3 day training for Optima Nutrition

Optima
Nutrition

Funding for the creation of these materials was provided by

WORLD BANK GROUP
Health, Nutrition & Population

Optima Nutrition

Agenda - Day 1: Optima Nutrition and Scenario Analysis

Time	Session name and description
	Welcome and introductions
8:30	**Introduction to training** • Objectives – topics covered, expected results, skills participants will learn • Overview of the training agenda • Roles, rules, and housekeeping
	Rationale for efficiency analysis
9:00	**Presentation: Allocative efficiency analysis** • Types of efficiency • Introduction to the Optima approach • Global issues in nutrition and how modelling can help • Nutrition modelling tools and where Optima fits in the mix
9:40	**Tour of the Optima Nutrition Graphical User Interface (GUI)**
	Modelling stunting using Optima Nutrition
10:00	**Presentation** • Introduction to session: overview, objectives and skills to learn • Introduction to modelling stunting in the Optima Nutrition model • How risks for stunting are modelled • Stunting programs and how their effects are implemented
10:40	**Practice: stunting interventions (GUI)** • Baseline scenarios and how they are defined • The impact of scaling up and down stunting interventions • Modifying IYCF packages
11:00	**Break**
11:30	**Practice: stunting interventions (GUI) (continued)**
	Modelling wasting using Optima Nutrition
12:00	**Presentation** • Introduction to session: overview, objectives and skills to learn • How wasting is incorporated into the Optima Nutrition model • Wasting risk factors, programs and how their effects are implemented
12:40	**Practice: wasting interventions (GUI)** • Prevention versus treatment interventions for reducing wasting • Understanding how adding management of MAM impacts the effects of the treatment • Modifying the delivery of treatment of SAM
13:00	**Lunch break**
14:00	**Practice: wasting interventions (GUI) (continued)**
	Modelling anaemia using Optima Nutrition
14:30	**Presentation** • Introduction to session: overview, objectives and skills to learn • Additional population groups (women of reproductive age) • How anaemia is incorporated into the Optima Nutrition model • Anaemia risk factors, programs and how their effects are implemented
15:10	**Practice: anaemia interventions (GUI)** • Program delivery modalities. • The two kinds of program dependencies, threshold and exclusion. • Exploring program impact on multiple nutritional outcomes.
16:00	**Break**
16:30	**Continued exercises**
16:45	Participants' feedback on the training and on the tool
17:30	**Closure of the day**

Agenda - Day 2: Optima Nutrition – Data, Objectives and Optimization

Time	Session name and description
8.30	Review of materials covered on Day 3, review questions, and plan for Day 4
	Other nutrition-sensitive and supplement interventions
9:00	**Presentation** • Introduction to the family planning module and WASH interventions • Remaining interventions included in the model
9:40	**Practice: all interventions** • The impact of nutrition-sensitive interventions on mortality numbers and mortality rates • Complex coverage scenarios relevant to program planning
11:00	**Break**
	The data input book: common data sources and model inputs
11:30	**Presentation** • Introduction to session: overview, objectives and skills to learn • Data requirements, data sources, and concerns • The data input book • Default values
12:00	**Practice: data session** • Collating and interpreting data • Familiarity with the data input book
	Interpreting data: costs and cost-coverage relationship
12:30	**Presentation** • Introduction to session: overview, objectives and skills to learn • Data requirements, data sources, and concerns • Review of cost and coverage values • Shape of cost functions and their implicit assumptions
12:45	**Practice: costs** • Estimating unit costs • Challenges interpreting data
13:00	**Lunch break**
	Optimisation and the objective function
14:00	**Presentation: different objectives** • Introduction to session: overview, objectives and skills to learn • How does the optimisation algorithm work? • How different objectives can lead to different results • Review of different analyses and outputs • Structuring recommendations based on different objectives
14:40	**Practice: optimisation** • Defining appropriate objective functions, the pros and cons of various choices. • Performing optimisations and developing recommendations (GUI)
16:00	**Break**
16:30	**Practice: optimisation (continued)**
16:45	Participants' feedback on the training and on the tool
17:30	**Closure of the Day**

Agenda - Day 3: Optimization and geospatial analysis

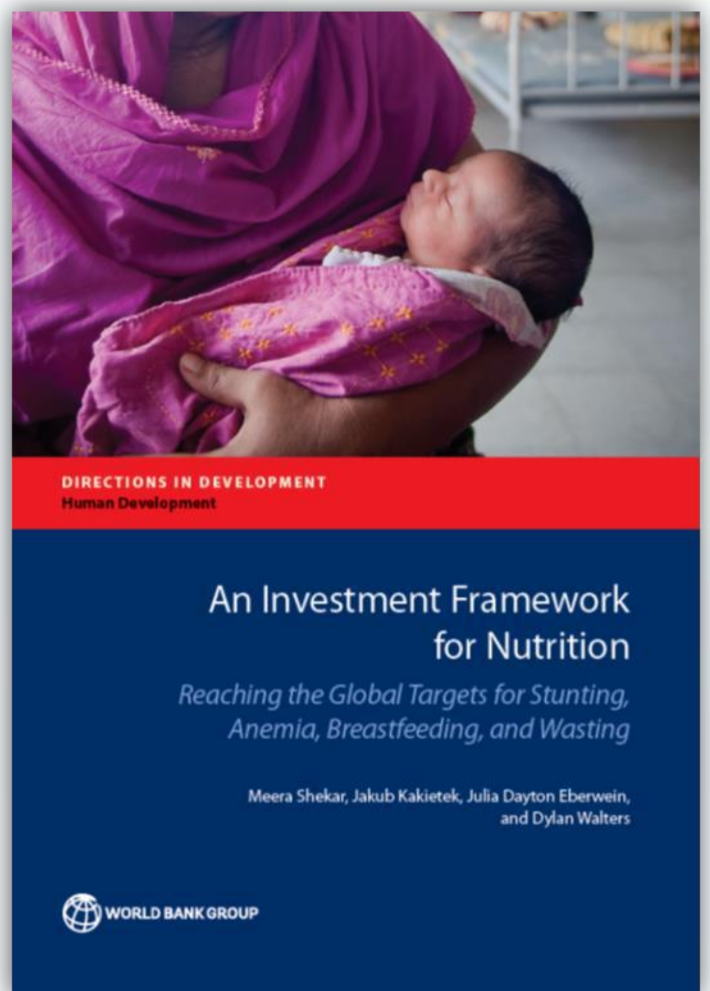
Time	Session name and description
8.30	Review of materials covered on Day 4, review questions, and plan for Day 5
	Optimisation and objective functions (continued)
9:00	**Presentation** • Being able to create suitable objective function • Weighted objective functions
9:30	**Practice: optimisation** • Using a weighted objective functions to make a more nuanced policy recommendation on budget allocation
11:00	**Break**
	Geospatial optimization
11:30	**Presentation** • Introduction to session: overview, objectives and skills to learn • Understanding the need for geospatial analysis • Selecting appropriate geographical resolution • Understanding the different types of geospatial analyses • Understanding the methodology
12:15	**Practice: geospatial analysis (using pre-loaded data books for regions)**
13:00	**Lunch break**
	Case study: Final practice of scenario analyses and optimisations
14:00	**Practice: use of GUI** • Practice with optimisations and recommendations • Remaining issues
16:00	Participants' feedback on the training and on the tool
16:30	**Plenary Closing Session**
17:30	**Workshop Closure**

Global issues in nutrition

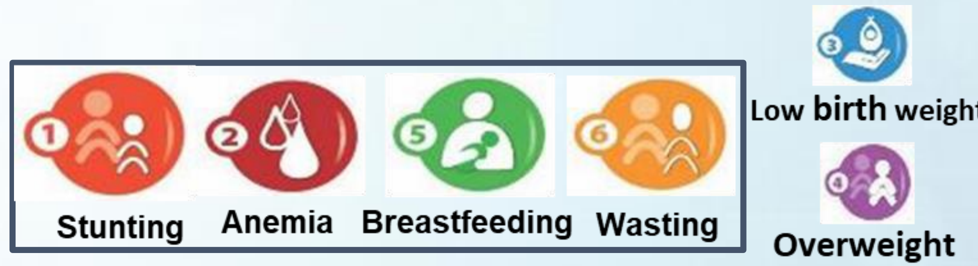
Day 1 – Session 1

Optima Nutrition

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"?

Optima Nutrition

Using Economic Analysis to Support Nutrition Programs in Client Countries: 6 Years of Analytic Engagement

Analytic program in partnership with BMGF:

- Analyses in 14 countries
- 10 stand-alone HNP discussion papers
- Multiple policy briefs and other dissemination materials

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	2016	✓	✓	
Madagascar	2016	✓		
Bangladesh	2016	✓	✓	
Afghanistan	2016	✓	✓	

Optima Nutrition

Analytic Products

For all publications see:

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

Using Data Analytics To Mobilize Resources

Types of analyses conducted

- Estimating the costs
- Cost effectiveness analysis
- Benefit-cost analysis

Types of engagement with governments

- **Development of key policy documents**
- **Prioritization of nutrition investments**
- **Advocacy for increased resource – "investment cases"**

Types of resource mobilized

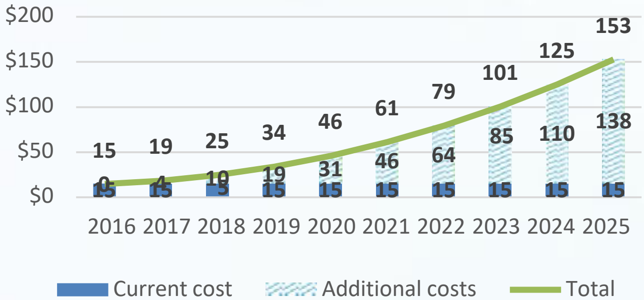
- IDA
- Innovative financing (GFF, PoN)
- Country budgets (DRM)

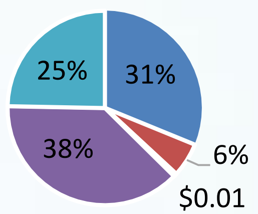
Optima Nutrition

Using Data Analytics To Improve Efficiency

Estimating the costs

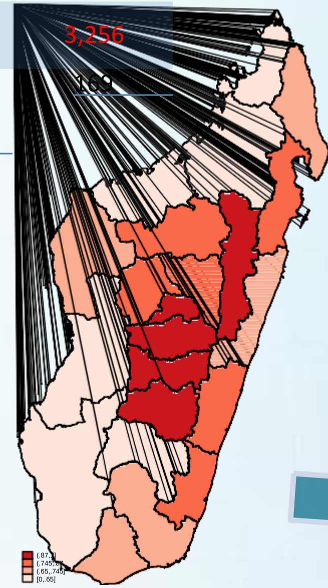
Annual Public Sector Cost of Scaling-up Nutrition-specific Interventions (USD million)





Cost effectiveness analyses

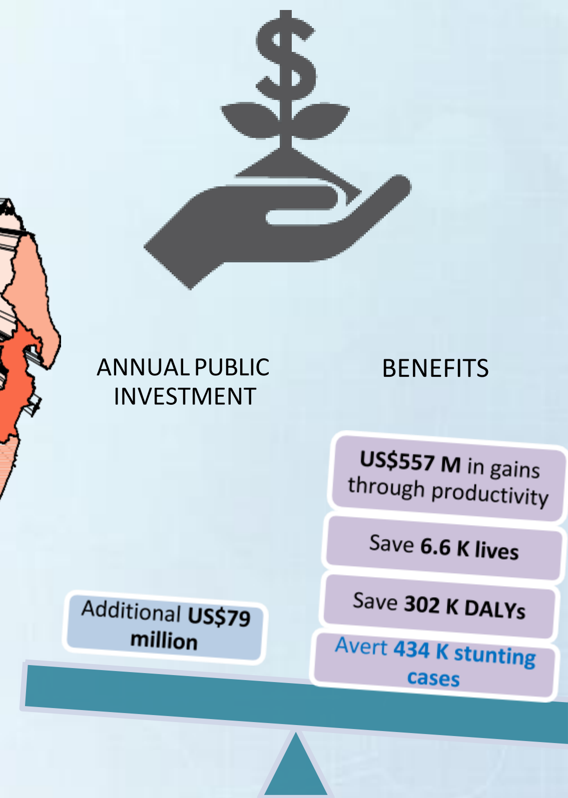
Intervention	Cost per DALY
IYCN	12
Vitamin A supplementation	29
Therapeutic Zinc suppl./ORS	216
Micronutrient powders	44
Deworming	264
Iron-folic acid supplementation	43
Iron fortification of staple foods	
Salt iodization	
Public provision of complementary food	3,256
CMAM for SAM	169



Cost-effectiveness map: Regions with the lowest cost per case of stunting averted

Benefit-cost analyses

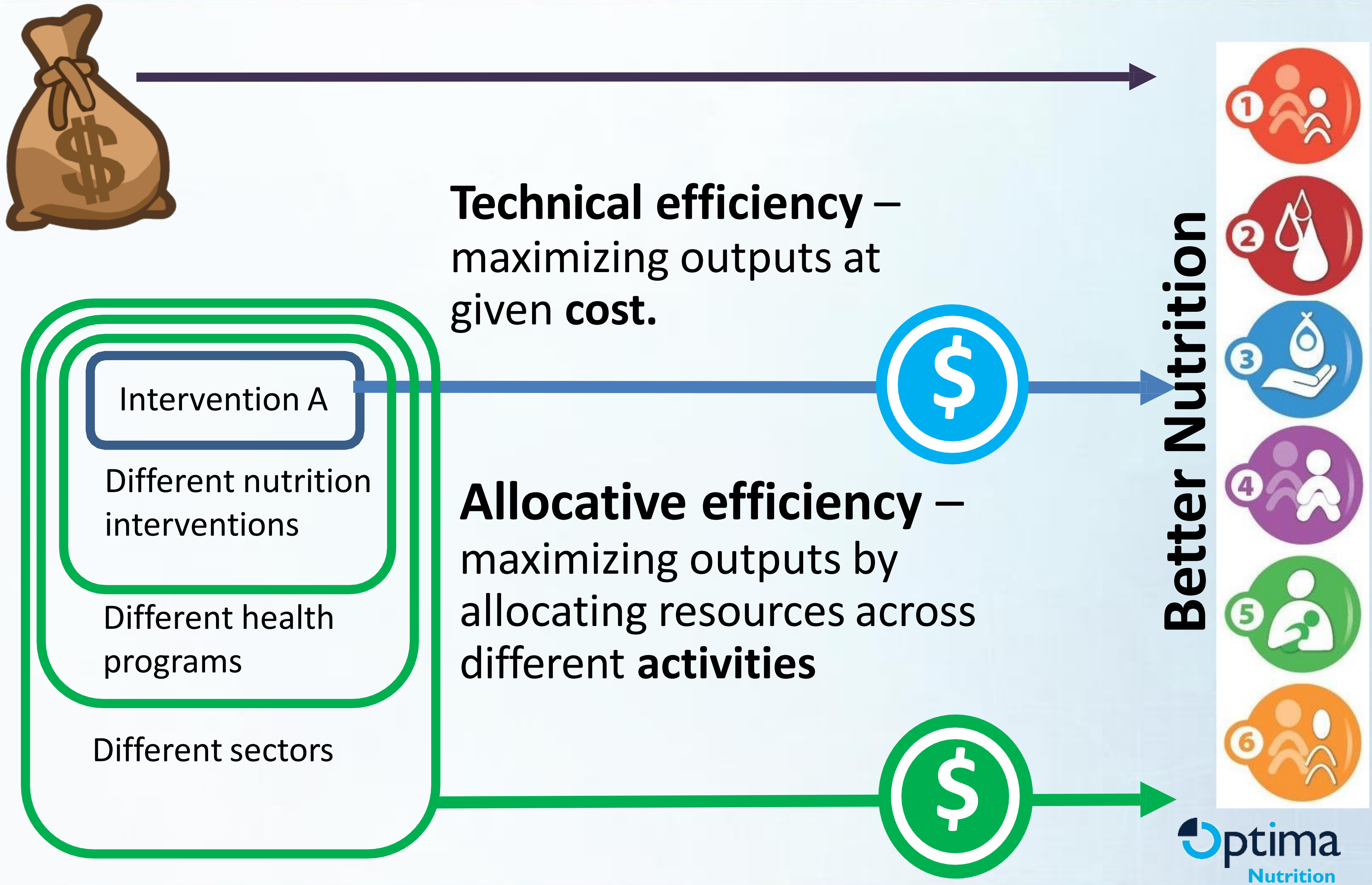
$1 invested = $22 returns



One key question we could not answer: what is **the optimal allocation** of resources across interventions?

Optima Nutrition

Using Data Analytics To Improve Efficiency



Optima Nutrition

Why Efficiency?

- Allocation among different interventions and different regions.
- 6 interventions:
  - vitamin A supplementation,
  - multiple micronutrient powder (MNP) supplementation,
  - deworming,
  - fortification of edible oil,
  - fortification of bouillon cubes,
  - biofortification of maize
- 3 Regions
- Analysis – comparison of 2 scenarios with the same cost/budget:
  - Current coverage over 10 years (status quo),
  - Most efficient (optimized) allocation.

	Current coverage	**Optimal allocation**
Children reached*	**13 million**	**13 million**
Cost per child	**$2.93**	**$1.63**

*Children whose vitamin A deficiency was eliminated due to interventions

- Findings: optimized allocation is **<u>44% less expensive</u>** than the current allocation

Optima Nutrition

THANK YOU

Optima Nutrition

Background on nutrition modelling

Day 1 – Session 2

Optima Nutrition

What is a model

- Modelling is a process:

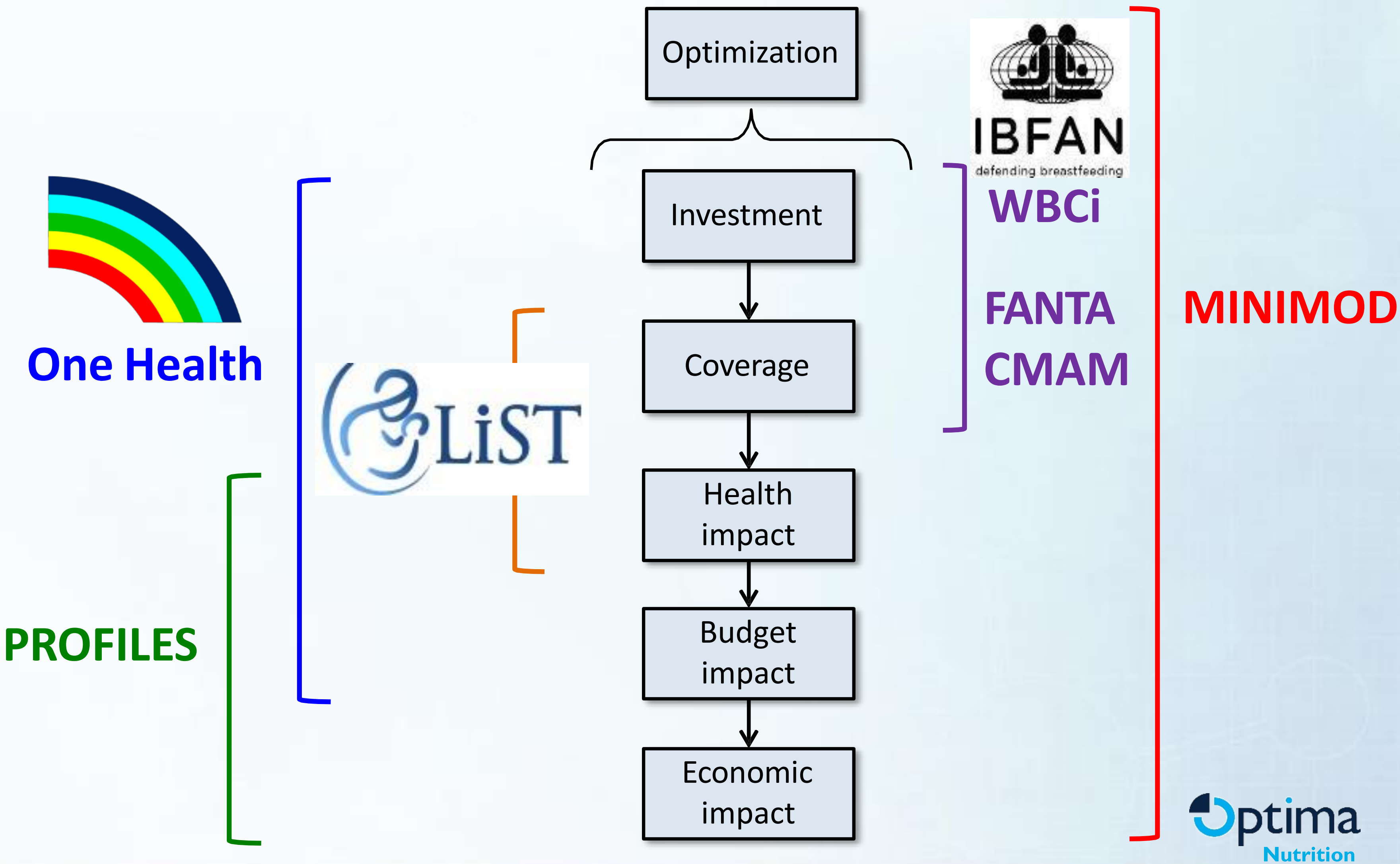
Problem → Gather data / observations → Simplify / filter relevant information → Consider constraints → Make decision

- We all use models everyday without realising it. For example, how are you going to travel to work?
  - Data: timetables, costs, weather
  - Simplify: maybe we don't care if a train could be 5 minutes late
  - Constraints: what are we prepared to pay and how fast do we need to get there?
- Sometimes there is too much information to consider, so we need to use a computer
- Models can help us to make decisions by organising all of the relevant data in a way that is useful for us

Optima Nutrition

Existing tools for impact and economic analyses for nutrition

Multiple interventions: Single intervention:



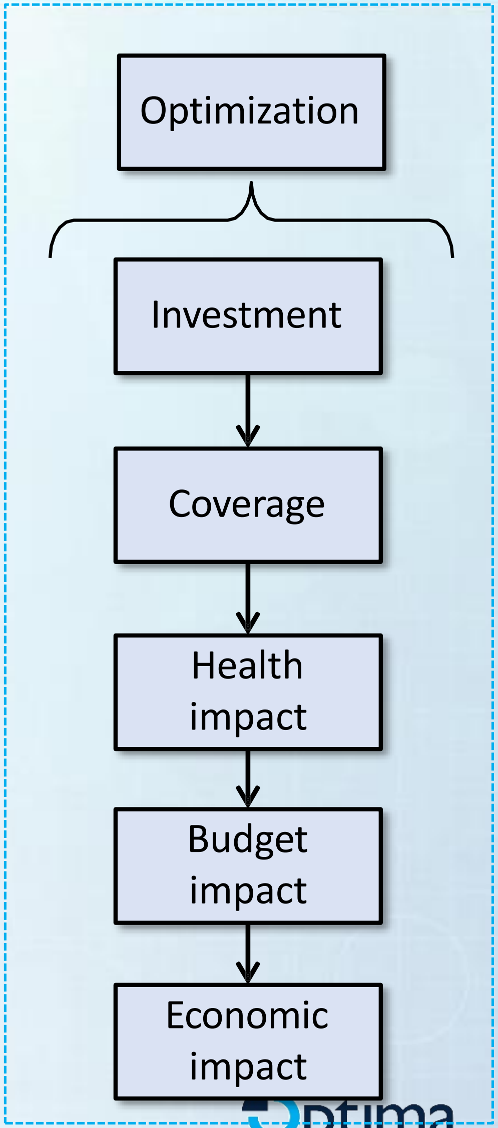
Where does Optima Nutrition fit in the mix

Optima Nutrition has two main uses:

- Optimising investment for best health and economic outcomes
- Projecting future scenarios: how will trends in malnutrition change under different funding scenarios?

The model has secondary uses for:

- Assessment of the impact of interventions on multiple malnutrition conditions:
  - Stunting in children
  - Wasting in children
  - Anaemia in children and women of reproductive age
  - Child and maternal mortality



Optima Nutrition

How does Optima Nutrition work?

1. Burden of malnutrition

- Data synthesis
- Model projections

2. Programmatic responses

- Identify interventions & delivery modes
- Costs and effects

3. Objectives and constraints

- Strategic goals
- Ethical, logistic & economic constraints

4. Optimization algorithm

Key questions addressed by Optima Nutrition

- How can a fixed budget be allocated across interventions to minimise malnutrition and associated conditions?
- Which interventions should receive priority additional funding, if it were available?
    - In a sub-national analysis: which geographical regions should receive priority additional funding, if it were available?
- How might trends in undernutrition change under different funding scenarios?
- How close is a country likely to get to their nutrition targets:
    - with the current allocation of funding?
    - with the current volume of funding, but reallocated optimally?
- What is the minimum funding required, if allocated optimally, to meet the nutrition targets?

Optima Nutrition

Health outcomes addressed by Optima Nutrition

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

- Optimal outcomes can be measured as:
  - minimised stunting cases
  - minimised stunting prevalence
  - minimised wasting prevalence
  - minimised anaemia prevalence
  - minimised deaths or
  - A combination of the above, e.g. maximising the number of alive non-stunted children ("alive and thrive").

Optima Nutrition

Tour of the graphic user interface (GUI)

Optima Nutrition

Modelling stunting using Optima Nutrition

Day 1 – Session 3

Objectives of session

- The objective of this module is to understand the underlying model framework, using the stunting model as an example
- We will start this module with a presentation and then do some exercises using the Optima Nutrition graphic user interface we showed you earlier this morning
- At the end of this module and exercises you should be able to:
  - Project status-quo / baseline scenarios
  - Estimate the impact of scaling up and down stunting interventions
  - Create and model different infant and young child feeding education packages

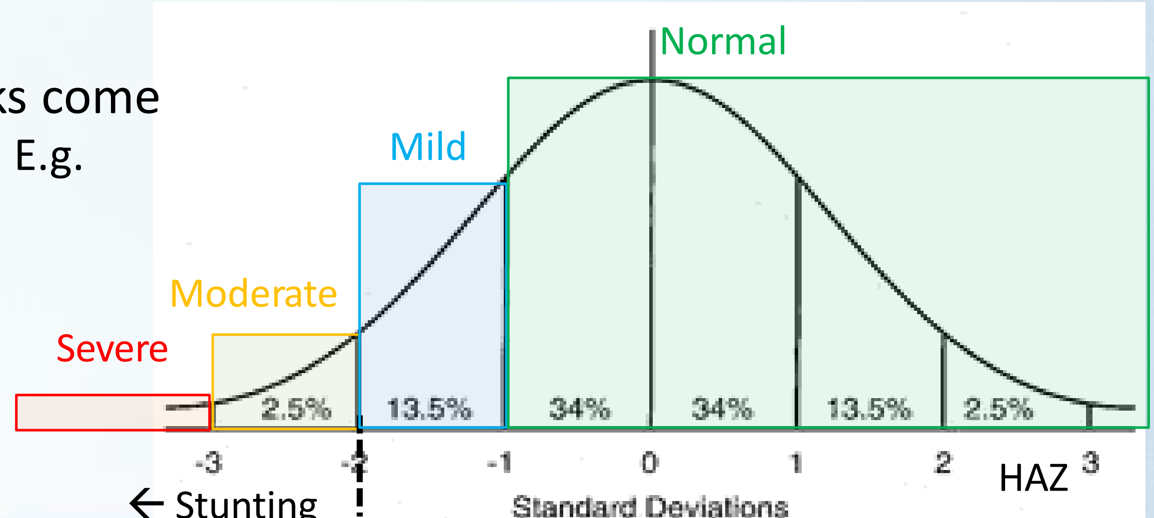
Overview of the Optima Nutrition model

- The underlying model is a reproduction of the LiST framework
  - Tracks the under-5 population over a given period (e.g. 2018-2030)
- The model includes risk factors that contribute to stunting and mortality (among other things)
- The model includes a range of interventions
  - For example: balanced energy protein supplementation, multiple micronutrient supplementation, vitamin A supplementation, prophylactic zinc supplementation, infant and young child feeding education and public provision of complementary foods.
- Key outcomes for this session include the number of deaths and stunting cases, and the prevalence of stunting
- An optimisation algorithm is used to allocate a given budget across the nutrition interventions to minimise a chosen objective
  - For example, maximise the number of alive and non-stunted children

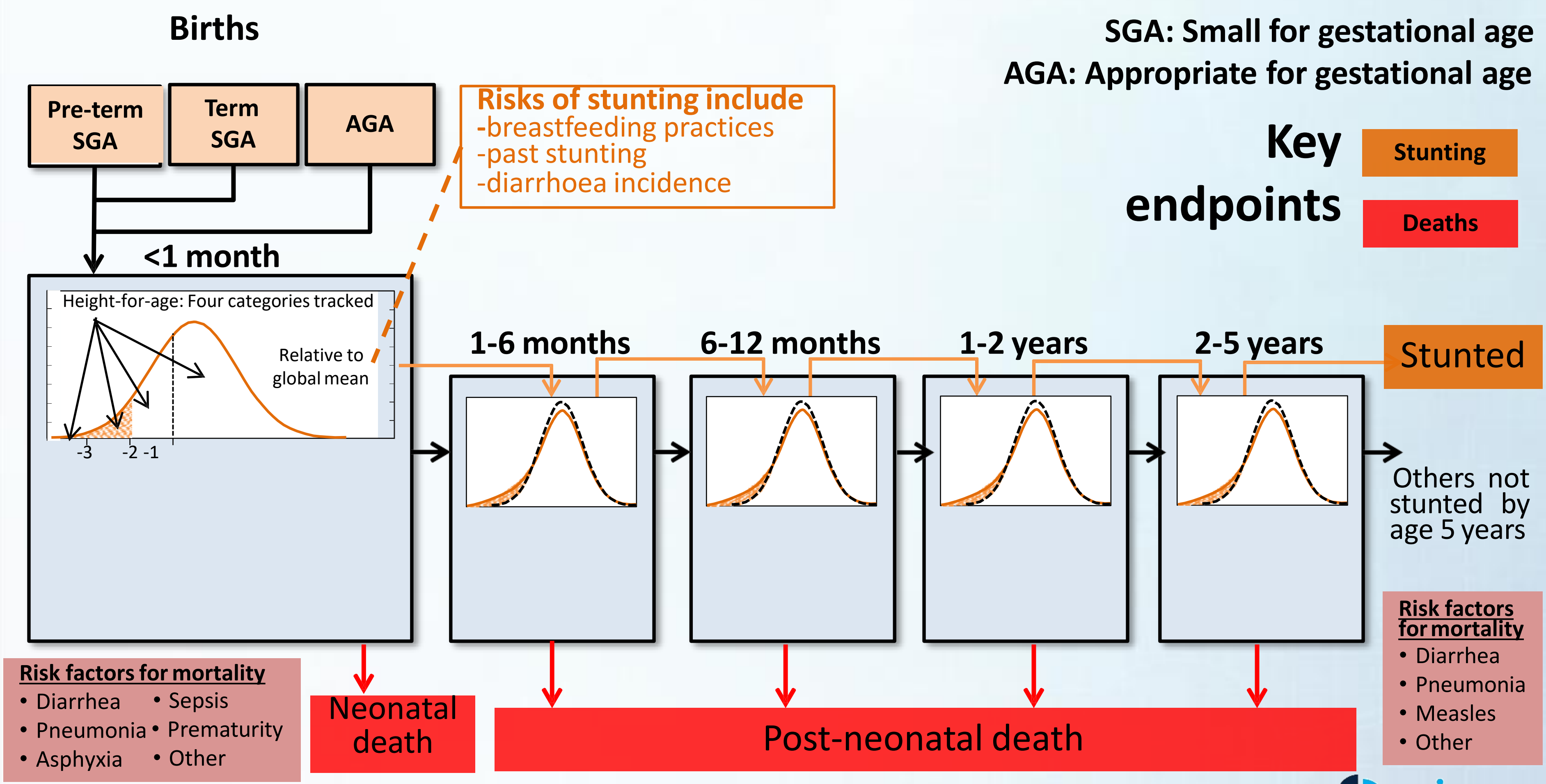
Optima Nutrition

Definition of stunting in the model

- Height-for-age distribution is classified into four Z-score (HAZ) categories
- Risk factors for stunting are:
  - Birth outcomes OR =5 for term SGA; OR = 6.4 for pre-term AGA; OR = 46.5 for pre-term SGA [LiST]
  - Diarrhoea incidence OR =1.04 for every additional episode [LiST]
  - Past stunting OR = 45; 361.6; 174.7 and 174.7 for 1-6 month, 6-12 month, 12-23 month and 23-59 month categories respectively [LiST]
- Stunting increases the risk of mortality for children who have diarrhoea, pneumonia, measles and other illnesses:
  - Odds ratios / relative risks come from available literature: E.g. OR for measles mortality = 6.01 if severely stunted *Olofin et al 2013, PLoS One*

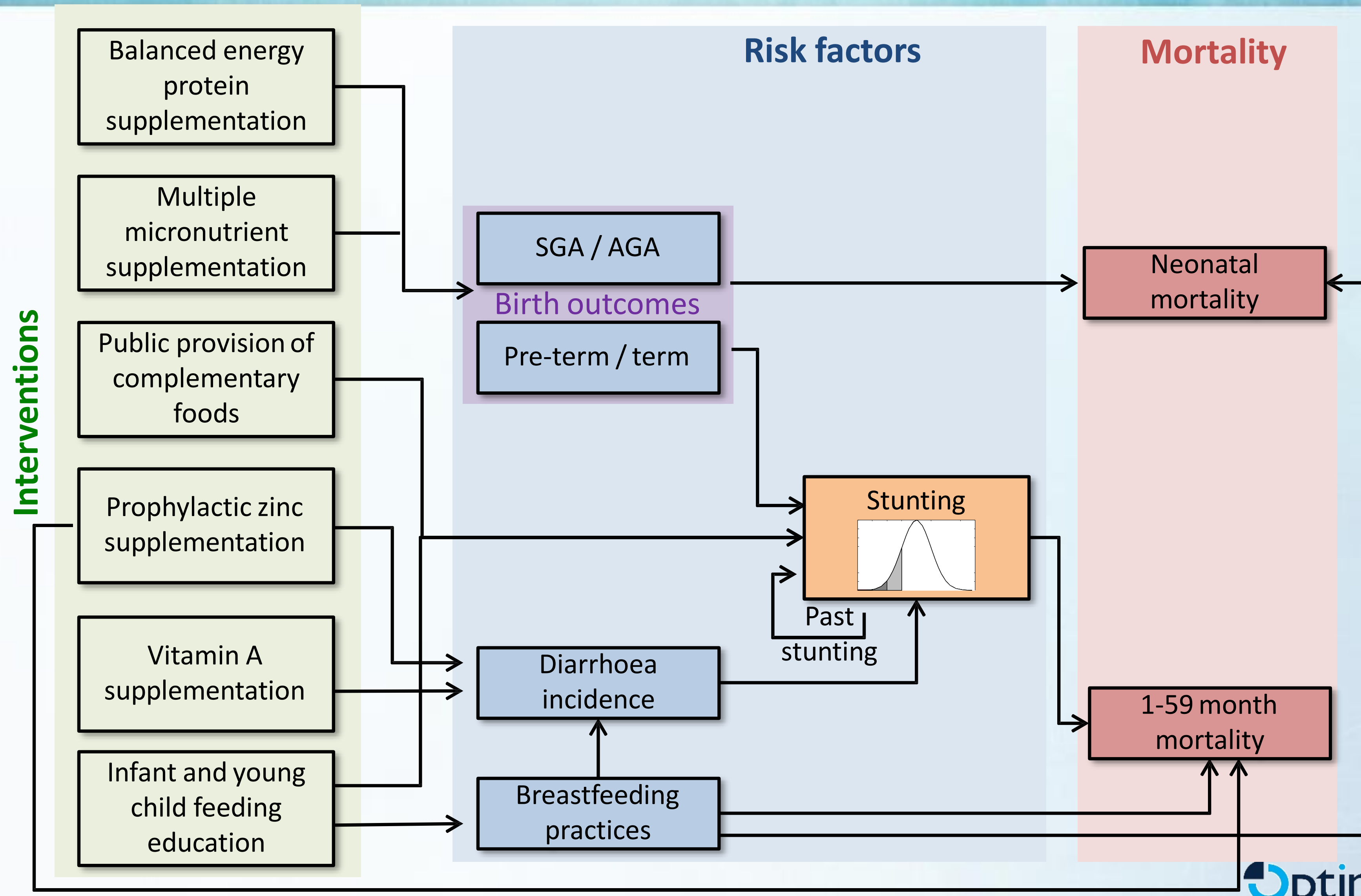


Model populations and ageing process



Optima Nutrition

Relationship between interventions, risk factors, stunting and mortality



Optima Nutrition

Summary of stunting-related interventions

Intervention	Target population	Effects	Source / effect size
Balanced energy protein supplementation	Pregnant women below the poverty line	Reduces risk of SGA birth outcomes	RRR = 0.79 [Ota et al. 2015, The Cochrane Library]
Multiple micronutrient supplementation in pregnancy	Pregnant women	Reduces risk of SGA birth outcomes	RRR = 0.77 [LiST]
Public provision of complementary foods	Children 6-23 months below the poverty line	Reduces the odds of stunting	OR = 0.89 [Bhutta et al. 2008, The Lancet; Imdad et al. 2011, BMC Public Health]
Prophylactic zinc supplementation	Children 1-59 months	Reduces diarrhoea incidence Reduces diarrhoea and pneumonia mortality	Diarrhoea incidence RRR = 0.805 [Bhutta et al. 2013, The Lancet; Yakoob et al. 2011, BMC Public Health] Mortalities RRR = 0.85 [Bhutta et al. 2013, The Lancet; Yakoob et al. 2011, BMC Public Health]
Vitamin A supplementation	Children 6-59 months	Reduces diarrhoea incidence mortality	Incidence RRR = 0.87 [Imdad et al. 2011, BMC Public Health] Mortality RRR = 0.82 [Imdad et al. 2011, BMC Public Health]
Infant and young child feeding education (IYCF)	Children <23 months	See next slide	

Modelling feeding practices and their impact

- Correct (or incorrect) feeding practices have a different impact in the model depending on the age of the child
- Therefore the model allows the user to choose what ages their education packages cover, and accounts for the different impacts.

Age group			Effect size / sources
< 6 months	Exclusive breastfeeding	Reduces diarrhoea Reduces mortality Indirectly reduces stunting and wasting (through decreased diarrhoea)	Diarrhoea incidence: compared to exclusive breastfeeding, OR = 1.26, 1.68, 2.65 for experiencing diarrhoea with predominant, partial or no breastfeeding[a] Diarrhoea mortality: compared to exclusive breastfeeding, OR = 2.28, 4.62, 10.53 for diarrhoea mortality and 1.66, 2.50, 14.97 for other causes with predominant, partial or no breastfeeding[b] Diarrhoea→ stunting: OR for stunting = 1.04 for every additional diarrhoea episode compared to exclusively breastfed children[c]
6-23 months	Partial breastfeeding	Reduces diarrhoea Reduces mortality	OR = 2.07 for no breastfeeding compared to partial breastfeeding[a]
	Appropriate complementary feeding	Reduces odds of stunting	OR = 0.67[d]

[a]Lamberti et al. *BMC Public Health* 2011, **11**(Suppl 3):S15); [b]Black et al. *The Lancet* 2008, **371**(9608):243-260; [c]LiST; [d]Imdad et al. *BMC Public Health* 2011, **11**(Suppl 3):S25.

Optima Nutrition

Combining education delivery in an infant and young child feeding (IYCF) package

- **Breastfeeding promotion and complementary feeding education interventions are combined in the model, as user-defined (IYCF) packages**
- An IYCF package can target one (or more) of: pregnant women, children 0-5 months or children 6-23 months
- An IYCF package can be delivered through one or more of:
  - Health facilities (GP, hospital): coverage is restricted by the fraction of the population who attend
  - Community health workers: reaches all women and can therefore have much higher coverage
  - Mass media: can cover all groups, depending on the message, with high coverage possible
  - If multiple delivery modes are selected, such as both health facility and community, then some parents will be exposed to multiple messages which can lead to greater impact.

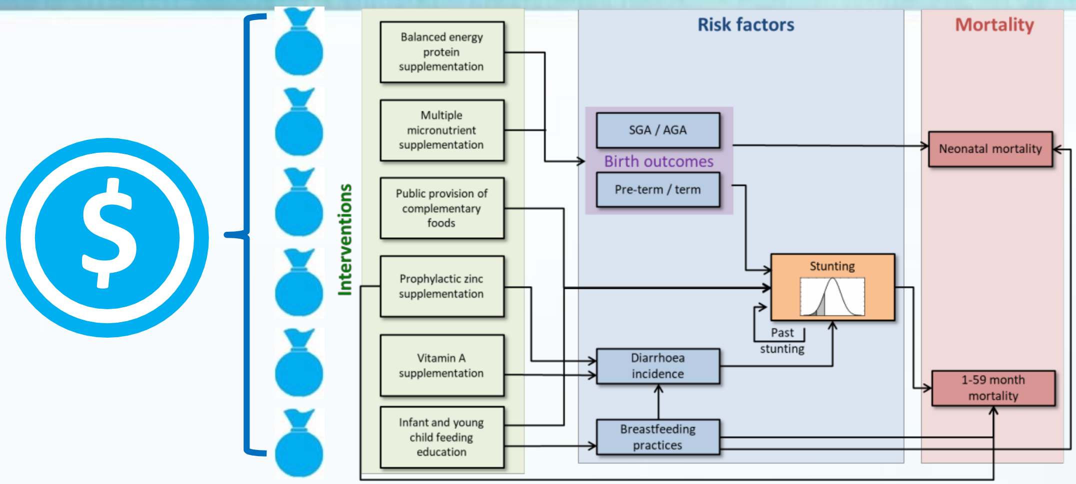
Optima Nutrition

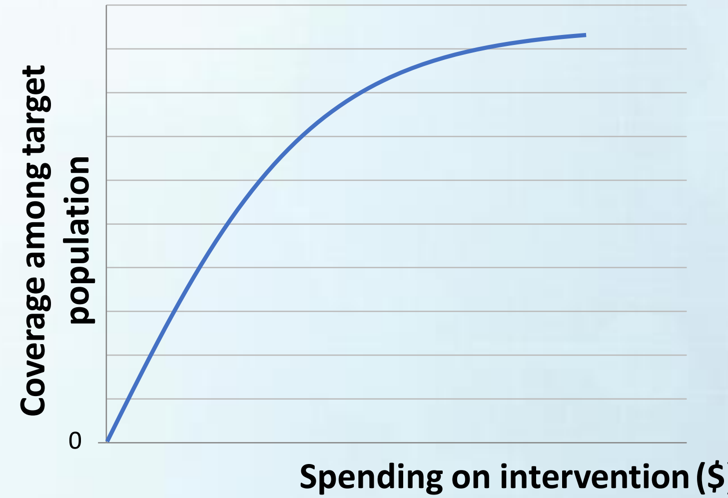
User defined IYCF packages and input sheet

- Users can design their own IYCF packages using the table below
- Multiple IYCF packages can be designed and used in an optimisation
- For example, below might reflect an IYCF package that includes:
  - **Pregnant women**: counseling for pregnant women attending health facilities
  - **<6 months**: visit from community health worker + counseling during facility child visits
  - **> 6 months**: community lectures + counseling during facility child visits
  - **Mass media messages** about advantages of exclusive breastfeeding 0-6 months

IYCF package	Target population	Health facility	Community	Mass media
IYCF 1	Pregnant women	x		
	<1 month	x	x	
	1-5 months	x	x	
	6-11 months	x	x	
	12-23 months	x	x	
	All			x

Linking investment in interventions to impact





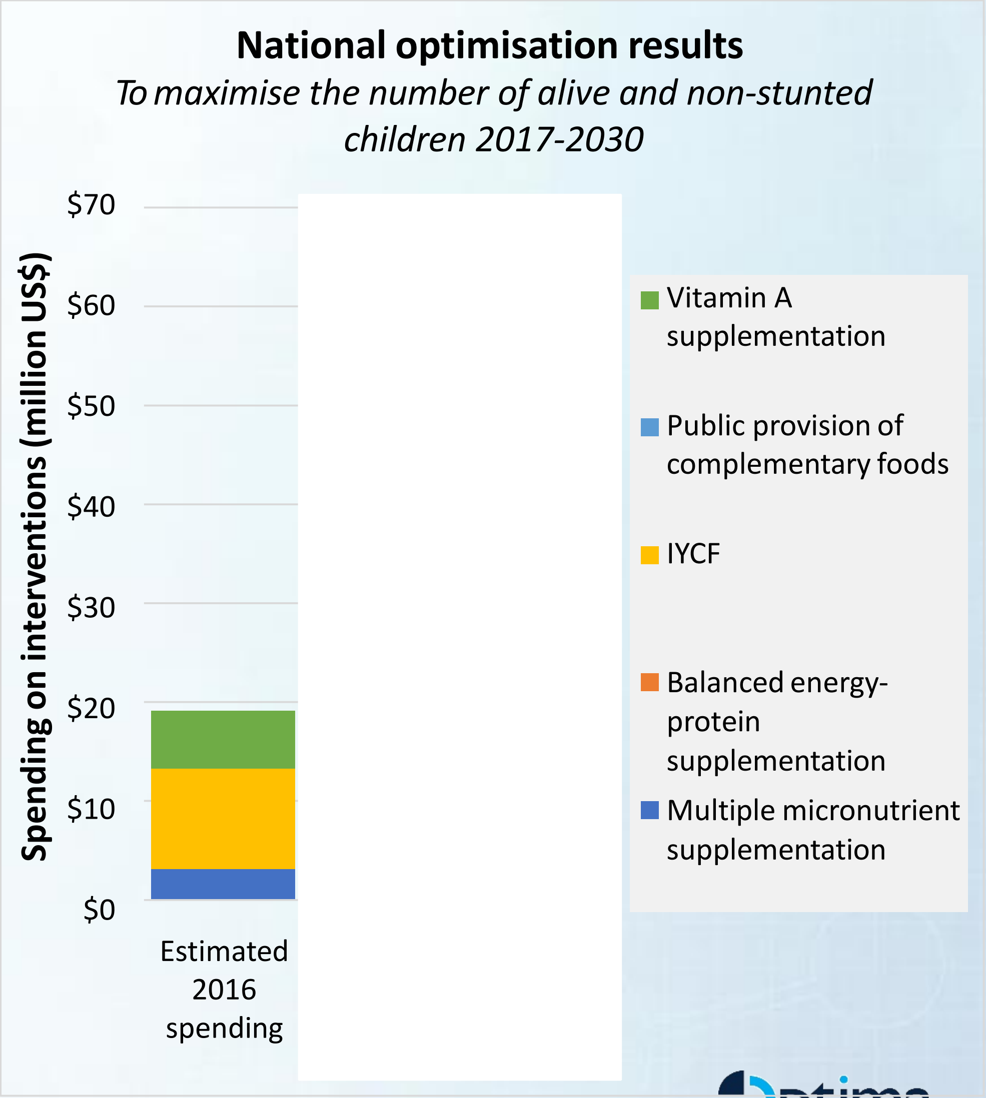
- The spending on interventions is linked to their coverage
- For each intervention, increasing investment:
  - Increases the number of people receiving the intervention
  - Leads to reductions in stunting and deaths according to estimated effectiveness
  - Has a saturation effect when scaling up interventions
- **The model is given inputs on how much to spend on each intervention, and produces estimates for stunting and mortality (among other things).**

Optima Nutrition

Tanzania Example: National Spending in 2016

Tanzania's 2016 nutrition funding was estimated at US$19.1 million[a]:

- IYCF (53%)
- Vitamin A supplementation (31%)
- Multiple micronutrient supplementation (pregnant women) (16%)

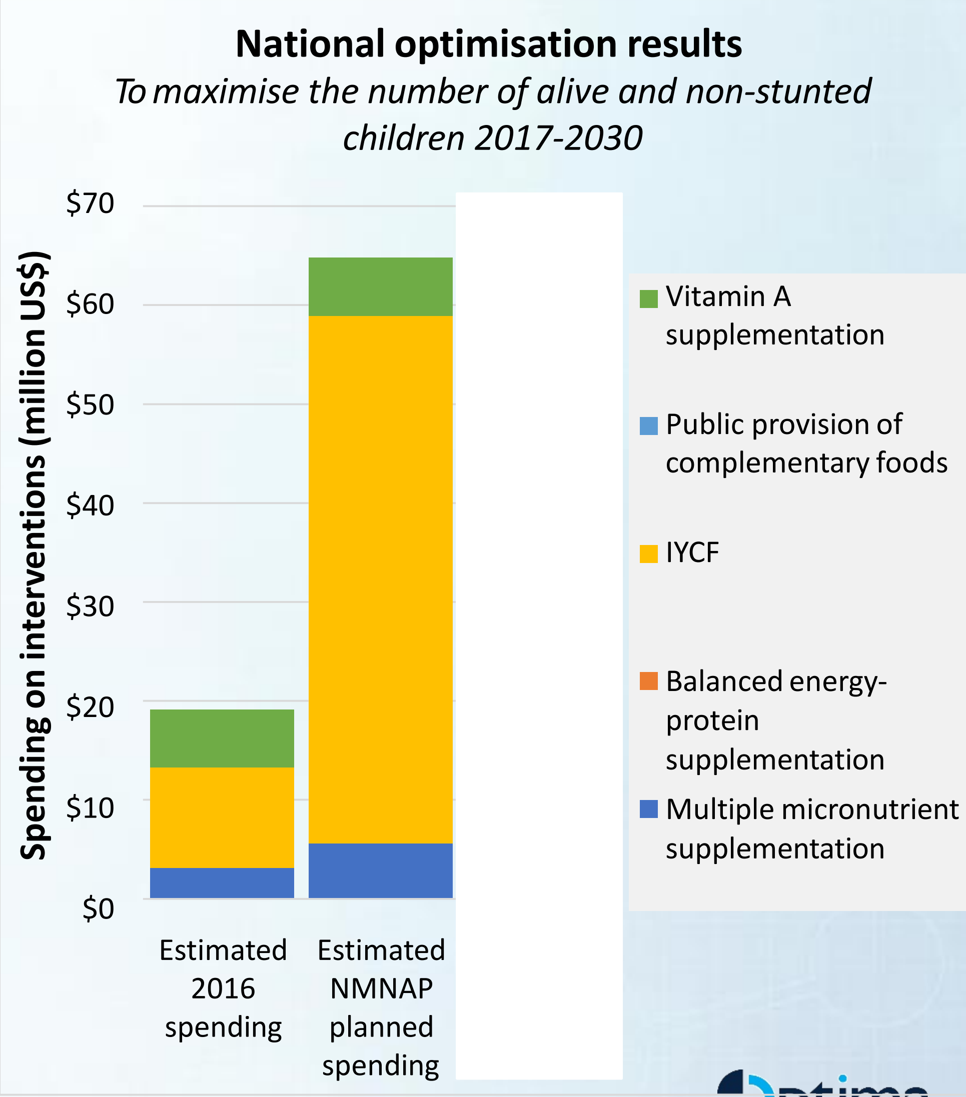


[a] Based on estimates of national intervention coverages and unit costs.

Optima Nutrition

Tanzania's National Multisectoral Nutrition Action Plan (NMNAP)

- Tanzania's NMNAP includes 2021 national coverage targets:
  - 65% IYCF
  - 58% for micronutrient supplementation (pregnant women)
  - 90% for vitamin A supplementation
- Estimated to cost a total US$64.8 million per annum
- If maintained to 2030 could result in a cumulative:
  - **949,000 (4.9%) additional alive and non-stunted children**, compared to continued estimated 2016 spending



Optima Nutrition

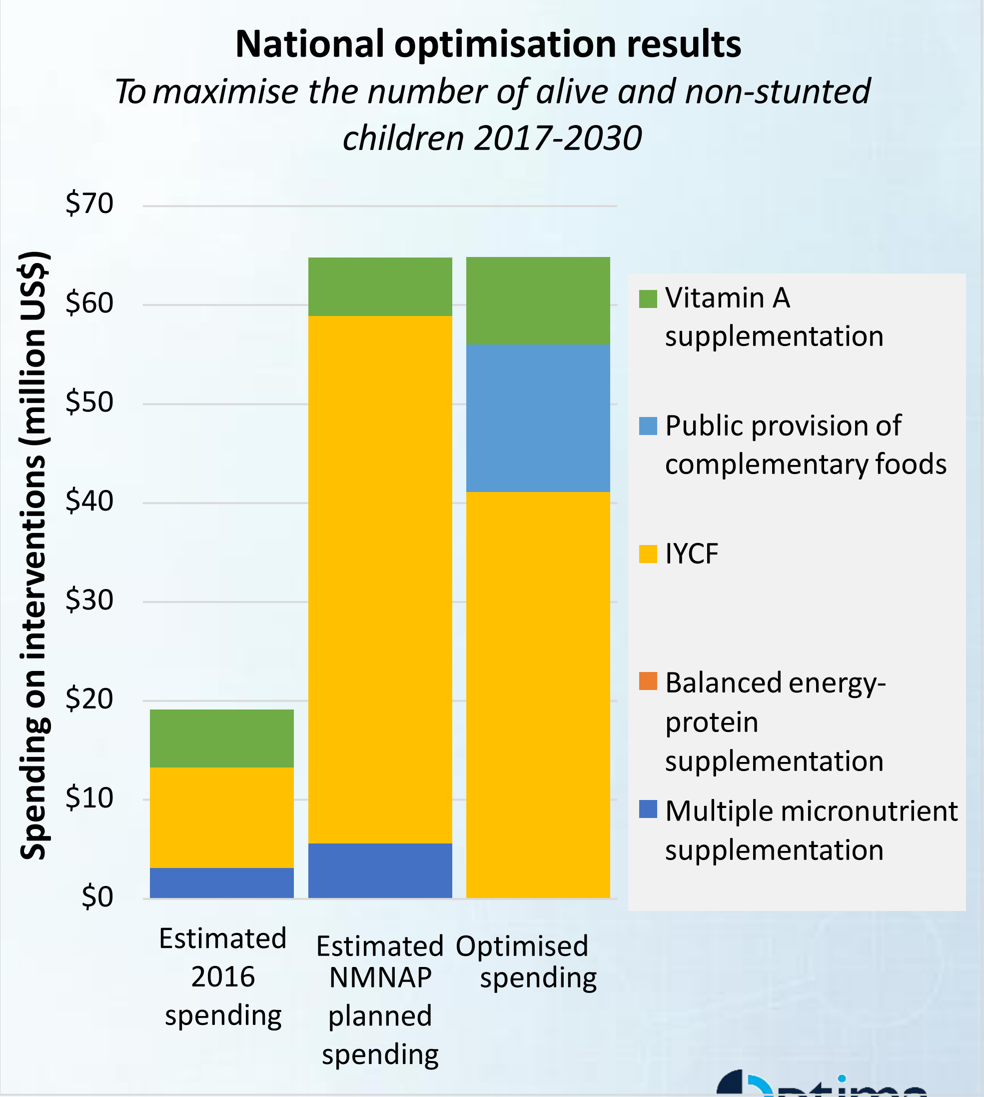
Optimisation of estimated NMNAP budget

To maximise the number of alive and non-stunted children, funding should be optimally targeted towards:

- IYCF (63%);
- public provision of complementary foods (23%); and
- vitamin A supplementation (14%).

Compared to the NMNAP scenario, optimisation is estimated to:

- **Increase the number of alive, non-stunted children by 192,000 (0.9%)** between 2017 and 2030
- **20%** higher impact than current NMNAP



Optima Nutrition

Exercises

- See worksheet

Modelling wasting using Optima Nutrition

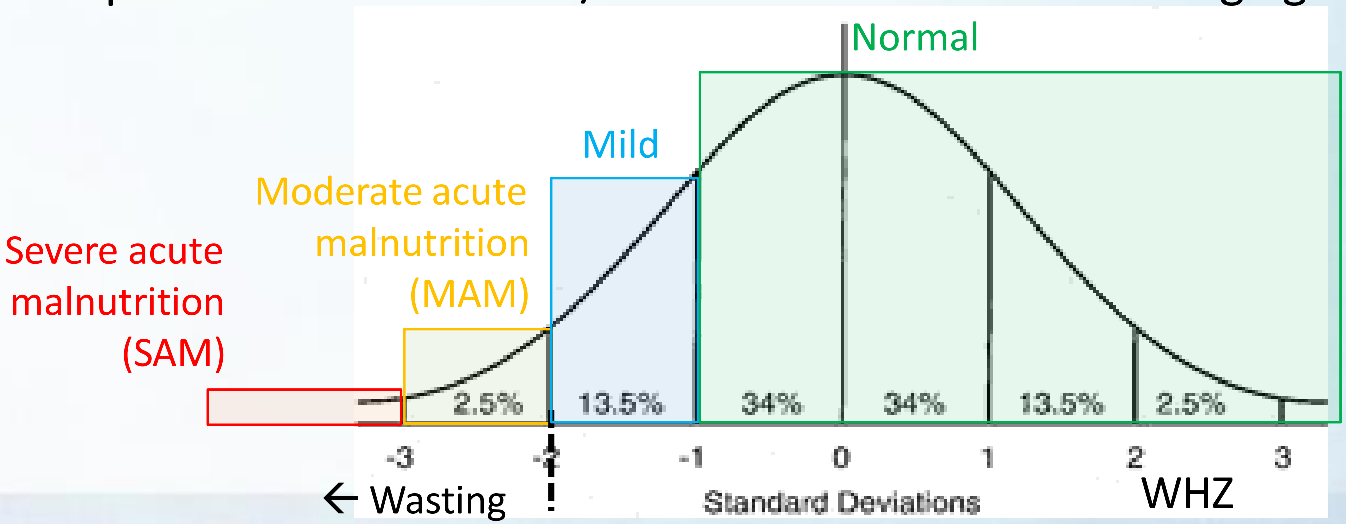
Day 1 – Session 4

Objectives of session

- Previously we covered stunting and stunting interventions in Optima Nutrition.
- This session will cover how wasting is incorporated in Optima Nutrition.
- We will start this module with a presentation and then do some exercises using the Optima Nutrition graphic user interface.
- At the end of this module and exercises you should be able to:
  - Understand the wasting component of the model, including prevention (incidence-reducing) interventions and treatment
  - Compare the impact of prevention and treatment interventions for reducing wasting
  - Understand how adding management of moderate acute malnutrition to a treatment intervention impacts its effects in the model
  - Be able to run budget scenarios in the model

Wasting implementation

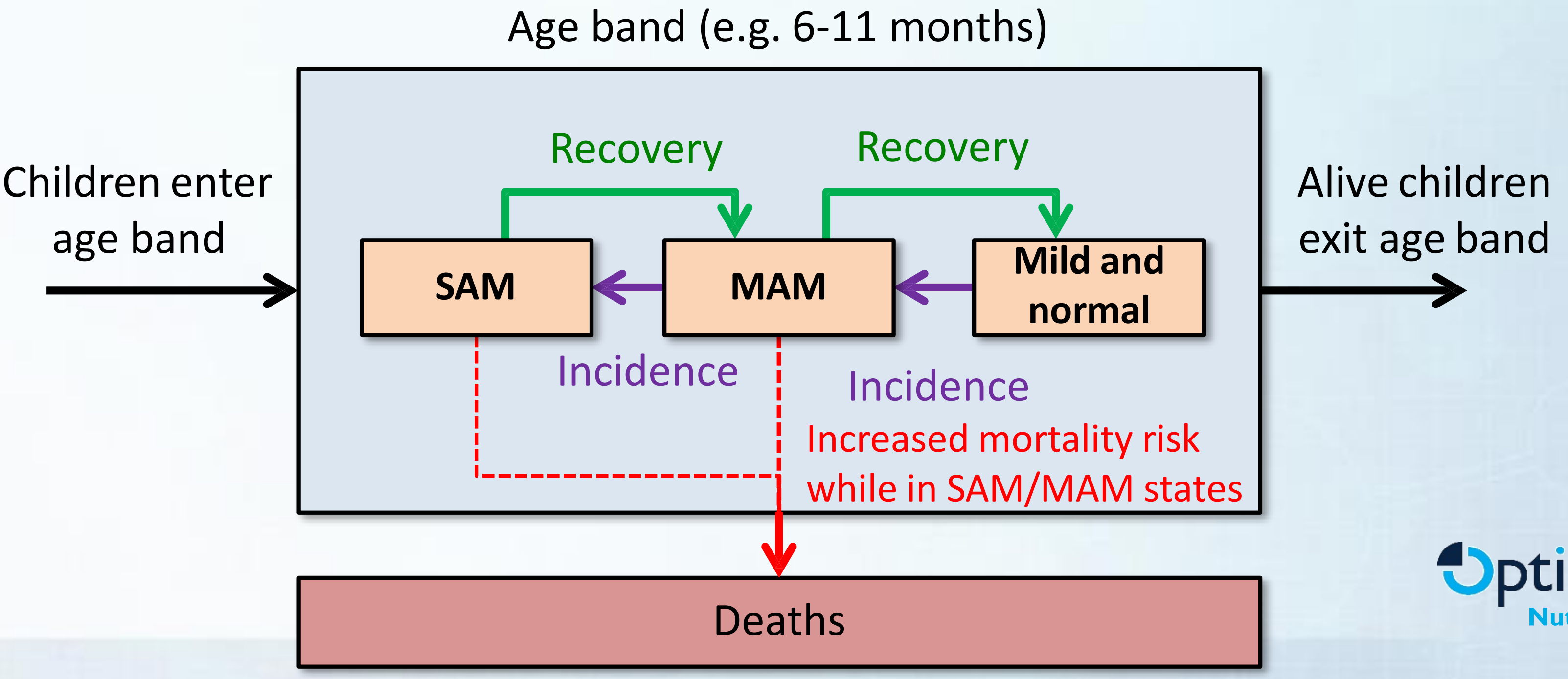
- The weight-for-height distribution is tracked for children in each age band
- Split according to weight-for-height Z-scores (WHZ) as four categories (similar to stunting)
  - Categories: severe acute malnutrition [SAM], moderate acute malnutrition [MAM], mild acute malnutrition, normal
  - Wasting considered to be SAM + MAM categories
- Wasting is modelled as an incident (short-duration) condition
  - Independent distributions / burden is allowed for each age group



Dynamics of wasting in the model

Wasting is modelled as a short-duration condition

- **Incidence** (purple arrows): children develop SAM/MAM
- Deaths (red arrows): children are at greater risk of death while in the SAM/MAM compartments
- **Recovery** (green arrows): scale-up of SAM/MAM treatment reduces the duration spent in those compartments

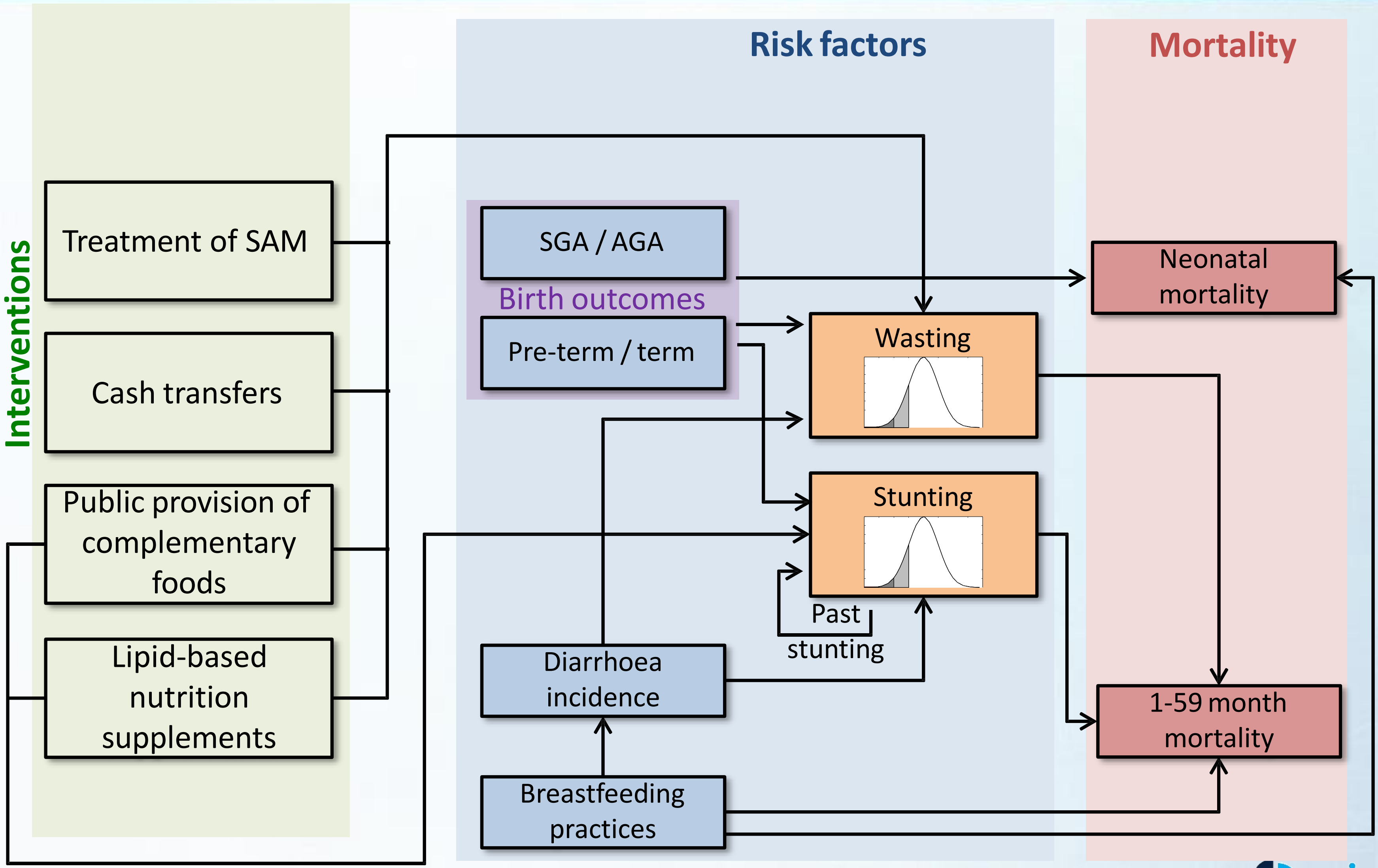


Risk factors for wasting

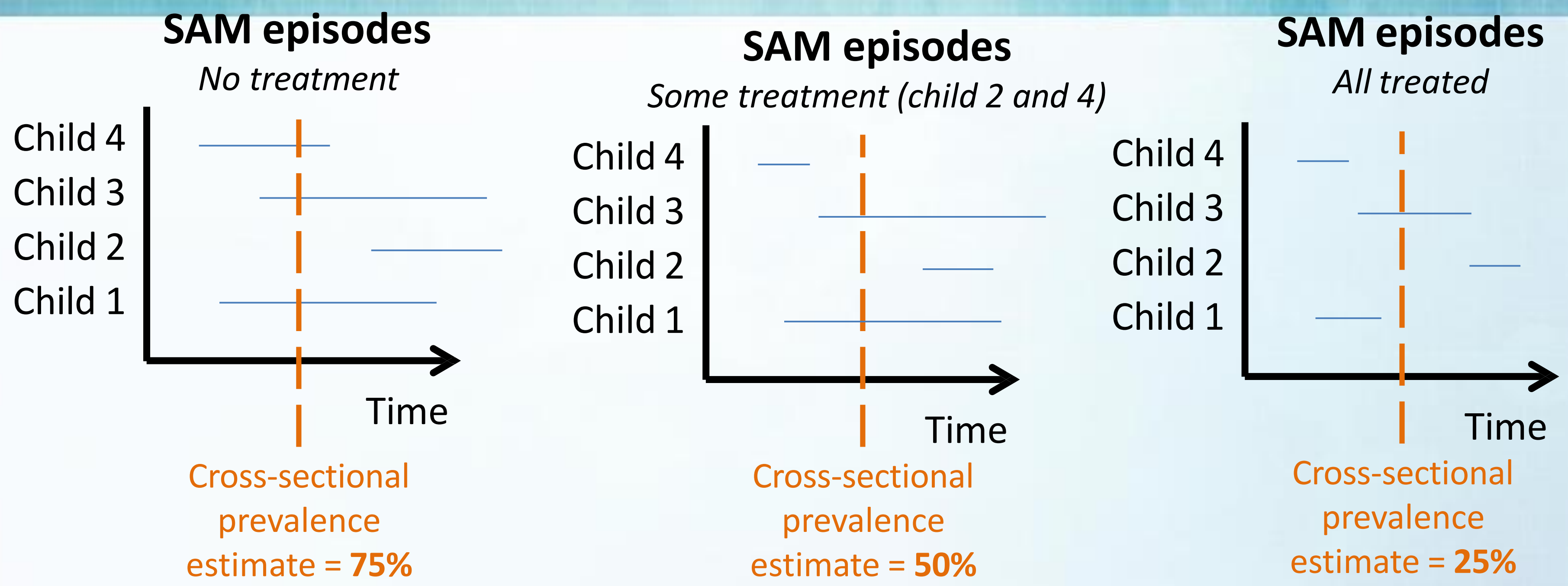
- Wasting is a risk factor for several causes of death in children > 1 month: [Olofin et al. 2013, PLoS One]
  - Diarrhoea RRR = 1.60, 3.41, 12.33 for mild, moderate and severe WHZ categories compared to normal
  - Pneumonia RRR = 1.92, 4.66, 9.68 for mild, moderate and severe WHZ categories compared to normal
  - Measles RRR = 2.58, 9.63 for moderate and severe WHZ categories compared to normal
  - Other RRR = 1.65, 2.73, 11.21 for mild, moderate and severe WHZ categories compared to normal
- Risk factors for wasting are:
  - Diarrhoea incidence OR = 1.025 for every additional episode; assumed the same OR as for stunting, from LiST
  - Preterm / term and SGA / AGA birth outcomes OR for wasting =1.65 for pre-term AGA, 2.58 for term SGA, 3.50 for pre-term SGA [Christian et al. 2013, International Journal of Epidemiology]
- Wasting and stunting modelled as independent
  - This is the approach taken in LiST

Optima Nutrition

Wasting: risk factors, outcomes and interventions



Treatment of wasting reduces episode duration

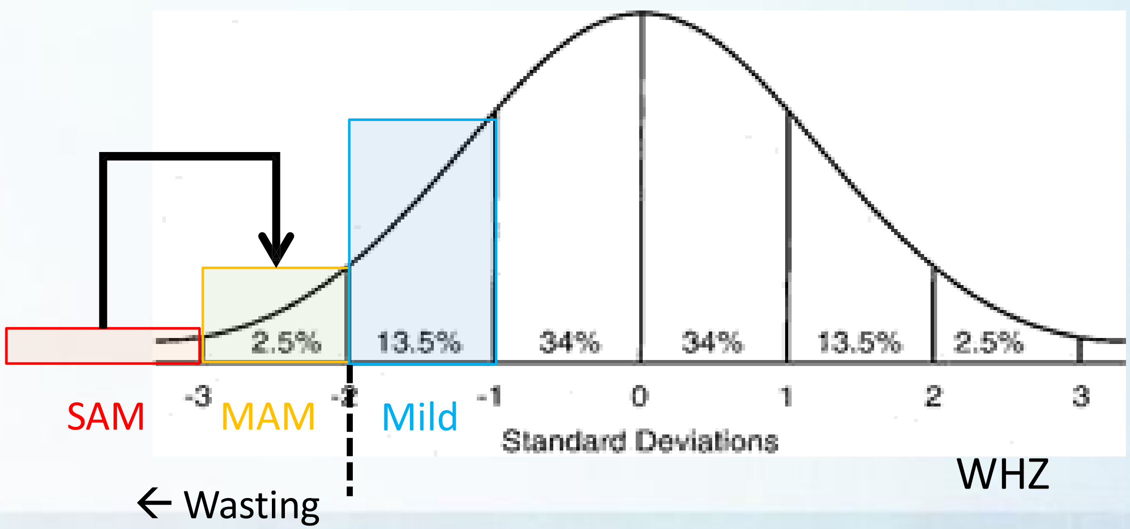


- Treatment of SAM reduces the duration of the condition Effectiveness = 0.78 for SAM if covered, OR = 0.84 for MAM [Lenters et al. 2013]
- This translates to a reduction in cross-sectional prevalence estimates

Optima Nutrition

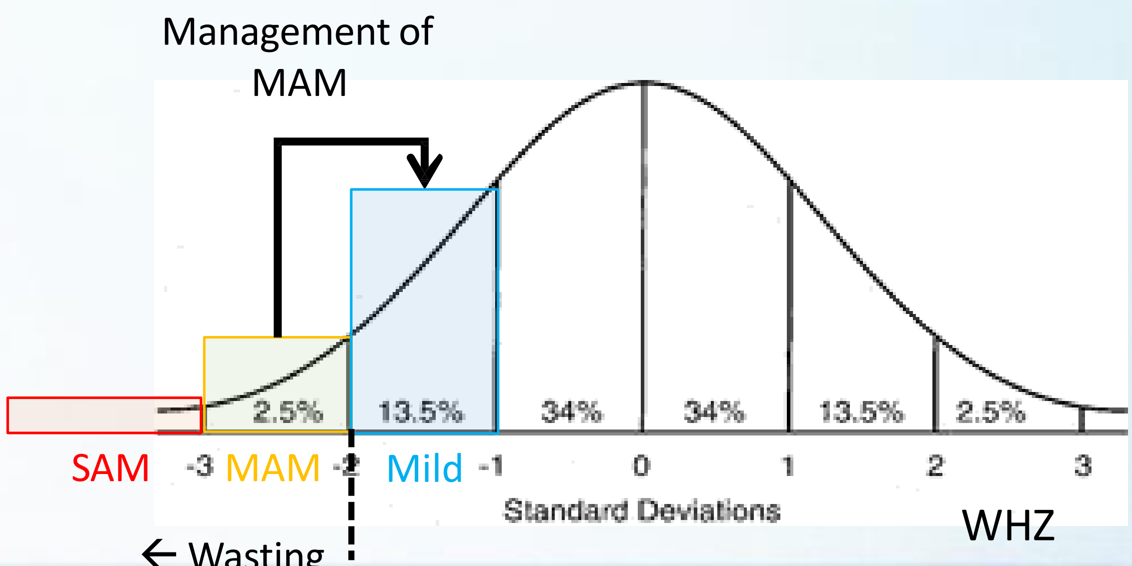
Interventions: treatment of SAM

- Treatment of severe acute malnutrition (SAM)
  - Target population is all children experiencing SAM
  - Treated children are moved to the MAM category
- Scaling up treatment of SAM:
  - Increases recovery from SAM Effectiveness on recovery rate = 0.78 [Lenters et al. 2013]
  - Therefore reduces the prevalence of SAM (i.e. RRR= 0.22)
  - Reduces mortality
  - **Increases the prevalence of MAM (indirectly increases mortality from MAM and incidence of SAM)**



Extending treatment of SAM to include MAM

- Scaling up treatment of SAM does not directly reduce wasting prevalence, since children recover to MAM
- The treatment of SAM intervention has an option to include management of MAM.
  - If selected, the treatment intervention will also shift children from MAM to mild
- Note that this will make the cost of the treatment intervention more expensive (by a user defined amount)



Extending treatment of SAM to include multiple delivery modes

- It is also possible to deliver treatment interventions through health facilities only, or health facilities + community.
  - The coverage of health facility delivery is restricted by the fraction of the population who attend health clinics
  - The cost of each delivery mode can be different, based on setting-specific data

	Default	Extension	Add extension
Program	Treatment of SAM	Management of MAM	
Delivery mode	Health facility	Community-based	

Save changes Revert

Optima Nutrition

Wasting prevention interventions

Intervention	Target population	Effects	Source / effect size
Public provision of complementary foods (PPCF)	Children 6-23 months below the poverty line	Reduces the odds of stunting Reduces the incidence of SAM Reduces the incidence of MAM *Indirectly reduces SAM mortality* *Indirectly reduces MAM mortality*	Stunting: OR = 0.89 [Bhutta et al. 2008, The Lancet; Imdad et al. 2011, BMC Public Health] SAM / MAM incidence RRR = 0.913 [LiST]
Lipid-based nutrition supplements (LNS)	Children 6-23 months below the poverty line	Similar to PPCF but also impacts anaemia (see next session)	
Cash transfers	All children below the poverty line	Reduces the incidence of SAM Reduces the incidence of MAM *Indirectly reduces SAM mortality* *Indirectly reduces MAM mortality*	SAM incidence: RRR = 0.766 for 6-23 months, RRR = 0.792 for 24-59 months [Langendorf et al. 2014, PLoS Med] MAM incidence: RRR = 0.719 for 6-23 months, RRR = 0.792 for 24-59 months [Langendorf et al. 2014, PLoS Med]

Optima Nutrition

Exercises

- See worksheet

Modelling anaemia using Optima Nutrition

Day 1 – Session 5

Objectives of session

- The previous sessions covered how stunting and wasting are modelled in Optima Nutrition.
- This session will cover how anaemia is incorporated in Optima Nutrition.
- We will start this module with a presentation and then do some exercises using the Optima Nutrition graphic user interface.
- At the end of this module and exercises you should be able to:
  - Understand the anaemia component of the model, including additional population groups (women of reproductive age, by age category).
  - Understand different delivery modalities for iron and folic acid supplementation interventions, and different food fortification vehicles
  - Understand the two kinds of intervention dependencies, threshold and exclusion.

Model populations: overview of stratifications

Population	Age group		
Non-pregnant women of Reproductive Age (WRA)	15 - 19 years	Not anaemic	Anaemic
	20 - 24 years	Not anaemic	Anaemic
	25 - 29 years	Not anaemic	Anaemic
	30 - 39 years	Not anaemic	Anaemic
	40 - 49 years	Not anaemic	Anaemic
Pregnant women	15 - 19 years	Not anaemic	Anaemic
	20 - 29 years	Not anaemic	Anaemic
	30 - 39 years	Not anaemic	Anaemic
	40 - 49 years	Not anaemic	Anaemic
Children	0 - 1 months	Not anaemic	Anaemic
	1 - 6 months	Not anaemic	Anaemic
	6 - 11 months	Not anaemic	Anaemic
	12 - 23 months	Not anaemic	Anaemic
	24 – 59 months	Not anaemic	Anaemic

Children
Also stratified by:

- Stunting
- Wasting
- Breastfeeding

Optima Nutrition

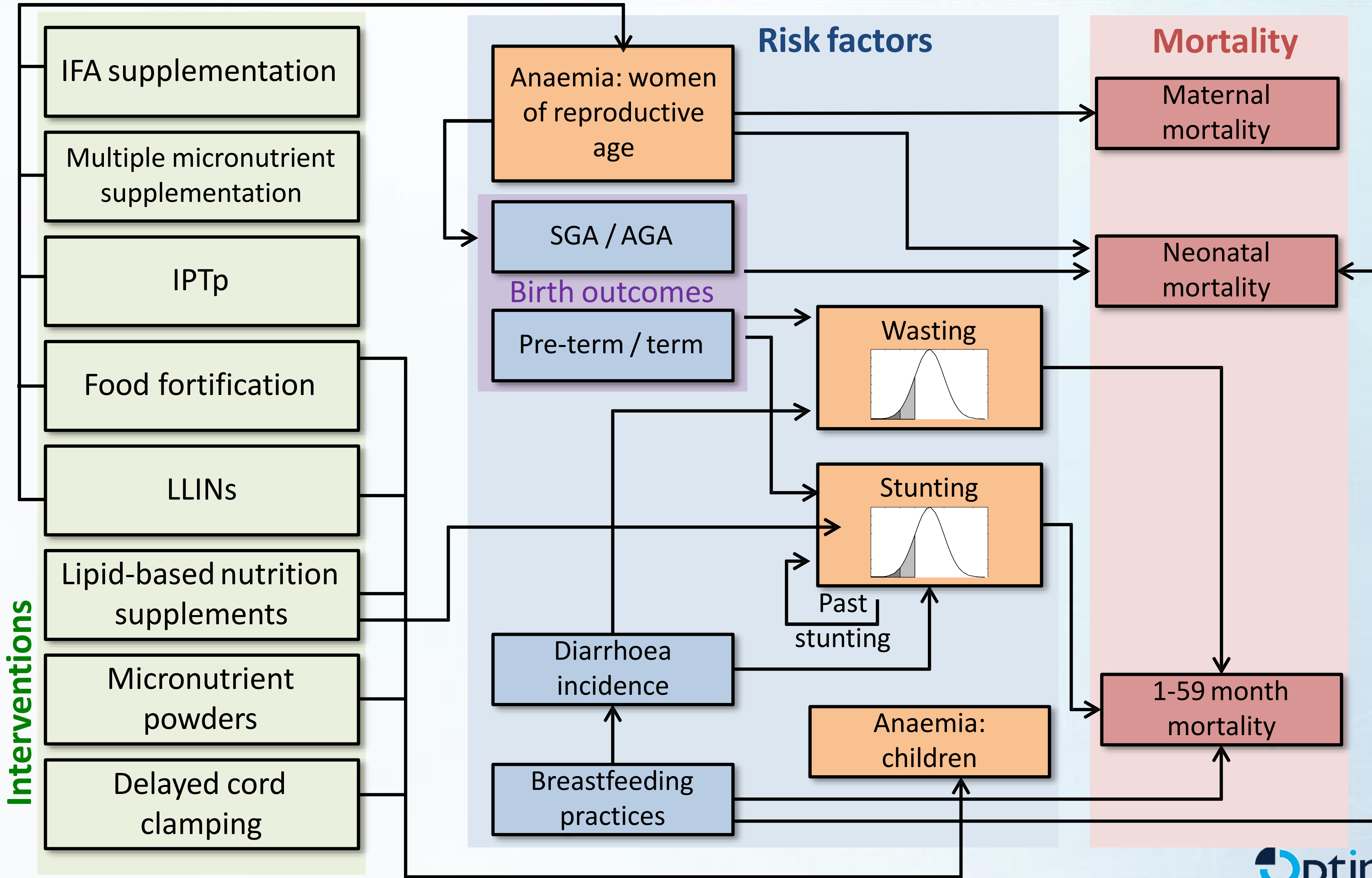
Anaemia: risk factors and effects

- Anaemia in pregnant women is modelled as a risk factor for maternal mortality (haemorrhage)
  - Anaemia increases relative risk of death due to haemorrhage RRR = 10.675 antepartum; intrapartum; and postpartum for the estimated fraction who are severely anaemic [LiST]

- Anaemia in pregnant women is modelled to be a risk factor for suboptimal birth outcomes OR =1.32 for pre-term AGA [Xiong et al. 2000, Am J Perinatology]; OR = 1.53 for term SGA; OR = 1.53 for pre-term SGA [Kozuki et al. 2012, J. Nutrition]
  - This can affect stunting, which in turn can affect mortality in children

Optima Nutrition

Anaemia: risk factors, outcomes and interventions

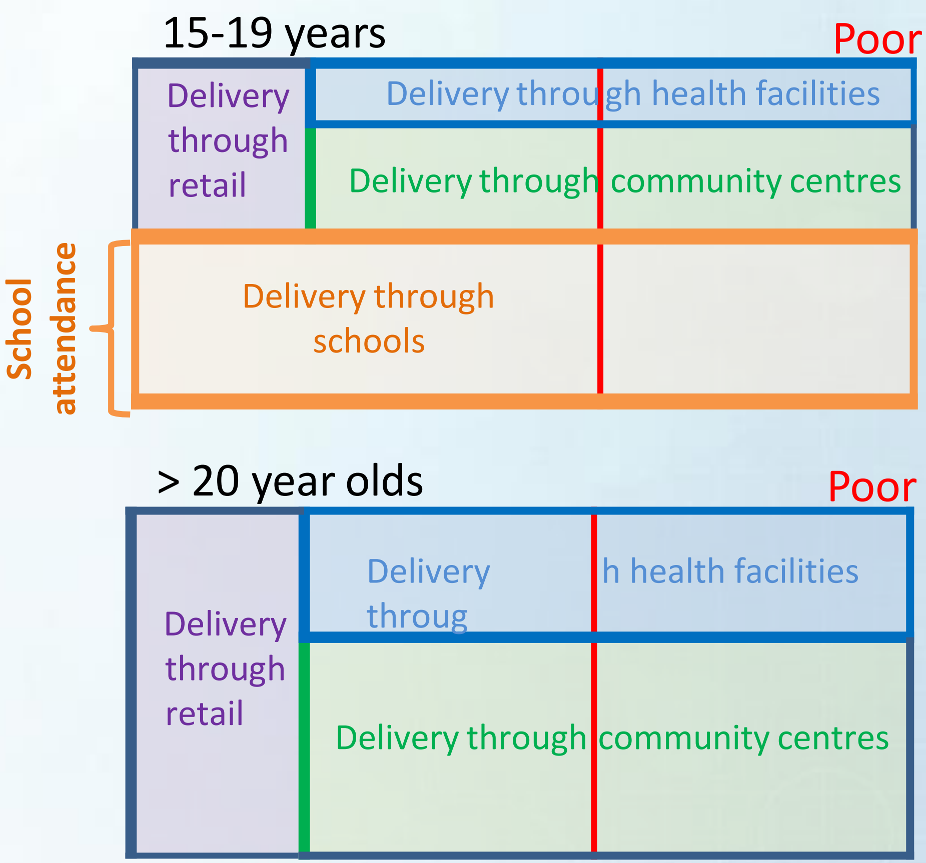


IFA supplementation: non-pregnant women of reproductive age

- Delivered through four modalities:
  - Schools (the only modality for 15-19 year olds who attend)
  - Health facilities (available for those not at school and attending health facilities)
  - Community (available for everybody)
  - Retail (only available for the fraction who are not poor)

- The fraction of the population who are likely to access each modality are entered by the user

Target populations



*Coloured areas represent 100% coverage of IFA supplementation through a particular delivery mode.

Optima Nutrition

Anaemia interventions

Intervention	Target population	Effects	Source / effect size
IFA supplementation for pregnant women	Pregnant women. Not given to women receiving MMS	Reduces anaemia Reduces SGA birth outcomes	Anaemia RRR = 0.33 [Pena-Rosas et al, Cochrane Database Reviews 2015] SGA RRR = 0.85 [Pena-Rosas et al, Cochrane Database Reviews 2015]
IFA supplementation for non-pregnant WRA		Reduces anaemia	RRR = 0.73 [Fernandez-Gaxiola & De-Regil 2011, Cochrane Database Syst Rev]
Multiple micronutrient supplementation	Pregnant women	Reduces risk of SGA birth outcomes	RRR = 0.77 [LiST]
IPTp	Pregnant women in areas where there is malaria risk	Reduces anaemia Reduces SGA birth outcomes	Anaemia RRR = 0.83 [Radeva-Petrova et al. 2014, The Cochrane Library] SGA RRR = 0.65 [Eisele et al. 2010, I J Epi]

Optima Nutrition

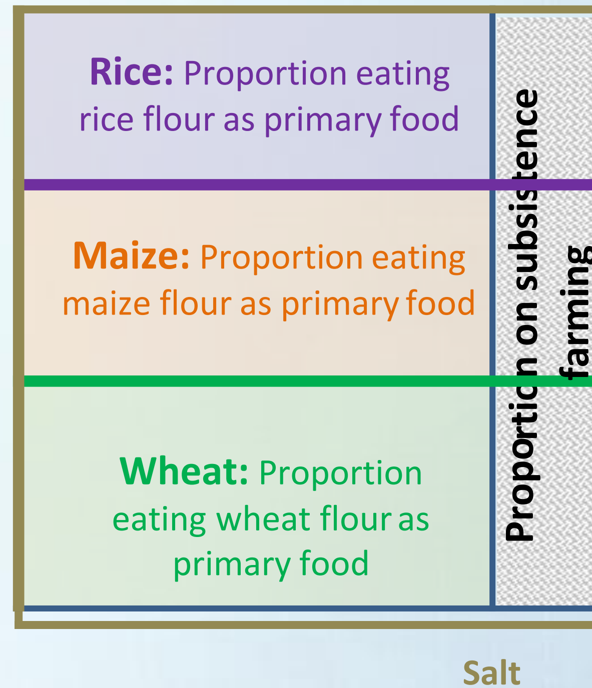
Anaemia interventions

Intervention	Target population	Effects	Source / effect size
Food fortification	Everyone	Reduces anaemia Reduces neonatal mortality	Anaemia OR = 0.976 [RRR = 0.678 Barkley et al. 2015, B J Nutrition] Neonatal mortality RRR = 0.678 [congenital defects; Blencowe et al. 2010, I J Epidemiology]
Long-lasting insecticide-treated bed nets	Everyone in areas where there is malaria risk	Reduces anaemia Reduces SGA birth outcomes	Anaemia RRR = 0.83 [Eisele et al. 2010, Int J Epi] SGA RRR = 0.65 [Eisele et al. 2010, Int J Epi]
Lipid-based nutrition supplements (LNS)	Children 6-23 months below the poverty line	Reduces stunting Reduces incidence of MAM/SAM Reduces anaemia	Stunting OR = 0.89 [assumed the same as PPCF] MAM/SAM incidence RRR = 0.913 [assumed to be the same as PPCF] Anaemia RRR = 0.69 for all-cause anaemia[assumed to be the same as micronutrient powders]
Micronutrient powders	Children 6-59 months, not already receiving LNS	Reduces anaemia	RRR = 0.69 [De-Regil et al. Chochrane review 2013]
Delayed cord clamping	Pregnant women (at birth)	Reduces anaemia	RRR = 0.53 [Hutton and Hassan, 2007 Jama]

Interventions: fortification of foods

- Women of reproductive age (pregnant and non-pregnant) and children >6 months can be impacted by food fortification
- **Fortification with iron and folic acid is modelled as three separate interventions**:
  - Fortification of wheat, rice and maize flour
  - Coverage restricted to fraction who eat each food as their staple, determined from consumption data
  - Does not reach the fraction on subsistence farming
- Double fortification of salt (iron + iodine)
  - Targets entire population

Food fortification target populations

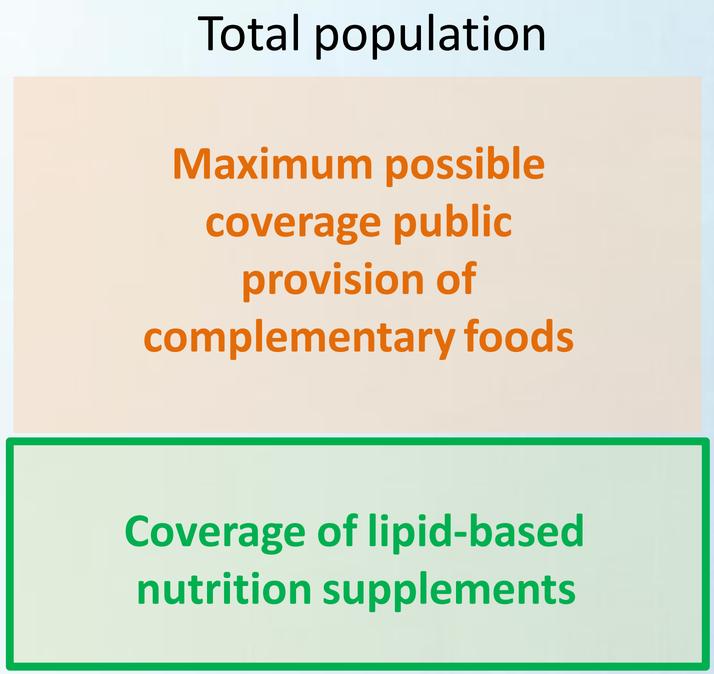


*Coloured areas represent 100% coverage of a particular food fortification.
**Depending on the country, the target population of a particular food vehicle may be zero

Exclusion dependencies in the model

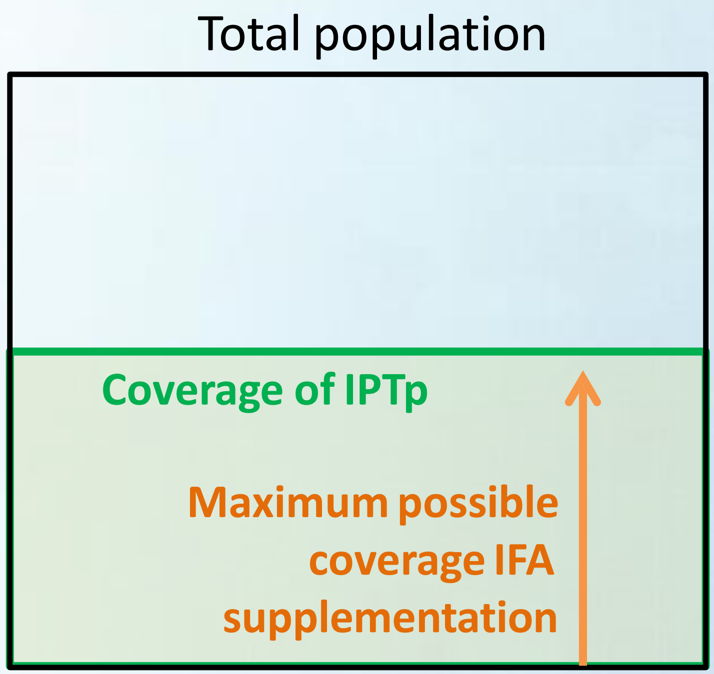
Two types of restrictions can be applied to interventions

- **Exclusion dependencies**, to prevent interventions from being given simultaneously
- For example, by default the model restricts some interventions so that:
  - Lipid-based nutrition supplements and public provision of complementary foods are not given to the same children
  - IFA supplementation and multiple micronutrient supplementation are not given to the same pregnant women, because they both contain iron
  - Multiple micronutrient powders and lipid-based nutrition supplement are not given to the same children as they both contain iron



Threshold dependencies in the model

- **Threshold dependencies**, where an interventions can only be given at the same time as another.
- For example, it is possible to apply restrictions so that in areas at risk of malaria:
  - IFA supplementation may only be given to pregnant women if they are taking IPTp (WHO recommendation).
  - Micronutrient powders may only be given to children who have a bed net.



Turning dependencies on and off

- Default dependencies are shown below
  - These can be removed by deleting them in the input sheet
  - More dependencies can be added by adding rows to the input sheet

	A	B	C
1	**Program**	**Exclusion dependency**	**Threshold dependency**
2	IFAS for pregnant women (community)	Multiple micronutrient supplementation	
3	IFAS for pregnant women (hospital)	Multiple micronutrient supplementation	
4	Public provision of complementary foods	Lipid-based nutrition supplements	
5	Micronutrient powders	Lipid-based nutrition supplements	
6			
7			
8			
9			
10			

Treatment of SAM | Programs cost and coverage | IYCF cost | **Program dependencies** | Incidence of conditions | P

Ready

Optima Nutrition

Exercises

- See worksheet

Nutrition-sensitive interventions
Family planning, WASH

Day 2 – Session 1

Optima Nutrition

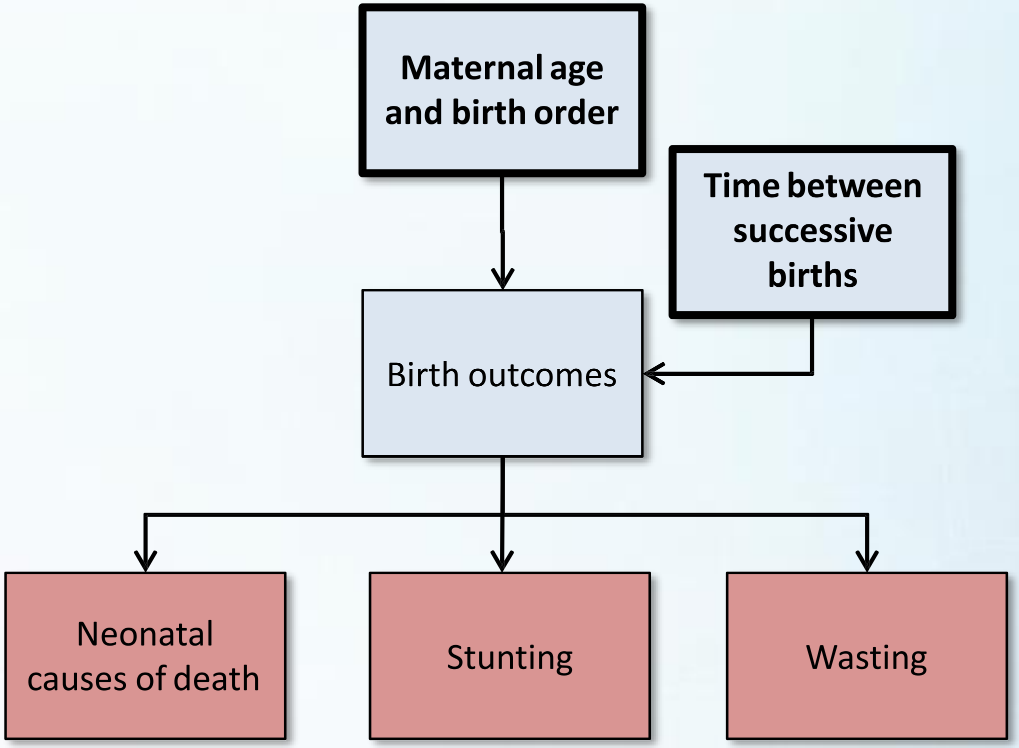
Objectives of session

- The previous sessions have covered Optima Nutrition's main outcomes (stunting, wasting and anaemia).
- This session will cover:
  - Family planning and WASH interventions
  - Any supplement interventions that have not been covered in previous sessions
- We will start this module with a presentation and then do some exercises using the Optima Nutrition graphic user interface
- At the end of this module and exercises you should be able to:
  - Understand how to interpret model outcomes associated with family planning (specifically its impact on mortality rather than mortality rates)
  - Understand how family planning impacts birth outcomes through birth spacing
  - Change default parameter values in the model

Optima Nutrition

Fertility risks

- Maternal age, birth order and time between successive births impact on birth outcomes
  - *Note: birth outcomes are also influenced by anaemia prevalence and the coverage of supplementation interventions in pregnant women*
- This impacts stunting, wasting and mortality



Fertility risks

Illustrates that children have a greater risk of being pre-term or SGA:

- If they are the first child
- Their mother is <18 years
- They are born within 18 months of an older sibling

Relative risks of birth outcomes for age, birth order and birth spacing

Age and birth order	Pre-term SGA RR	Pre-term AGA RR	Term SGA RR
Less than 18 years			
First birth	3.14	1.75	1.52
Second and third births	1.6	1.4	1.2
Greater than third birth	1.6	1.4	1.2
18 - 34 years old			
First birth	1.73	1.75	1.52
Second and third births	1	1	1
Greater than third birth	1	1	1
35 - 49 years old			
First birth	1.52	1.75	1.52
Second and third births	1	1.33	1
Greater than third birth	1	1.33	1
Birth intervals[a]			
First birth	1	1	1
less than 18 months	3.03	1.49	1.41
18-23 months	1.77	1.1	1.18
24 months or greater	1	1	1

Kozuki et al. 2013

How family planning works

- When family planning services are scaled up this decreases the number of projected births
  - Expanded services are restricted by unmet need
- Having fewer births means that the total number of the following will decrease:
  - unfavorable birth outcomes
  - total number of non-stunted children reaching age 5
  - total number of maternal and child deaths
- Family planning also decreases the odds of suboptimal birth spacing OR = 0.66 of of women without contraception achieving 24 months or greater birth spacing [de Bocanegrea et al. 2014]
- There is a need to be cautious because family planning can radically reduce the number of stunted children (but only has a small and indirect impact on stunting prevalence)

Optima Nutrition

Water, sanitation and hygiene (WASH)

- Five WASH interventions are available in the model:
  1. Improved water source
  2. Piped water
  3. Improved sanitation
  4. Hygienic disposal of stools
  5. Handwashing with soap

- Evidence on the effectiveness of these interventions is mixed and unclear, in particular given some recent large studies
  - WASH Benefits (Bangladesh and Kenya) and SHINE (Zimbabwe)

Optima Nutrition

WASH Benefits and SHINE studies

- **The WASH Benefits study** (Bangladesh[a], N=5551 and Kenya[b], N=8426) compared diarrhoea and stunting between a control group and groups with:
  1. Chlorinated drinking water: no effect on diarrhoea or stunting
  2. Upgraded sanitation: diarrhoea prevalence ratio 0.61 in Bangladesh, no effect in Kenya; no effect on stunting
  3. Promotion of handwashing with soap: diarrhoea prevalence ratio 0.60 in Bangladesh, no effect in Kenya; no effect on stunting
- **The SHINE study** (Zimbabwe[c], N=5280) compared diarrhoea, stunting, anaemia and mortality between a control group and groups with:
  - WASH (treated water, latrines, handwashing facilities + promotion, hygienic disposal of stools): no effect on diarrhoea, stunting, anaemia, mortality
  - IYCF (breastfeeding promotion, complementary feeding education, provision of Nutributter): reduction in stunting and anaemia, no impact on diarrhoea and mortality

Optima Nutrition

[a]Luby et al. Lancet Glob Health 2018; [b]Null et al. Lancet Glob Health 2018
[c]The Sanitation Hygiene Infant Nutrition Efficacy Trial team. Clinical Inf Dis. 2017

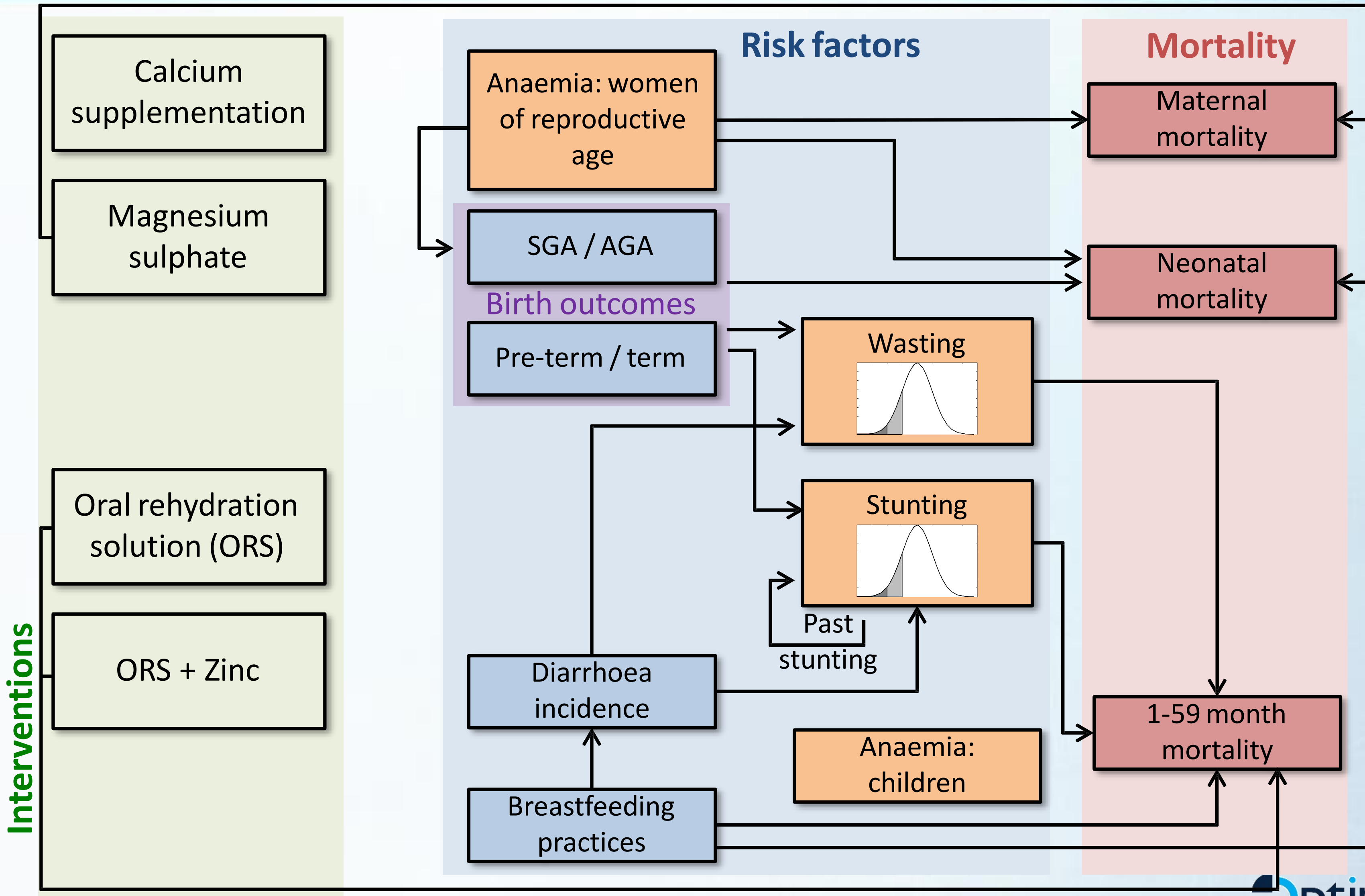
Water, sanitation and hygiene (WASH)

For all five WASH interventions:

- Target population is all children (0-59 months)
- Interventions can be set to reduce diarrhoea incidence
- The current effect size estimates have been set to 1 (no effect);
  - This can be adjusted by users based on local evidence (see exercises).
- **Coverage of WASH interventions are assumed to not decrease** (i.e. funding cannot be removed and invested in other interventions)

Optima Nutrition

Other supplement and diarrhoea interventions



Optima Nutrition

Other supplement and diarrhoea interventions

Intervention	Target population	Effects	Source / effect size
Oral rehydration salts (ORS)	Children 0-59 months (different quantity by age)	Reduces diarrhoea mortality	RRR = 0.18 [Munos, et al. 2010, I J Epi; Walker & Black 2010, I J Epi]
ORS + Zinc	Children 0-59 months (different quantity by age)	Reduces diarrhoea mortality	RRR = 0.14 [Munos, et al. 2010, I J Epi; Walker & Black 2010, I J Epi]
Calcium supplementation	Pregnant women	Reduces maternal mortality (hypertensive disorders) Reduces pre-term births	Mortality RRR = 0.80 [Ronsmans et al. 2011, BMC Public Health] Pre-term RRR = 0.78 [Imdad et al. 2011, BMC Public Health]
MgSO4 for pre-eclampsia / eclampsia	Pregnant women	Reduces maternal mortality (hypertensive disorders)	RRR = 0.41 [Ronsmans et al. 2011, BMC Public Health]

Optima Nutrition

Exercises

- See worksheet

The data input book: common data sources and model inputs

Day 2 – Session 2

Objectives of session

- The previous sessions have covered how interventions and outcomes are modelled in Optima Nutrition
- This session will cover how data is gathered, stored and used as inputs for a given setting
- At the end of this module and exercises you should:
    - Be familiar with the data inputs workbook. In particular, why each piece of data is relevant and where it is typically available from.
    - Be able to source appropriate data and fill out a workbook for a particular country. This can be challenging as often some of the data needs to be interpreted.
    - Make basic assumptions where data is missing or needs interpretation

Optima Nutrition

Summary of data input tabs

- The model uses an Excel book to store all of the data inputs
- A template can be downloaded from the GUI
- The input book consists of tabs for:
  - Population inputs in a baseline year
  - Demographic projections
  - Mortality by cause
  - Nutritional status (stunting, wasting and anaemia status by age group)
  - Breastfeeding behaviours
  - Fertility risks (age of birth and birth order data)
- These data can be obtained from commonly available sources (largely DHS reports, shown in next slides) and are important for calibrating to the baseline characteristics of the setting being modelled.

Optima Nutrition

Population inputs tab

Population inputs include some miscellaneous data, usually obtained from Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS), or other population surveys.

- Poverty, school and health facility attendance, unmet need for family planning:
  - Important for defining the target populations and possible coverage of interventions
  - **Common source: DHS/MICS reports**

	A	B	C
1	**Baseline year data**		
2	Projection years		
3		Baseline year (projection start year)	2017
4		End year	2030
5			
6	Population data		
7		Percentage of population food insecure (default poor)	28%
8		Percentage of population at risk of malaria	100%
9		School attendance (percentage of 15-19 year women)	23%
10		Percentage of pregnant women attending health facility	51%
11		Percentage of children attending health facility	37%
12		Unmet need for family planning	22%
13			

Optima Nutrition

Population inputs tab

- Food habits:
  - Important for defining the possible coverage / impact of food fortification interventions
  - **Common source: DHS/MICS reports, other consumption surveys**
- Birth age and spacing:
  - Important for the family planning module
  - **Common source: DHS/MICS reports**

13			
14	Food		
15		Fraction of subsistence farming	30%
16		Fraction eating rice as main staple food	0%
17		Fraction eating wheat as main staple food	0%
18		Fraction eating maize as main staple food	80%
19		Fraction on other staples as main staple food	20%
20			
21	Age distribution of pregnant women		
22		Percentage of pregnant women 15-19 years	13%
23		Percentage of pregnant women 20-29 years	45%
24		Percentage of pregnant women 30-39 years	33%
25		Percentage of pregnant women 40-49 years	9%
26			
27	Birth spacing		
28		First birth	20.8%
29		less than 18 months	63.7%
30		18-23 months	11.9%
31		24 months or greater	3.6%
32		*Total (must be 100%)*	100%
33			
34	**Baseline year mortality and risk factors**		

Baseline year population inputs | Demographic projections

Optima Nutrition

Population inputs tab

- Mortality rates, birth outcome distributions, and diarrhoea incidence:
  - Important for calibrating the model to the underlying determinants of malnutrition
  - **Common source: DHS/MICS reports**

	A	B	C
34	**Baseline year mortality and risk factors**		
35	Mortality		
36		Neonatal mortality (per 1,000 live births)	25
37		Infant mortality (per 1,000 live births)	43
38		Under 5 mortality (per 1,000 live births)	67
39		Maternal mortality (per 1,000 live births)	4.01
40		Fraction of pregnancies ending in spontaneous abortion	13%
41		Stillbirths (per 1,000 total births)	22.4
42			
43	Birth outcome distribution		
44		Pre-term SGA	3%
45		Pre-term AGA	11%
46		Term SGA	37%
47		Term AGA	50%
48			
49	Diarrhoea incidence		
50		Average episodes per year: <1 month	1.66
51		Average episodes per year: 1-5 months	1.66
52		Average episodes per year: 6-11 months	5.64
53		Average episodes per year: 12-23 months	5.43
54		Average episodes per year: 24-59 months	1.91
55			
56	Other risks		
57		Percentage of diarrhea that is severe	20%
58		Percentage of anaemia that is iron deficient	42%
59			
60			
61			
62			
63			
64			
65			

Baseline year population inputs | Demographic projections

Ready

Optima Nutrition

Demographic data tab

- Demographic data is required to project the expected number of births and changes in the number of women of reproductive age
- This is important to inform projections of number of deaths (and other outcomes)
  - **Common source: UN population division (https://esa.un.org/unpd/wpp/), national population projections**

year	Number of births	Children under 5	WRA: 15-19 years	WRA: 20-29 years	WRA: 30-39 years	WRA: 40-49 years	Total WRA	Estimated pregnant women	non-pregnant WRA
2017	2,110,000	9,862,402	3,032,037	4,756,743	3,406,589	2,174,712	13,370,081	2,480,859	10,889,222
2018	2,150,000	10,050,371	3,164,674	4,882,700	3,520,083	2,275,309	13,842,766	2,527,889	11,314,877
2019	2,200,000	10,237,786	3,296,354	5,018,666	3,634,703	2,379,017	14,328,740	2,586,677	11,742,063
2020	2,240,000	10,438,537	3,418,969	5,168,014	3,750,324	2,484,409	14,821,716	2,633,708	12,188,008
2021	2,280,000	10,636,534	3,532,758	5,332,455	3,869,436	2,592,003	15,326,652	2,680,738	12,645,914
2022	2,330,000	10,854,967	3,637,390	5,508,952	3,990,560	2,701,259	15,838,161	2,739,526	13,098,635
2023	2,380,000	11,089,897	3,737,403	5,696,990	4,112,898	2,811,667	16,358,958	2,798,314	13,560,644
2024	2,420,000	11,331,595	3,840,674	5,895,615	4,235,117	2,922,818	16,894,224	2,845,345	14,048,879
2025	2,480,000	11,574,198	3,951,644	6,103,745	4,356,516	3,034,340	17,446,245	2,915,891	14,530,354
2026	2,530,000	11,838,769	4,065,313	6,319,831	4,477,188	3,144,612	18,006,944	2,974,679	15,032,265
2027	2,580,000	12,092,177	4,185,562	6,545,116	4,597,739	3,255,252	18,583,669	3,033,467	15,550,202
2028	2,630,000	12,338,218	4,309,237	6,776,307	4,722,286	3,366,750	19,174,580	3,092,255	16,082,325
2029	2,690,000	12,584,924	4,430,738	7,008,703	4,856,898	3,479,917	19,776,256	3,162,801	16,613,455
2030	2,740,000	12,839,335	4,546,624	7,239,465	5,005,361	3,595,278	20,386,728	3,221,589	17,165,139

Demographic projections | Causes of death | Nutritional status distribution | Breastfeeding distribution | Time trends | IYCF packages | Treatment of SAM | Programs cost an

Ready

Causes of death tab

- Fraction of mortality attributable to various causes:
  - Important to appropriately model the impact of interventions
  - For example, ORS + Zinc lowers the relative risk of diarrhoea mortality, and so the model only applies this to the fraction of diarrhoea-attributable deaths.
  - **Common source: the Global Burden of Disease (GBD) project [(http://apps.who.int/gho/data/node.main.ghe3002015-by-country?lang=en), national](http://apps.who.int/gho/data/node.main.ghe3002015-by-country?lang=en) bureau of statistics**

Percentage of deaths in baseline year (2017) attributable to cause	<1 month	1-5 months	6-11 months	12-23 months	24-59 months
Neonatal diarrhoea	0.27%	0	0	0	0
Neonatal sepsis	19.66%	0	0	0	0
Neonatal pneumonia	6.21%	0	0	0	0
Neonatal asphyxia	29.29%	0	0	0	0
Neonatal prematurity	24.71%	0	0	0	0
Neonatal tetanus	0.48%	0	0	0	0
Neonatal congenital anomalies	13.20%	0	0	0	0
Neonatal other	6.18%	0	0	0	0
Diarrhoea	0	13.68%	13.68%	13.68%	13.68%
Pneumonia	0	20.66%	20.66%	20.66%	20.66%
Meningitis	0	2.11%	2.11%	2.11%	2.11%
Measles	0	0.75%	0.75%	0.75%	0.75%
Malaria	0	8.62%	8.62%	8.62%	8.62%
Pertussis	0	2.86%	2.86%	2.86%	2.86%
AIDS	0	1.53%	1.53%	1.53%	1.53%
Injury	0	13.59%	13.59%	13.59%	13.59%
Other	0	36.20%	36.20%	36.20%	36.20%
Antepartum haemorrhage	0	0	0	0	0
Intrapartum haemorrhage	0	0	0	0	0
Postpartum haemorrhage	0	0	0	0	0
Hypertensive disorders	0	0	0	0	0
Sepsis	0	0	0	0	0
Abortion	0	0	0	0	0
Embolism	0	0	0	0	0

Causes of death | Nutritional status distribution | Breastfeeding distribution | Time

Ready

Nutritional status tab

- Stunting, wasting and anaemia status:
  - Important for setting up background risks, in the absence of any changes to interventions.
  - It is important that these are entered for each age group due to the chronic nature of stunting*. For example, it would be typical for the prevalence of stunting to increase from younger to older age bands.
  - **Common source: DHS reports**

	A	B	C	D	E	F	G	
1	**Percentage of population in each category in baseline year (2017)**	**Status**	<1 month	1-5 months	6-11 months	12-23 months	24-59 months	
2	Stunting (height-for-age)	Normal (HAZ-score > -1)	54.5%	54.5%	45.0%	24.5%	23.3%	
3		Mild (HAZ-score between -2 and -1)	32.2%	32.2%	35.9%	37.7%	37.4%	
4		Moderate (HAZ-score between -3 and -2)	8.7%	8.7%	13.4%	24.7%	25.9%	
5		High (HAZ-score between < -3)	4.6%	4.6%	5.7%	13.2%	13.4%	
6								
7								
8	Wasting (weight-for-height)	Normal (WHZ-score > -1)	62.4%	62.4%	68.4%	73.2%	81.2%	
9		Mild (WHZ-score between -2 and -1)	28.2%	28.2%	24.7%	21.5%	15.8%	
10		MAM (WHZ-score between -3 and -2)	5.4%	5.4%	5.4%	4.3%	2.2%	
11		SAM (WHZ-score < -3)	4.0%	4.0%	1.6%	1.0%	0.7%	
12								
13	Anaemia		<1 month	1-5 months	6-11 months	12-23 months	24-59 months	PW:
14		Prevalence of anaemia	10.0%	10.0%	78.1%	73.0%	48.4%	
15		Prevalence of iron deficiency anaemia	4.2%	4.2%	32.8%	30.6%	20.3%	
16								
17								

Nutritional status distribution / Breastfeeding distribution / Time trends / IYCF packages / Treatment of SAM / Programs cost and coverage / IYCF cost / Program

Ready

* Note that age-specific prevalence often needs to be recalculated because Optima uses smaller age bands than those commonly reported in DHS reports.

Optima Nutrition

Breastfeeding distribution tab

- Breastfeeding distributions:
  - Important for capturing the impact of IYCF interventions
  - **Common source: DHS reports**
- Breastfeeding practice indicators available in DHS by age group:
  - Exclusive
  - Breastfeeding + liquids = predominant
  - Breastfeeding + solids = partial
  - None

Percentage of children in each category in baseline year (2017)	Status	<1 month	1-5 months	6-11 months	12-23 months	24-59 months
Breastfeeding	Exclusive	84.0%	44.3%	1.4%	0.0%	0.0%
	Predominant	9.2%	21.7%	3.3%	0.1%	0.0%
	Partial	5.8%	31.6%	93.5%	72.1%	0.0%
	None	1.0%	2.4%	1.9%	27.8%	100.0%

Exercises

- See worksheet

Interpreting the data: costs and cost-coverage relationship

Day 2 – Session 3

Optima Nutrition

Objectives of session

- The previous session covered where population and malnutrition data come from and how they are stored in Optima Nutrition
- This session will cover the relationship between intervention cost and coverage in the model, and some of the assumptions that are required
- At the end of this module you should be able to make reasonable assumptions to estimate the unit cost of interventions

How much do things cost?

- Delivering an intervention to someone requires many different types of costs:
  - Commodity costs
  - Logistics and transport costs
  - Staff costs
  - Equipment costs
  - Infrastructure costs
  - Program management costs

Definition of costs:

- The *unit cost* of an intervention is defined as
  - total intervention cost divided by the number of people covered at a specific coverage level
  - Total cost/number of people covered
  - E.g. $100/10 = $10 unit cost
- The *marginal cost* of an intervention is defined as
  - cost of covering one more person

Optima Nutrition

The cost of expanding interventions

- The cost of expanding the coverage of interventions may not be linear. It may depend on the coverage level from which we start:
  - Economies of scale can reduce the cost as interventions expand
  - The need for additional infrastructure can increase the cost as interventions expand
  - Saturation coverage as it becomes more difficult to reach the final few, and demand generation activities may be required
- Optima allows users to specify interventions with costs that vary depending on coverage
- We generally expect increasing marginal costs as interventions expand coverage to increasingly hard to reach populations [saturation]

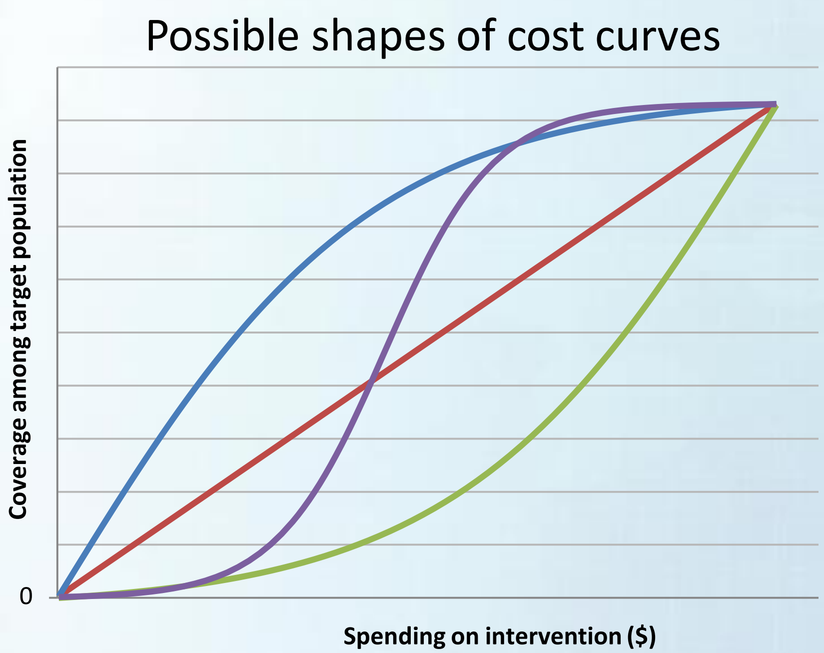
Optima Nutrition

Estimating costs

- Ideally, data would be available for several (total budget, total people reached) observations at different levels of funding:
  - This could be used to fit a curve
  - In nutrition, this information is rarely available, so assumptions need to be made
- Typically calculate a single "unit cost", which includes a measure of the coverage of an intervention and the total cost at the base point in time.

Cost-coverage curves

- The model can use a variety of shapes of cost-coverage curve
- Possible options include:
  - Constant marginal costs (red)
  - Increasing marginal costs (blue, current)
  - Decreasing marginal costs (green)
  - Logistic (purple)
- Default curves are likely to be constant or increasing marginal costs



Currency

- Suggested currency (for consistency): USD
  - Any currency can be used, inform modelling team of currency used, consistently use the same currency across the entire project
- Model does not apply inflation or discounting
  - These adjustments to spending output can be made outside the model

Optima Nutrition

Exercises

- See worksheet

Optimization and the objective function

Day 2 – Session 4

Objectives of session

- The previous sessions have covered the model inputs, model structure and model outputs, including running scenario analyses using the graphical user interface.
- This session will cover how the model can be used for optimisation
- We will start this module with a presentation and then do some exercises using the Optima Nutrition graphic user interface
- At the end of this module and exercises you should be able to:
  - Understand how the choice of the objective function can produce different, and sometimes conflicting outcomes
  - Run optimisations with multiple objective functions to identify:
    - Which interventions regularly appear in the mix
    - Which interventions never do
  - Generate policy recommendations based on optimisation results

How the optimisation algorithm works

- When the model is run for a given amount of money spent on each intervention, it produces a collection of outcomes for:
  - Number of deaths
  - Number of stunted children leaving the model (i.e. turning age 5)
  - Stunting, wasting and anaemia prevalence among children at the end of the projection period
  - Anaemia prevalence among pregnant women and women of reproductive age
  - Number of maternal deaths
- When the model is run with a different allocation of funding, it will produce different set of outcomes.

Optima Nutrition

The objective function

- To run an optimisation, we need to define an "**objective function**"
- An objective function takes all of the model outcomes and combines them into **a single number**
- For example, an objective function could be the total number of child deaths
- The optimisation can then iteratively shift funding around until it finds the allocation that produces the highest (or lowest) value of the objective function
- For different objective functions, the model is likely to suggest different sets of interventions
- This is logical given the variety of interventions and outcomes in the model, but from a programming perspective requires consideration

Optima Nutrition

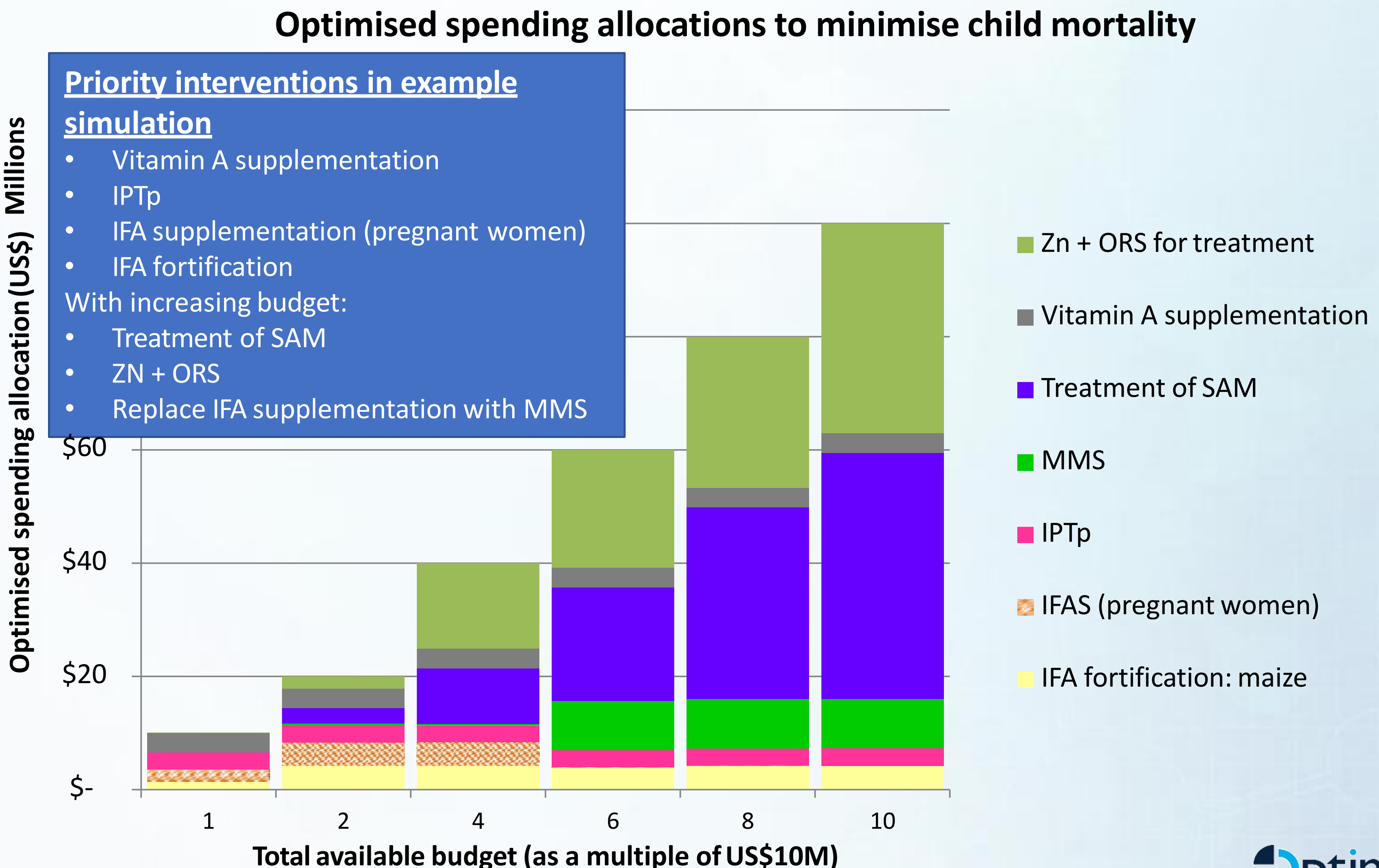
Sample optimisation: minimise child mortality

Priority interventions in example simulation

- Vitamin A supplementation
- IPTp
- IFA supplementation (pregnant women)
- IFA fortification

With increasing budget:

- Treatment of SAM
- ZN + ORS
- Replace IFA supplementation with MMS



Sample optimisation: minimise anaemia

Optimised spending allocations to minimise anaemia prevalence

Among women of reproductive age and children

Priority interventions

IFA supplementation (multiple modalities, pregnant / non-pregnant women)

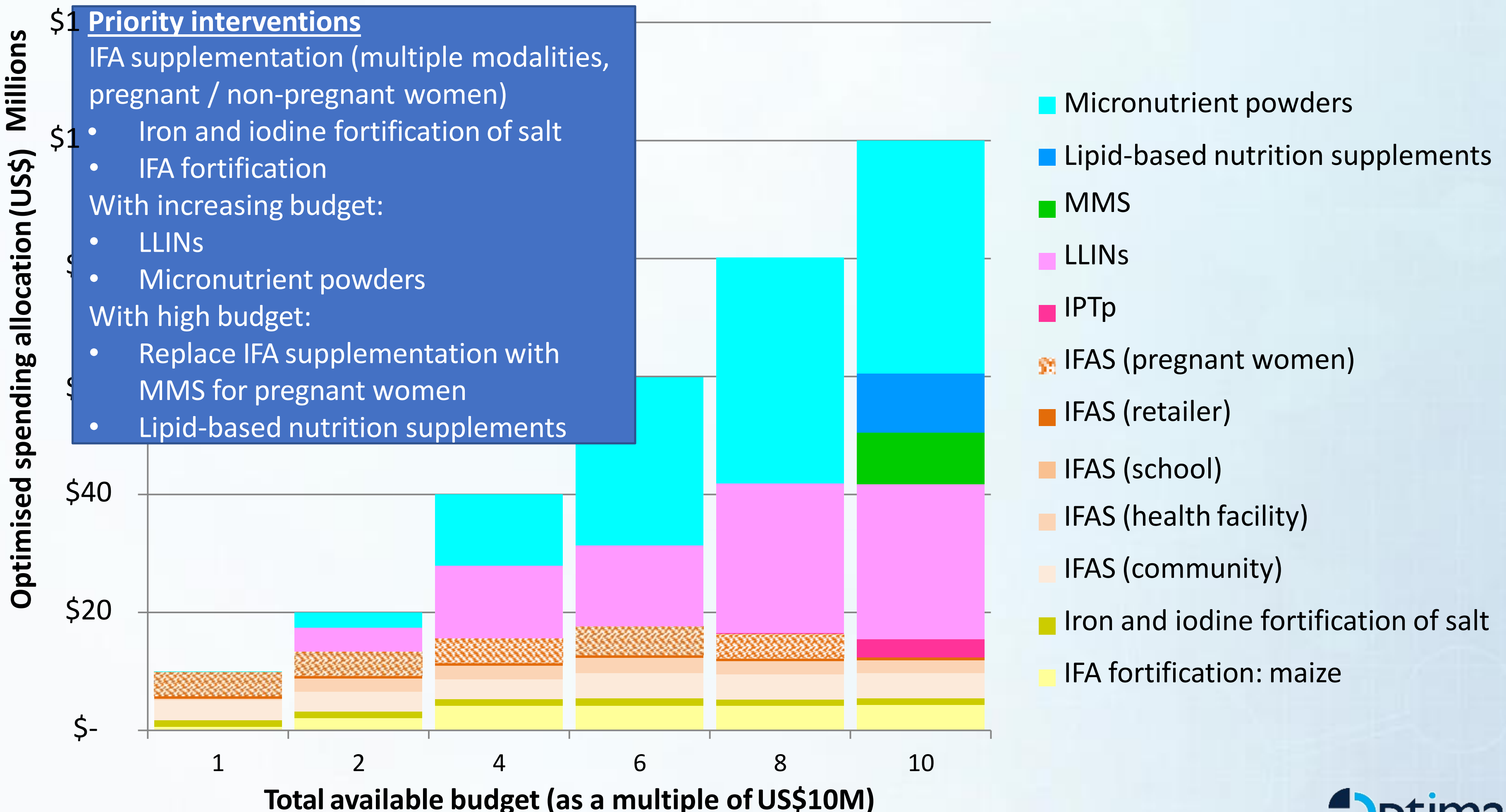
- Iron and iodine fortification of salt
- IFA fortification

With increasing budget:

- LLINs
- Micronutrient powders

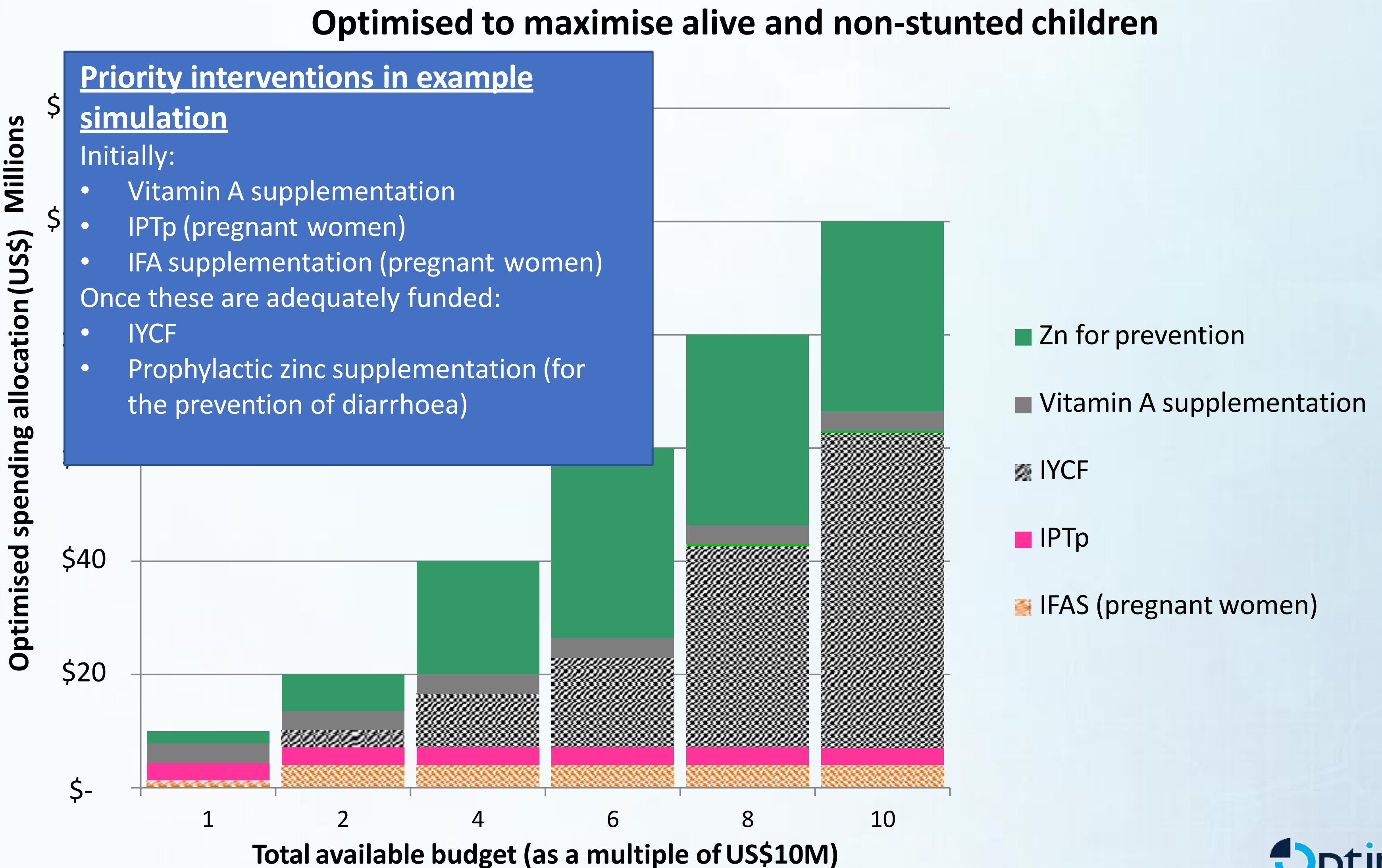
With high budget:

- Replace IFA supplementation with MMS for pregnant women
- Lipid-based nutrition supplements



Optima Nutrition

Sample optimisation: maximise alive and non-stunted children



Priority interventions in example simulation

Initially:

- Vitamin A supplementation
- IPTp (pregnant women)
- IFA supplementation (pregnant women)

Once these are adequately funded:

- IYCF
- Prophylactic zinc supplementation (for the prevention of diarrhoea)

Optima Nutrition

How can Optima Nutrition help with programming choices

- There are several ways of selecting the best interventions for a specific nutrition program
- First, it is important to engage with nutrition planners to determine which interventions they are likely to consider feasible:
  - Which interventions are already implemented in a given country, which interventions may be implemented, and which interventions are unlikely to be implemented.
- Second, strategic objectives of the national nutrition and health plans and interventions can help define the outcomes that should matter.
  - The national strategic nutrition plan may prioritize stunting reduction over anaemia

Optima Nutrition

How can Optima Nutrition help with programming choices

- Third, objective can be created using combinations of outcomes:
  - Maximise alive, non-stunted, non-wasted and non-anaemic children
  - Minimise the sum of maternal and child deaths

- Fourth, it is recommended that for a given setting, many different objective functions are tested:
  - What are the interventions that are “optimal” for multiple choices of objective?
  - What interventions can be eliminated because they are rarely or never considered “optimal”?

Optima Nutrition

Exercises

- See worksheet

Optimization and the objective function (continued)

Day 3 – Session 1

Objectives of session

- In the previous session we covered how to run optimisations in the Optima Nutrition model, and how to interpret the outcomes
- In this session we will cover how to create more complex objective functions
- At the end of this module and the exercises that it includes you should be able to:
  - Understand what an objective function is
  - Define appropriate weightings for objective functions
  - Create weighted objective functions in the graphic user interface

Optima Nutrition

Weighted objective functions

- It is possible to assign weights to particular outcomes
  - “Weights” are numbers that are used to assign a relative importance across each of the model outcomes
  - For example, we might care about stunting more than anaemia, so we could give stunting a larger weight

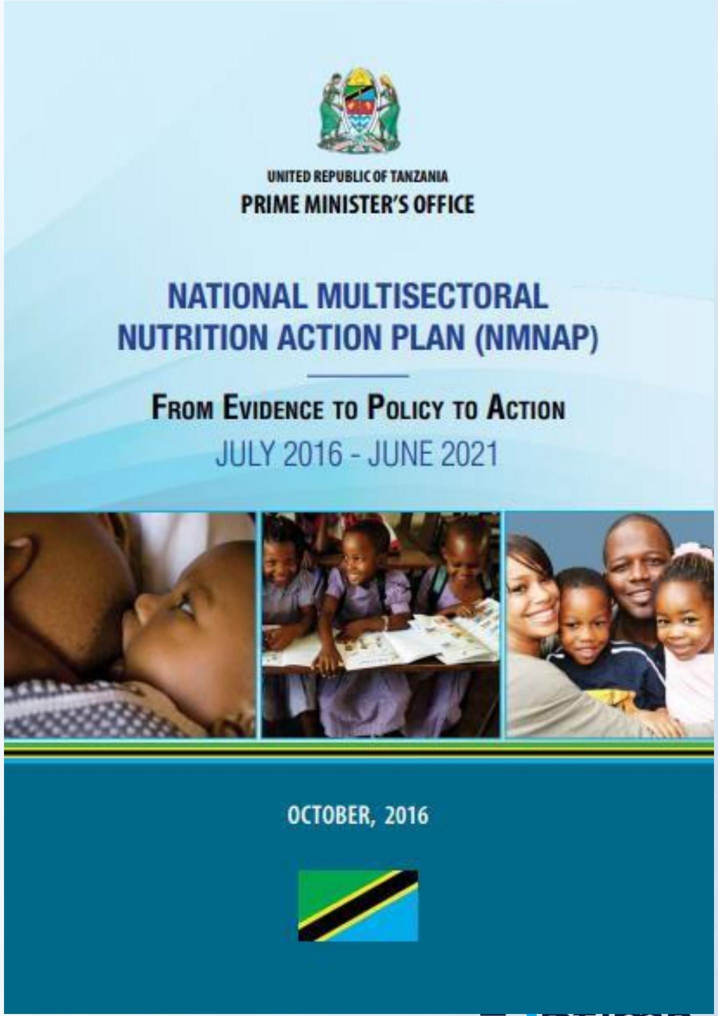
- In the model it is possible to minimises multiple outcomes. For example for some factors X and Y, minimise:

  *X * number of child deaths + Y * number of stunted children*

Optima Nutrition

Tanzania example, nutrition action plan

- If completely unsure about what is "best", national nutrition strategies can provide some guidance.
- For example, Tanzania's nutrition action plan includes:
  - Reduce stunting prevalence among children under 5 from 34% in 2015 to 28% in 2021
  - Reduce anaemia prevalence among children 6-59 months from 57% in 2015 to 50% in 2021
  - Maintain prevalence of wasting among children under 5 at < 5%
- This can help when choosing weights for outcomes



Optima Nutrition

Tanzania example, nutrition action plan

- To come as close as possible to the targets, we need to be include relative weightings for stunted and anaemic children
- Suggestion:
  - NMNAP targets aim for approximately equal relative reductions in stunting and anaemia
  - In Tanzania, it costs 3.37 times as much to prevent a case of stunting than a case of anaemia (determined by use of the model)
  - Therefore, we want to use weightings so that a stunting case averted counts for 3.37 anaemia cases averted
  - Use an objective that is to maximise:

    *3.37 * alive and non-stunted children + alive and non-anaemic children*

  - BUT, wasting prevalence also has to remain below 5%. So we want to find a budget allocation that maximises:

    3.37 * alive and non-stunted children + alive and non-anaemic children

    - 1,000,000,000 if wasting >5%

Optima Nutrition

Exercise

- See worksheet

Geospatial analysis

Day 3 – Session 2

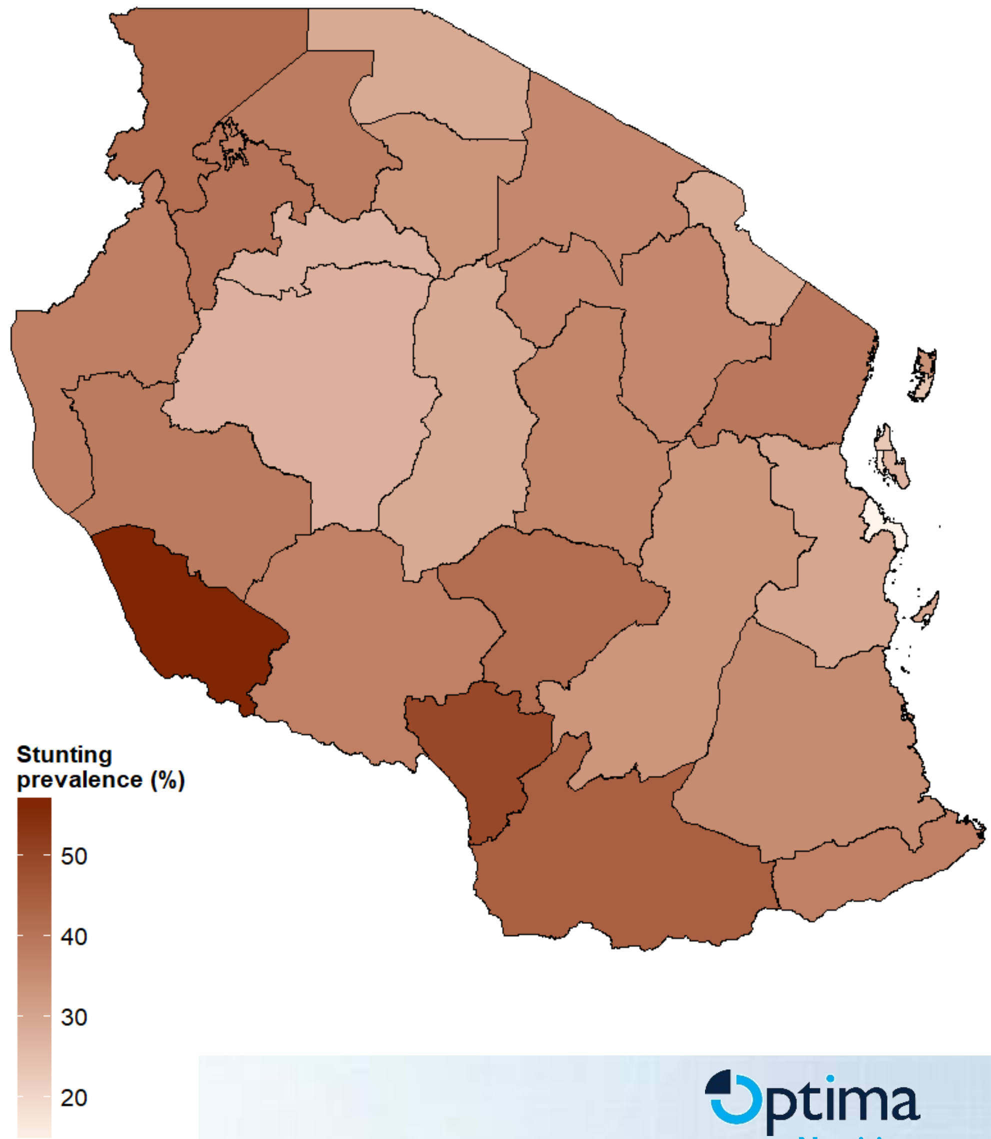
Objectives of session

- The previous sessions have covered all of the essentials of a country level analysis using Optima Nutrition
- This session will cover how Optima Nutrition can be used for subnational analyses
- At the end of this module you should be able to:
  - Understand the need for geospatial analysis
  - Select an appropriate geographical resolution
  - Understand the different types of geospatial optimisations
  - Be able to perform geospatial and programmatic optimisations in the graphic user interface

Optima Nutrition

Introducing the need for geospatial analysis

- The burden of malnutrition can vary significantly in different parts of a country
- Decision-makers may need to decide how much money to allocate to different regions
- These decisions are often made simply based on the number of people who reside in different regions.
  - **However, this is not necessarily the most efficient allocation or resources**
- Therefore, there is often a need to consider sub-national analyses



Optima Nutrition

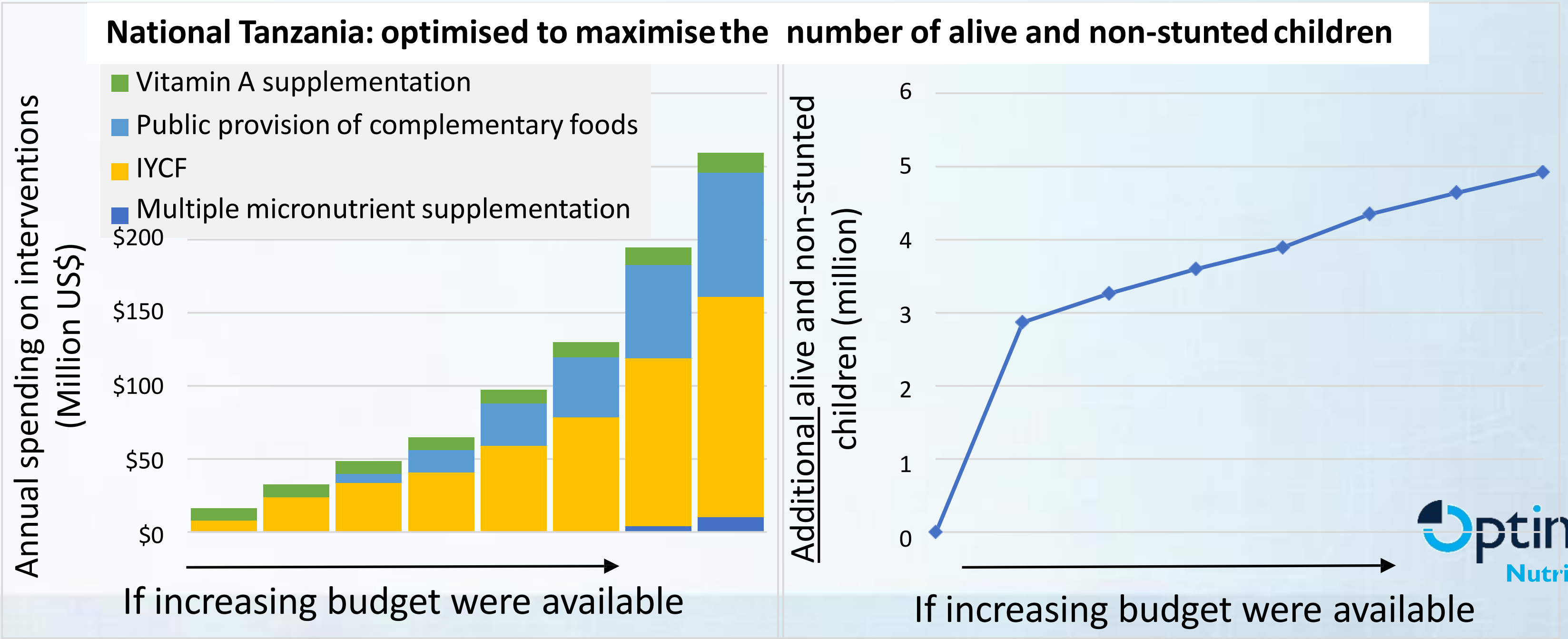
Defining the problem

- The granularity that a sub-national analysis occurs at should be determined by the availability of data
  - Often where data is missing national estimates need to be used, so drilling down to more granular levels will not necessarily lead to more insight.
- Once the regions are selected, possible constraints need to be considered both within each region and across regions.
  - Within each region: are any interventions fixed (i.e. cannot be completely or partially defunded)?
  - Across regions: is the total amount of funding movable across regions? For example, if individual regions provide their own funding to nutrition interventions, they are unlikely to shift it to support interventions in other states
  - Is there any additional funding available?
  - What is the objective function? Is it the same for all regions?

Optima Nutrition

Investment staircase for each region

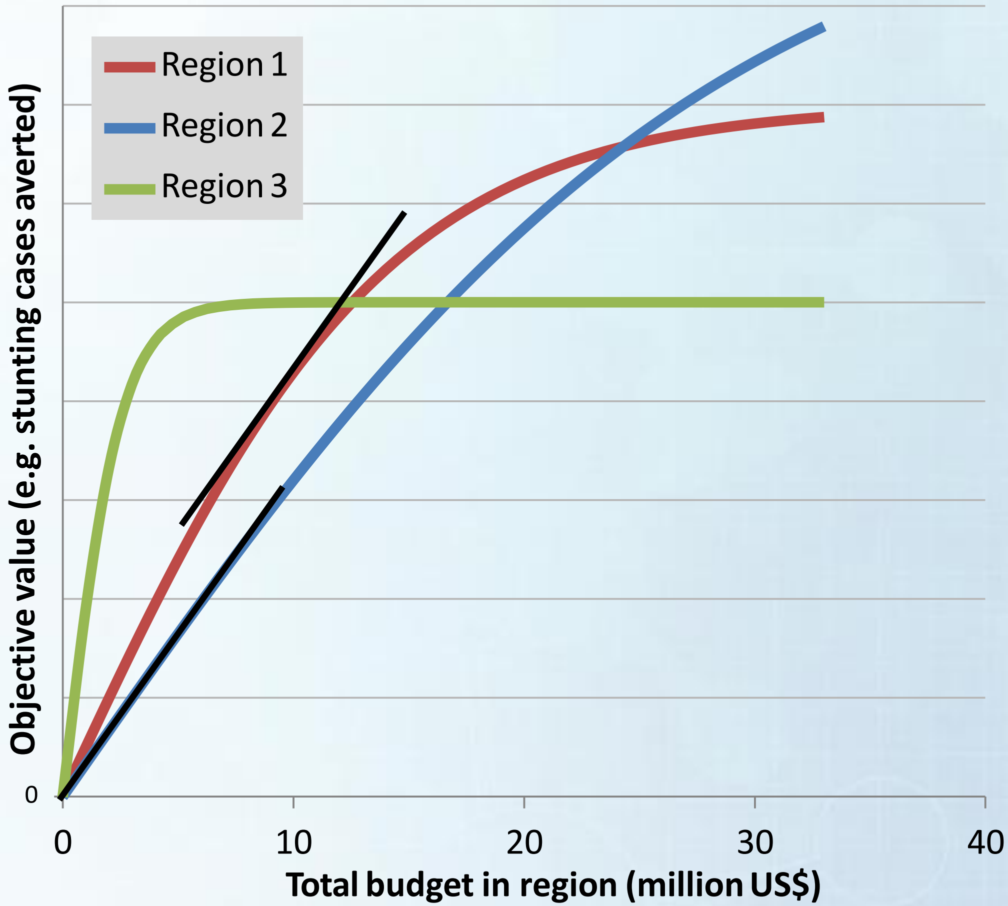
- For each region, an “investment staircase” can be produced
  - This is the impact that can be achieved for a range of different funding
- The impact can be measured as the objective function value, for example the total number of alive and non-stunted children that could be achieved with $10 million, $25 million, etc.
- For each region, a budget-impact curve (right) can be constructed
  - X-values are total amount available; Y-values are possible impact



Optima Nutrition

Comparing budget-impact curves across regions

- When the budget-impact curves for each region are compared, we can see where the best value for money is.
- For example, the first ~$4.5 million would have the best cost-per-outcome in region 3.
- The next ~$8 million is best spent in region 1
- After this, the cost-per-outcome (black tangent line) becomes worse than in region 2.



Optima Nutrition

Example geospatial analysis

AIM 1: Estimate the impact of programmatically optimising nutrition spending within 22 selected regions of Tanzania

AIM 2: Estimate the impact of an additional US$200 million investment in Nutrition in Tanzania (over the period 2019-2025), if optimised geographically across the 22 selected regions and programmatically within each region

The following scenarios were projected for the period 2019-2025:

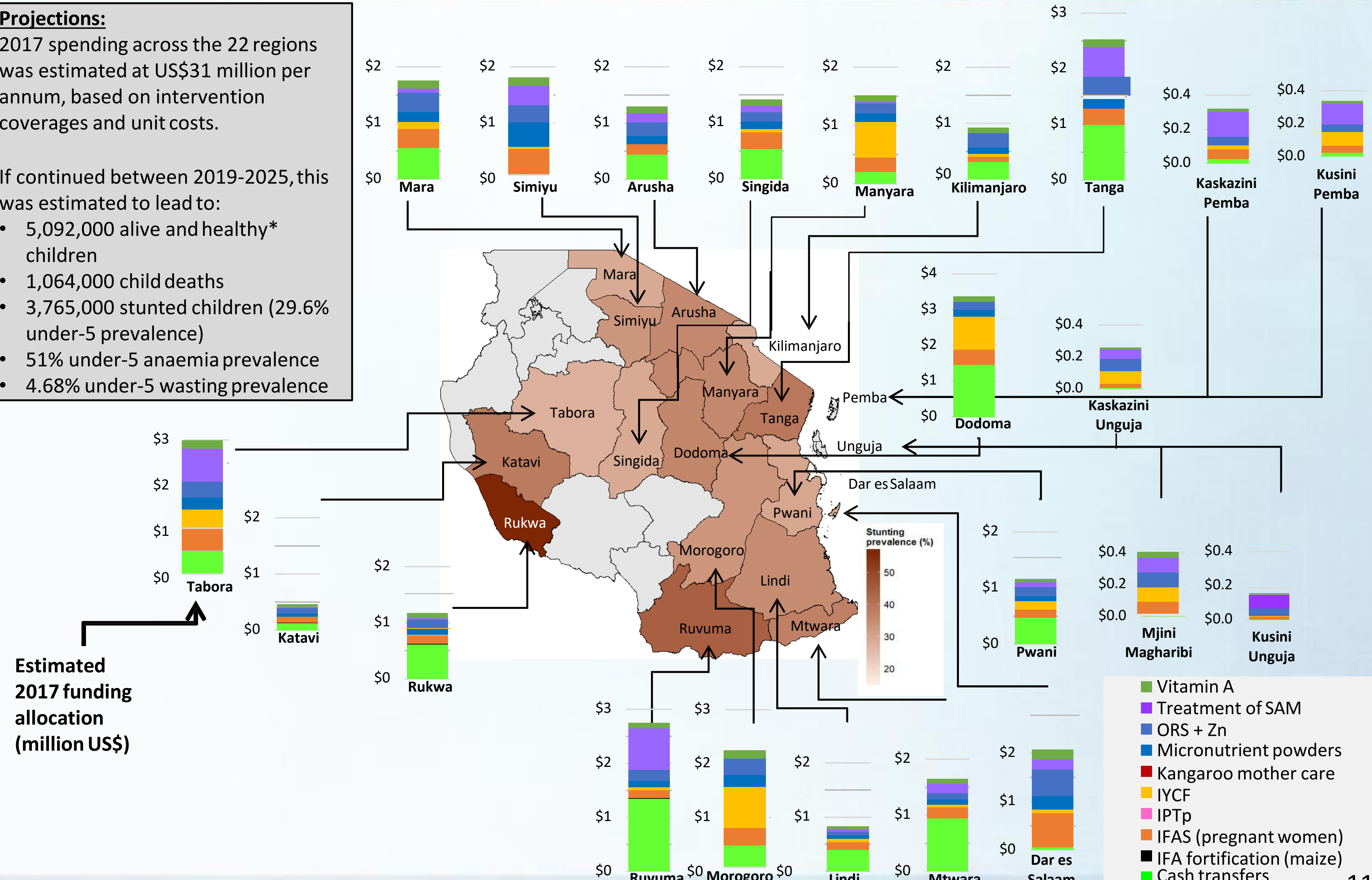
Scenario	Total budget	Programmatic optimisation	Geographic allocation of additional funding
1a	Continued estimated 2017 spending	--	--
1b	Continued estimated 2017 spending	Existing funding	--
2a	Continued estimated 2017 spending **+ US$33 million per annum**	Only additional funding	Optimised across regions
2b	Continued estimated 2017 spending **+ US$33 million per annum**	All funding (existing + additional)	Per capita
2c	Continued estimated 2017 spending **+ US$33 million per annum**	All funding (existing + additional)	Optimised across regions

1a) Estimated 2017 spending

Projections:
2017 spending across the 22 regions was estimated at US$31 million per annum, based on intervention coverages and unit costs.

If continued between 2019-2025, this was estimated to lead to:

- 5,092,000 alive and healthy* children
- 1,064,000 child deaths
- 3,765,000 stunted children (29.6% under-5 prevalence)
- 51% under-5 anaemia prevalence
- 4.68% under-5 wasting prevalence

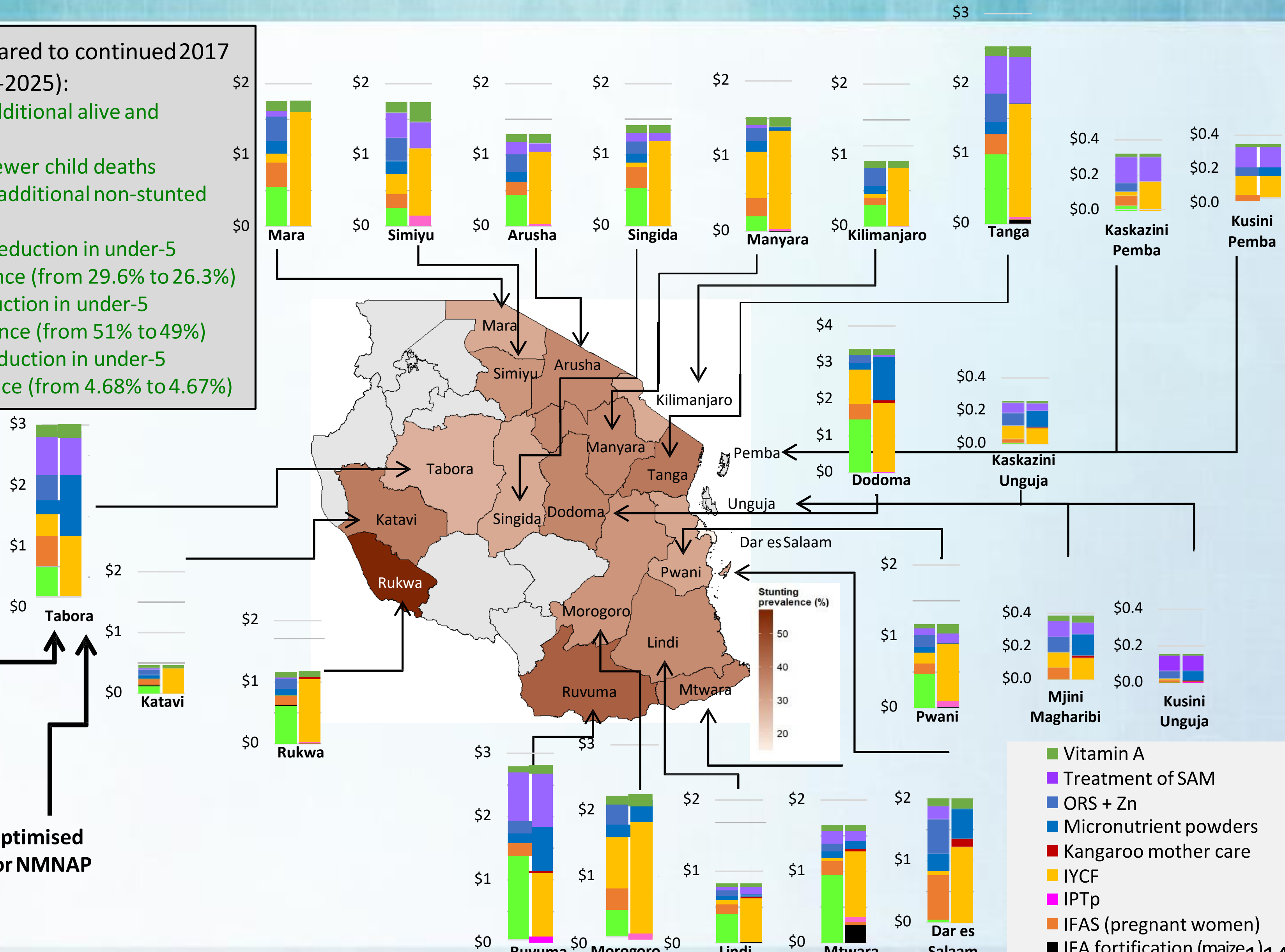


*Alive and non-stunted, non-wasted and non-anaemic children leaving the model 2019-2025

1b) Programmatically optimised spending

Impact (compared to continued 2017 spending, 2019-2025):

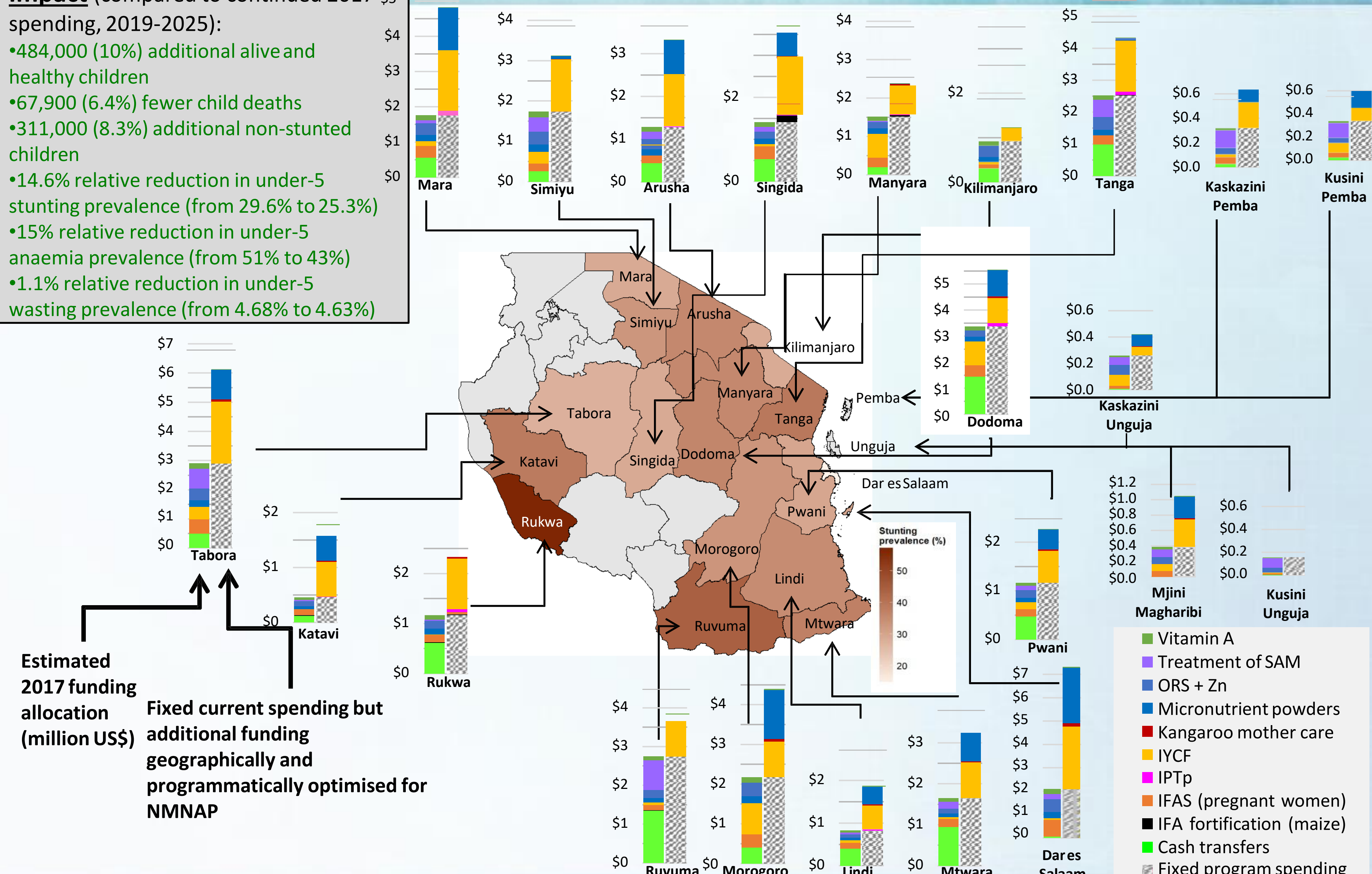
- 231,000 (5%) additional alive and healthy children
- 32,500 (3.1%) fewer child deaths
- 246,000 (6.5%) additional non-stunted children
- 11.1% relative reduction in under-5 stunting prevalence (from 29.6% to 26.3%)
- 3% relative reduction in under-5 anaemia prevalence (from 51% to 49%)
- 0.3% relative reduction in under-5 wasting prevalence (from 4.68% to 4.67%)



2a) An additional US$33M per annum, distributed optimally across regions, only additional money programmatically optimised

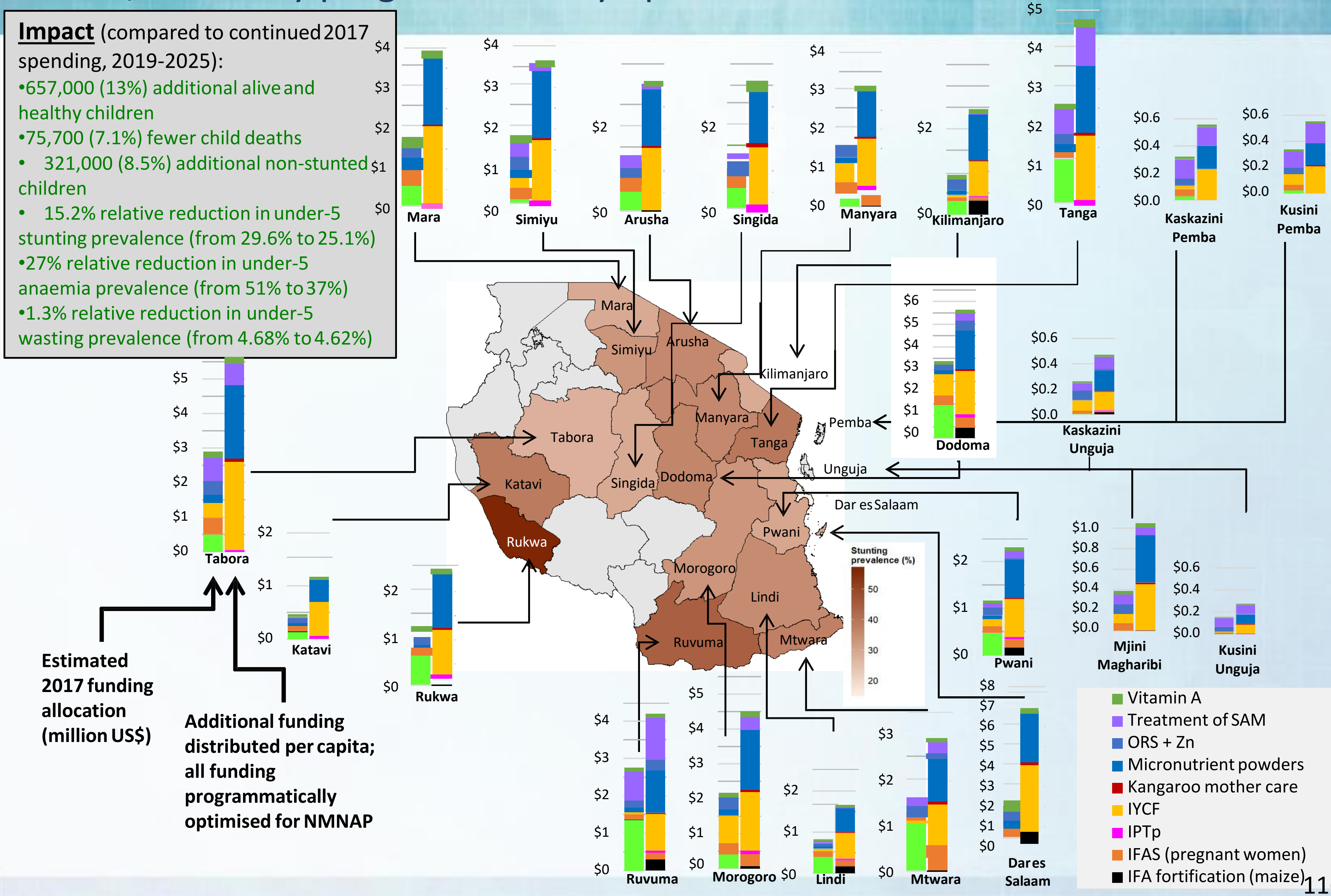
Impact (compared to continued 2017 spending, 2019-2025):

- •484,000 (10%) additional alive and healthy children
- •67,900 (6.4%) fewer child deaths
- •311,000 (8.3%) additional non-stunted children
- •14.6% relative reduction in under-5 stunting prevalence (from 29.6% to 25.3%)
- •15% relative reduction in under-5 anaemia prevalence (from 51% to 43%)
- •1.1% relative reduction in under-5 wasting prevalence (from 4.68% to 4.63%)



2b) An additional US$33M per annum, distributed on a per capita basis, all money programmatically optimised

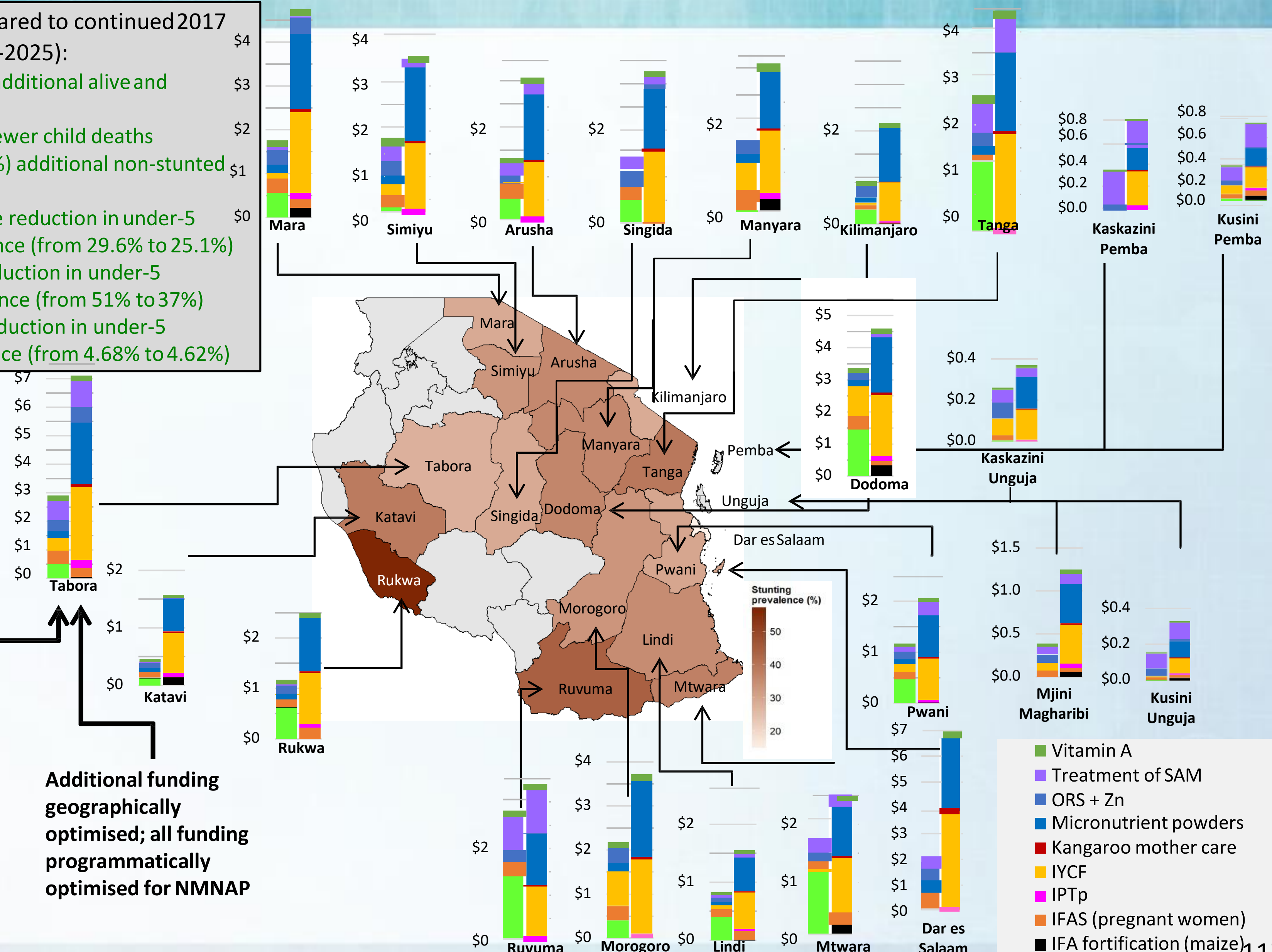
Impact (compared to continued 2017 spending, 2019-2025):
- 657,000 (13%) additional alive and healthy children
- 75,700 (7.1%) fewer child deaths
- 321,000 (8.5%) additional non-stunted children
- 15.2% relative reduction in under-5 stunting prevalence (from 29.6% to 25.1%)
- 27% relative reduction in under-5 anaemia prevalence (from 51% to 37%)
- 1.3% relative reduction in under-5 wasting prevalence (from 4.68% to 4.62%)



2c) An additional US$33M per annum, distributed optimally across regions, all money programmatically optimised

Impact (compared to continued 2017 spending, 2019-2025):

- 663,000 (13%) additional alive and healthy children
- 81,000 (7.6%) fewer child deaths
- 322,000 (8.5%) additional non-stunted children
- 15.2% relative reduction in under-5 stunting prevalence (from 29.6% to 25.1%)
- 27% relative reduction in under-5 anaemia prevalence (from 51% to 37%)
- 1.3% relative reduction in under-5 wasting prevalence (from 4.68% to 4.62%)



Projected impact of scenarios (over 22 regions)

Scenario			Increase in healthy children* (2019-2025)	Reduction in number of stunted children (2019-2025)	Reduction in child deaths (2019-2025)	Relative reduction in 2025 under-5 prevalence of		
Total budget	Programmatic optimisation	Geographic allocation of additional funding				Stunting	Wasting	Anemia
1b) Continued estimated 2017 spending	Existing funding	--	231,000 (5%)	246,000 (6.5%)	32,500 (3.1%)	11.1%	0.3%	3%
2a) Continued estimated 2017 spending + US$33 million per annum	Only additional funding	Optimised across regions	484,000 (10%)	311,000 (8.3%)	67,900 (6.4%)	14.6%	1.1%	15%
2b) Continued estimated 2017 spending + US$33 million per annum	All funding (existing + additional)	Per capita	657,000 (13%)	321,000 (8.5%)	75,700 (7.1%)	15.2%	1.3%	27%
2c) Continued estimated 2017 spending + US$33 million per annum	All funding (existing + additional)	Optimised across regions	663,000 (13%)	322,000 (8.5%)	81,000 (7.6%)	15.2%	1.3%	27%

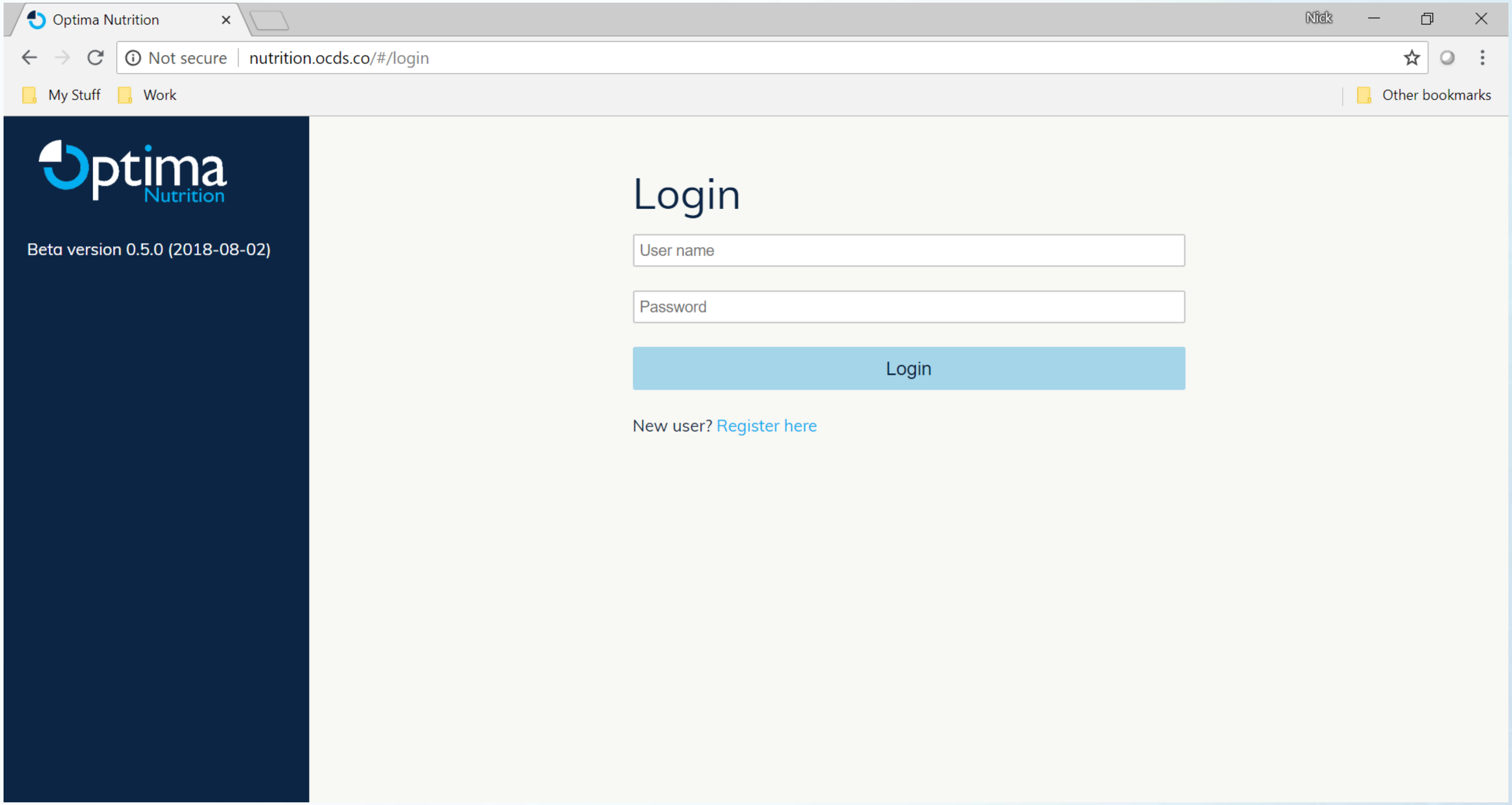
*Additional alive and non-stunted, non-wasted and non-anaemic children leaving the model 2019-2025, compared to a scenario of continued estimated 2017 spending

Summary of analysis

- Vitamin A supplementation, IYCF and micronutrient powders were the highest impact interventions for achieving the NMNAP targets
- Relatively large gains may be possible by optimising existing funding
  - For most regions, existing funding volumes were sufficient to scale up the highest impact interventions
- Additional funding should be allocated to ensure that Vitamin A supplementation, IYCF and micronutrient powders interventions have high coverage in all regions
- The optimal distribution of additional funding was similar to the per capita distribution
  - Adequate coverage of the three highest impact interventions in all regions was a greater priority than incremental gains from geographical funding allocations

Optima Nutrition

Geospatial analysis in the GUI



Exercises

- See worksheet

Continuation of individual country case studies

Day 3 – Session 3

Country case studies

- See worksheet