Artificial Intelligence for Social Good: Our Approach at Wadhwani AI

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Wadhwani AI

AI FOR SOCIAL GOOD

2018 SKILLS BUILDING PROGRAM

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

WORLD BANK GROUP
Health, Nutrition & Population

AI, Decision and Delivery Science In Health: an Overview and World Bank Perspective

Marelize Görgens, World Bank

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Wadhwani AI — AI FOR SOCIAL GOOD

THE UNIVERSITY OF SYDNEY

saMRC advancinglife

Machine Intelligence Institute of Africa — *Transform Africa through Machine Intelligence*

UNIVERSITY OF COPENHAGEN

iDSI — Better decisions. Better health

FPD

GHCC Global Health Cost Consortium

UNDP

BILL & MELINDA GATES foundation

Key Messages

- This meeting is at the nexus of **3 things that the World Bank believes is essential** to reduce extreme poverty and boost shared prosperity
  1. Disruptive Technology and Artificial Intelligence for Development
  2. Human Capital Development
  3. Universal Health Coverage
- For countries to reach towards universal health coverage, they need to focus both on **WHAT to finance** in health (priority setting) and **HOW to implement it well** (service delivery and quality)
- During the past 5 years, progress has been made with **developing and using decision science tools** – including some big data analytics – to improve priority setting and delivery of health and nutrition services

1. Disruptive Technology and Artificial Intelligence: The World Bank's focus

https://youtu.be/KtTuA-PLrAg

2. Important of Human Capital: World Bank Focus on the Human Capital Project

https://www.youtube.com/watch?v=wbHUyXTLWRM

3. Importance of Universal Health Coverage

- Health is a foundational investment in human capital and in economic growth—without good health, children are unable to go to school and adults are unable to go to work.
- UHC is also key to achieving the World Bank's twin goals of ending extreme poverty and increasing equity and shared prosperity.
- Essential part of the Sustainable Development Goals:
  - **SDG 3** includes a target to "*achieve universal health coverage, including financial risk protection, access to quality essential health care services, and access to safe, effective, quality, and affordable essential medicines and vaccines for all*."

To achieve UHC, some priority setting is needed
Core characteristics of health priority setting processes

- How budget and program funding decisions are made
- Whether and how prioritization is done and the extent to which evidence, data and quantitative methods are used
- Governance for priority setting, who leads and who is involved in the process
- Essential Medicines Lists - existence, processes and evidence used in development
- Standard Treatment Guidelines /Program Guidelines - existence, processes and evidence used in development
- Beyond prioritization – focus on implementation and quality of provision

	Stage 0	Stage 1	Stage 2	Stage 3	Stage 4
Budget and program funding decisions	History	History	Investment cases	Prioritisation – CEA/ECEA and mathematical models	Full
Whether and how prioritization is done	No	No	Partial	Partial	Full
Governance for priority setting	None	Ad hoc	Committee	Technical working Group	Formalised processes
Essential Medicines Lists	No	Yes	Yes	Yes	Yes
Standard Tx Guidelines	No	No	Partial	Yes	Yes
Beyond prioritization	None	None	Some	Partial focus on implementation and quality	Implementation and quality improvements

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  - These examples have shown that *it is possible to do more with existing resources*, and use existing data in smarter ways to improve health and nutrition

Decision Science Tools covered during this course

	Health Service Priority Setting	Improvements in Implementation and Quality
Improve TB Program Allocative Efficiency using Optima TB	YES	YES
Improve HIV Program Allocative Efficiency using Optima HIV	YES	YES
Improve Nutrition Program Allocative Efficiency using Optima Nutrition	YES	YES
Health Services Prioritisation Tool for UHC Benefits	YES	
Cascade Diagnostics and Optimization		YES
Big Data Analytics	YES	YES

Optima HIV and Optima TB

Improving allocative efficiency using mathematical modelling

Optima is helping countries to identify the optimal mix of interventions to maximize the impact of investments ... Ensuring we deploy the right interventions in the right mixes for the right people in the right places can transform the impact of health investments and bring the goal of a science of delivery closer."

Jim Kim, World Bank

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optima
DECISION SCIENCE

Burnet Institute
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Introduction to Mathematical Optimization:

What's *New* and *Different*?

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How does Optima work?

1. Burden of 'disease'

- Data synthesis
- Epidemic modelling

2. Programmatic responses

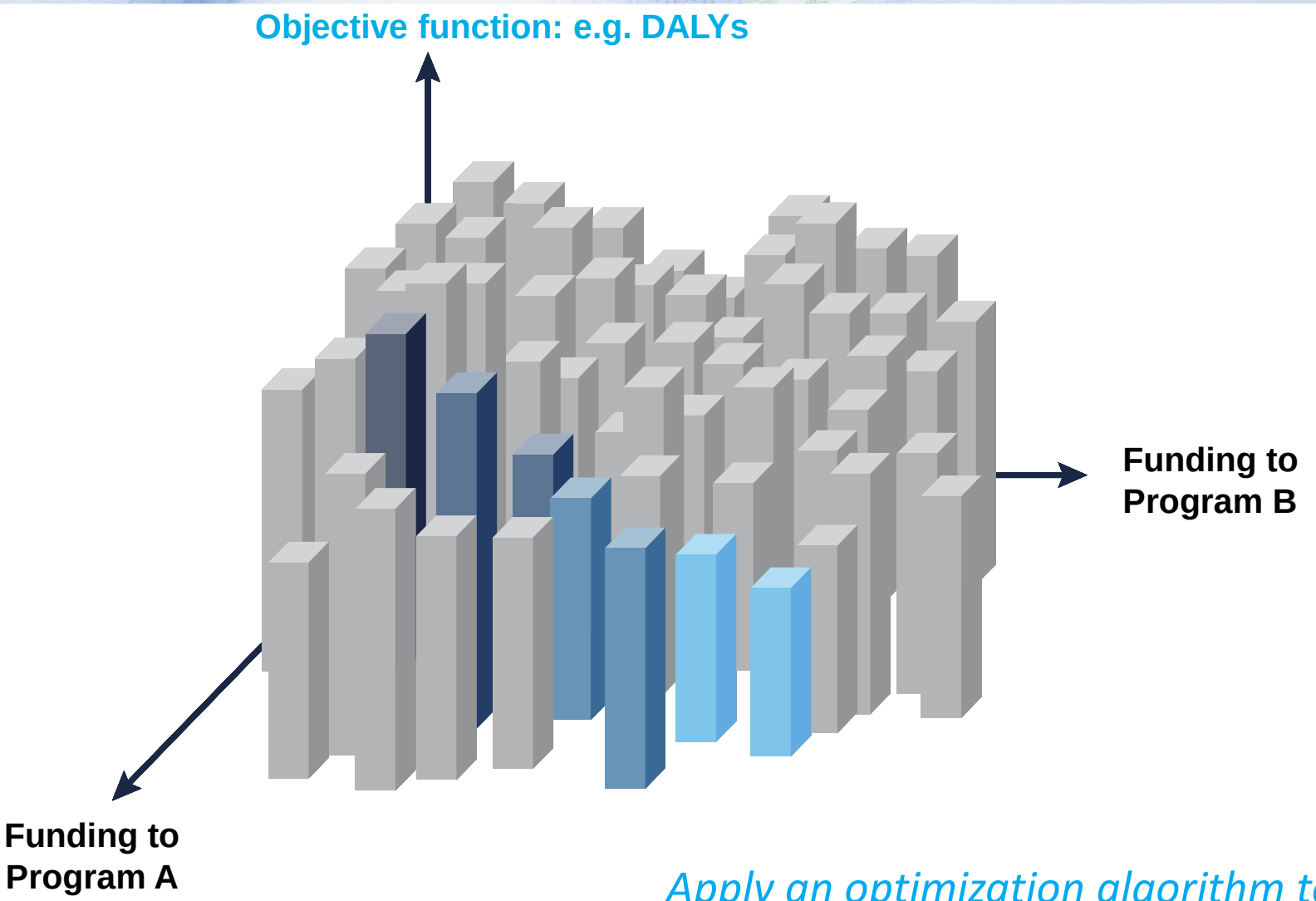
- Identify interventions & delivery modes

3. Objectives and constraints

- Strategic goals
- Ethical, logistic & economic

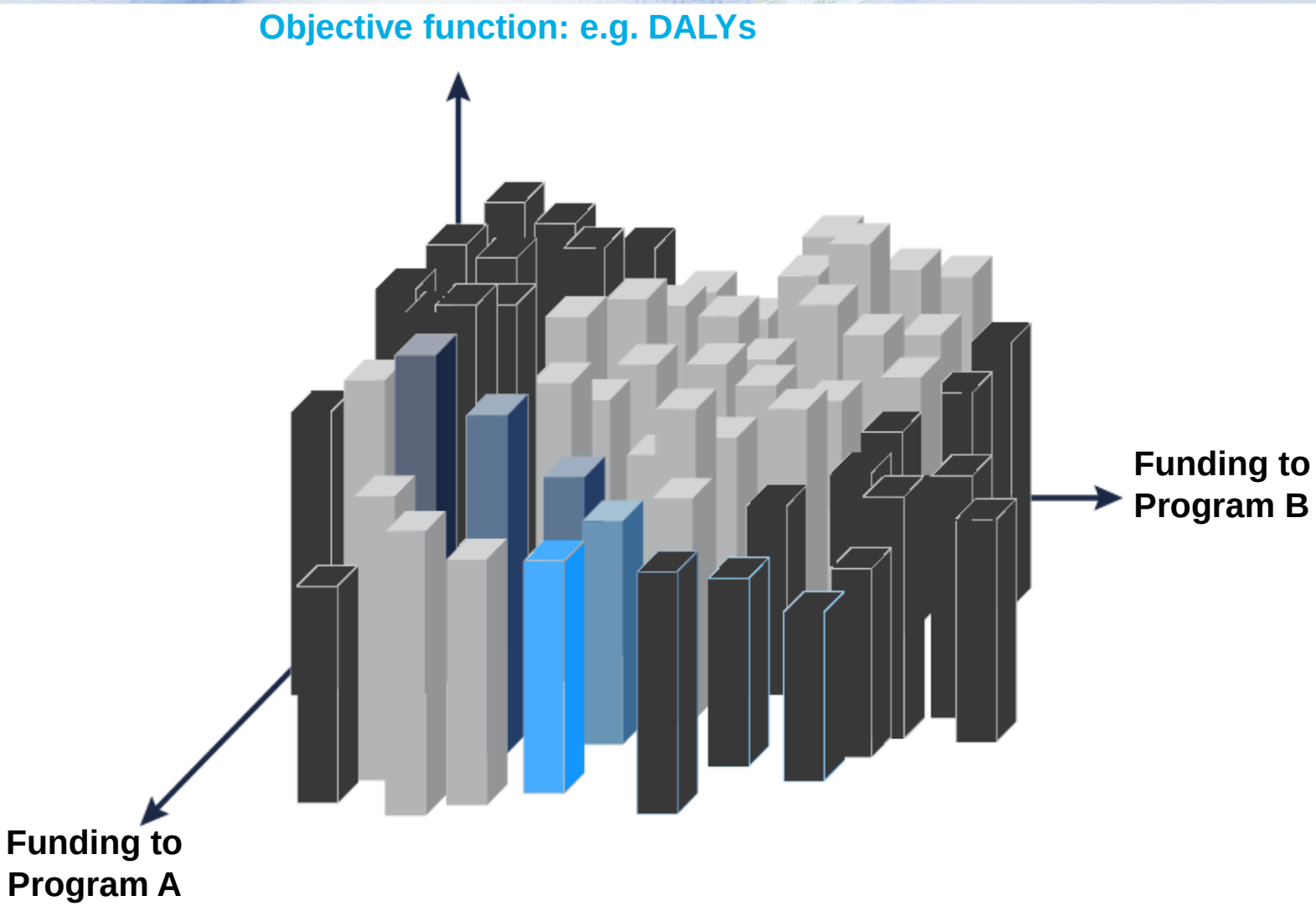
4. Optimization algorithm

Mathematical optimization is tricky: consider just two programs (most programs have many more than 2)



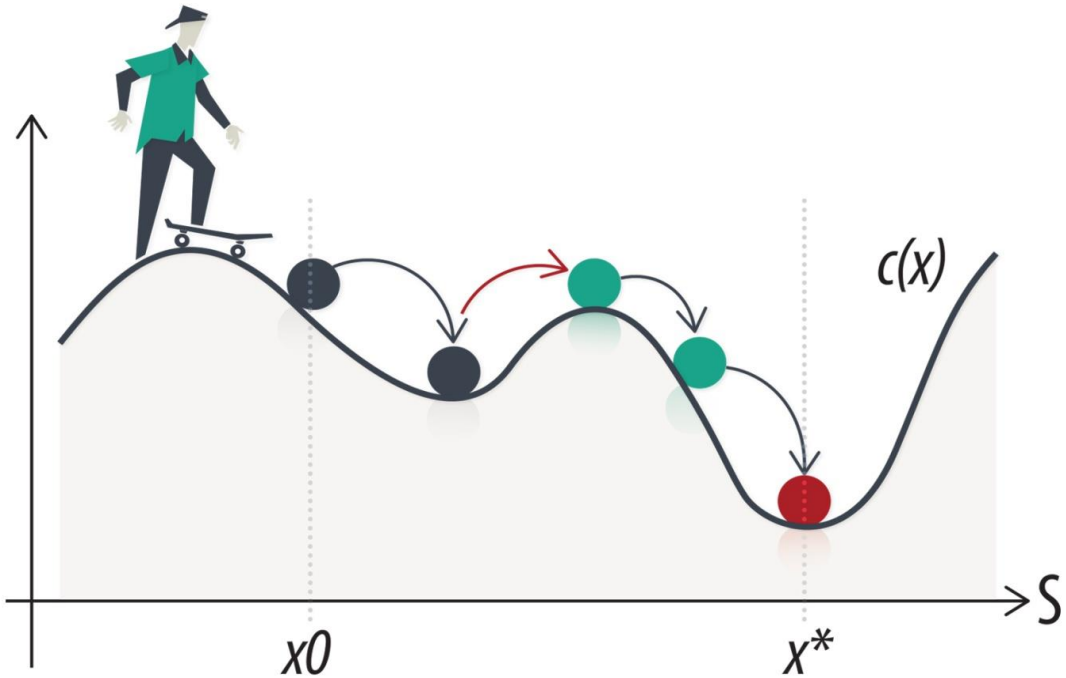
Apply an optimization algorithm to calculate best resource allocation

Non-financial constraints: logistic, political, ethical



Which OPTIMIZATION ALGORITHM?

Traditional algorithms (e.g., simulated annealing) require many function evaluations—**slow**



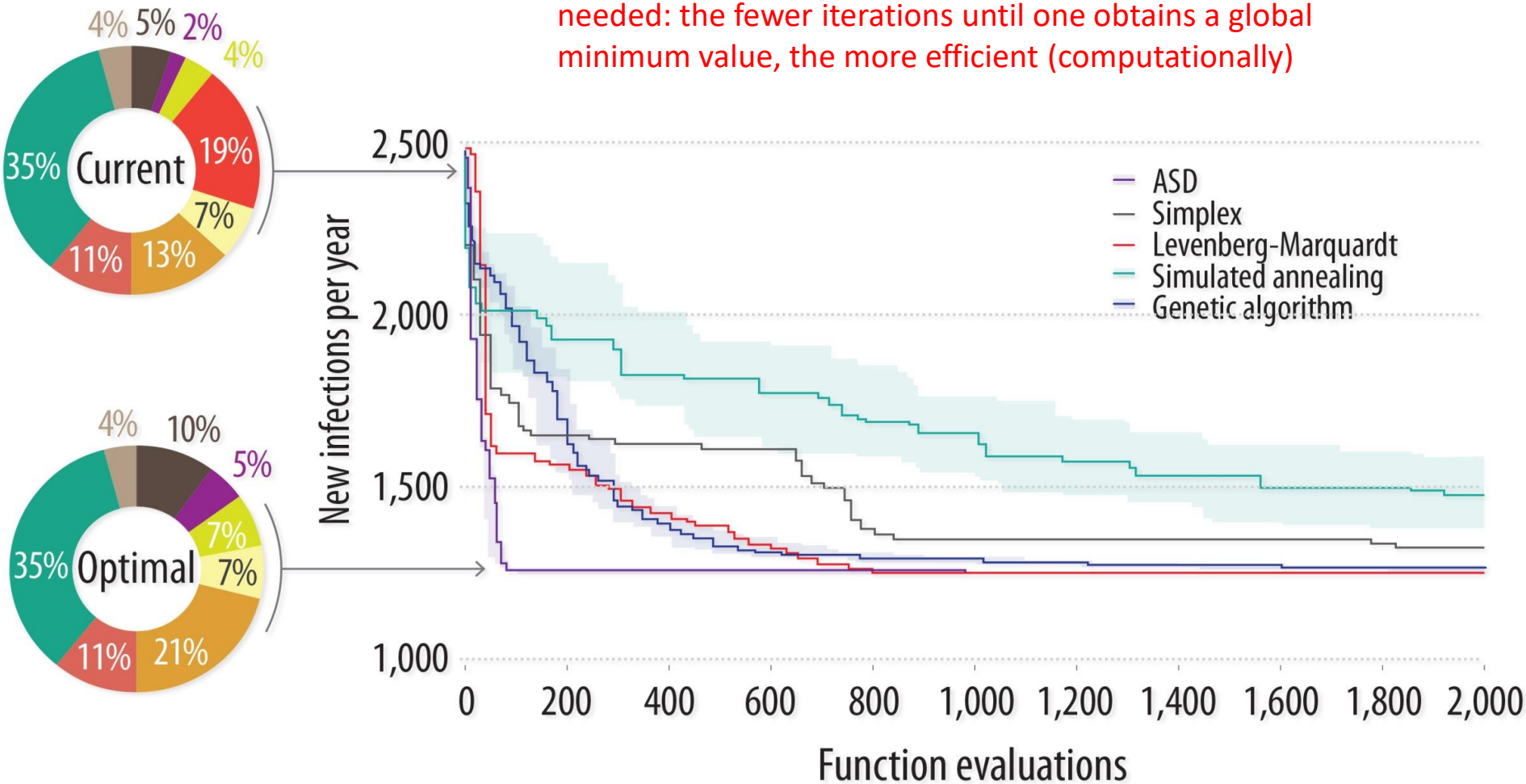
Optima's algorithm:

"**A**daptive **s**tochastic **d**escent"

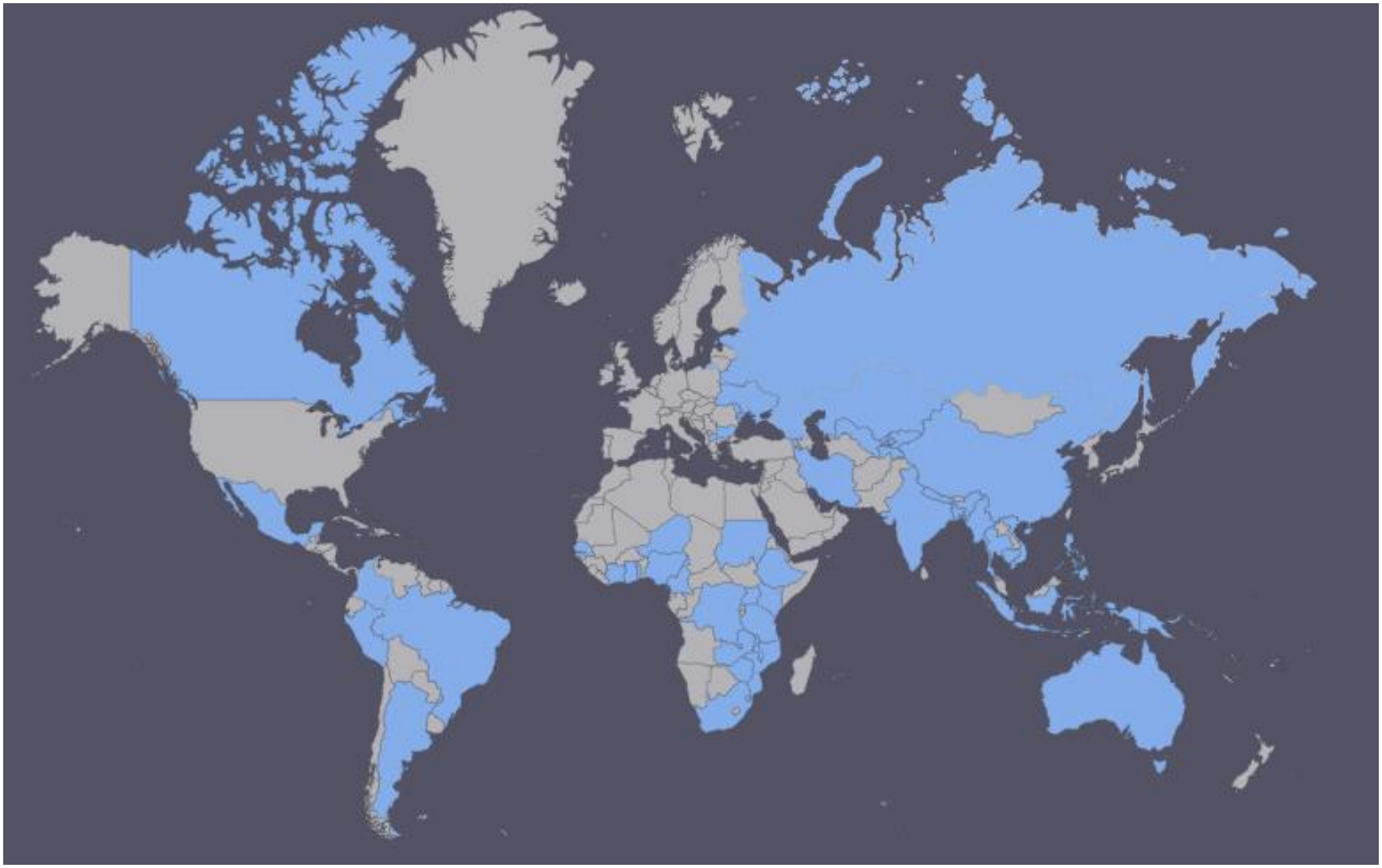
- **Adaptive:** learns probabilities and step sizes
- **Stochastic:** chooses next parameter to vary at random
- **Descent:** only accepts downhill steps

Comparison of algorithms: The ASD ALGORITHM PERFORMS VERY EFFICIENTLY for this class of problems

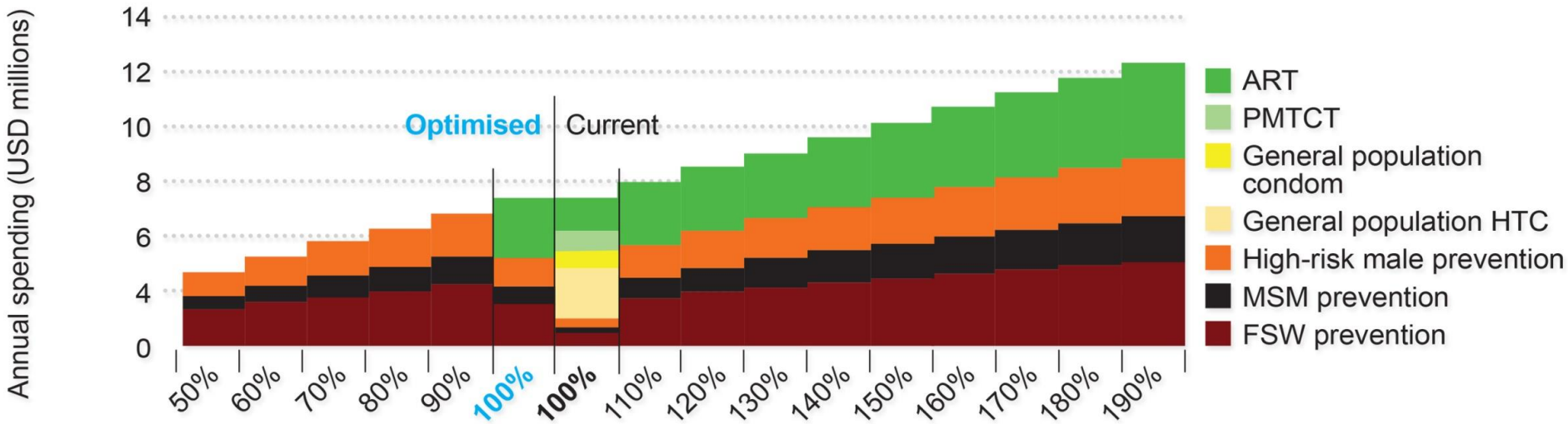
The choice of algorithm is essential for the computing power needed: the fewer iterations until one obtains a global minimum value, the more efficient (computationally)

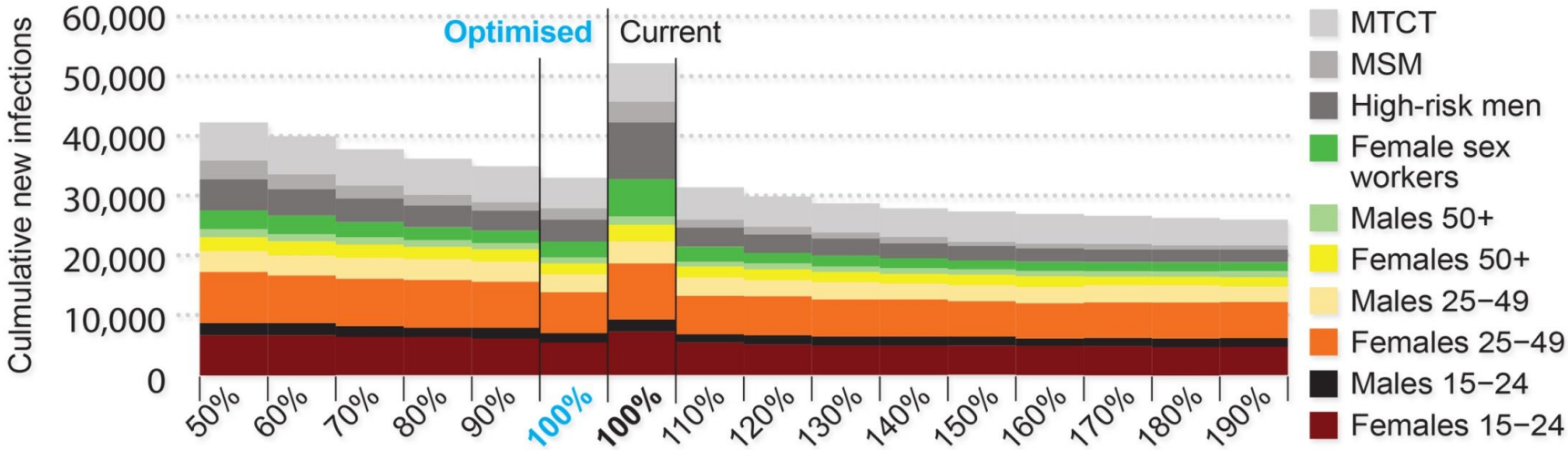


Countries where OPTIMA HAS BEEN APPLIED

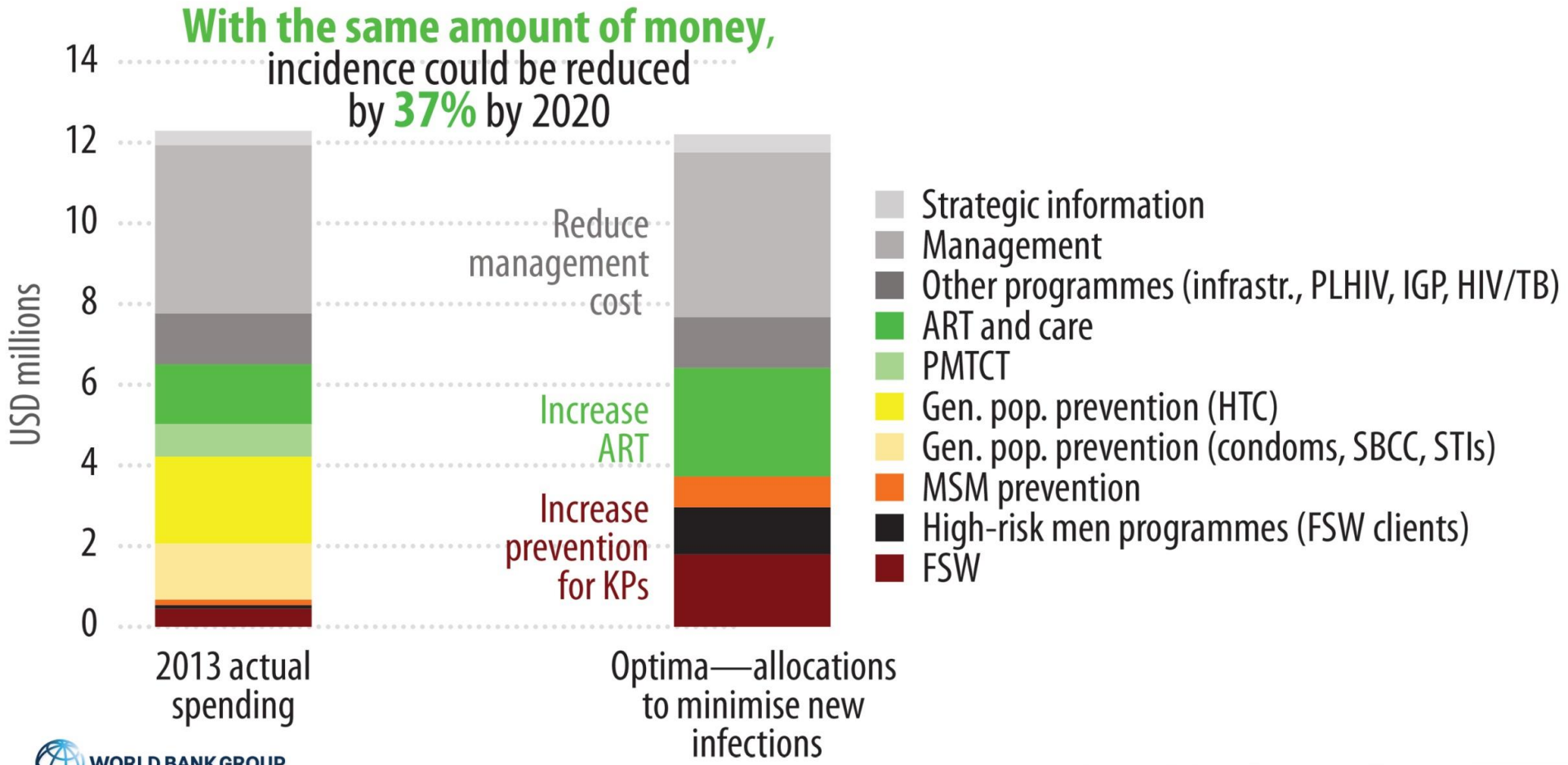


The case of SUDAN





Sudan example, a fragile country with political and OPPOSITION TO HIV PROGRAMS for Key Populations



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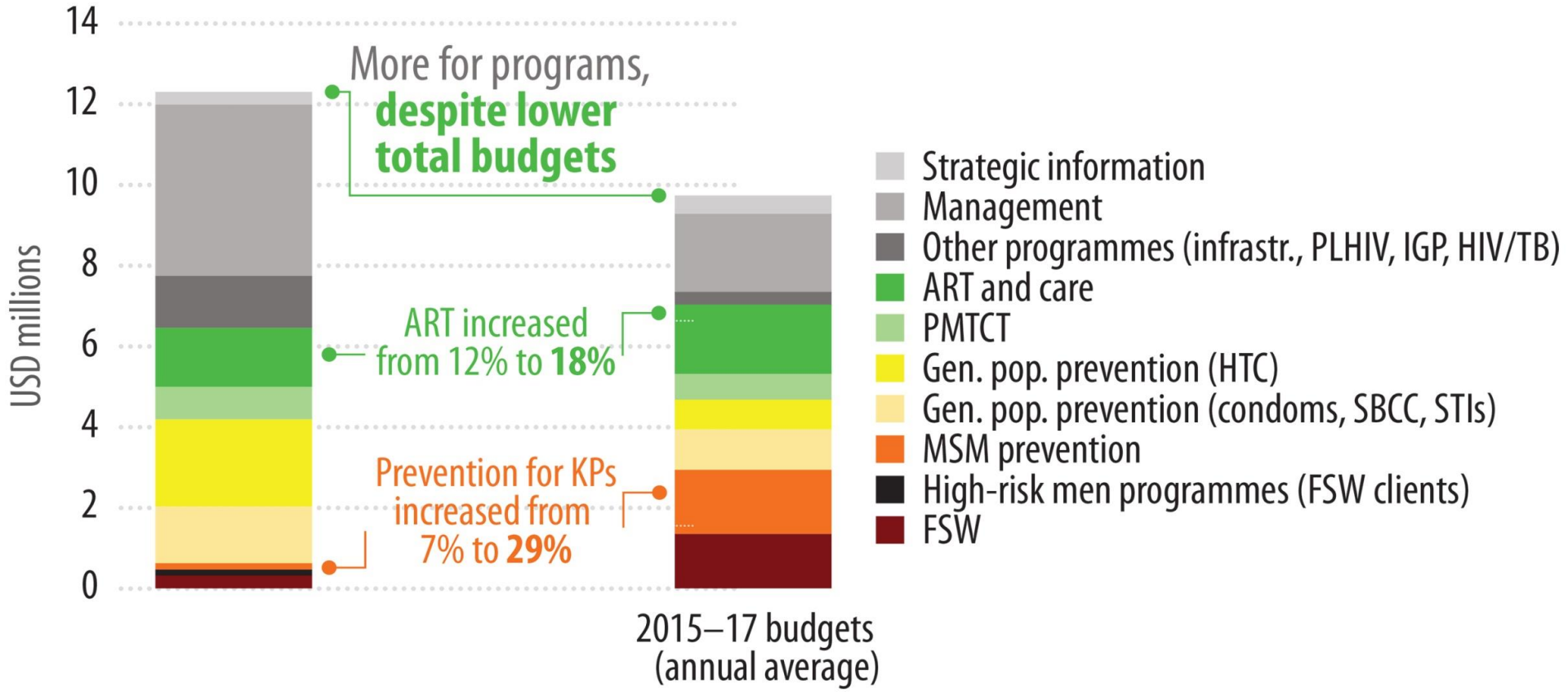
How did budgets actually change?

Reallocation of HIV resources in 2015–17 budget for the HIV response

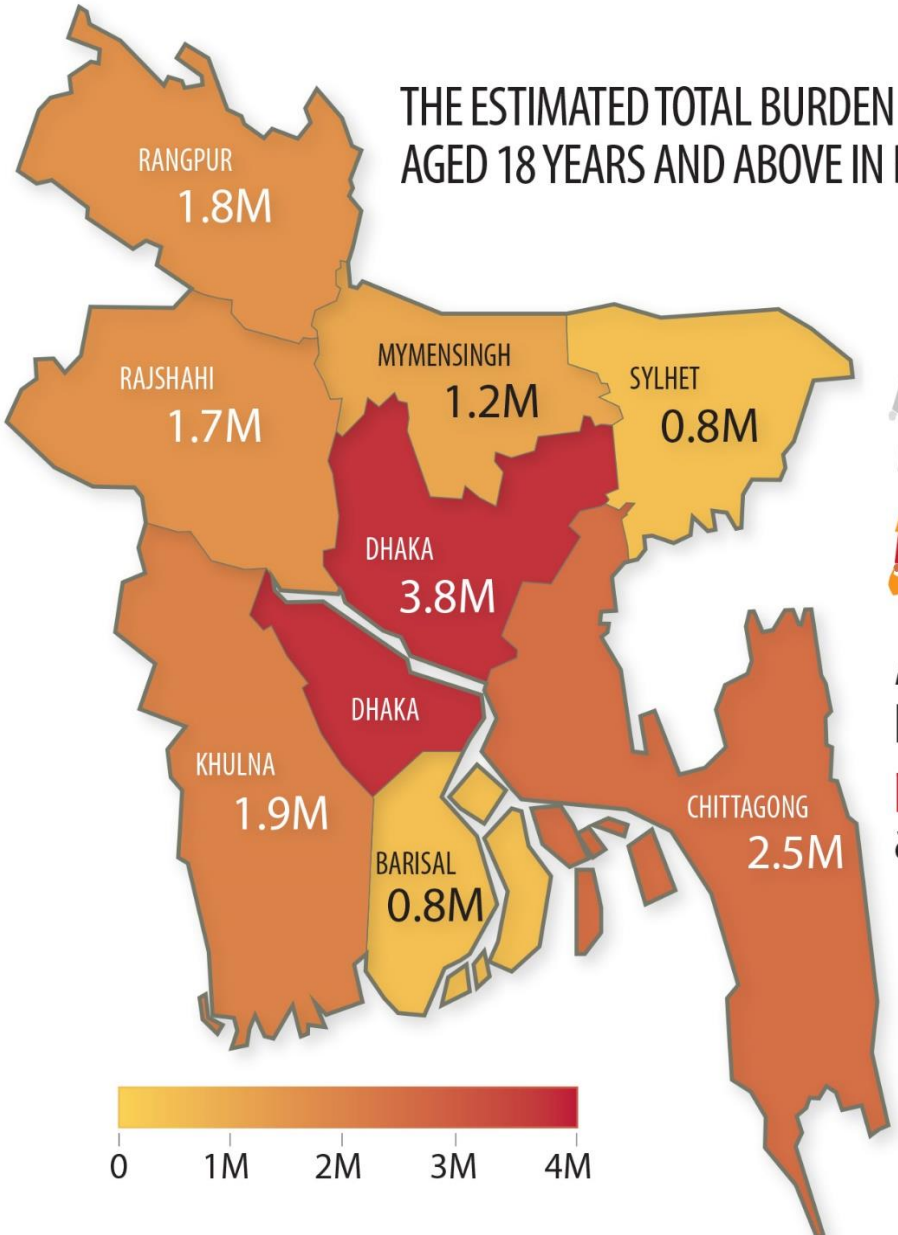


Implementation Cascade Diagnosis and Optimisation

THE SERVICE DELIVERY CASCADE

HYPERTENSION BY DIVISION

THE ESTIMATED TOTAL BURDEN OF HYPERTENSION IN ADULTS AGED 18 YEARS AND ABOVE IN BANGLADESH DIVISIONS



About 14% of adults in Bangladesh are hypertensive, with a significant higher prevalence of hypertension in females and in urban settings

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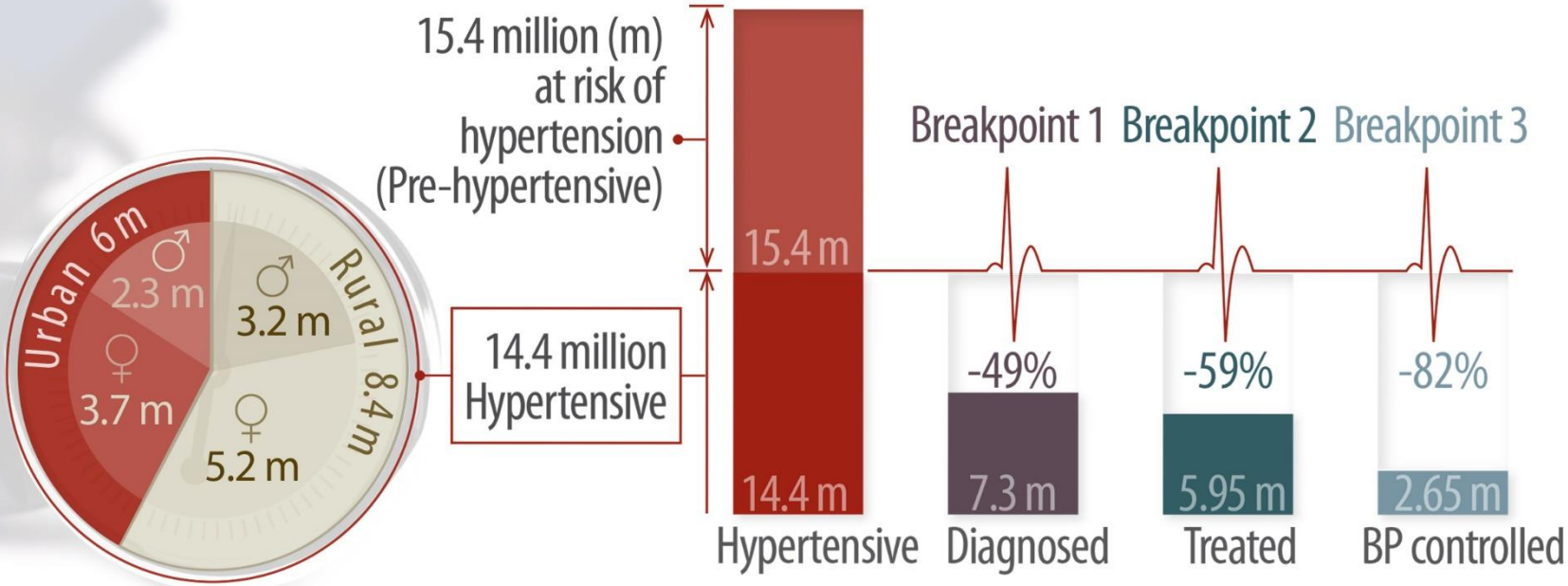
HYPERTENSION CASCADE IN BANGLADESH (ADULTS 35+ YRS)

- Approx. 14.4 million hypertensive (of 56 million adults 35+) – 26%
- Another 15.4 million pre-hypertensive
- Hypertension burden highest in rural women
- Only 18% (2.8 million) of all hypertensives have BP control



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Pre-hypertensive = 120-139 SBP or 80-89 DSP; Hypertensive 140+ SBP or 90+ DBP

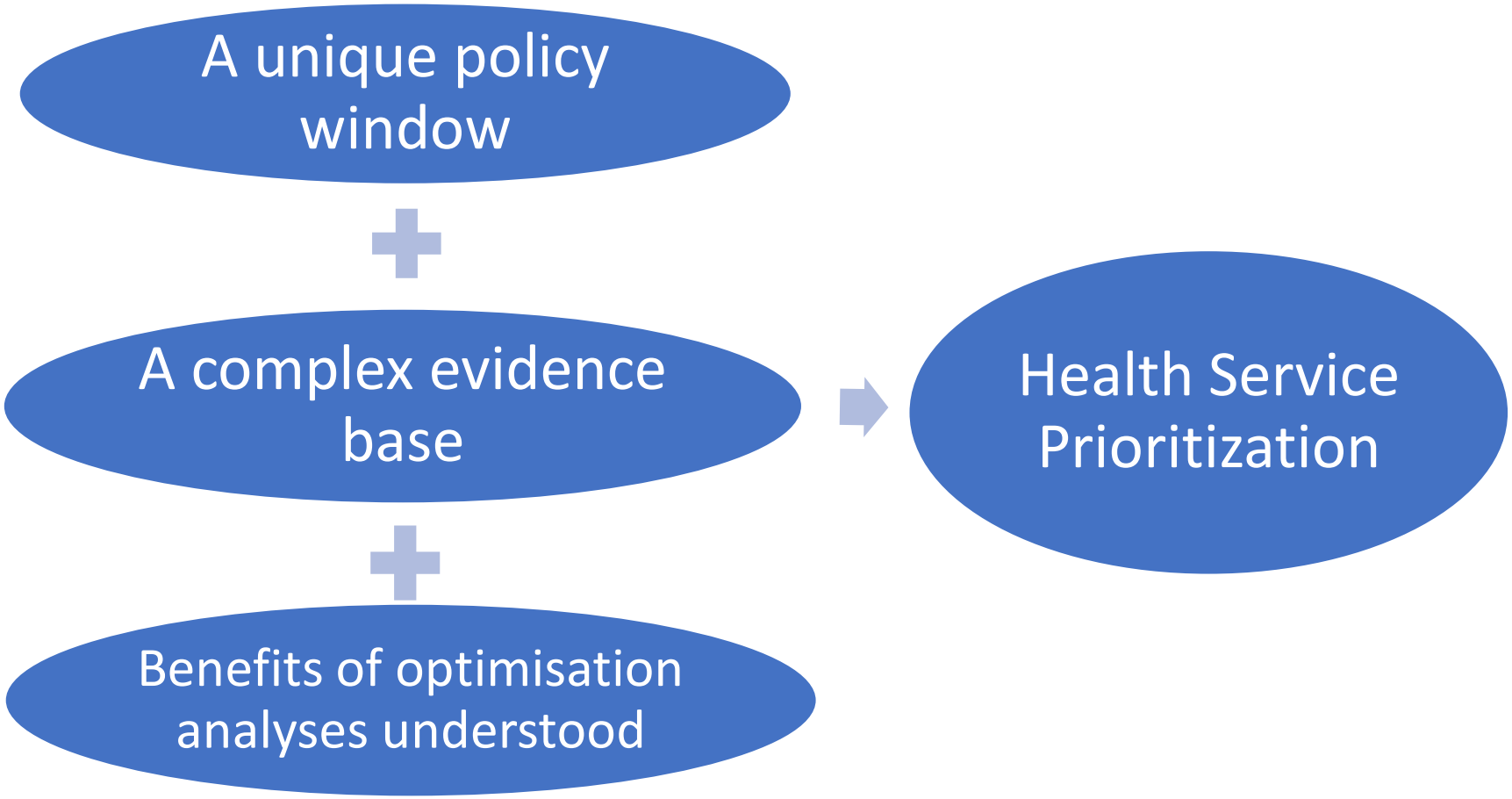
Sources: BDHS 2011 and 2016 UN population estimates

HSP Tool for Improved UHC

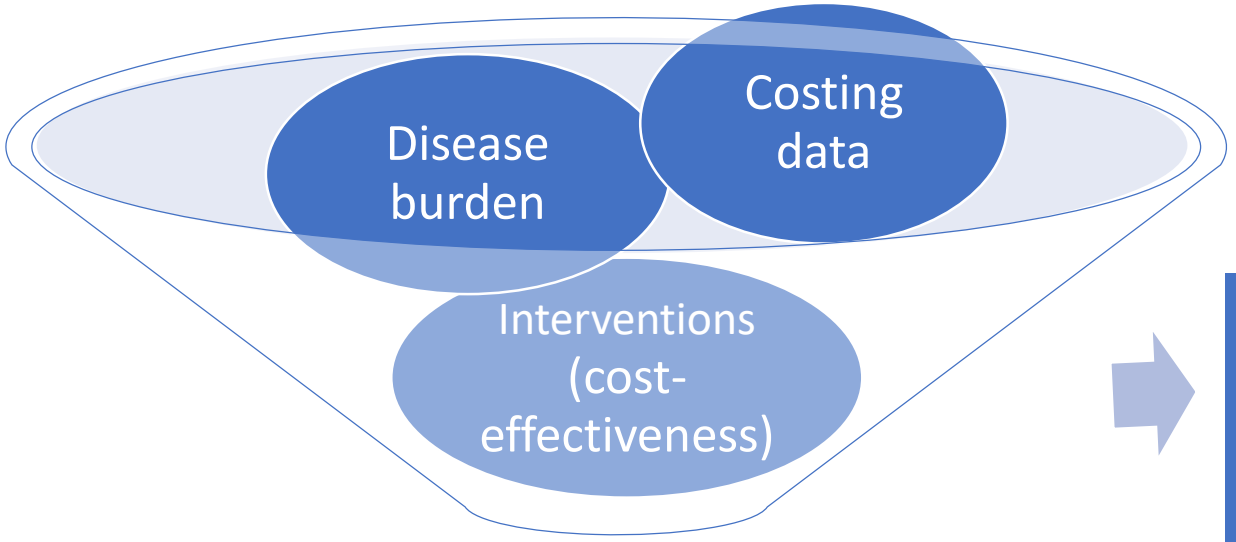
Key Question in UHC

How to prioritize health services given the limited fiscal space?

We are much better positioned to answer this question now: can complement cost effectiveness analysis approaches



Health Services Prioritization tool: From evidence base to user-friendly outputs in order to better guide resource allocation



A complex evidence base

User friendly Interface and outputs

Evidence based resource allocation

Optima Nutrition

More Money for Nutrition and More Nutrition for the Money:

Using Data to support Nutrition the efficiency of nutrition investments

Jakub Kakietek,
Health Economist, World Bank

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RESULTS FOR DEVELOPMENT

1,000 DAYS

CHILDREN'S INVESTMENT FUND FOUNDATION

BILL & MELINDA GATES foundation

The Problem

151 MILLION* CHILDREN UNDER 5 ARE STUNTED WORLDWIDE

*As of 2017

85% live in 37 high-burden countries

Investments in Nutrition Build Human Capital and Boost Shared Prosperity

SCHOOLING

Early nutrition programs can increase school completion by one year

EARNINGS

Early nutrition programs can raise adult wages by 5-50%

POVERTY

Children who escape stunting are 33% more likely to escape poverty as adults

ECONOMY

Reductions in stunting can increase GDP by 4-11% in Asia & Africa

Source: Investment Framework for Nutrition, Shekar et al, World Bank 2017

Using Economic Analysis to Support Nutrition Programs in Client Countries:

Analytic program in partnership with BMGF:

- Analyses in 14 countries
- 10 stand-alone HNP discussion papers
- Multiple policy briefs and other dissemination materials
- 1 regional report for Sub-Saharan Africa
- Global Nutrition Investment Framework

Country	Year	Analysis completed	Discussion Paper	Policy Brief
Nigeria	2013/4	✓	✓	✓
Togo	2013/4	✓	✓	
Mali	2014/5	✓	✓	✓
DRC	2014/5	✓	✓	✓
Zambia	2015/6	✓	✓	
Uganda	2015/6	✓	✓	
Cameroon*	2015	✓		
Kenya	2015/6	✓	✓	✓
Tanzania*	2015	✓		
Cote d'Ivoire	2015/6	✓		
Guinea Bissau	2017	✓	✓	
Madagascar	2016	✓		
Bangladesh	2018	✓	✓	
Afghanistan	2018	✓	✓	
Regional SSA	2017	✓	✓	
Global Investment Framework	2017	✓	✓	✓

All publications available at:

Analytic Reports

http://www.worldbank.org/en/topic/nutrition

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Global Analytics: Global Investment Framework

Global Targets (WHA/SDGs)

- How much it will cost?
- What will we buy with this investment?
  - Nutrition
  - Health/lives saved
  - Economy
- How can it be financed?
- How can these analytics generate national political commitment? And how can we maximize the "bang for the buck"?

http://www.worldbank.org/en/topic/nutrition/publication/an-investment-framework-for-nutrition-reaching-the-global-targets-for-stunting-anemia-breastfeeding-wasting

Benefits of Achieving Nutrition Targets in 2025

STUNTING

65 million cases of stunting prevented

2.8 million child deaths averted

ANEMIA

265 million cases of anemia in women prevented

800,000 child deaths averted

BREASTFEEDING

105 million additional babies exclusively breastfed

520,000 child deaths averted

WASTING

91 million children treated for severe wasting

More than **860,000** child deaths averted

BENEFITS OF ACHIEVING ALL FOUR TARGETS

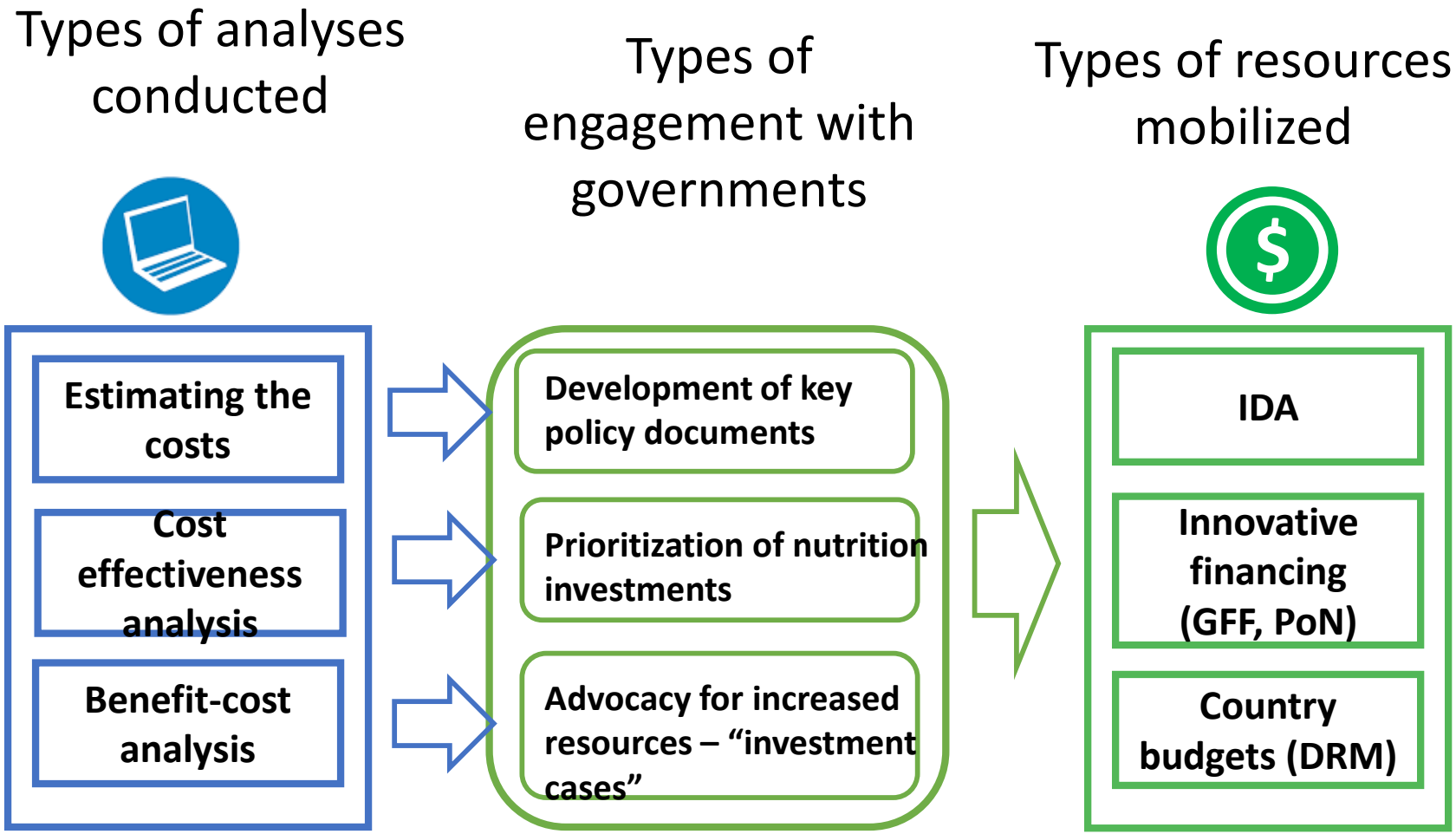
65 million cases of stunting prevented

At least 3.7 million child deaths prevented

Investments to Meet the Global Nutrition Targets Have Enormous Economic Returns

	Total Economic Benefits (Billions)*	$1 Invested Yields
STUNTING	$417	$11
BREASTFEEDING	$298	$35
ANEMIA	$110	$12
WASTING	$25	$4

Using Data Analytics To Mobilize Resources for Nutrition and Improve Efficiency



Political Commitment for Nutrition is Rising… *Spotlight on Nutrition*, Spring Meetings April 2017

"…. we're focusing on nutrition; and there's really no excuses…we can make a difference for something around $10.00 per child, per year, in all of those numbers. So, the failure to act is unconscionable." - *Dr. Jim Yong Kim, World Bank President*

"Stunting would be one very important issue, but you're making an investment in the future of your country." – *Sir Ratan N. Tata, Tata Trusts*

THE HUMAN CAPITAL PROJECT

TRANSFORMING HUMAN CAPITAL

MORE AND BETTER INVESTMENT IN PEOPLE GLOBALLY

1. **Human Capital Index:** A entry point to raise the profile of the investment case for human capital
2. **Measurement:** A focus on evidence-based investments in human capital formation
3. **Country engagement:** A commitment to support Early Adopters, and ultimately all countries, to prepare national strategies to accelerate progress on human capital

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HUMAN CAPITAL INDEX & THE SUSTAINABLE DEVELOPMENT GOALS

The Human Capital Index indicators are linked closely to the SDGs

SURVIVAL

- Under-5 mortality links to SDG target 3.2

SCHOOL

- Quality adjusted school years links to SDG target 4.1

HEALTH

- Improving adult survival rate by reducing causes of premature mortality links to SDG target 3.4
- Stunting links to SDG target 2.2

More Nutrition for the Money: Optima Nutrition

For different funding levels, how should resources be allocated across a mix of nutrition interventions and what impact is achievable?

Overall public health budget available for nutrition

Which investment **combination** leads to **optimal** outcomes?