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Health, Nutrition & Population

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Optimizing Nutrition Investment in Sierra Leone

Prioritizing nutrition-specific interventions toward achieving the national strategic objectives for stunting and wasting

Optima
Nutrition

Overview of Optima Nutrition Model

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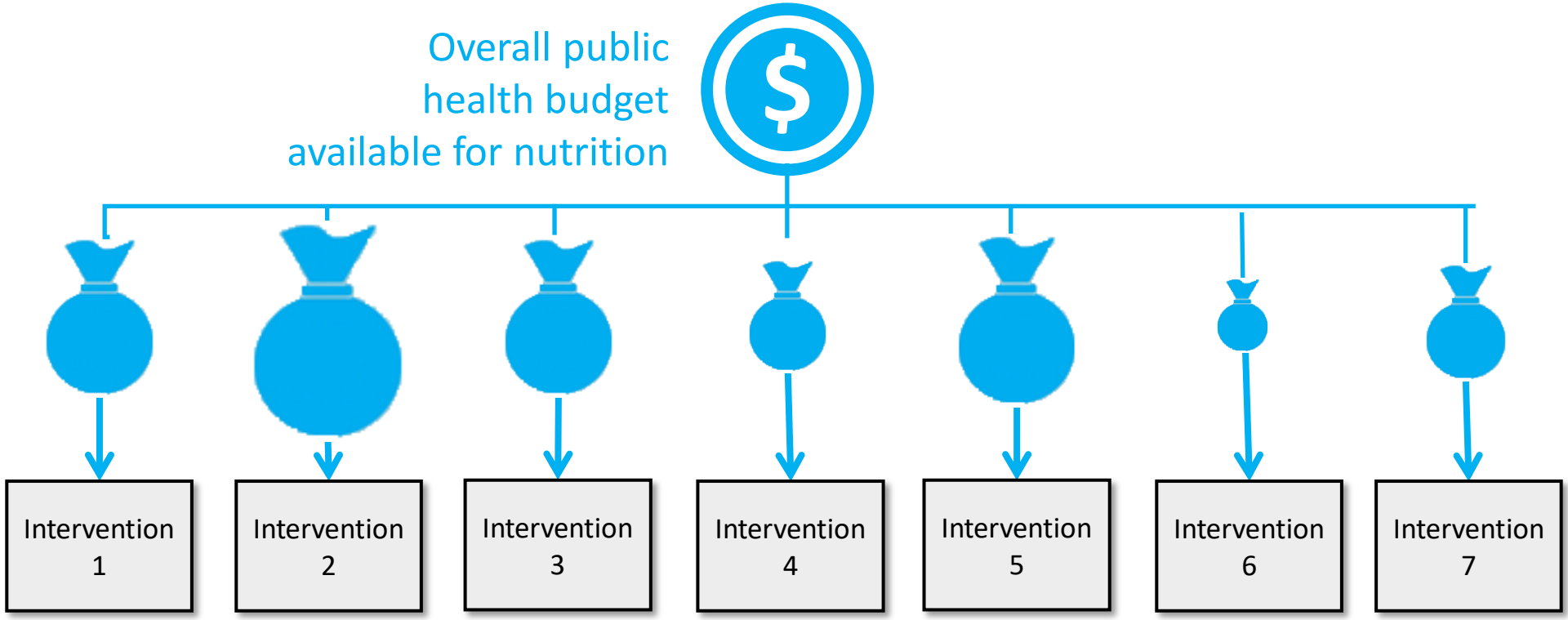
What is the purpose of Optima Nutrition?

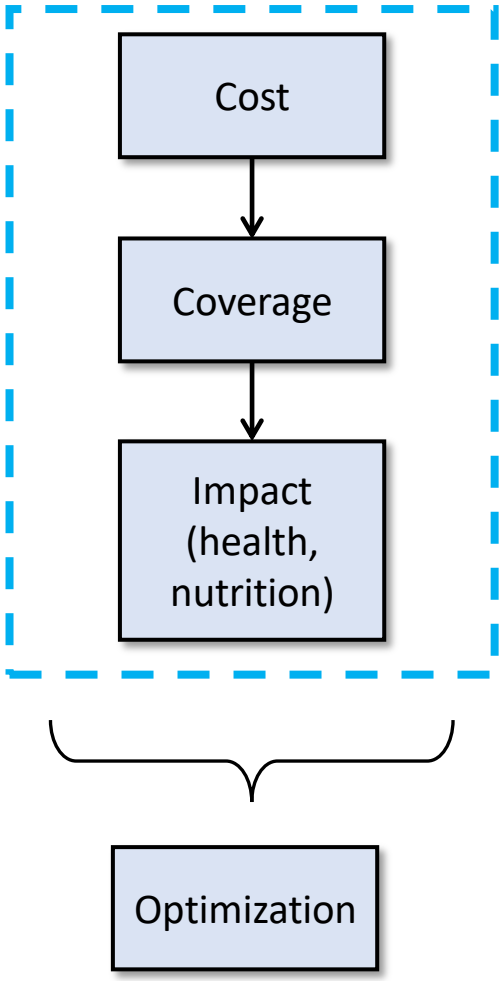
Which investment combination in nutrition programs leads to optimal outcomes?



Optima Nutrition

How Optima Nutrition Works:

- Underlying model is a ***reproduction of the LiST*** framework
  - Tracks under-5 population over a time period (e.g. 2016-2030)
  - Tracks risk factors that contribute to malnutrition and mortality
  - Key malnutrition outcomes include: stunting, wasting, anemia, breastfeeding
- Estimates the impact under a given (e.g. status quo) allocation.
- Estimates the impact under the optimal allocation (one that maximizes a specific outcome or set of outcomes)



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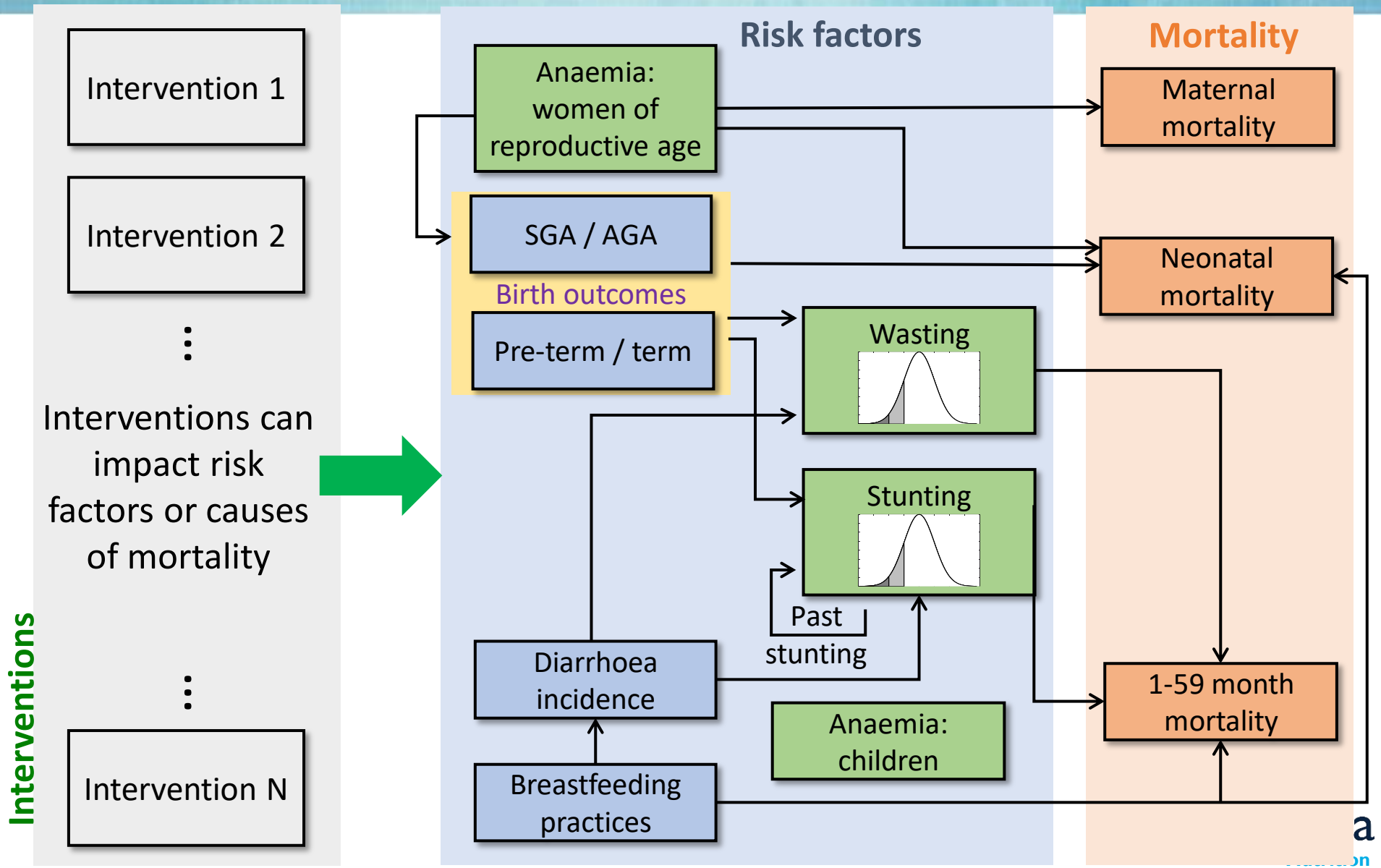
Risk factors, outcomes and interventions



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:
  - minimized stunting cases
  - minimized stunting prevalence
  - minimized wasting prevalence
  - minimized anemia prevalence
  - minimized deaths or
  - A combination of the above, e.g. maximising the number of alive non-stunted children ("alive and thrive").

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Results from Sierra Leone Optima Nutrition analysis

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Optima Nutrition analysis for Sierra Leone

Strategic objective:

- Determine the optimal allocation of resources to nutrition-specific interventions to accelerate progress toward stunting and wasting targets of the Multi-Sector Strategic Plan to Reduce Malnutrition in Sierra Leone, 2019-2025
  - Reduce stunting prevalence to 25%
  - Reduce wasting prevalence to less than 5%

Analytic objective:

- Maximize the number of alive, non-stunted children
- Minimize the number of wasted children
- Minimize the number of child deaths

Scenarios

1. Optimize current budget based on estimated coverage and unit cost of interventions
2. Optimize the total budget for nutrition-specific interventions from the costed national strategic plan
3. Optimize only the additional resources needed to reach the national strategic plan cost based on current budget

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Demographic, child health and nutrition data sources

	Main data source
Population: total & under-5	2015 Sierra Leone Census – medium variant projections
Projected births	Estimated based on DHS 2019 ASFR and 2015 census projections
Pregnant women	Calculated in Optima
Mortality rates	DHS 2019
Causes of death	Children – IHME Global Burden of Disease 2017 estimates Pregnant women –Sierra Leone Maternal Death Surveillance and Response (MDSR) 2016
Poverty	World Bank
Breastfeeding	DHS 2019
Stunting	DHS 2019
Wasting	DHS 2019
Birth outcomes (i.e. pre-term/SGA)	Default values from Lives Saved tool
Diarrhoea incidence	DHS 2019

Unit cost and baseline coverage of modelled interventions

	Target population	Unit cost (US $)*	Coverage (%)
Balanced energy protein supplementation	Pregnant women below the poverty line / food insecure	131.5	9
Iron folic acid supplementation (IFAS) (health facility)	Pregnant women	4.54	28
IYCF education and counseling (health facility)	Caregivers of children under 2	3.89	78
IYCF education and counseling (community + mass media)	Caregivers of children under 2	0.35	100
ORS for diarrhea treatment	Children 0-59 months	1.06^	36
Public provision of complementary foods	Children 6-23 months below poverty line / food insecure	145.07	7
Treatment of severe acute malnutrition (SAM) [(a)]	Children 6-59 months	114.48^	74
Vitamin A supplementation	Children 6-59 months	0.63	69
Zinc + ORS for diarrhea treatment	Children 0-59 months	1.48^	50

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(a) In this analysis, treatment of SAM assumes follow-up with management of MAM

** Cost per beneficiary per year ^ Cost per treatment episode*

Fixed budget programs

While additional interventions were included in the analysis, the model was restricted from reallocating resources from these interventions. This assumes that funding for these programs are outside the nutrition budget. Coverage for these interventions cannot be decreased but can be increased by reallocating resources from other interventions.

	Target	Unit cost (US $)*	Coverage (%)
Delayed cord clamping	Children at birth	0.65	15
Family planning	Women of reproductive age	34.78	50
Intermittent presumptive treatment of malaria in pregnancy (IPTp)	Pregnant women	5.21	73
Kangaroo mother care	Newborn infants	0.55	9
Long lasting insecticide treated bednets	All population	2.32	33
Magnesium sulphate for eclampsia	Pregnant women	56.49^	32
Magnesium sulphate for pre-eclampsia	Pregnant women	56.49^	32

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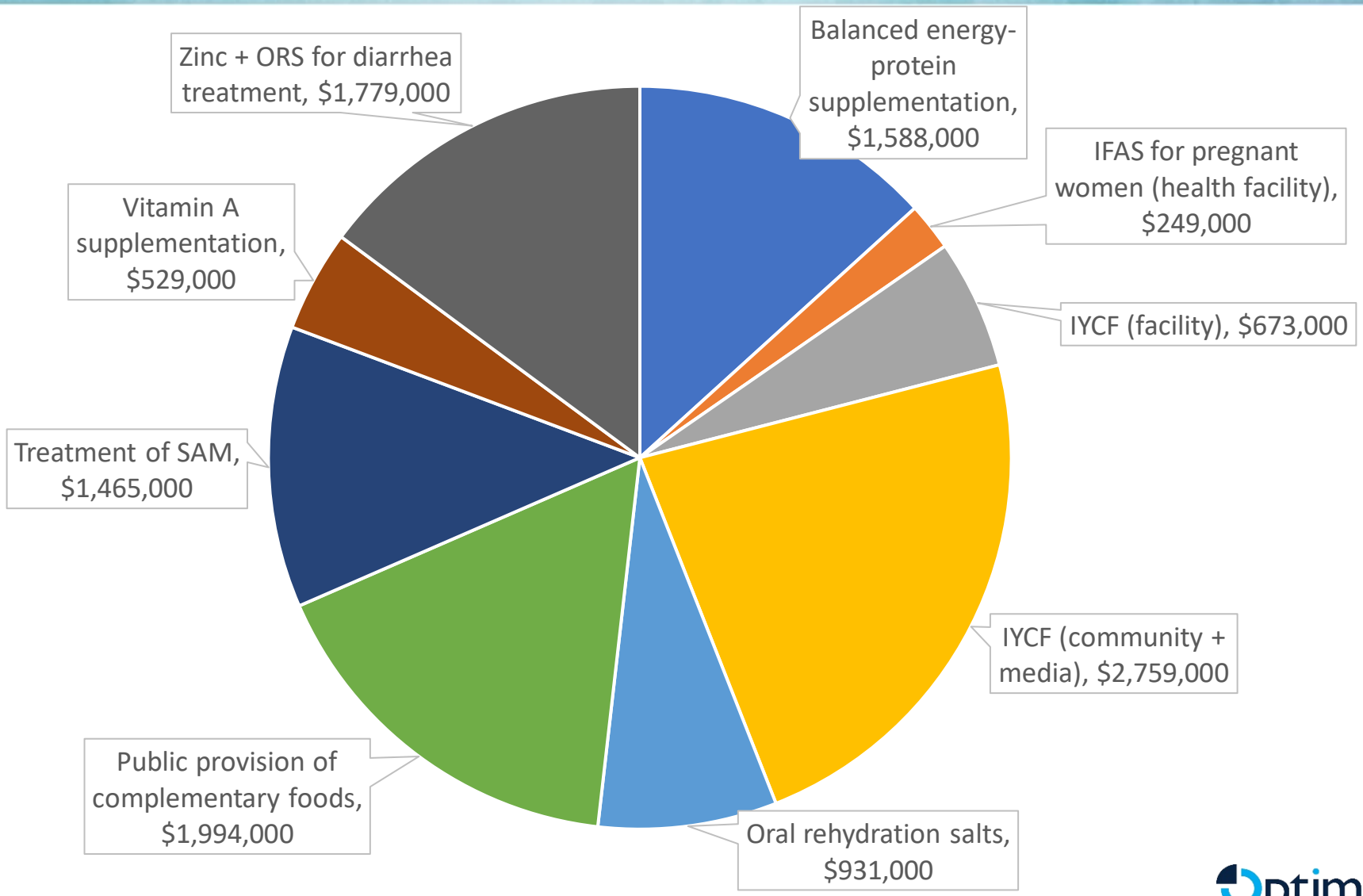
** Cost per beneficiary per year ^ Cost per treatment episode*

Estimated current expenditure on nutrition interventions



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Results

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Optimized current budget allocations to nutrition-specific interventions

Optimizing funding allocations would require:

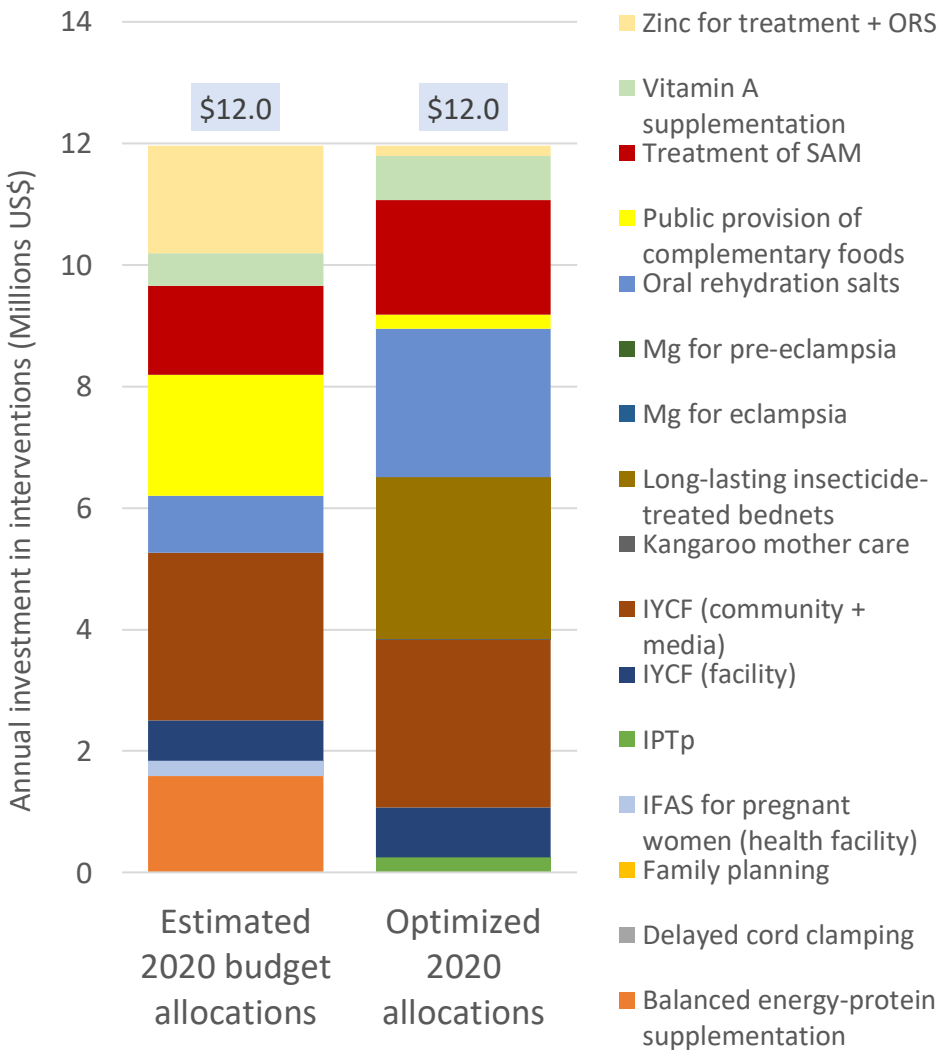
- Maintaining high coverage of community IYCF
- Diverting funds from balanced energy protein supplementation (BEPS), IFAS for pregnant women, public provision of complementary foods (PPCF), and zinc + ORS for treatment of diarrhea
- Reallocating these funds to:
  - achieve high (>90%) IYCF at facility, Vitamin A supplementation, treatment of SAM, ORS, IPTp, and kangaroo mother care
  - expanding coverage of LLINs.

This occurs because:

- BEPS and PPCF are expensive relative to their impact
- IFAS has indirect and minimal impact on stunting
- IYCF and vitamin A supplementation are very low-cost interventions with significant impact on improving breastfeeding and reducing the risk of diarrhea
- ORS alone, while less effective than ORS+zinc, is less costly and able to achieve greater coverage at lower cost
- Treatment of SAM significantly reduce the risk of mortality
- LLINs and IPTp reduce stunting risk by protecting against preterm births and children born too small, significant early risk factors for stunting

Optimizing over 5 years could result in:

- 8,200 fewer stunted children
- 4,400 fewer wasted children
- 5,700 fewer child deaths



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Optimized allocations of strategic plan budget for nutrition-specific interventions

Optimizing funding allocations would require:

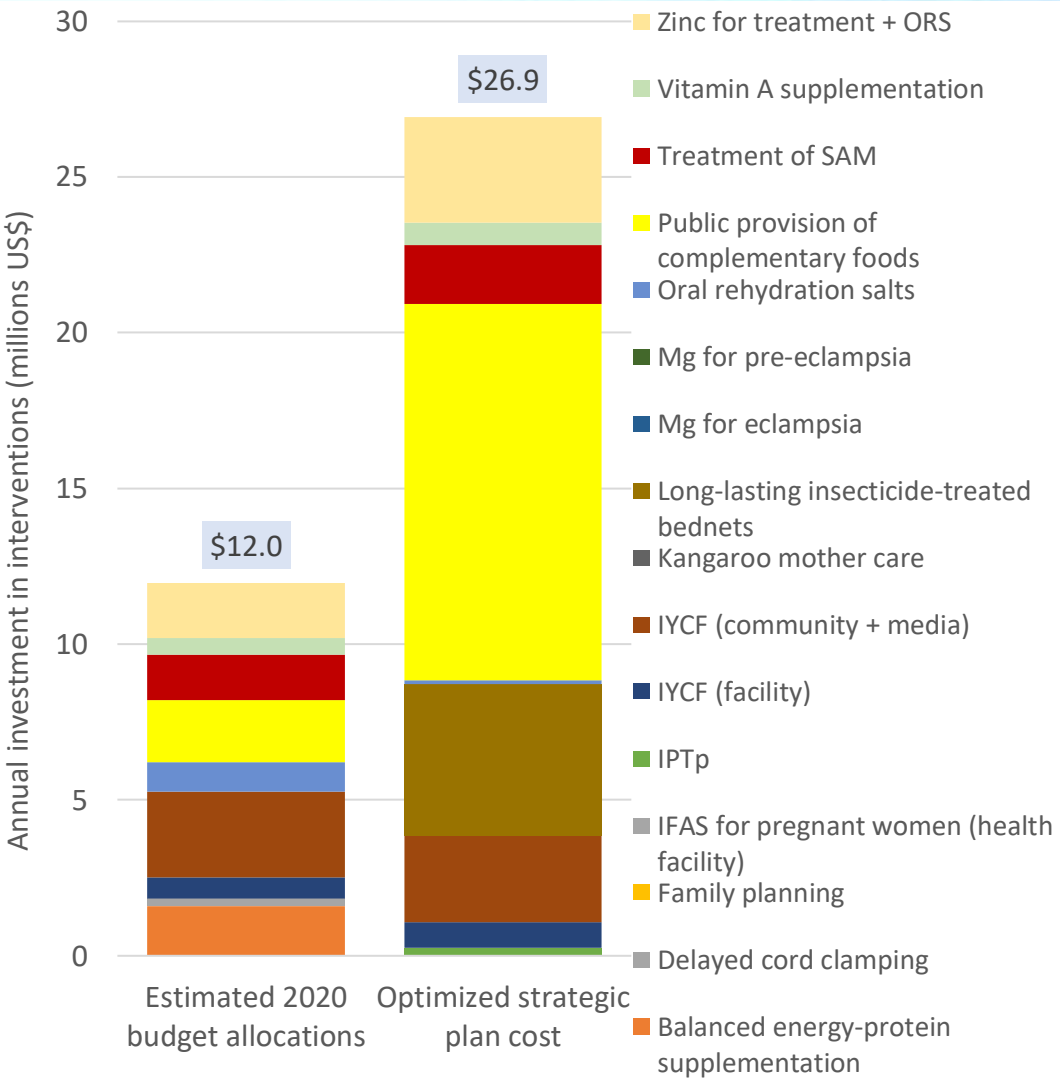
- Diverting funds from balanced energy protein supplementation (BEPS), IFAS for pregnant women, and ORS for treatment of diarrhea
- Prioritizing high coverage (>90%) of IYCF at health facility, Vitamin A supplementation, LLINs, zinc + ORS, treatment of SAM, IPTp, and KMC
- Significantly increasing coverage of public provision of complementary foods (PPCF)

This occurs because:

- IYCF reduces stunting risk through reduced diarrhea incidence due to improved feeding practices
- Increased vitamin A supplementation reduces number of children susceptible to diarrhea episodes and thus lowers stunting risk.
- LLINs and IPTp reduce stunting risk by protecting against preterm births and children born too small, a significant early risk factor for stunting, and are more cost-efficient than BEPS and IFAS in this scenario.
- Treatment of SAM and zinc + ORS significantly reduce the risk of mortality
- While expensive, PPCF has modest impact on reducing stunting and can be scaled up with this expanded budget.

Optimizing over 5 years could result in:

- 11,700 fewer stunted children
- 4,400 fewer wasted children
- 6,400 fewer child deaths



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Optimized allocations of additional $14.9m/year for nutrition-specific interventions

Optimizing funding allocations would require:

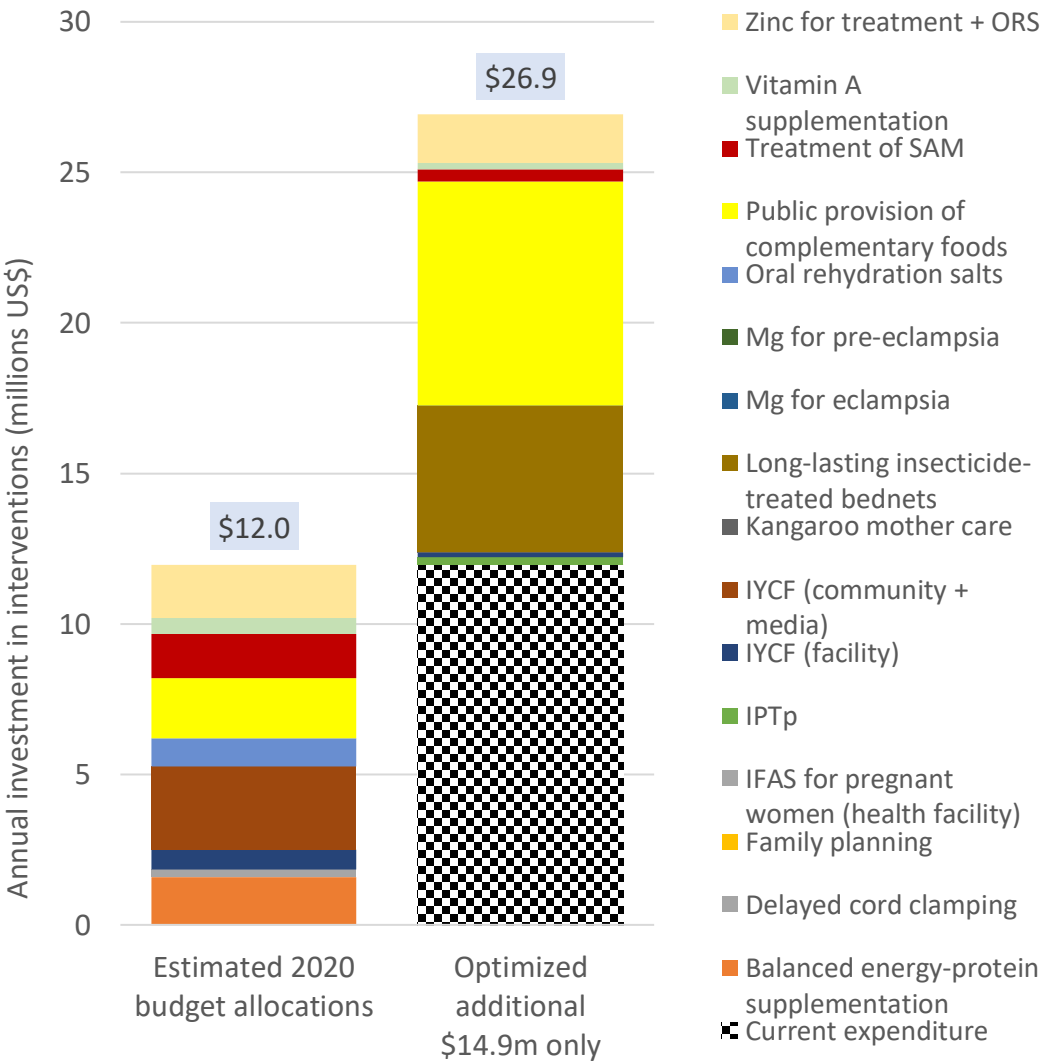
- Maintaining current funding for all interventions
- With the additional $14.9m/year, prioritizing high coverage (>90%) of IYCF at facility, vitamin A supplementation, LLINs, treatment of SAM, zinc + ORS, IFAS for pregnant women, IPTp, and kangaroo mother care.
- Significantly increasing coverage of public provision of complementary foods

This occurs because:

- IYCF and vitamin A supplementation are very low-cost interventions with significant impact on improving breastfeeding and reducing the risk of diarrhea
- Treatment of SAM and zinc + ORS significantly reduce the risk of mortality
- LLINs and IPTp reduce stunting risk by protecting against preterm births and children born too small, significant early risk factors for stunting

Optimizing over 5 years could result in:

- 11,000 fewer stunted children
- 4,400 fewer wasted children
- 7,300 fewer child deaths



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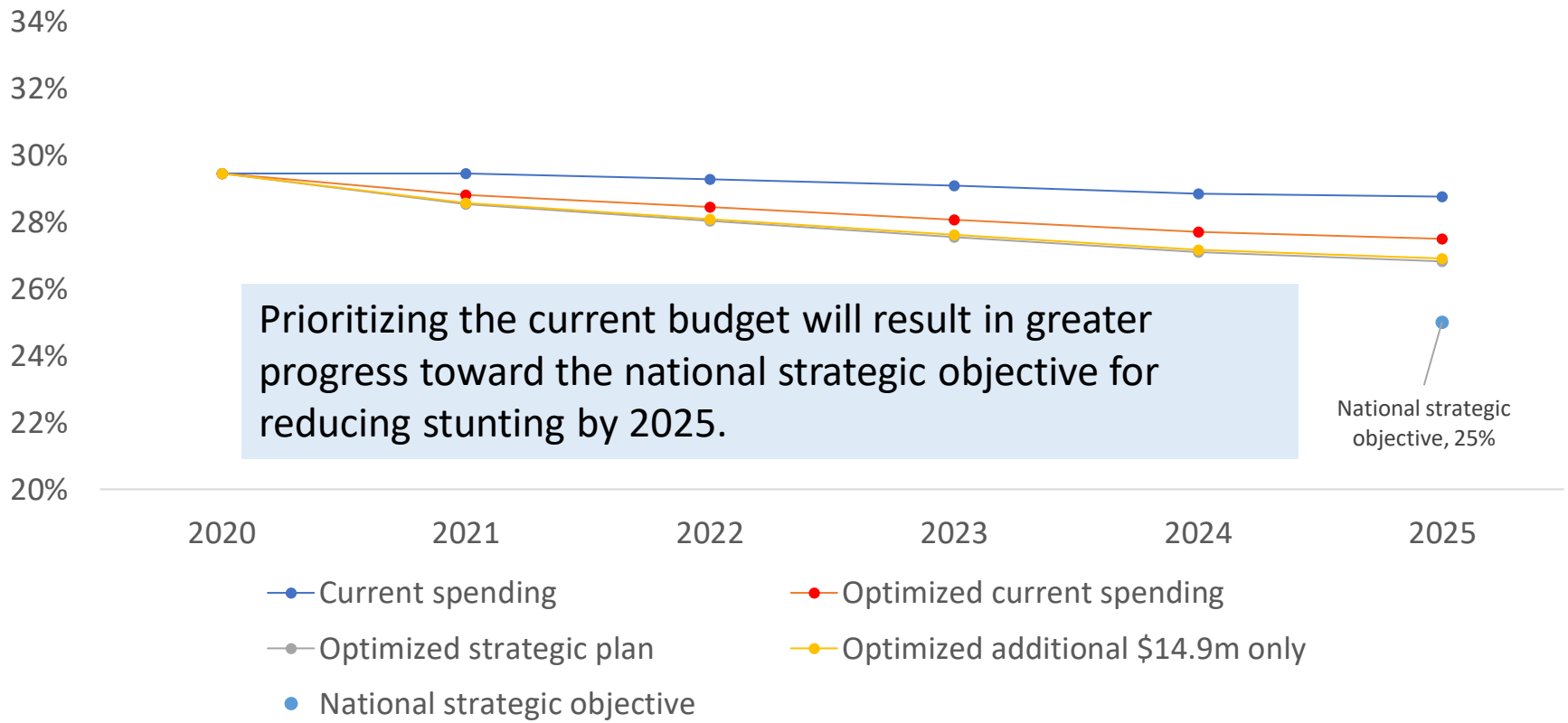
Expected trends in stunting prevalence

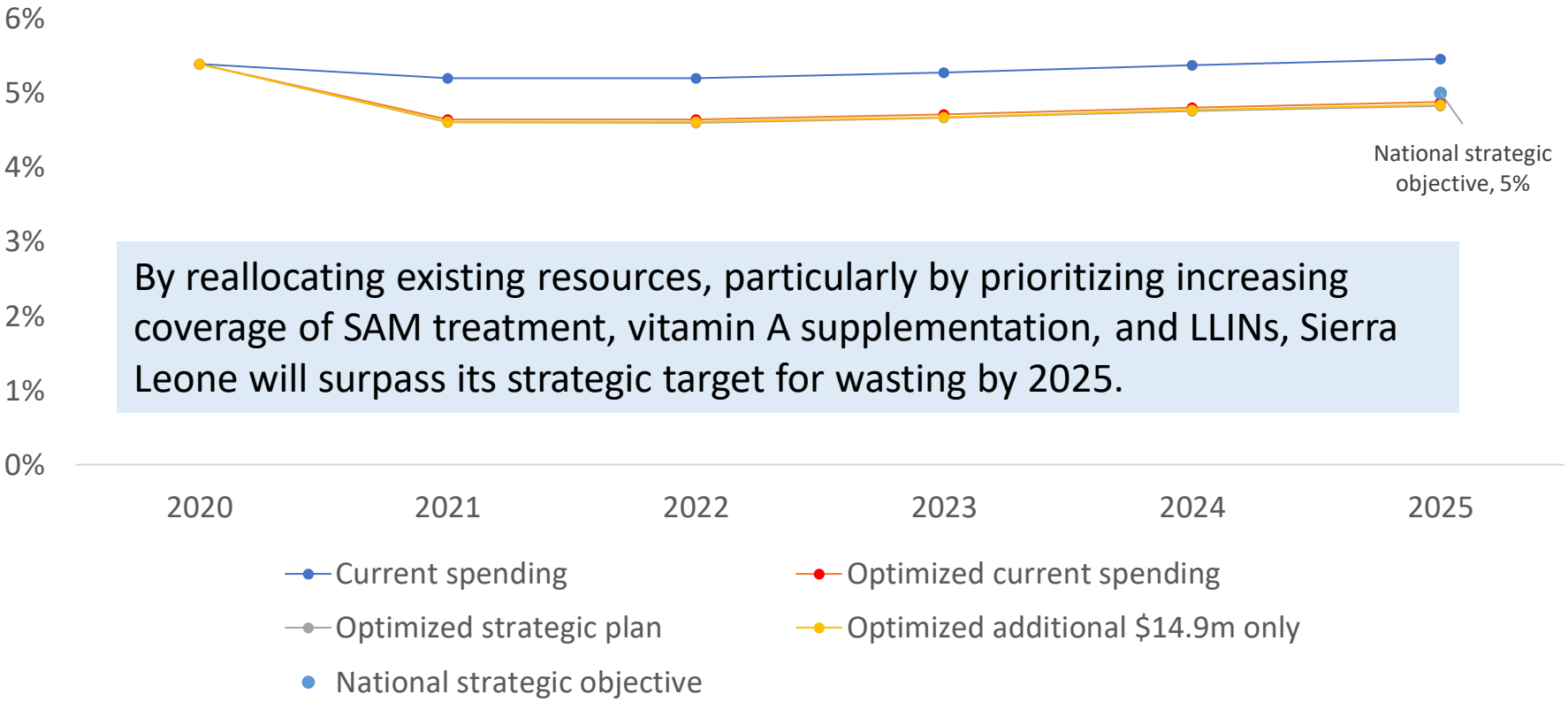


Prioritizing the current budget will result in greater progress toward the national strategic objective for reducing stunting by 2025.

- Largest incremental change in stunting prevalence occurs with reallocation of the estimated current budget
- Increasing the budget to the level proposed in the new multisectoral plan will result in further declines in stunting

Nutrition

Expected trends in wasting prevalence



By reallocating existing resources, particularly by prioritizing increasing coverage of SAM treatment, vitamin A supplementation, and LLINs, Sierra Leone will surpass its strategic target for wasting by 2025.

- Largest incremental change in wasting prevalence occurs with reallocation of the estimated current budget

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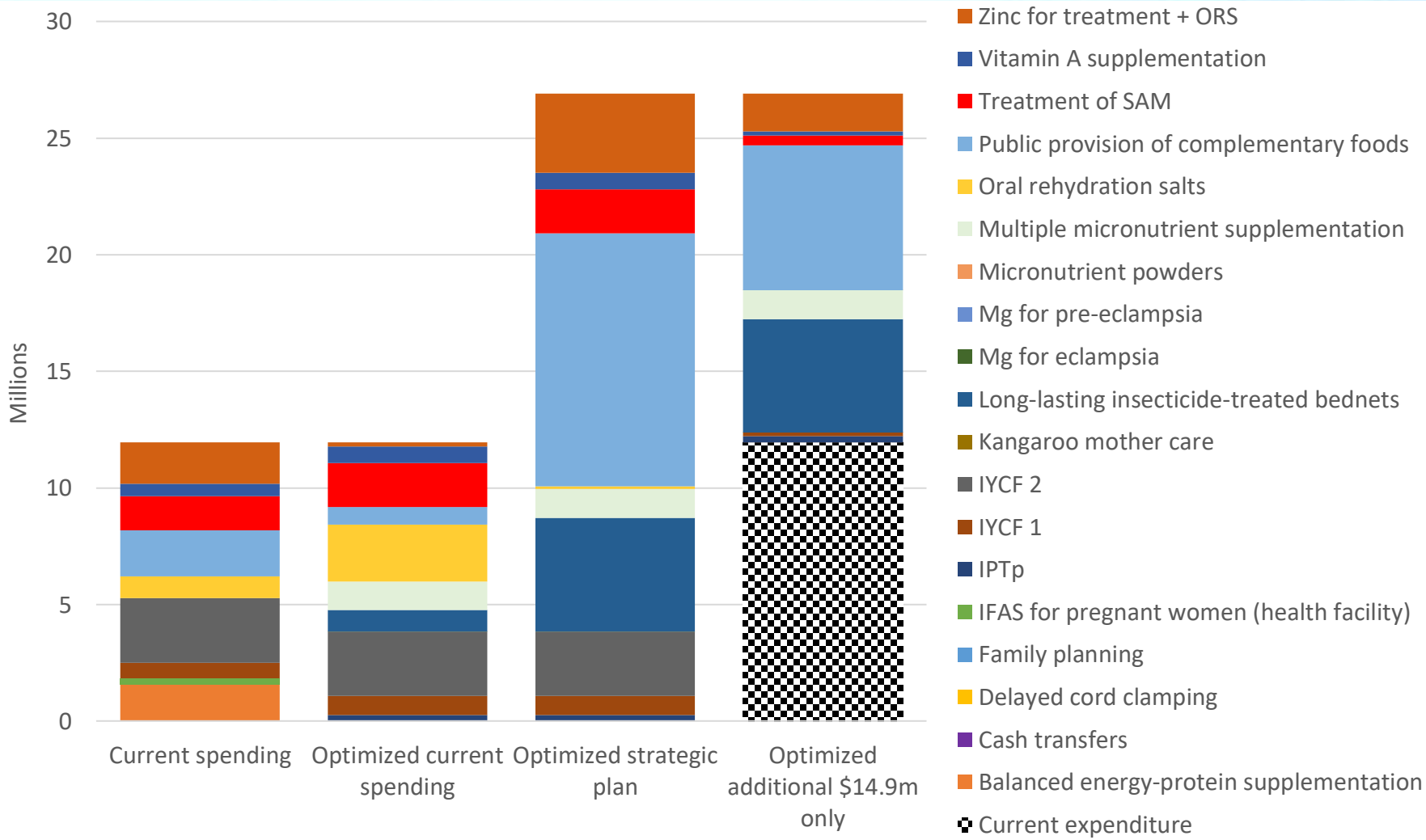
Additional Optimizations: inclusion of MMS



Note: In the model, coverage for delayed cord clamping, family planning, IPTP, kangaroo mother care, LLIN, magnesium sulphate for eclampsia/pre-eclampsia were fixed and could not be scaled down. Hence, their budgets were not included in the total budget available for reallocation. Amounts in the optimized scenario for these interventions represent additional amounts reallocated from other interventions.

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Key messages

- **Optimizing existing funding will result in the largest incremental improvement in stunting and wasting outcomes and progress toward achieving the national strategic objectives.**
  - Stunting prevalence could be reduced to 28.3%. While implementing these interventions alone may not result in reaching the national target, this would improve on current budget allocations.
  - Wasting prevalence will be reduced to 4.7%, surpassing the national strategic target
- **Increasing resources to reach the costed plan for nutrition-specific interventions in the national strategic plan will result in additional gains in stunting and wasting reduction**
- **Additional interventions may result in further gains in improved nutritional status**
  - A separate set of models included nutrition-sensitive cash transfers, multiple micronutrient supplementation for pregnant women (MMS), and micronutrient powders for children (MNP)
  - In the prioritization results, IFAS for pregnant women was replaced by MMS
    - While more expensive, MMS is more cost-efficient in preventing maternal anemia in pregnancy
    - This results in better birth outcomes and reduces maternal mortality
    - Improved birth outcomes translate into reduced stunting risk
  - With just the current funding, replacement of IFAS with MMS could result in 24,600 fewer pregnant women with iron-deficiency anemia.
  - Stunting and wasting outcomes were similar to those obtained with the existing set of interventions
  - *Budget allocations for this alternate set of scenarios presented in appendix.*

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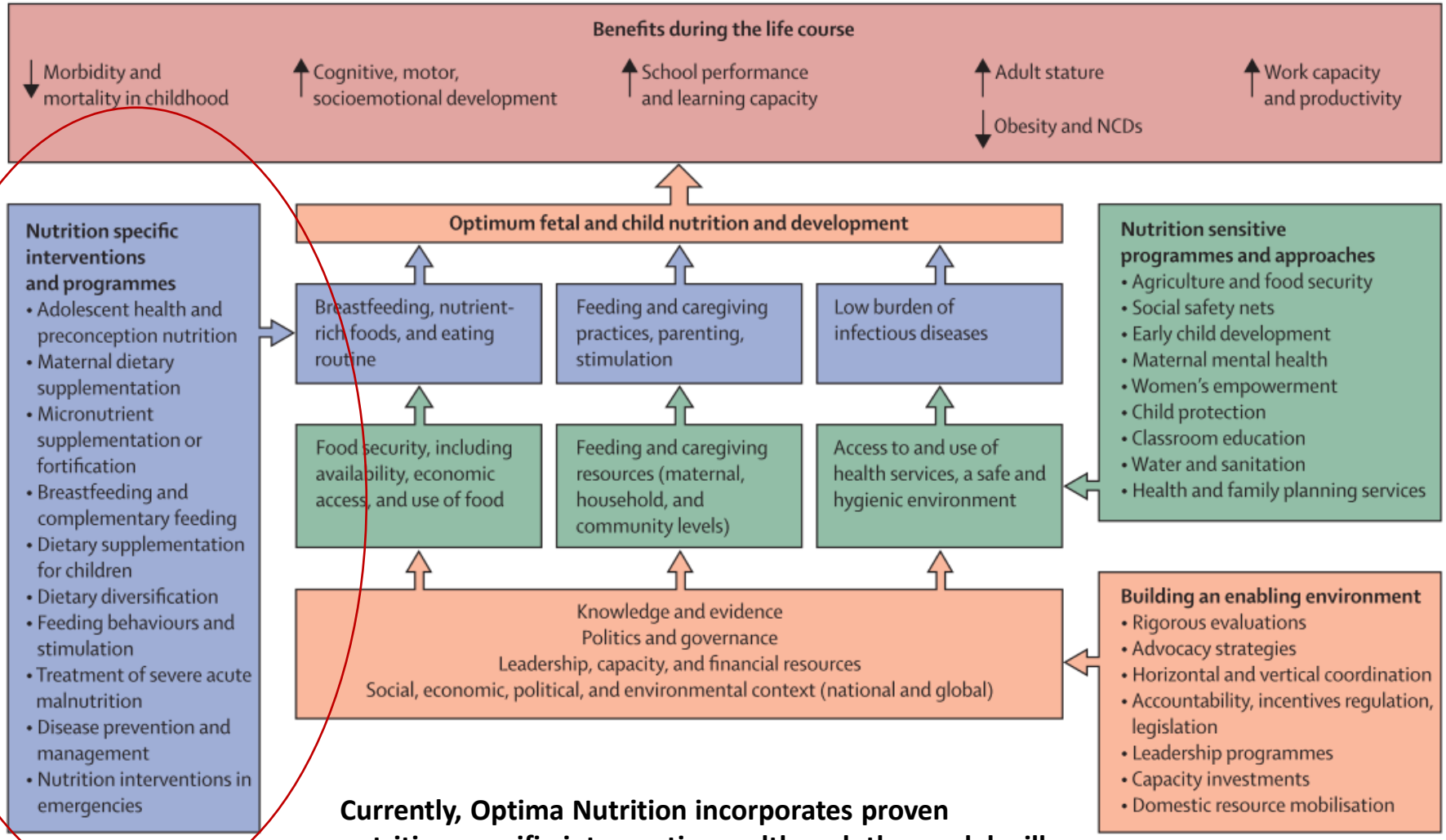
Optima Nutrition within the multisectoral approach to nutrition



Currently, Optima Nutrition incorporates proven nutrition-specific interventions, although the model will expand as evidence from other sectors become available

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Figure source: Black et al. 2013. Maternal and child undernutrition and overweight in low-income and middle-income

Limitations

- **Intervention effect sizes** come from the published literature and are largely based on the results of randomized controlled trials
  - The estimated impact is based on interventions being implemented effectively, and is assumed to be the same in Sierra Leone
- **Unit costs** were taken from a costing study undertaken by the DFN and a World Bank consultant
  - In reality, unit costs may vary depending on many factors such as geographic location, remoteness, service provider and facility type.
- **Available budget** was calculated as the product of the unit cost and the estimated coverage, summed across all interventions in the analysis
- **Feasibility of budget reallocation** should also be considered when interpreting these results:
  - There may be ethical factors, as well as potential infrastructure, human resource or logistical barriers, to achieving the optimal budget allocations in practice.
  - However, even if the optimal allocation cannot be reached, shifts in budget allocation that increase funding for the identified priority interventions are expected to derive benefits.

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Annex

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Interventions: target populations and effects (1)

Intervention	Target population	Effects	Source / Effect sizes
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]
Cash transfers (nutrition-sensitive)	Children below the poverty line	Reduces the incidence of SAM Reduces the incidence of MAM	RRR = 0.32 for SAM incidence RRR = 0.40 for MAM incidence [Langendorf et al. 2014, PLoS Med, super cereal plus + cash compared to super cereal plus.]
Delayed cord clamping	Pregnant women (at birth, but impact is for children <1 month)	Reduces anaemia	RRR = 0.53 [Hutton and Hassan, 2007 Jama]
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]
Infant and young child feeding (IYCF) education	Home/community promotion for children 0-23 months:		
	For children < 1 months	Increases exclusive breastfeeding	OR = 2.17 for exclusive breastfeeding [Sinha et al. 2017 J Nutr for interventions delivered in home or community settings in low- and middle-income countries]
	For children < 6 months	Increases exclusive breastfeeding	OR = 2.48 for exclusive breastfeeding [Sinha et al. 2017 J Nutr for interventions delivered in home or community settings in low- and middle-income countries]
	For children 6-23 months	Increases age-appropriate (partial) breastfeeding	OR = 1.82 for age-appropriate breastfeeding; [Sinha et al. 2017 J Nutr]
	For children 6-23 months	Promotion of appropriate complementary feeding reduces odds of stunting	OR = 0.77 for stunting; [Panjwani et al. 2017 J Nutr food secure population with nutrition education or counselling compared to receiving no intervention]
Intermittent presumptive	Pregnant women in areas where there is	Reduces anaemia; Reduces	Anaemia RRR = 0.83 [Radeva-Petrova et al. 2014, The Cochrane Library]; SGA

Interventions: target populations and effects (2)

Intervention	Target population	Effects	Source / Effect sizes
Kangaroo mother care	Children < 1 month	Increases exclusive breastfeeding Reduces deaths due to prematurity	OR = 1.50 for exclusive breastfeeding in children < 1 month. OR = 1.39 for exclusive breastfeeding in children 1-6 months [Boundy et al. 2016, Pediatrics] RRR = 0.49 for mortality due to prematurity [Lawn et al. 2010, I J Emi 2010]
Long-lasting insecticide-treated bed nets (LLIN)	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 [14]], SGA RRR = 0.65 [Eisele et al. 2010, Int J Epi [14]]
Micronutrient powders (i.e. iron sprinkles)	Children 6-59 months, not already receiving SNF	Reduces anaemia	RRR = 0.69 for anaemia [De-Regil et al. 2013 Cochrane review]
Multiple micronutrient supplementation	Pregnant women	Reduces anaemia and risk of SGA birth outcomes	RRR = 0.33 for anaemia in pregnant women [Pena-Rosas et al, Cochrane Database Reviews 2015] RRR = 0.92 for SGA births [Keats et al. 2019 Cochrane Database Reviews]
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 [19]; Walker & Black 2010, I J Epi [20]]
ORS + Zinc	Children 0-59 months (different quantity by age)	Reduces diarrhoea mortality	RRR = 0.24 for diarrhoea mortality. Calculated as RRR = 0.31 for ORS [Munos, et al. 2010, I J Epi], with additional RRR of 0.77 due to the addition of zinc [Walker & Black 2010, I J Epi]
Public provision of complementary foods (WFP's "fortified blended foods")	Children 6-23 months old who live in households 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]
Treatment of severe acute malnutrition (SAM)	Children experiencing SAM	Increases recovery from episode	OR = 0.78 for wasting among children receiving intervention [Bhutta et al. 2013, Lenters et al. 2013].
Vitamin A	Children 6-59	Reduces diarrhoea	RRR = 0.85 for diarrhoea incidence [Imdad et al. 2017, Cochrane review]