Allocative Efficiency in Nutrition: Recent Applications and Key Considerations

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Conference on Improving Efficiency in Health
Setting the Stage

• Extensive literature(s) on:
  • **Cost** (e.g.: Evans, Edejer, Adams, & Lim, 2005; Neidecker-Gonzales, Nestel, & Bouis, 2007; Horton et al., 2010; Wilford, Golden, & Walker, 2011; Puett et al., 2012; Bhutta et al., 2013)
  • **Impact** (e.g. Bhutta et al., 2008; Bhutta et al., 2013)
  • **Benefits** (e.g. Hoddinot, Alderman, Behrman, Haddad, & Horton, 2013; Horton & Hoddinot, 2014)

  of nutrition interventions.

• Little work on efficiency
  • Optimal mix of interventions to improve nutritional status of populations
Some Definitions

• **Productive efficiency** – maximizing outputs with a given amount of inputs.
• **Technical efficiency** – maximizing outputs at given cost.
• ** Allocative efficiency** – maximizing welfare by allocating resources across different activities.
Applications: Optimization Model for Vitamin A

- Optimization model for a single micronutrient.
- Key questions:
  - Given a fixed cost/budget, what is the maximum impact that can be achieved?
  - What is the optimal allocation of resources across interventions AND regions that reaches a given target at the lowest cost?
- Example application – Cameroon.

Applications: Optimization Model for Vitamin A

• 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.

• Findings: optimized allocation is **44% less expensive** than the current allocation

<table>
<thead>
<tr>
<th></th>
<th>Current coverage</th>
<th>Optimal allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children reached*</td>
<td>13 million</td>
<td>13 million</td>
</tr>
<tr>
<td>Cost per child</td>
<td>$2.93</td>
<td>$1.63</td>
</tr>
</tbody>
</table>

*Children whose vitamin A deficiency was eliminated due to interventions*
Optimization Model for Vitamin A - Limitations

• Only 1 micronutrient (vitamin A)
  • But ongoing work to add zinc, iron, folate and vitamin B12

• Only micronutrient supplementation
  • No other nutrition interventions
  • Cannot analyze allocative efficiency across a broader range of interventions or outcomes (e.g. morality, stunting reduction)

• Not a tool
  • Cannot be used by “external” users
Applications: World Bank’s Nutrition Costing in Africa and South Asia

• Inform the development of national nutrition policies and operational plans:
  • Estimate the costs and benefits of scaling up the key high-impact nutrition-specific and nutrition-sensitive interventions.
  • Inform prioritisation of interventions based on the estimated cost-effectiveness of different scale-up options (allocative efficiency).

• Support advocacy
  • Estimating the benefits of investing in nutrition.
  • Build an investment case for nutrition to mobilize support and resources through domestic financing and development assistance.

• Analyses completed in Cote d’Ivoire, DRC, Kenya, Nigeria, Mali, Togo, Zambia

• Ongoing work in Afghanistan, Bangladesh, Cameroon, Guinea Bissau, Madagascar
World Bank’s Nutrition Costing in Africa and South Asia: Methodology

• Costing using program experience approach
  • Data collected from budgets or expenditure reports of organizations implementing interventions in countries.

• Impact analysis – LiST used to estimate:
  • Reductions in stunting prevalence
  • Under 5 mortality
  • DALYs

• Cost effectiveness analysis - cost per outcome

• Benefit analysis
  • Productivity gained due to reduced mortality and stunting prevalence (human capital approach)
Example: Cost and Benefits of Investing in Nutrition in Kenya

High impact nutrition interventions:
- IFA supplementation
- Breastfeeding counseling
- Complementary feeding education
- Vitamin A supplementation
- Zinc for treatment of diarrhea
- MNP supplementation
- Treatment of severe acute malnutrition
- Management of moderate acute malnutrition
- Deworming
- Salt iodization
- Iron fortification of staples

ANNUAL PUBLIC INVESTMENT

BENEFITS

- US$557 M in gains through productivity
- Save 6.6 K lives
- Save 302 K DALYs
- Avert 434 K stunting cases

Additional US$79 million
### Allocative Efficiency: Examples from Nigeria

Certain interventions are more cost-effective than others...

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Cost/DALY Saved</th>
<th>Cost/Life Saved</th>
<th>Cost/Stunting Case Averted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CNPs (EBF, CF &amp; hygiene promotion)</strong></td>
<td>12</td>
<td>53-153</td>
<td>783</td>
</tr>
<tr>
<td>Vitamin A supplementation</td>
<td>29</td>
<td>3-16</td>
<td>433</td>
</tr>
<tr>
<td>Therapeutic Zinc suppl./ORS</td>
<td>216</td>
<td>73</td>
<td>932</td>
</tr>
<tr>
<td>Micronutrient powders</td>
<td>44</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Deworming</td>
<td>264</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Iron-folic acid supplementation</td>
<td>43</td>
<td>66-115</td>
<td>974</td>
</tr>
<tr>
<td>Iron fortification of staple foods</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Salt iodization</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Public provision of complementary food</td>
<td>3,256</td>
<td>500-1000</td>
<td>28,557</td>
</tr>
<tr>
<td>CMAM for SAM</td>
<td>169</td>
<td>41</td>
<td>3,214</td>
</tr>
</tbody>
</table>
### Allocative Efficiency: Example from Kenya

Certain scale-up scenarios are more cost-effective than others...

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Annual Public Investment (US$ millions)</th>
<th>Annual Benefits</th>
<th>Cost per benefit ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>DALYs Saved</td>
<td>Lives Saved</td>
</tr>
<tr>
<td>Full National Coverage</td>
<td>79.1</td>
<td>301,563</td>
<td>6,617</td>
</tr>
<tr>
<td>Prioritizing high and medium burden regions</td>
<td>64.3</td>
<td></td>
<td>5,318</td>
</tr>
<tr>
<td>Gradual Scale-up</td>
<td>63.7</td>
<td>290,199</td>
<td>6,185</td>
</tr>
<tr>
<td>Gradual Scale-up in priority regions</td>
<td>50.2</td>
<td>229,806</td>
<td>4,903</td>
</tr>
</tbody>
</table>

**MOST COST-EFFECTIVE**
Results and Limitations

• Informed policy development
  • Contributed to the development of national nutrition plans.

• Resource mobilization for nutrition
  • IDA financing,
  • GFF investment cases for Kenya and Cameroon,
  • Power of Nutrition investment cases for Tanzania, Cameroon, Madagascar.

• Limitations:
  • No optimization
  • Cannot directly answer key questions:
    • How to maximize impact given a specific budget?
    • How to achieve a given target with minimum cost?
Gaps in Efficiency Assessment for Nutrition

• What we can do:
  • Estimate the costs of scaling up the key high-impact nutrition-specific and nutrition-sensitive interventions
  • Estimate the expected impact of the scale up
  • Estimate cost per outcome
  • Estimated financial benefits
  • Compare cost-effectiveness and benefits of some *a priori* defined scale-up options

• What we cannot do (for now):
  • Estimate the most efficient (optimal) resource allocation to maximize impact given a specific budget
The Optima approach
Helping national decision-makers, program managers, and funding partners achieve maximum impact with the funding available for the country’s public health response and plan for sustainability
Countries where Optima has been applied
The approach

1. Burden of disease
   - Epidemic model
   - Data synthesis
   - Calibration / projections

2. Programmatic responses
   - Identify interventions
   - Delivery modes
   - Costs and effects

3. Objectives and constraints
   - Strategic goals
   - Ethical & logistic constraints
   - Economic constraints

4. Optimization algorithm
1. Epidemic analysis and inference in [Optima]
2. Defining program cost-coverage relationship

- A program with decreasing and then increasing marginal costs
  - Program can be at any level (e.g., national or site)
3. Resource allocation to meet strategic objectives

How should the budget be allocated amongst these ‘n’ programs, modalities, and delivery options, considering their interactions with synergies and limitations?
4. Optimization: *consider just two dimensions* 

- New HIV infections
- Funding to ART program
- Funding to FSW program

*Apply an efficient Adaptive Stochastic Descent Algorithm*

Kerr et al. (2016)
Questions typically addressed by Optima

- **Evaluate** past interventions
- Project future **scenarios**
- **Optimize** resources
  - With fixed budget, what is the best way to allocate resources?
  - What is minimal amount of spending required to achieve targets?
Sudan: Where was the money going?

2013 actual spending

- Strategic Information
- Other programs (infrastr., PLHIV, IGP, HIV/TB)
- PMTCT
- Gen. pop. prevention (condoms, SBCC, STIs)
- High-risk men programs (FSW clients)
- Management
- ART & care
- Gen. pop. prevention (HTC)
- MSM prevention
- FSW
Sudan: What did Optima recommend?

Increase ART
Increase prevention for KPs
Reduce management cost

Same $ but reduce incidence by 37% by 2020

2013 actual spending  Optima - allocations to minimize new infections:

- Strategic Information
- Other programs (infrastr., PLHIV, IGP, HIV/TB)
- PMTCT
- Gen. pop. prevention (condoms, SBCC, STIs)
- High-risk men programs (FSW clients)
- Management
- ART & care
- Gen. pop. prevention (HTC)
- MSM prevention
- FSW
Sudan: How did budgets actually change?

2013 actual spending

- Reduce management cost
- Increase ART
- Increase prevention for KPs

Optima - allocations to minimize new infections

Despite lower total budgets, more $ for programs

2015-17 budgets (annual average)

- ART ↑ from 12% to 18%
- KPs ↑ from 7% to 29%

- Strategic Information
- Other programs (infrastr., PLHIV, IGP, HIV/TB)
- PMTCT
- Gen. pop. prevention (condoms, SBCC, STIs)
- High-risk men programs (FSW clients)
- Management
- ART & care
- Gen. pop. prevention (HTC)
- MSM prevention
- FSW
Zambia: Minimum spending required to achieve targets

Range in non-optimized costs
- Antiretroviral therapy
- HIV counseling and testing
- Prevention of mother-to-child transmission
- MCM condom programs
- Medical male circumcision programs
- FSW and client condom programs
- Youth BCC and condom programs
- Adult BCC and condom programs

Potential Funding Gap USD 580 million

2.4 times current spending

Annual Spending (millions USD)

- $0
- $200
- $400
- $600
- $800
- $1,000
- $1,200

2013 spending

Minimal spend for ambitious targets
In HIV, we have found that with existing $ and the right combinations of interventions:

- 10-30% *reductions in new infections* are achievable
- Similar *increases in viral suppression* for PLHIV

Evidence that allocative efficiency analysis can have a similar impact in nutrition.
Towards an Optima nutrition

- Costing
- Cost of interventions
- Epidemiological model
  - Number of prevented cases of stunting and lives saved
1. Epidemiological model

2. Programmatic response
   - Identify interventions & delivery modes
   - Costs & effects

3. Objectives & constraints
   - Strategic goals
   - Ethical & logistic constraints

4. Optimization algorithm
Discussion on Allocative Efficiency in Nutrition

- Actions to consider
  - Lancet series?
  - Nutrition-sensitive actions?
- Impact modelling
  - On which existing models should we build?
- Cost considerations
  - What is our understanding of the key cost drivers of nutrition actions?
  - How to best consider cost over time (cost functions, cost escalation)?
- Using allocative efficiency assessment to inform programming and resource allocation in nutrition:
  - within specific areas (e.g. within stunting)?
  - within nutrition (e.g. tradeoffs between stunting, wasting, overweight)?
  - within health?
THANK YOU