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MINIMOD: TOOLS FOR IDENTIFYING EFFECTIVE AND COST-EFFECTIVE MICRONUTRIENT INTERVENTIONS

USAID Advancing Nutrition Webinar

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MOTIVATION FOR DEVELOPMENT OF MINIMOD TOOLS

Substantial contribution of micronutrient deficiencies to global burden of disease and excess mortality across LMICs

- Detrimental impacts on health, cognitive development, human capital acquisition, work capacity, productivity → high private and social costs, hindering economic growth

Long-term solution

- Adequate diets for all – this will take time and investments

What to do in the short-term?

- Many options exist -- Fortification of staple foods and condiments, biofortification, supplementation, etc.
- We cannot do everything, everywhere, forever
- So, what to choose (and what not to choose) – When, where, how and how long to intervene?

What we need to know

- The nature and severity of MN deficiencies
- How effective the alternative intervention programs will be
- How costly these alternative intervention programs will be
- Hence, how cost-effective alternative intervention programs will be
- The most cost-effective national and sub-national portfolio of MN intervention programs

MINIMOD OBJECTIVES AND FRAMEWORK

Primary objective

- Develop and use tools to help design and manage a more cost-effective set of national and sub-national micronutrient intervention programs in LMICs

Framework: 3-part model

- Nutritional needs and intervention program benefits model
- Intervention program cost model
- Economic optimization model

Spatially and temporally explicit

MINIMOD TOOL FRAMEWORK

Dietary Intake Data

↓

Nutrition Needs and Benefits Model with Link to LiST

- Usual dietary intakes and dietary inadequacy estimated from primary or secondary data sources
- Predicts effects of all combinations of candidate interventions on number of individuals with low intake and with intake above the UL
- Lives Saved Tool (LiST) used to predict functional outcomes (lives saved, anemia averted)
- Spatially and temporally explicit

Program Cost Data

↓

Cost Model

- Planning, establishment, and operational costs for all combinations of candidate interventions estimated using "activity-based costing"
- Spatially and temporally explicit

Estimated program benefits →

Relative Cost-effectiveness of Alternative MN Intervention Programs

← Estimated program costs

↓

Economic Optimization Model

↓

- Finds the most cost-effective set of intervention programs
- Reports summary measures of nutritional benefits
- Reports costs and cost savings vis-à-vis alternative sets of intervention programs

NUTRITIONAL NEEDS AND INTERVENTION BENEFITS MODEL

MEASURES OF SUCCESS/NUTRITION BENEFITS

Reach: number (%) of individuals who receive an intervention

Effective Coverage: number (%) of individuals who are both at risk of deficiency due to inadequate intake and also receive sufficient additional intake from an intervention or multiple interventions to be classified as having sufficient intake

Minimum additional intake (iron and zinc): number (%) of individuals who receive more than a specified amount of additional micronutrient intake from an intervention(s)

Functional outcomes: Lives saved; cases of anemia averted

Excessive intake: number (%) of individuals whose intake would exceed the tolerable upper intake level (UL) due to the intervention(s)

CALCULATING EFFECTIVE COVERAGE: BASIC APPROACH

1. Estimate distribution of ***usual**** nutrient intakes at baseline

    Estimate % < EAR and % > UL

2. Simulate distribution of ***usual**** nutrient intakes under new program scenario(s)

    Re-assess % EAR and % > UL

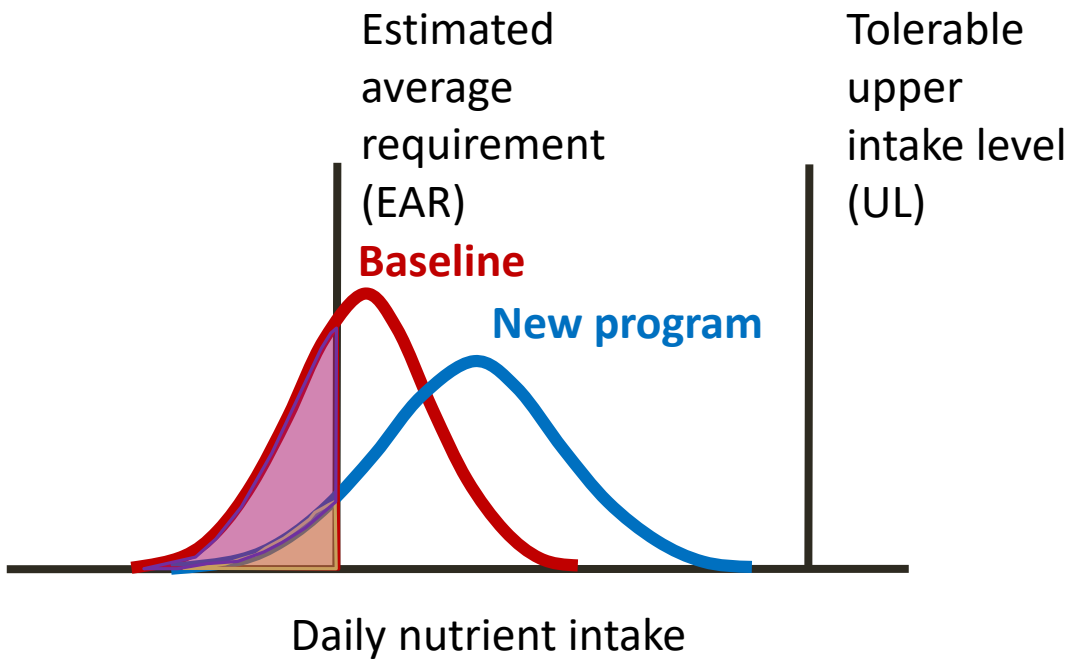
3. Effective Coverage =

% inadequate *before* – % inadequate *after*

50% inadequate *before* – 20% inadequate *after*

= 30% effective coverage

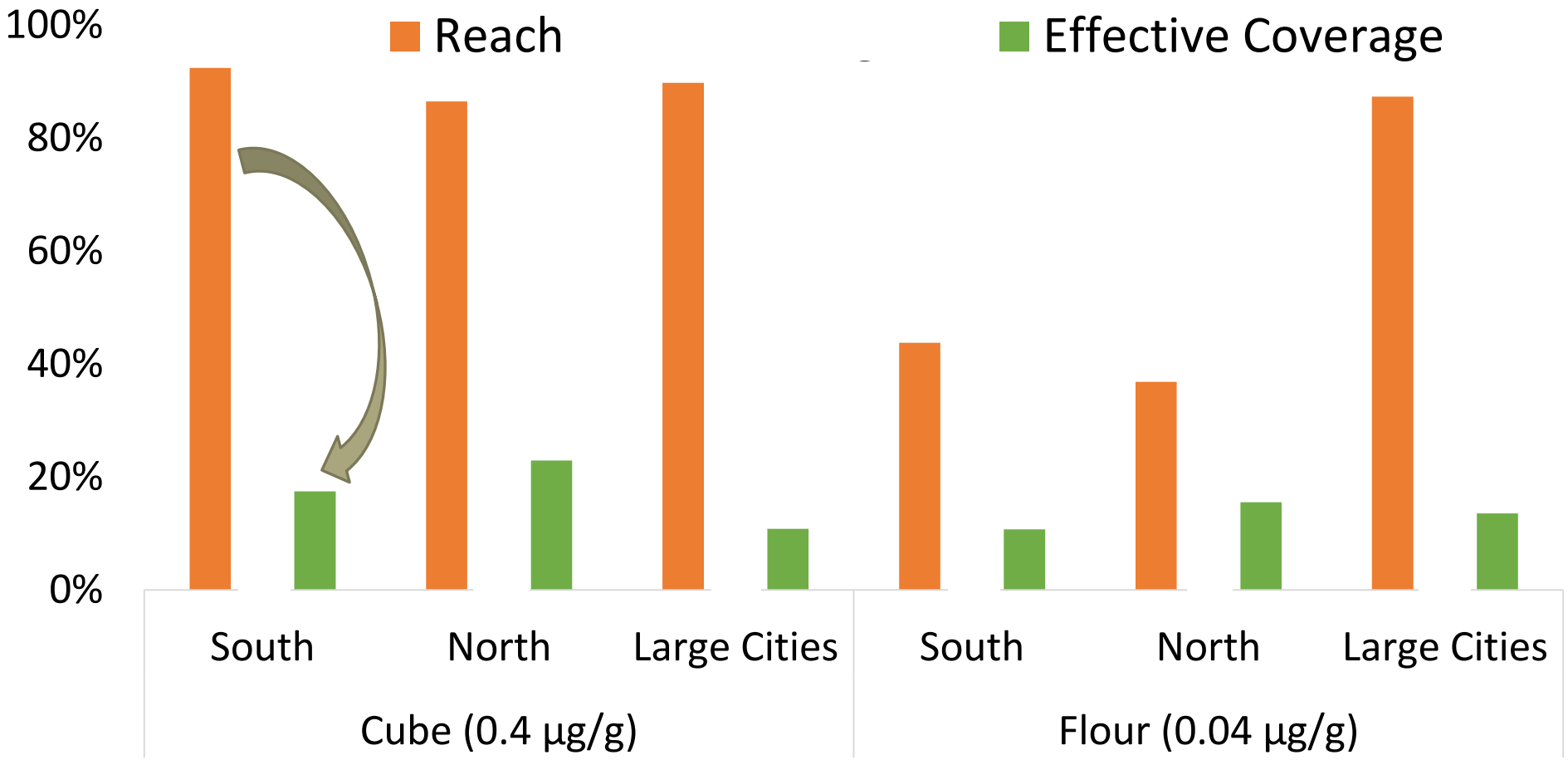
Shape of the new distribution of intakes will depend on:
> Baseline nutrient intakes,
> program reach, and
> amount of nutrient delivered,
all of which can vary spatially



*Usual intake distributions estimated using National Cancer Institute (NCI) method.
See: http://riskfactor.cancer.gov/diet/usualintakes/

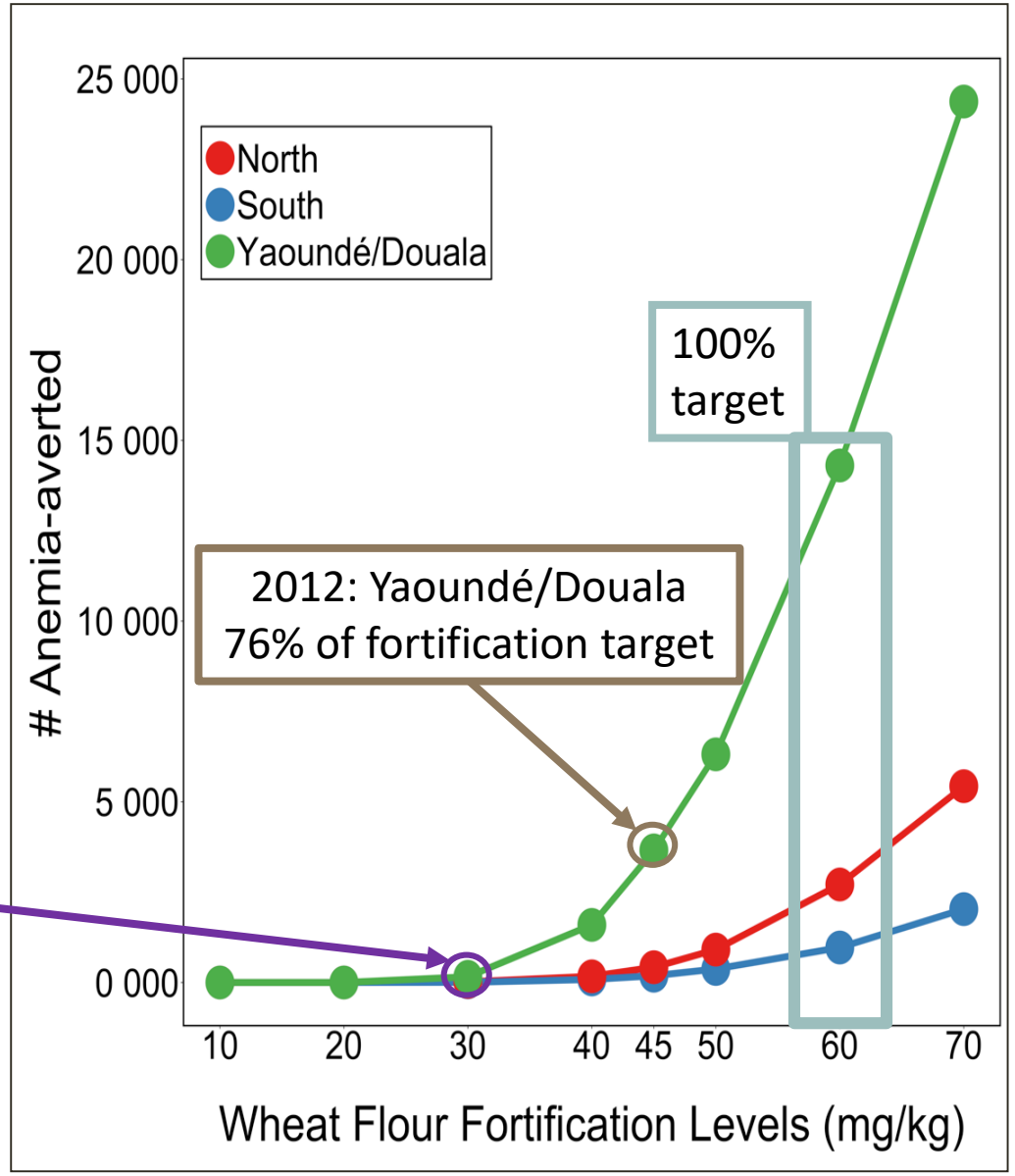
MODEL IS USEFUL IN ESTIMATING THE EFFECTS OF CURRENT AND HYPOTHETICAL PROGRAMS, AND COMBINATIONS OF THEM

PROGRAM BENEFITS DEPEND ON THE DEFINITION OF SUCCESS: PREDICTED EFFECTS OF FORTIFICATION WITH VITAMIN B-12 AMONG CHILDREN IN CAMEROON



Unpublished results: not for circulation or citation

PREDICTED NUMBER OF ANEMIA CASES AVERTED AMONG WOMEN BY STRENGTHENING WHEAT FLOUR FORTIFICATION WITH IRON IN CAMEROON



2016: National, 12 sites
50% of flour fortification target

Unpublished results: not for circulation or citation

MICRONUTRIENTS AND DELIVERY PLATFORMS

Delivery Platforms	Micronutrients
Periodic high-dose supplements*	Vitamin A
Daily supplementation*	Zinc
Industrial fortification (edible oils, wheat flour, salt, sugar, bouillon cubes)	Vitamin A, Zinc, Iron, Folate, Vitamin B12, Iodine
Biofortification (orange-flesh sweet potatoes, beans {iron}, maize {VA})	Vitamin A
Agronomic Fortification (enriched fertilizers)	Zinc, selenium
Other intervention strategies (LNS, MMP, other)*	Vitamin A, Zinc, Folate, Vitamin B12, Iodine

*Delivery platforms: Child Health Days, Health Centers (primary care), Community Distribution

All Delivery Models Require Investments and M&E!!

Benefits and Cost-effectiveness Depend on Delivery Model Performance!!

MINIMOD INTERVENTION PROGRAM COST MODEL

COMPONENTS OF THE COST MODEL

Start-up Costs

- Planning, legislation change, advocacy, etc.; initial staffing, training, infrastructure, vehicles, etc.

Operational Costs

- Fixed costs – Overhead costs, management, etc.
- Variable costs -- costs that increase with the scale of the program

Costs Faced by all Stakeholders

- Public sector costs
- Private Sector costs
- Caregiver/household costs

Marginal/Incremental Costs

- Costs of adding MN intervention programs to existing platforms
- Costs of designing/implementing completely new programs

Calculates Costs for All Intervention Programs and Combinations of Them

National and sub-national predicted nutritional impacts, costs, and cost-effectiveness of selected vitamin A programs over 10 years

		Reach, 000s of child-years	Effective Coverage, 000s of child-years	Child Deaths Averted, # of children	Total Cost, 000s US$	Cost per Child Reached, US$	Cost per Child-Year Effectively Covered, US$	Cost per Child Death Averted, US$
VA-Fortified Edible Oils (44% target)								
	National	17,188	5,075	9,724	$2,657	$0.15	$0.52	$273
VA-Fortified Edible Oils (44% to 100% target)								
	National	17,188	8,055	15,527	$4,851	$0.28	$0.60	$312
VA-Fortified Bouillon Cubes								
	National	29,039	7,731	16,098	$2,932	$0.10	$0.38	$182
VA-Biofortified Maize								
	National	13,435	2,512	5,720	$1,398	$0.10	$0.56	$244
VA Supplementation via Child Health Days								
	National	23,649	8,586	19,267	$26,923	$1.14	$3.14	$1,397
	North	11,340	5,201	13,630	$8,766	$0.77	$1.69	$643
	South	8,918	2,131	3,889	$12,963	$1.45	$6.08	$3,333
	Cities	3,391	1,253	1,748	$5,194	$1.53	$4.15	$2,972

MEETING VA NEEDS OF YOUNG CHILDREN IN CAMEROON: A CLOSER LOOK AND BENEFITS, COSTS AND COST-EFFECTIVENESS

Vosti et al., 2019

MINIMOD ECONOMIC OPTIMIZATION MODEL

WHAT THE OPTIMIZATION MODEL DOES

Combines the Results of the Nutrition Benefits and Cost Models

- Nutrition model predicts impacts of specific MN intervention programs, and combinations of them
- Cost model predicts the costs of specific MN intervention programs, and combinations of them

Uses Linear Programming Techniques

- Mixed integer programming (General Algebraic Modeling System – GAMS)

Seeks Economically Optimal Combinations to MN Intervention Programs (over space & time)

- Minimum cost of meeting specific program objectives
- Maximum contribution to objectives given funding or other constraints

BUSINESS AS USUAL* IN CAMEROON: VAS FOR CHILDREN

(* Implies the replication over 10 years of programs administered over the past few years.)

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
VA Supplementation	SNC	SNC	SNC	SNC	SNC	SNC	SNC	SNC	SNC	SNC
Fortified Cooking Oil (44%)	SNC	SNC	SNC	SNC	SNC	SNC	SNC	SNC	SNC	SNC
# of Child-Years Effectively Covered ('000s)	1,110	1,127	1,147	1,166	1,186	1,205	1,224	1,243	1,262	1,281
Total Cost ('000s USD)	$2,951	$2,957	$2,963	$2,968	$2,974	$2,979	$2,984	$2,989	$2,994	$2,999

S = South Macro-region; N = North Macro-region; C = Cities

Number of Children Effectively Covered ('000s)	11,951
Total Cost ('000s $)	$29,758
Cost per Child Effectively Covered ($/child)	$2.49

	National	North	South	Cities
# of Children Effectively Covered ('000s)	11,951	6,554	3,213	2,183
Cost per Child Effectively Covered ($/child)	$2.49	$1.48	$4.35	$2.71

Vosti et al., 2019

LET'S TRY SOMETHING NEW

Add New MN Intervention Programs

- Develop VA-fortified bouillon cube (267 IU/g target) -- delivered via markets; begins to generate benefits in year 4
- Biofortified maize (delivered via markets; begins to generate benefits in year 4)
- Improve efficiency of oil fortification program over three years (from 44% to 72% to 100% of 40 IU/g target)

Use the Optimization Model

- Objective: Achieve the 10-year BAU* effective coverage benefits (~11.9m children) at lowest cost

VAS Programs Assessed at 2009 Reach Levels

- CHD reach ➔ Cities=58%, North=89%, South=64%

Economically Optimal VA Programs for Children, Effective Coverage

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
VA Supplementation	N	N								
Fortified Cooking Oil (44%-72%-100%)	SNC#	SNC#	SNC#	SNC	SNC	SNC	SNC	SNC	SNC	SNC
Fortified Bouillon Cube	SNC*	SNC*	SNC*	SNC	SNC	SNC	SNC	SNC	SNC	SNC
VA Bio-Fortified Maize										
# of Child-Years Effectively Covered ('000s)	998	1,188	873	1,415	1,435	1,455	1,475	1,496	1,516	1,536
Total Cost ('000s USD)	$1,472	$1,478	$598	$855	$855	$855	$855	$855	$855	$855

S = South Macro-region; N = North Macro-region; C = Cities

*= zero benefits but some costs; #=increasing benefits thanks to investments

Number of Children Effectively Covered ('000s)	13,386
Total Cost ('000s $)	$9,537
Cost per Child Effectively Covered ($/child)	$0.71

Vosti et al., 2019

ONGOING AND PLANNED MINIMOD WORK

Ongoing MINIMOD Work

- Cameroon
- Ethiopia
- Haiti

New MINIMOD Work in West Africa

- Senegal
- Nigeria
- Burkina Faso

In All Sites

- MINIMOD teams are formed
- Collaborative research, including data collection/processing and modeling
- Policy engagement
- Capacity strengthening

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THANK YOU!

For more information about MINIMOD, visit:

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