WORLD BANK GROUP
Health, Nutrition & Population

2018 SKILLS BUILDING PROGRAM

BIG DATA, ARTIFICIAL INTELLIGENCE AND DECISION SCIENCE IN HEALTH AND NUTRITION

Optima TB optimization analysis

In partnership with

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Transform Africa through Machine Intelligence

GHCC Global Health Cost Consortium

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Optimizing resource allocation to best meet objectives

How should the budget be allocated amongst these ‘n’ programs, modalities, and delivery options, considering their interactions with synergies and limitations?

Wanting to achieve maximum impact

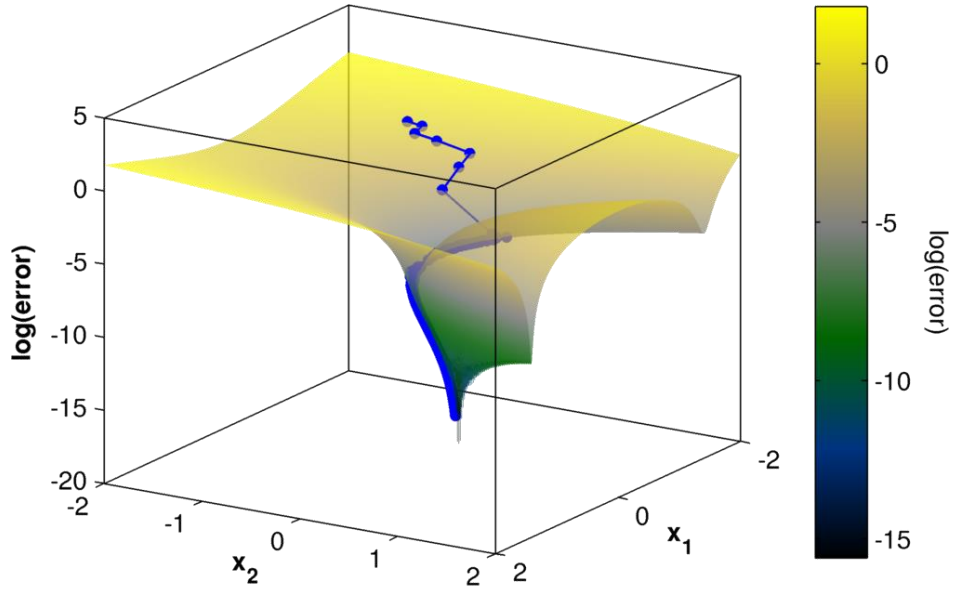
- National strategic plans often have multiple objectives to be achieved before the end of the strategy timeframe
  - For example:
    - 60% reduction in TB incidence by 2022 (compared with most recent levels)
    - 50% reduction in TB-related deaths by 2020 (compared with most recent levels)
    - Attain universal treatment coverage by 2035
  - Simultaneously get as close as possible to all national strategic plan targets with the funding available

Theory of optimization

Aim: For a given amount of money, what's the best outcome we can achieve?

"Best" could mean:

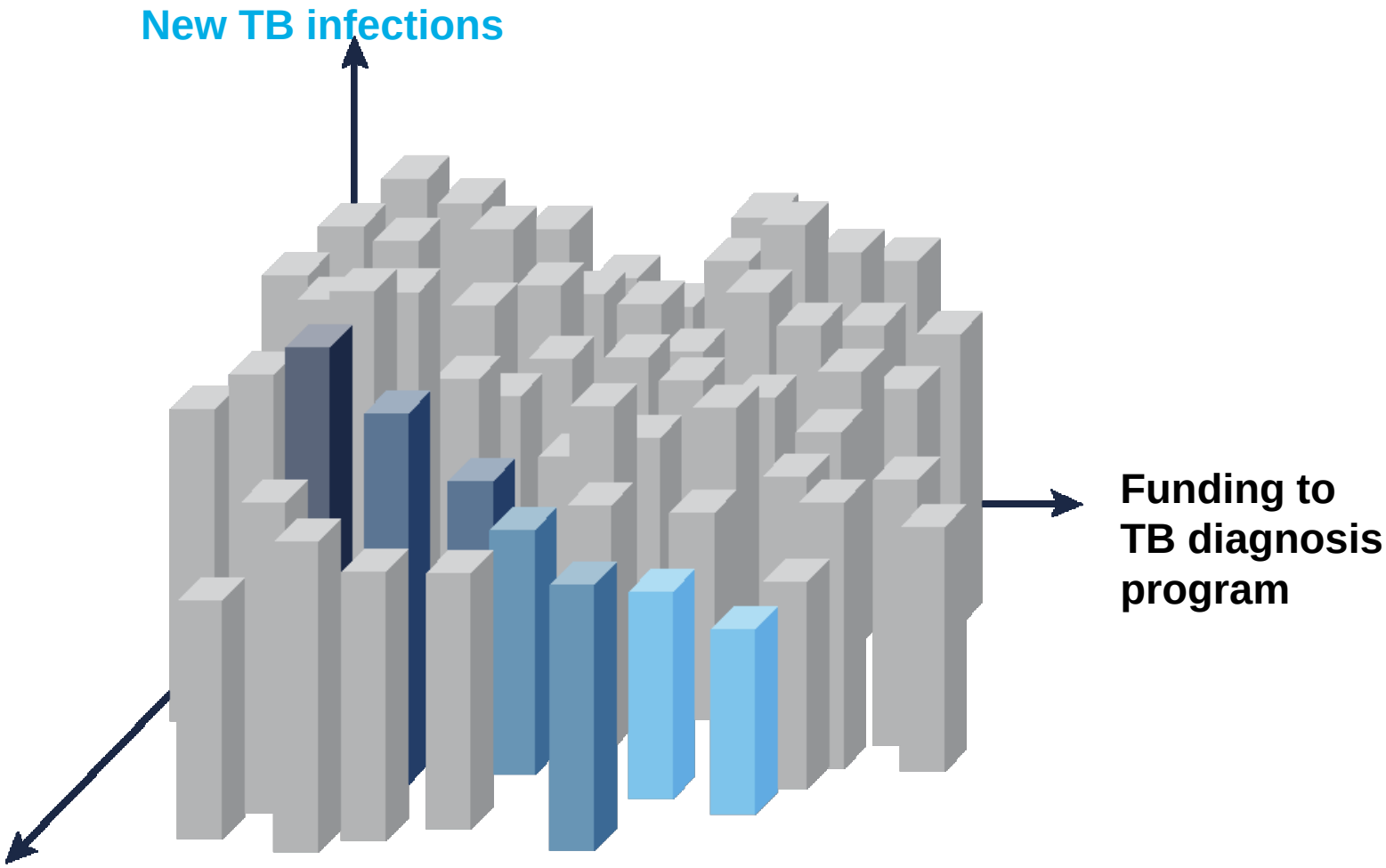
- Fewest infections
- Fewest deaths
- Lowest costs
- All of the above



Formally:

For resource vector $\mathbf{R}$ such that $\sum \mathbf{R} = \text{const.}$ and outcome $O = f(\mathbf{R})$, find $\mathbf{R}$ that minimizes O.

Optimization between just two programs



An efficient Adaptive Stochastic Descent algorithm is applied

Adaptive: learns probabilities and step sizes
Stochastic: chooses next parameter to vary at random
Descent: only accepts downhill steps

Kerr et al. 2018

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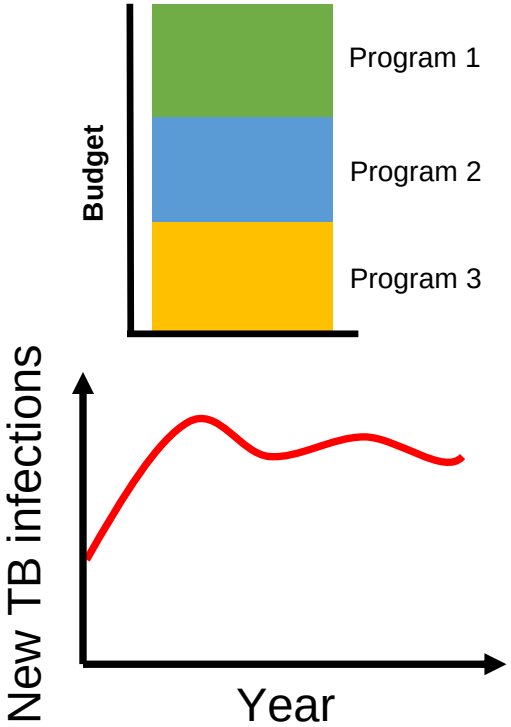
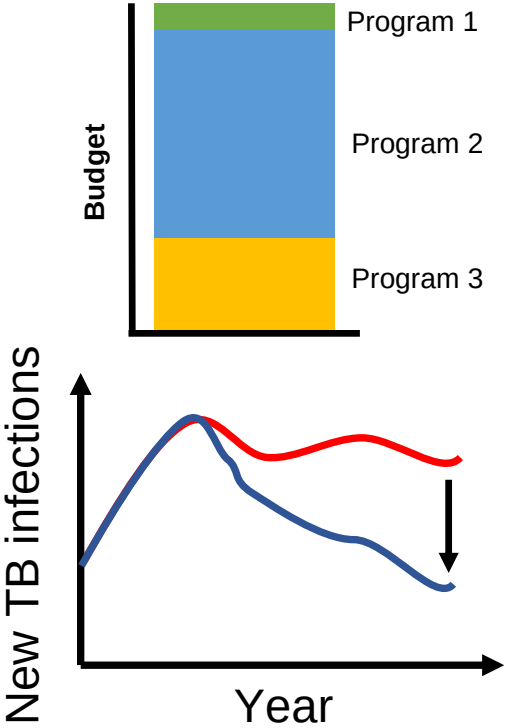
Optimizing resource allocation: What does it do?

Optimized allocation redistributes budget across the most cost-effective combination of programs

Most recent allocation

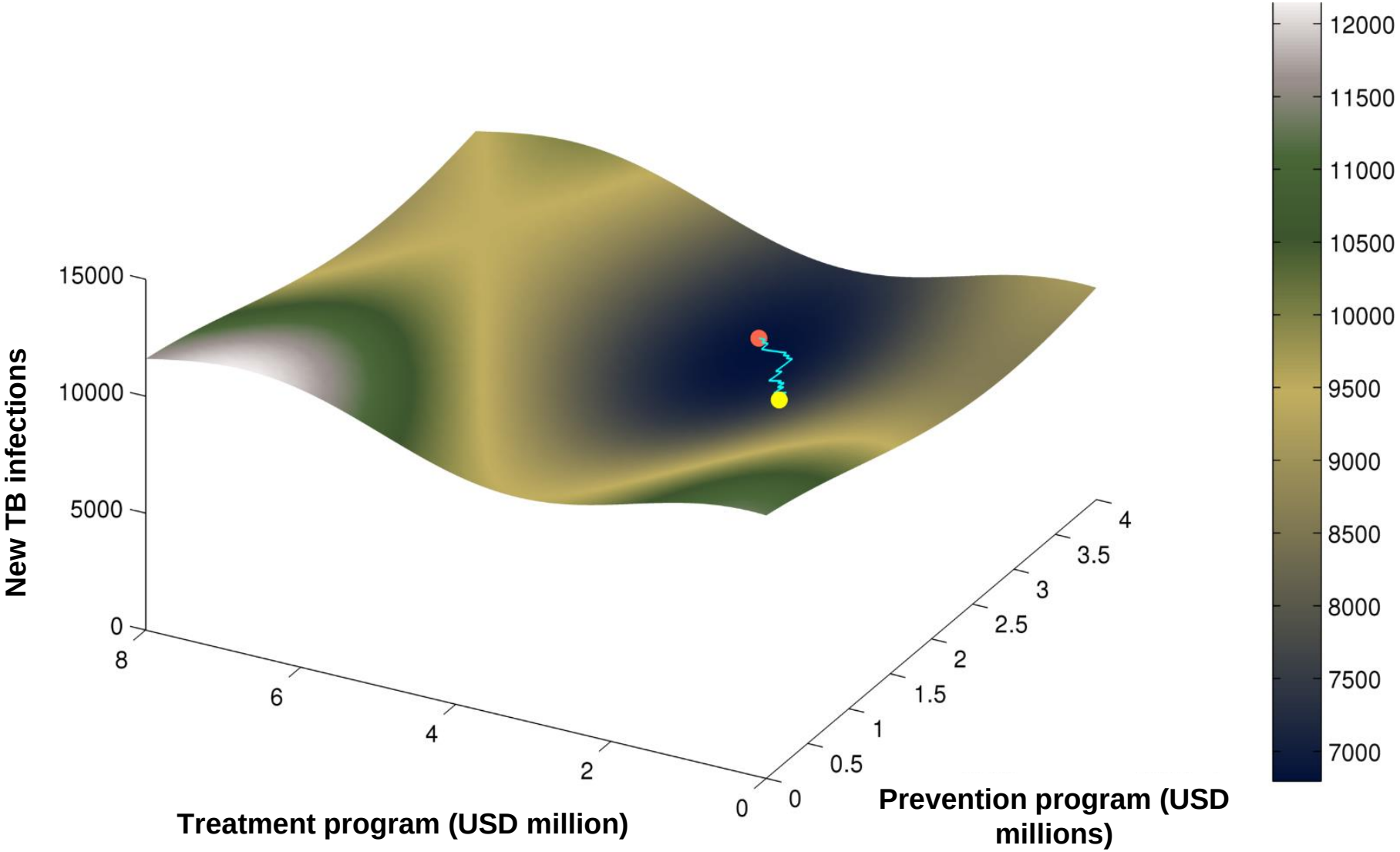


Optimized allocation



Optimization aims to identify the best combination of investment in programs to minimize new TB infections and/or TB-related deaths

Different allocation lead to a certain result



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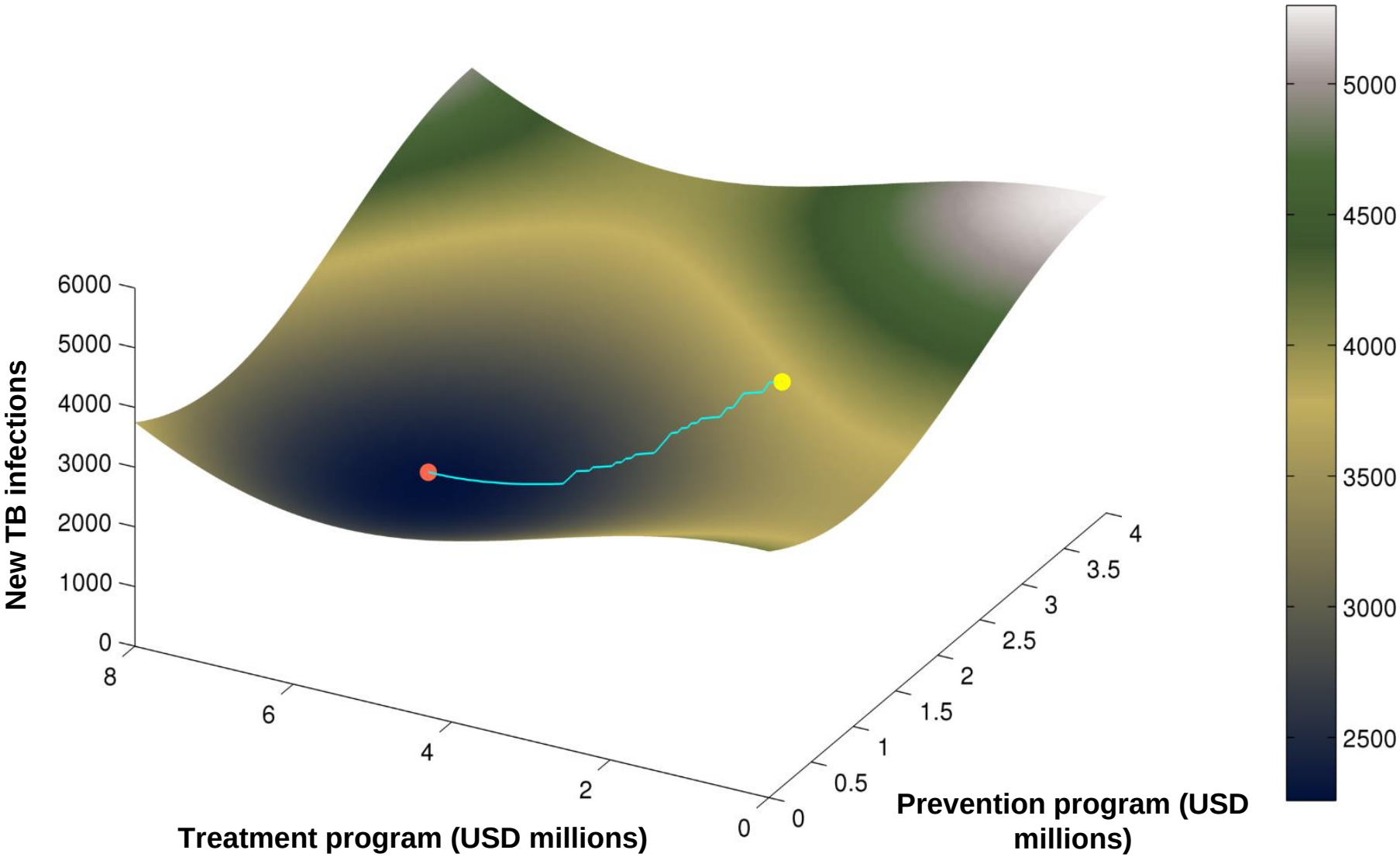
Different allocation leads to different results



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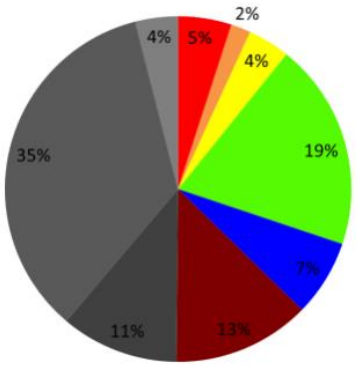
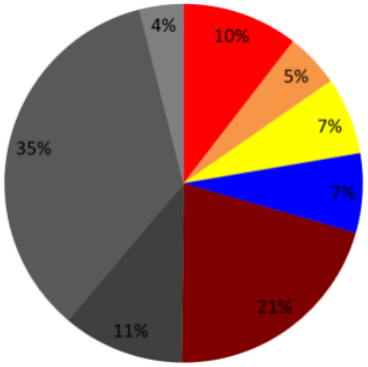
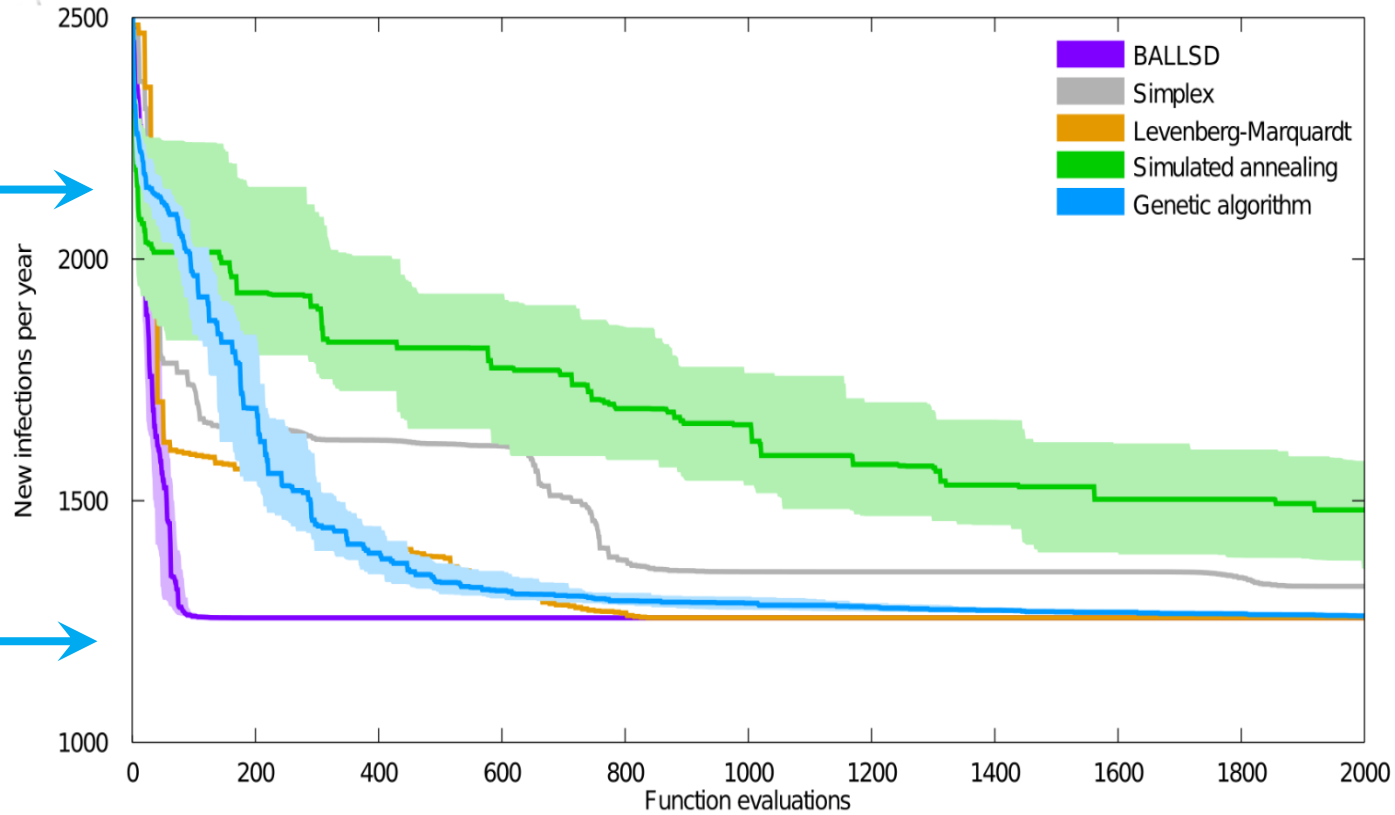
Comparing optimization algorithms

Most recent



Optimized





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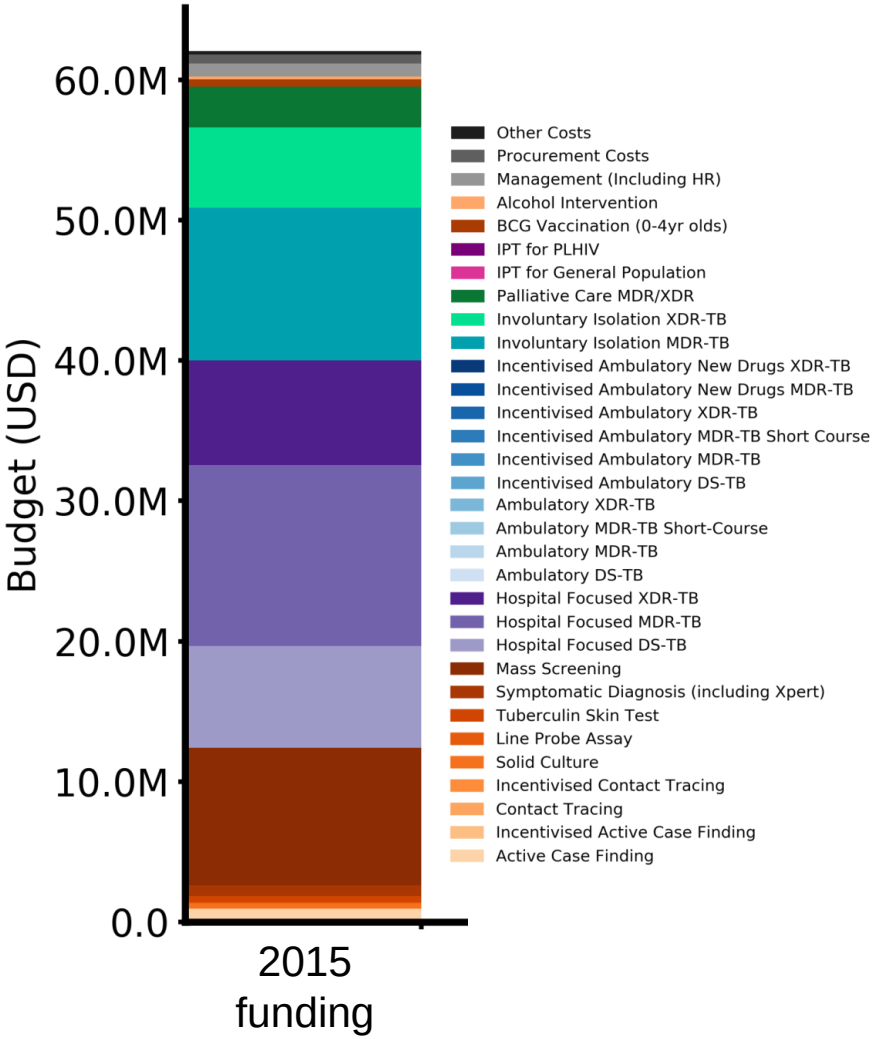
Impact of optimized budget allocation

- 2015 funding $61 million
- Could a different budget allocation:
  - Avert more new infections?
  - Prevent additional TB deaths?
  - Decrease the number of MDR/XDR-TB cases?
  - Bring us closer to 2020 and 2035 targets?

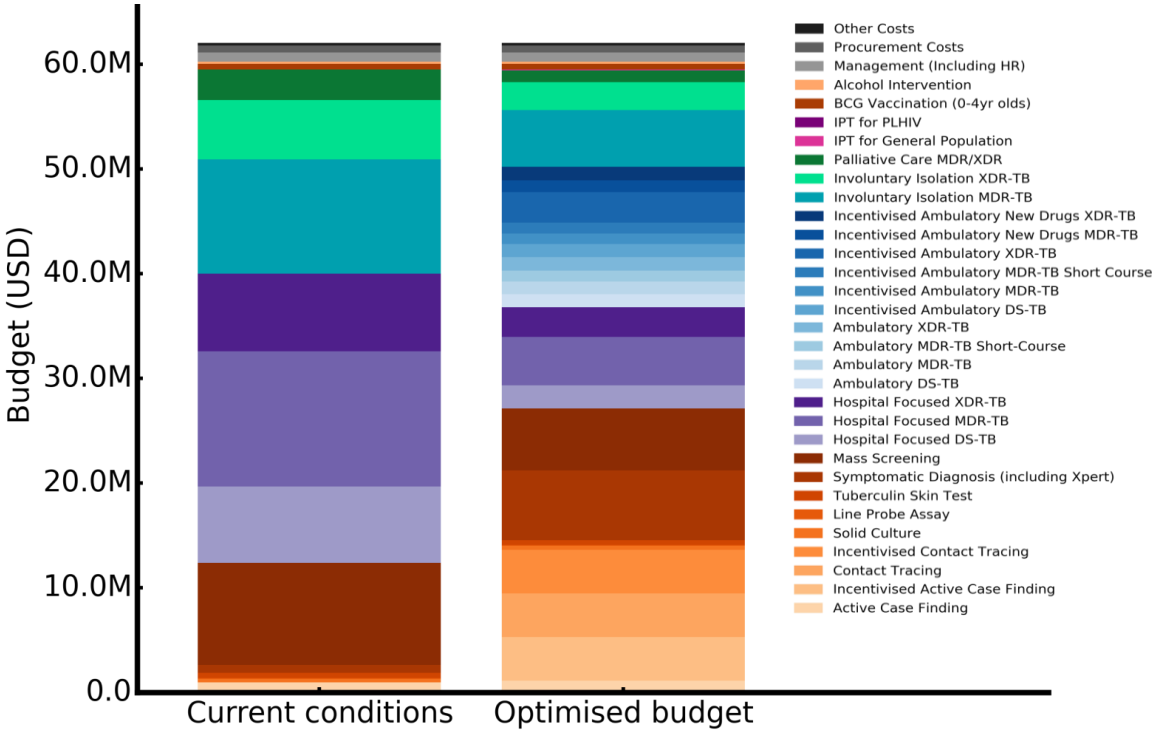


Optimizing TB program funding allocations

After identifying the initial starting budget, targets and constraints, the most recent budget allocation is optimized

To reduce incidence, prevalence and TB-related deaths, **an optimized budget allocation:**

- **Doubles the budget for testing programs**, with a marked shift towards active case finding and contact tracing while reducing mass screening
- Shifts funding from hospital-based to ambulatory treatment modalities



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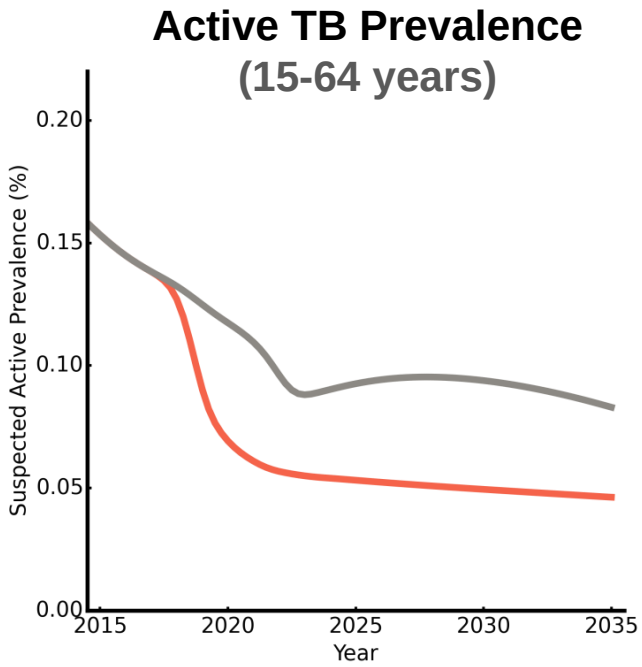
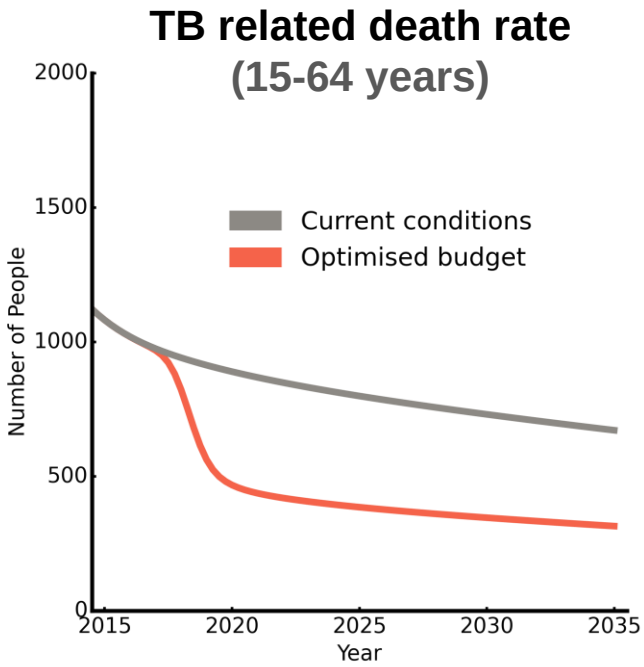
Impact of optimized budget: general population

With the optimized budget, we can compare its impact against the most recent conditions overall

- Among the general population An optimized budget allocation could:
  - Reduce adult TB prevalence by 45% to 0.05% by 2035 in comparison to most recent funding
  - Reduce TB-Deaths by 60% in comparison to most recent funding, and 70% of 2015 levels, by 2035





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Recap: optimization

- **Optimization** uses mathematical algorithm to identify combination of programs that will have maximal impact

- Impact can be defined for **one or multiple targets**, such as
  - Reducing infections
  - Reducing number of active cases
  - Among one or many populations

- **Constraints** and **implementation limits** are included and should be defined

- **Compare optimization for multiple targets** to identify consistent trends

- Use optimized budget to **compare progress towards goals**

QUESTIONS?