FACT SHEET

Stop TB Partnership
Working Group on New TB Vaccines

Modeling in TB vaccine development

Mathematical modeling can be a powerful tool when advocating for TB vaccine research and development (R&D).

What is a model?

Mathematical modeling is the process of using mathematics to represent a real-world problem to better understand it. Models can also help predict what may happen in the future.

TB models can be useful for:

- Understanding the natural history of TB or its epidemiology
- Developing TB care and prevention strategies
- Estimating public health impact and cost effectiveness of interventions (e.g. vaccines)
- Advocating for funding and research

Advocates can use modeling results that show the potential health and economic benefits of new TB vaccines to support their efforts to increase support and funding for TB vaccine research

Modelling can be considered the "best educated guess" for future impact. There are still many unknowns about TB, the characteristics of future vaccines, and how future vaccines will be made available and accessible. These unknowns will affect modelling predictions.

Terminology & key concepts in TB vaccine models

Vaccine efficacy (VE): Reduction in the chance of infection and/or disease an individual gains if vaccinated.

Duration of protection: How long a vaccine is effective for.

"A vaccine of 50% efficacy, duration of protection around 5 years in China, 4 years in South Africa and 3 years in India, could lead to ~25% reduction in TB incidence in 2050"
- After Harris, *Sci Transl Med*, 2020.

Incidence: Rate at which new cases occur in a population during a specified period.

The **time horizon** of the model is the time over which the costs and benefits of the vaccine have been calculated.

Other concepts used in vaccine modelling

Public health impact

Positive and negative changes in community health due to a policy or intervention.

Targeting

The population on which the model focuses, for example elderly, adolescents, or adults.

Cost-effectiveness

In terms of economic impact; the cost of a policy or intervention in relation to changes in health outcomes.

Implementation strategy

How the vaccine will be rolled out (e.g., routine vs mass vaccination campaign) and what percentage of the target population receives it.

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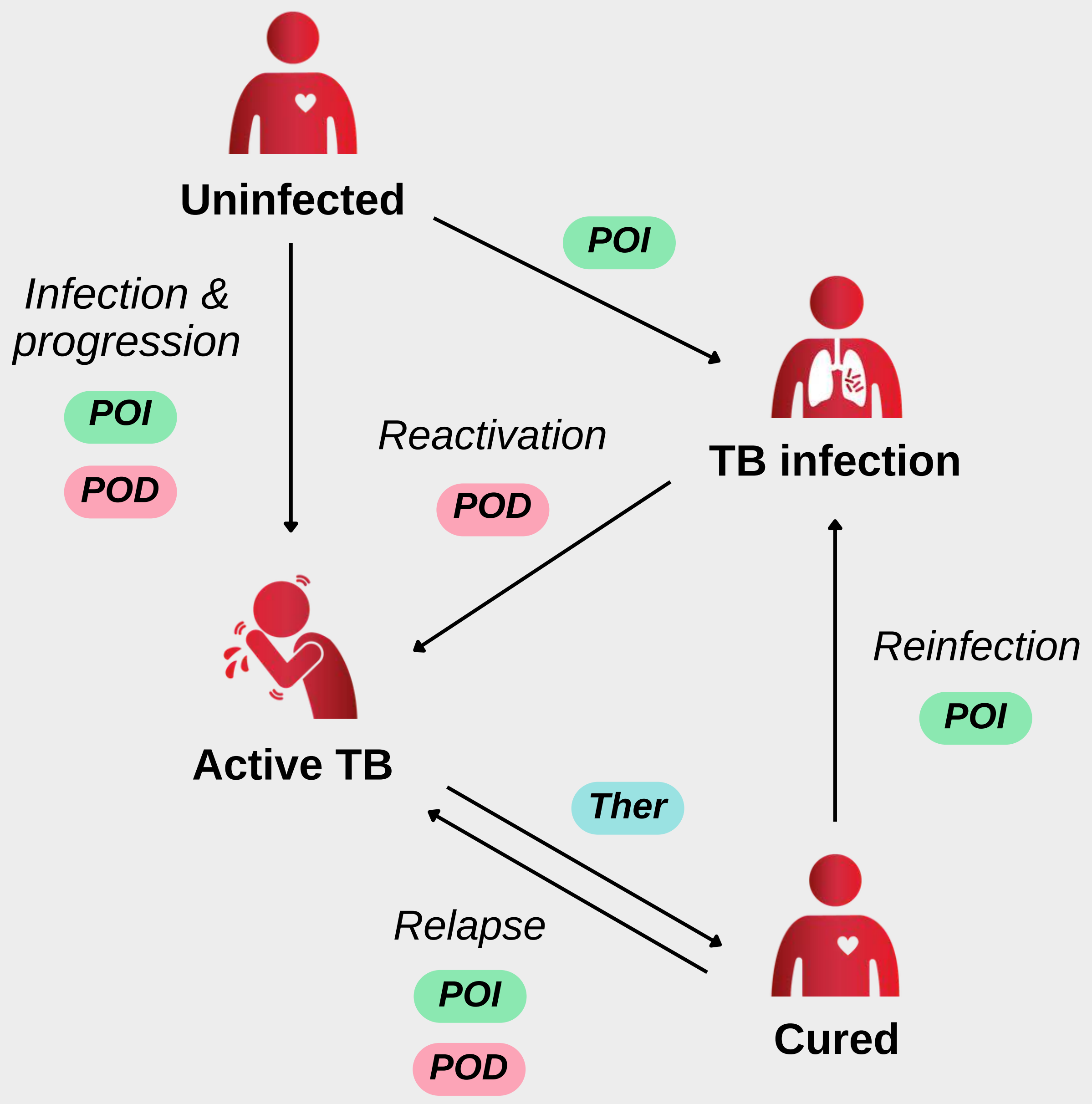

TB vaccine indications

Indication: A condition or circumstance that makes a particular type of treatment (vaccine) advisable. Vaccines may be indicated and effective if given pre-(before) and/or post-(after) TB infection.

POI — **Prevention of infection (POI) vaccine:** Reduce chance of infection or re-infection.

POD — **Prevention of disease (POD) vaccine:** Reduce the chance of disease.

Ther — **Therapeutic vaccine:** Shorten TB treatment and/or improve chances of cure.

Key takeaways from TB vaccine modelling literature

Prevention of infection (POI) vs Prevention of disease (POD)

Over 2025-2050, **POD vaccines would provide faster and greater impact than POI vaccines**; but the impact of POI vaccines increases in higher transmission settings, e.g., India and South Africa.
- Harris, *Sci Trans Med.* 2020.

Pre-(before) vs post-(after) infection

In China, South Africa and India, **a POD vaccine in post-infection populations would have the greatest impact**, but POI or POD vaccines in pre-infection populations have increasing impact in higher transmission settings.
- Harris, *Sci Trans Med.* 2020.

Duration of protection

In lower and middle income countries (LMICs), **as little as 5 years protection may be cost effective if targeted at adolescents and adults**; with 10-yearly mass campaigns and 50% VE, duration of protection of ~5 years in China, 4 years in South Africa and 3 years in India could lead to **~25% reduction in TB incidence in 2050.**
- Knight, *PNAS*, 2014 and Harris, *Sci Tans Med.* 2020.

Vaccine efficacy (VE) & cost-effective dose price

In LMICs, **as low as 20% VE could be cost effective if delivered to adolescents and adults.** For a 50% VE, 10 year duration of protection, pre- and post- infection, POD vaccine, the cost-effective price could be USS6-8 per dose if delivered to adolescents and adults.
- Knight, *PNAS*, 2014.

Visit http://tb-mac.org/Resources for more publications & resources about TB modelling.