HPLC; Free/unincorporated nucleosides by IP-RP-HPLC; Residual DNA template quantification by RT-PCR; Residual T7 RNA Polymerase quantification by ELISA; dsRNA quantification by ELISA.
mRNA-LNP	Ionizable lipid purity and LNP composition by HPLC-CAD; Particle size, PDI, and Zeta Potential of LNPs by DLS+ELS; Encapsulated mRNA content and encapsulation efficiency for LNPs via RiboGreen assay.

PopVax's RNA Foundry in Hyderabad includes a **small-scale fast-turnaround GMP-capable manufacturing facility**. We are equipped for end-to-end mRNA-LNP production and quality control (QC) from pDNA to LNP encapsulation, including synthesis and purification of our novel ionizable lipids. This allows for rapid low-cost production of clinical trial batches.

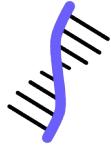
The facility includes:

- Eight ISO 7/8 Cleanrooms
 - A total capacity of 1 million doses/year with the ability to increase to 10 million/year

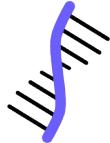
NIAID, part of the U.S. National Institutes of Health, has selected PopVax's next-generation COVID-19 vaccine candidate for inclusion in Project NextGen, under which NIAID will conduct & sponsor a US-based Phase I Clinical Trial for our vaccine in the first half of next year.



Estimated impact of
COVID-19 vaccines:
20+ million lives saved



Combating health inequity and vaccine hesitancy with **verifiable open source vaccines**

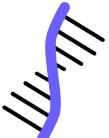


The PopVax Million Lives Mission

PopVax intends to develop, bring to licensure, and widely distribute effective vaccines against **HCV, Strep A, and Adult TB** over the next decade.

Pathogen	Lives lost per year	Realistic vaccine efficacy target	PopVax target lives saved per year*
Tuberculosis (in adults)	1M+	70%	700k
Strep A	500k	80%	400k
HCV	350k	80%	280k
(total)	>1.8M	N/A	>1.3M

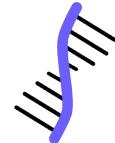
**Assuming 100% vaccine distribution to all at-risk populations*



A new sustainable model for public health vaccines:

- Philanthropic funding for vaccine R&D + clinical trials
- Full details needed for vaccine verification, further R&D + improvement, and manufacturing + QC released openly
- Transparent cost structure with a capped profit percentage in developing countries; licensing of IP on fair & transparent terms available publicly to any interested manufacturer
- Uncapped profits in rich countries
- ***Never privilege an extra dollar over a human life***





The PopVax Million Lives Mission

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Questions, suggestions, collaboration, funding:
soham@popvax.com