Roadmap to National Benefit Cost Ratio

<table>
<thead>
<tr>
<th>Baseline Losses (Status Quo)</th>
<th>Coverage</th>
<th>Effective</th>
<th>Benefits (Saved Losses)</th>
<th>Cost</th>
<th>Benefit Cost Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>$/yr</td>
<td>%</td>
<td>%</td>
<td>$/yr</td>
<td>$/yr</td>
<td>#</td>
</tr>
</tbody>
</table>

\[
\text{Baseline Losses} \times \text{Coverage} \times \text{Effective} = \text{Benefits (Saved Losses)} / \text{Cost} = \text{Benefit Cost Ratio}
\]
Defining National Economic Consequences Micronutrient Deficiencies

- Scientific literature has established coefficients on Health Risks or Performance Deficits related to specific Nutrition Indicators.
- These Coefficients can be applied to national data and statistics to project magnitude of loss for each of its indicator by indicator.

<table>
<thead>
<tr>
<th>Size of Population Affected</th>
<th>Potential Earning</th>
<th>Labor Participation Rate (%)</th>
<th>Coefficient Of Risk or Deficit</th>
<th>= Baseline Annual Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Data: Prevalence &amp; Mortality</td>
<td>National Data</td>
<td>National Data</td>
<td>Global Scientific Literature</td>
<td>$/yr</td>
</tr>
</tbody>
</table>

\[
\text{Baseline Annual Loss} = \text{Size of Population Affected} \times \text{Potential Earning} \times \text{Labor Participation Rate} \times \text{Coefficient Of Risk or Deficit}
\]
4 Pathways of “Damage” to Measure Baseline Economic Loss

- Mortality: NPV Lost Workforce
- Cognition & Growth: NPV Future Productivity
- Higher Morbidity: Excess Health Care Costs
- Adult Work Deficits: Lower Current Productivity
Pathway #1: Mortality

Maternal Anemia & IDA → Neonatal Conditions
Maternal Folic Acid Deficiency → Maternal Death
Child Vitamin A Deficiency → Birth Defect (NTD)

Childhood Diseases
Applying Global Evidence (RR) to National MNM Prevalence & Mortality Rates

<table>
<thead>
<tr>
<th>Prevalence Indicator Risk Group</th>
<th>Relative Risk of Mortality</th>
<th>Population Attributable Risk (PAR)</th>
<th>Mortality in Risk Group</th>
<th>Number Deaths/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>From National Statistics</td>
<td>RR From Global Literature</td>
<td>Fraction or % of Risk Group Affected</td>
<td>From National Child Mortality Statistics</td>
<td>Fraction Mortality Attributed To Indicator*</td>
</tr>
</tbody>
</table>

W/ statistical adjustment for periods of multiple risks
National Data: Baseline Micronutrient Deficiency and Mortality

<table>
<thead>
<tr>
<th>Demographics</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Population</td>
<td>13,300,410</td>
<td>National Stats</td>
</tr>
<tr>
<td>Working Age Adults 15-65</td>
<td>7,615,962</td>
<td>National Stats</td>
</tr>
<tr>
<td>Working Age Male Adults 15-65</td>
<td>3,576,944</td>
<td>National Stats</td>
</tr>
<tr>
<td>Working Age Female Adults 15-65</td>
<td>4,039,018</td>
<td>National Stats</td>
</tr>
<tr>
<td>Children &lt; 15 years</td>
<td>5,679,275</td>
<td>National Stats</td>
</tr>
<tr>
<td>Children &lt; 5 years</td>
<td>1,893,092</td>
<td>National Stats</td>
</tr>
<tr>
<td>Birth Rate</td>
<td>35.6</td>
<td>UNICEF</td>
</tr>
<tr>
<td>Annual Live Births</td>
<td>474,027</td>
<td>Calculated</td>
</tr>
<tr>
<td>Population Growth</td>
<td>2.51%</td>
<td>CIA</td>
</tr>
<tr>
<td>Birth Rate Growth</td>
<td>2.00%</td>
<td>National Stats</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mortality Rates</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 5 Mortality/1000</td>
<td>72</td>
<td>DHS URBAN</td>
</tr>
<tr>
<td>Infant Mortality/1000</td>
<td>47</td>
<td>DHS URBAN</td>
</tr>
<tr>
<td>Neonatal &lt; 1 month/1000</td>
<td>26</td>
<td>UNICEF</td>
</tr>
<tr>
<td>Maternal Mortality Rate/100,000</td>
<td>392</td>
<td>UNICEF</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mortality</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Mortality</td>
<td>1,858</td>
<td>Calculated from Mortality &amp; Birth Rates</td>
</tr>
<tr>
<td>Under 5 Mortality</td>
<td>34,130</td>
<td>Calculated from Mortality &amp; Birth Rates</td>
</tr>
<tr>
<td>Infant Mortality/1000</td>
<td>22,279</td>
<td>Calculated from Mortality &amp; Birth Rates</td>
</tr>
<tr>
<td>Neonatal &lt; 1 month</td>
<td>12,325</td>
<td>Calculated from Mortality &amp; Birth Rates</td>
</tr>
<tr>
<td>Mortality Months 1-11</td>
<td>9,955</td>
<td>Calculated: Infant Minus Neonatal</td>
</tr>
<tr>
<td>Estimated 6-11 months</td>
<td>4,344</td>
<td>Calculated: 6/11ths of 1-11 months x 80% as estimated correction for lower death rate in 6-11 months</td>
</tr>
<tr>
<td>Mortality 6-59 months</td>
<td>16,194</td>
<td>Calculated: &lt; 5 minus Infant Plus 6-11 months</td>
</tr>
</tbody>
</table>

Prevalence of Micronutrient Deficiencies

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
Global Sources:
Major Medical & Public Health Sources

Relative Risk:

- Ratio of risk of death or disease among those exposed to the risk among those not exposed.
- >1 = Threat
- < 1 = Protection
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Risk*</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Anemia: Maternal Mortality /per 1 g/dL Hb increase</td>
<td>RR 1.41</td>
<td>In Black et al Lancet, 2008/2013</td>
</tr>
<tr>
<td>Maternal Folic Acid Deficiency: Neural Tube Defect (NTD)</td>
<td>RR 1.38</td>
<td>Cochrane Review, 2012</td>
</tr>
<tr>
<td>Child Vitamin A Deficiency Mortality 6-59 Months</td>
<td>RR 1.32</td>
<td>In Black et al Lancet, 2013</td>
</tr>
</tbody>
</table>

Converted from protective as inverse/
Population Attributable Risk:

- **Population Attributable Risk**
  - Proportion of cases that can be attributed to a specific exposure.
  - Proportion of mortality that can be attributed to current rates of anemia, folic acid or vitamin A deficiency?

- PAR in a population depends on:
  - National Data: Prevalence of the risk factor
  - Global Evidence strength of association (RR) with disease.
  - The formula: \( \frac{\text{PREV} \times (\text{RR} - 1)}{1 + \text{PREV} \times (\text{RR} - 1)} \)

http://medical-dictionary.thefreedictionary.com/relative+risk
Deaths from Vitamin A Deficiency

VAD: 22.3%
318 thousand

Attributed Deaths:
RR 1.32 = PAR: 6.6%

Deaths 6-59 months

392
5995
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAD Associated Deaths of Children 6-59 months</td>
<td></td>
</tr>
<tr>
<td>Deaths of Children 6-59 months</td>
<td>16,194</td>
</tr>
<tr>
<td>Prevalence of vitamin A deficiency</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Coefficient of Loss</strong></td>
<td></td>
</tr>
<tr>
<td>Relative risk of death due to vitamin A deficiency</td>
<td>1.32</td>
</tr>
<tr>
<td>Population attributable risk</td>
<td>8.7%</td>
</tr>
<tr>
<td>The number of deaths due to vitamin a deficiency</td>
<td>1,401</td>
</tr>
<tr>
<td><strong>Loss of Productive Potential</strong></td>
<td></td>
</tr>
<tr>
<td>Annual wage</td>
<td>$1,489</td>
</tr>
<tr>
<td>National Labor Participation Rate</td>
<td>77.3%</td>
</tr>
<tr>
<td>NPV Economic Loss (13 years to workforce entry)</td>
<td>$19,622,856</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Mortality Summary</td>
<td>2014</td>
</tr>
<tr>
<td>Maternal Mortality</td>
<td>288</td>
</tr>
<tr>
<td>Neo Natale Mortality</td>
<td>654</td>
</tr>
<tr>
<td>Birth Defect</td>
<td>418</td>
</tr>
<tr>
<td>Vitamin A Def</td>
<td>1,401</td>
</tr>
<tr>
<td>Total Deaths</td>
<td>2,761</td>
</tr>
<tr>
<td>Under 5 year Deaths</td>
<td>2,473</td>
</tr>
<tr>
<td></td>
<td>7%</td>
</tr>
</tbody>
</table>
## Converting Lives to Currency: A Cold Banker’s Approach

### Net Present Value of Work Lost to Childhood Mortality Discount over 45 Year Projected Work-life @ 3%

<table>
<thead>
<tr>
<th>Size of Population Affected</th>
<th>Average Earning</th>
<th>Labor Participation Rate (%)</th>
<th>NPV Lifetime Earning.*</th>
<th>Baseline Annual Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrition Attributed Deaths</td>
<td>$/y National Data</td>
<td>% National Data</td>
<td>45 years 15y Delay 3% Rate</td>
<td>$/yr</td>
</tr>
</tbody>
</table>

*Lifetime Earning = Baseline Annual Loss
Net Present Value (NPV): Converting Units to Value Future Benefits

- Human perceptions of value change over time.
  - People value current money more than future money.
  - Value diminishes with added “waiting time” for benefits.

- FF Costs current. FF benefits extend far into future
  - Period of No Returns. Earnings 2028-2073

- What’s the value or discount of waiting for the Benefit?
  - NPV converts future into present value using a discount rate.
  - Discount Rate charges for waiting:

- NPV % Discount Rate makes big difference in assessing value of interventions that yield long term benefits.
  - Higher % rates diminish the value of future benefits.
  - Model Default: 3% World Bank from World Development Report
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of Child deaths attributed to IDA in Mother</td>
<td>654</td>
<td>Calculated</td>
</tr>
<tr>
<td>Loss of Productive Potential</td>
<td>$1,489</td>
<td></td>
</tr>
<tr>
<td>Annual wage</td>
<td></td>
<td>$1,489</td>
</tr>
<tr>
<td>National Labor Participation Rate</td>
<td>77.3%</td>
<td></td>
</tr>
<tr>
<td>NPV Economic Loss (15 years to workforce entry)</td>
<td>$8,177,876</td>
<td>Calculated</td>
</tr>
</tbody>
</table>

45 Years @ $1489

= > $60 thousand/Child

NPV over 60 years with no earnings for first 15 years

= ~$12 thousand/child
Pathway #2: Anemia
Lost Future Earnings Potential Children

Physical Growth & Strength
Cognitive Development
Cognition & Growth
School Performance

PRODUCTIVITY
Childhood Anemia and Iron Deficiency: Future Productivity and Earnings

- Nutrition Literature:
  - Iron deficiency in childhood causes cognitive deficit.*
  - Iron interventions improve cognition 0.5 to 1 SD.**

- Economic Literature:
  - 0.5 SD increase in IQ = increase in wages 5-10%**

- Future earnings deficit in anemic children 2.5%***

* Multiple./Journal of Nutrition  **Lancet/multiple  ***Copenhagen Consensus
Childhood Anemia and Future Productivity

2014: Current Child Status

Mental Development & Schooling

2029-2074: Future Productivity

NPV Annual Losses to National Economy

$/YR
<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Child Productivity Loss from ID</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>Health Data Background</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Population &lt;5 yrs</td>
<td>1,893,092</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Children with IDA</td>
<td>8.08%</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Children with Anemia</td>
<td>152,993  Calculated</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Project proportion/ratio children with ID but without IDA</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Children with ID/IDA Cognitive Deficit</td>
<td>305,985</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td><strong>Demographic and Labor Background Data</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Average Annual Wage in All Sectors</td>
<td>$1,489</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>National Labor Participation Rate</td>
<td>77.3%</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td><strong>Economic Productivity Loss Projections</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Reduction in future productivity in all sectors due to anemia</td>
<td>2.50% Horton &amp; Ross, 2003</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>NPV Economic Loss (12.5 years to workforce entry)</td>
<td>$22,016,574 Calculated</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td><strong>10 Year Status Quo Losses at Current Population Growth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>2014</td>
<td>$22,016,574</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>2015</td>
<td>$22,456,905</td>
<td></td>
</tr>
</tbody>
</table>
Pathway #3: Anemia Impact on Adult Productivity

- **Health Impact**
  - Weakness & fatigue

- **Work Impact**:
  - Lower performance or output

- **Consensus Estimates**
  - Copenhagen Consensus, PROFILES/USAID, ADB/CIPs
  - 5% in Manual Labor
  - 17% Heavy Manual Labor

- **White-Collar, Parenting & Voluntary work not calculated**
Adult Female Workers
Productivity Deficits from Anemia

Adult Female Workers
5.7 million

Adult Female Workers Anemic
2.2 million

80% Female Labor Participation
1.81 million

74% in Manual Labor
1.5 Million

15% in Heavy Manual Labor

+12% Deficit

15% Deficit

Annual Losses to National Economy

Female Deficit: $/yr

Male Deficit: $/yr

Female Labor Loss: $100 Million/yr

Male Deficit: $/yr
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Adult Productivity Loss from IDA</strong></td>
<td></td>
<td></td>
<td></td>
<td>Calculated</td>
</tr>
<tr>
<td><strong>Health Data Background</strong></td>
<td></td>
<td></td>
<td></td>
<td>Calculated</td>
</tr>
<tr>
<td>Iron Deficiency Anemia</td>
<td>10.3%</td>
<td>2.6%</td>
<td>Calculated</td>
<td>Calculated</td>
</tr>
<tr>
<td>Demographic and Labor Data Background</td>
<td></td>
<td></td>
<td></td>
<td>Calculated</td>
</tr>
<tr>
<td>Working Age Adults</td>
<td>2,669,791</td>
<td>3,162,018</td>
<td>5,831,809</td>
<td>National Data and Assumption</td>
</tr>
<tr>
<td>Labor Participation Rate (Male and Female)</td>
<td>66.1%</td>
<td>88.4%</td>
<td></td>
<td>National Data and Assumption</td>
</tr>
<tr>
<td>Employed Population</td>
<td>1,764,732</td>
<td>2,795,224</td>
<td>4,559,956</td>
<td>Calculated</td>
</tr>
<tr>
<td>Manual Labor Share</td>
<td>88.5%</td>
<td>88.5%</td>
<td></td>
<td>National Data and Assumption</td>
</tr>
<tr>
<td>Working in Manual Labor</td>
<td>1,561,788</td>
<td>2,473,774</td>
<td>4,035,561</td>
<td>Calculated</td>
</tr>
<tr>
<td>Workers in Heavy Manual Labor</td>
<td>234,268</td>
<td>371,066</td>
<td>605,334</td>
<td>Calculated</td>
</tr>
<tr>
<td>Average Wage Sector</td>
<td>$1,005</td>
<td>$1,117</td>
<td></td>
<td>Calculated</td>
</tr>
<tr>
<td>Economic Productivity Loss Projections</td>
<td></td>
<td></td>
<td></td>
<td>Calculated</td>
</tr>
<tr>
<td>Workers with IDA in Manual Labor</td>
<td>160,519</td>
<td>63,563</td>
<td>224,083</td>
<td>Calculated</td>
</tr>
<tr>
<td>Productivity Deficit</td>
<td>5%</td>
<td>5%</td>
<td></td>
<td>From Horton et al 2003</td>
</tr>
<tr>
<td>Manual Labor Loss Subtotal</td>
<td>$8,056,446</td>
<td>$3,549,096</td>
<td>$11,615,542</td>
<td>Calculated</td>
</tr>
<tr>
<td>Workers with IDA in Heavy Manual Labor</td>
<td>24,077.92</td>
<td>9,534.48</td>
<td>33,612</td>
<td>Calculated</td>
</tr>
<tr>
<td>Additional Deficit</td>
<td>12%</td>
<td>12%</td>
<td></td>
<td>From Horton et al 2003</td>
</tr>
<tr>
<td>Additional Loss for Heavy Manual Labor Subtotal</td>
<td>$2,903,921</td>
<td>$1,277,674</td>
<td>$4,181,595</td>
<td>Calculated</td>
</tr>
<tr>
<td>Grand Total</td>
<td>$10,970,367</td>
<td>$4,826,770</td>
<td>$15,797,137</td>
<td>Calculated</td>
</tr>
</tbody>
</table>
Pathway #4: Excess Health Care Costs

NTD Survivors

- Surgery
- Rehab & Care
- Social Welfare
- Home Treatment

COSTS
<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td><strong>Cost Estimates for Care of Survivors</strong></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>% Births with Access to Special Care or Pediatric Surgery for NTD</td>
<td>10%</td>
</tr>
<tr>
<td>23</td>
<td>Estimate of Annual Cost per Case for Pediatric Surgery for NTD Cases</td>
<td>$1,000</td>
</tr>
<tr>
<td>24</td>
<td>Estimated Annual Cost per Case of Ongoing Rehabilitation and Care for Severely Disabled</td>
<td>$250</td>
</tr>
<tr>
<td>25</td>
<td>Estimated Annual Cost per Case of Ongoing Rehabilitation and Care for Moderately Disabled</td>
<td>$100</td>
</tr>
<tr>
<td>26</td>
<td>Annual Social Security, Welfare or Other Special Programs</td>
<td>$200</td>
</tr>
<tr>
<td>27</td>
<td>Surgery Cost Per Year</td>
<td>$51,195</td>
</tr>
<tr>
<td>28</td>
<td>Ongoing Medical Care and Rehab Costs per Year</td>
<td>$16,626</td>
</tr>
<tr>
<td>29</td>
<td>Annual cost of Social Security, Welfare and Other Special Programs</td>
<td>$15,358</td>
</tr>
<tr>
<td>30</td>
<td>Total Recurring Costs for Care of Survivors</td>
<td><strong>$83,179</strong></td>
</tr>
<tr>
<td></td>
<td><strong>10 Year Status Quo Losses at Current Population Growth</strong></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>2014</td>
<td>$4,475,852</td>
</tr>
<tr>
<td>34</td>
<td>2015</td>
<td>$4,565,369</td>
</tr>
<tr>
<td>35</td>
<td>2016</td>
<td>$4,656,677</td>
</tr>
<tr>
<td>36</td>
<td>2017</td>
<td>$4,749,810</td>
</tr>
<tr>
<td>37</td>
<td>2018</td>
<td>$4,844,806</td>
</tr>
</tbody>
</table>
## Summary Economic Consequences for All Indicators

<table>
<thead>
<tr>
<th></th>
<th>Lost Workforce</th>
<th>Lost Future Productivity</th>
<th>Lost Current Healthcare</th>
<th>Current Healthcare</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal Mortality</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>5.29</td>
</tr>
<tr>
<td>Neo Nata Mortality</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>8.18</td>
</tr>
<tr>
<td>Birth Defect NTD</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>4.48</td>
</tr>
<tr>
<td>Childhood IDA</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>16.51</td>
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<tr>
<td>Vitamin A Def</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>19.62</td>
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<tr>
<td>IDA in Adults</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>000,000/yr</td>
<td>15.80</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>$37.0</strong></td>
<td><strong>$17.0</strong></td>
<td><strong>$15.8</strong></td>
<td><strong>$15.8</strong></td>
<td><strong>69.88</strong></td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th>%</th>
<th>%</th>
<th>%</th>
<th>% of GDP</th>
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<tbody>
<tr>
<td>Mat Mort</td>
<td>53%</td>
<td>24%</td>
<td>23%</td>
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</tr>
<tr>
<td>Neo Mort</td>
<td></td>
<td></td>
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<tr>
<td>Birth Defect NTD</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Childhood IDA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vitamin A Def</td>
<td></td>
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<tr>
<td>IDA in Adults</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>53%</strong></td>
<td><strong>24%</strong></td>
<td><strong>23%</strong></td>
<td><strong>% of GDP</strong></td>
</tr>
</tbody>
</table>
Team Work Session 1: 3-4 Hours

- 1A: Review National Data Inputs (Yellow)
- 1B: Review Mortality Projections (Red)
- Review Lost Productivity Projections (Green)
- Consider Results:
  - Discuss work to be done as follow-up
  - How to use in communications and advocacy.
Session 1A: Yellow Worksheets
Background Information 30 Minutes

☐ Demo-Health and Econ Data Sheet
  ■ Discuss and Fill In Data
  ■ If no data: discuss & agree on educated assumption
    ☐ A placeholder until you get better data
  ■ Review assumption cells and calculations (no highlight)

☐ IDA Issues
  ■ Review Lancet Table Link (DEMO Lines 44-51)
  ■ Review “region” from web table.

☐ Average Over-all Wage Earnings (ECON Line 19)
  ■ Fill in your best estimate for line 19 OR
  ■ Review logic of Model’s Assumption (lines 16-19)
Causes of Iron Deficiency:
• Deficient iron intake
• Excessive iron loss

Biological marker:
• Serum ferritin

Causes of Iron Deficiency Anemia:
• Iron deficiency

Biological marker:
• Serum ferritin & hemoglobin

Causes of Anemia:
• Deficiency of iron, folate, vitamin A & B12
• Blood Disorders
• Infections
• Biological marker:
• Hemoglobin

Flour Fortification Protection for Iron Deficiency & Iron Deficiency Anemia

 Courtesy of H. Pachon, FFI Zimmermann 2008; Gleason 2007; Scott 2007; West 2007; Cameron 2011
Lancet Web Table: Anemia and Iron Deficiency Anemia in Africa Regions

Web Table 3: Prevalence of total and severe iron deficiency anemia (IDA) in children under 5 years of age and pregnant women

<table>
<thead>
<tr>
<th>UN regions and sub-regions</th>
<th>Anemia prevalence in under-5 Children (%)</th>
<th>Anemia prevalence in pregnant women (%)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Total anemia (95% CI)</td>
<td>IDA total anemia (95% CI)</td>
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<tr>
<td></td>
<td>Severe anemia (95% CI)</td>
<td>IDA severe anemia (95% CI)</td>
</tr>
<tr>
<td></td>
<td>Total anemia (95% CI)</td>
<td>IDA total anemia (95% CI)</td>
</tr>
<tr>
<td></td>
<td>Severe anemia (95% CI)</td>
<td>IDA severe anemia (95% CI)</td>
</tr>
<tr>
<td>Africa</td>
<td>60.2 (57.6-63.1)</td>
<td>20.2 (18.6-21.7)</td>
</tr>
<tr>
<td></td>
<td>3.3 (3.0-3.6)</td>
<td>1.0 (0.9-1.0)</td>
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<tr>
<td>Eastern Africa</td>
<td>54.3 (51.3-57.3)</td>
<td>20.6 (19.0-22.2)</td>
</tr>
<tr>
<td></td>
<td>3.2 (2.8-3.6)</td>
<td>1.2 (0.9-1.5)</td>
</tr>
<tr>
<td>Middle Africa</td>
<td>64.9 (57.9-71.7)</td>
<td>21.0 (17.8-24.2)</td>
</tr>
<tr>
<td></td>
<td>3.0 (2.5-3.5)</td>
<td>1.6 (0.7-2.5)</td>
</tr>
<tr>
<td>Northern Africa</td>
<td>44.7 (32.0-57.7)</td>
<td>19.2 (12.3-27.2)</td>
</tr>
<tr>
<td></td>
<td>0.5 (0.0-1.0)</td>
<td>0.3 (0.0-0.7)</td>
</tr>
<tr>
<td>Southern Africa</td>
<td>41.6 (23.2-61.1)</td>
<td>20.3 (9.7-32.0)</td>
</tr>
<tr>
<td></td>
<td>0.4 (0.0-0.8)</td>
<td>0.3 (0.0-0.6)</td>
</tr>
<tr>
<td>Western Africa</td>
<td>73.5 (69.8-76.9)</td>
<td>19.8 (17.6-22.0)</td>
</tr>
<tr>
<td></td>
<td>1.8 (1.2-2.3)</td>
<td>1.2 (0.3-2.1)</td>
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</table>

IDA% / Anemia % = % Anemia from IDA
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 Anemia in Children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28 Anemia in Children 6-59 months</td>
<td>30%</td>
<td>National Data</td>
</tr>
<tr>
<td>29 Iron Deficiency Anemia Proportion</td>
<td>27%</td>
<td>National Data or Calculated % from From Black et al</td>
</tr>
<tr>
<td>30 Estimated IDA in Children 6-59 months</td>
<td>8.1%</td>
<td>Calculated</td>
</tr>
<tr>
<td>31 Anemia in Pregnant Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32 Anemia in Pregnant Women</td>
<td>30%</td>
<td>National Data</td>
</tr>
<tr>
<td>33 Proportion IDA in Pregnant Women</td>
<td>42%</td>
<td>National Data or Calculated % from From Black et al</td>
</tr>
<tr>
<td>34 Estimated IDA in Pregnant Women</td>
<td>12%</td>
<td>Calculated</td>
</tr>
<tr>
<td>35 Anemia in Adult Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>36 Anemia Adult Women</td>
<td>30%</td>
<td>National Stats</td>
</tr>
<tr>
<td>37 Proportion IDA in WRA</td>
<td>34%</td>
<td>National Data or Average Children &amp; Pregnant Women</td>
</tr>
<tr>
<td>38 Estimated IDA in WRA</td>
<td>10.3%</td>
<td>Calculated</td>
</tr>
<tr>
<td>44 Regional Statistic for IDA From Black et al in Lancet</td>
<td>58.20%</td>
<td></td>
</tr>
<tr>
<td>45 Pregnant Women Regional Anemia</td>
<td></td>
<td>Linked to B 34</td>
</tr>
<tr>
<td>46 Pregnant Women Regional IDA</td>
<td>24.20%</td>
<td>Linked to B 34</td>
</tr>
<tr>
<td>47 Pregnant Women Proportion IDA</td>
<td></td>
<td>Linked to B 34</td>
</tr>
<tr>
<td>48 Child Regional Anemia</td>
<td>73.50%</td>
<td></td>
</tr>
<tr>
<td>49 Child Regional IDA</td>
<td>19.80%</td>
<td></td>
</tr>
<tr>
<td>50 Child Proportion IDA</td>
<td>26.9%</td>
<td>Linked to B 34</td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>------------------------------------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>Female Labor Participation rate</td>
<td>66.1%</td>
<td><a href="http://data.un.org/CountryProfile.aspx?crName=SENegal#Economic">http://data.un.org/CountryProfile.aspx?crName=SENegal#Economic</a></td>
</tr>
<tr>
<td>Economically Active Adults</td>
<td>5,883,331</td>
<td>Calculated from B2 and Demo &amp; Health B3</td>
</tr>
<tr>
<td>Economically Active Male Adults</td>
<td>3,162,018</td>
<td>Calculated</td>
</tr>
<tr>
<td>Economically Active Female Adults</td>
<td>2,669,791</td>
<td>Calculated</td>
</tr>
<tr>
<td>Healthy Life Expectancy</td>
<td></td>
<td></td>
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<tr>
<td>Healthy Life Expectancy, Male</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy Life Expectancy, Female</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Maternal Age at Birth</td>
<td></td>
<td></td>
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<tr>
<td>Work Force Entry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women's Worklife</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male Worklife</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work Life Average</td>
<td>39</td>
<td>Calculated</td>
</tr>
<tr>
<td>GDP (current US$)</td>
<td>$14,600,000,000</td>
<td></td>
</tr>
<tr>
<td>GDP/Working Person</td>
<td>$2,482</td>
<td>Calculated from line 5 and 16</td>
</tr>
<tr>
<td>Individual Wage/Labor Share</td>
<td>60%</td>
<td>ILO from 16 Developing Countries</td>
</tr>
<tr>
<td>Average Over-all Wage/Earnings/Income</td>
<td>$1,489</td>
<td>From National Statistics or Calculated from line 17 and 18</td>
</tr>
<tr>
<td>Manual Earnings % Overall Earnings</td>
<td>75%</td>
<td>National Data or Assumption</td>
</tr>
<tr>
<td>Adjustment for Manual Wage</td>
<td>$1,117</td>
<td>Calculated from National Stat or Assumption</td>
</tr>
<tr>
<td>Female % Male Manual Wage</td>
<td>90%</td>
<td>National Data or Assumption</td>
</tr>
<tr>
<td>Discount Rate</td>
<td>3%</td>
<td>Judgement Based on World Bank 1993</td>
</tr>
</tbody>
</table>

\[(\text{GDP} \div \text{Economically Active Adults}) \times 60\% \text{ Wage Share of GDP}\]
Session 1B: Mortality:
(4 Red Worksheets) 1 hour

- For Each Red Worksheet: Consider & Explore Results:
  - Review logic in the sequence of cells:
    - Reasonable? Credible?
    - Sensitivity Analysis: Consider impact of light blue cells:
  - Issue: NTD Worksheet
    - Review and correct assumptions made in yellow cells
    - If no data, use a placeholder until you get better data
  - Issue: Maternal Mortality Worksheet
    - RR Based on Hb distribution not simple prevalence
- Review Blue Worksheet: SUM Mort
- Consider & Discuss:
  - How would you communicate these results?
  - Balance of mortality and economics
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>IDA Associated Neonatal Deaths</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Deaths of &lt; 1 month</td>
<td>12,325</td>
<td></td>
</tr>
<tr>
<td>Prevalence of IDA in Pregnant Women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coefficient of Loss</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative risk of Neonatal Death due IDA in Mother</td>
<td>1.45</td>
<td>Dibley et al in Black et al Lancet 2013</td>
</tr>
<tr>
<td>Population attributable risk</td>
<td>5.3%</td>
<td>Calculated</td>
</tr>
<tr>
<td>The number of deaths attributed to IDA in Mother</td>
<td>654</td>
<td>Calculated</td>
</tr>
<tr>
<td>Loss of Productive Potential</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual wage</td>
<td>$1,489</td>
<td></td>
</tr>
<tr>
<td>National Labor Participation Rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPV Economic Loss (15 years to workforce entry)</td>
<td>$8,177,876</td>
<td>Calculated</td>
</tr>
<tr>
<td>10 Year Status Qquo Losses at Current Population Growth</td>
<td>Status Quo Deaths</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>$8,177,876</td>
<td>654</td>
</tr>
<tr>
<td>2015</td>
<td>$8,341,434</td>
<td>667.1</td>
</tr>
<tr>
<td>2016</td>
<td>$8,508,262</td>
<td>680.5</td>
</tr>
<tr>
<td>2017</td>
<td>$8,678,427</td>
<td>694.1</td>
</tr>
<tr>
<td>2018</td>
<td>$8,851,996</td>
<td>708.0</td>
</tr>
<tr>
<td>2019</td>
<td>$9,029,036</td>
<td>722.1</td>
</tr>
</tbody>
</table>
Incidence of Neural Tube Defects

Neural Tube Defects per 10,000 live births

March of Dimes estimates for all countries except South Africa. South Africa data from 2008 literature.
Session 1C: Future and Current Productivity (2 Green Tabs) 1 hour

- Worksheet: IDA Kids
  - Discuss and agree on Yellow Cells
  - Case Iron Deficiency as well as IDA
  - Review logic in the sequence of cells:
    - Reasonable? Credible? Agree?

- Worksheet: IDA Adults
  - Discuss and agree on Yellow Cells
    - Line 9, Heavy Manual Labor: Make credible estimate
# Child Productivity Loss from ID

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
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<tbody>
<tr>
<td>1. Child Productivity Loss from ID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Health Data Background</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Population &lt;5 yrs</td>
<td>1,893,092</td>
<td></td>
</tr>
<tr>
<td>4. Children with IDA</td>
<td>8.08%</td>
<td></td>
</tr>
<tr>
<td>5. Children with IDA</td>
<td><strong>152,993</strong></td>
<td>Calculated</td>
</tr>
<tr>
<td>6. Project proportion/ratio children with ID but without IDA</td>
<td>0.50</td>
<td></td>
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<tr>
<td>7. Children with ID/IDA Cognitive Deficit</td>
<td>229,489</td>
<td></td>
</tr>
<tr>
<td>8. Demographic and Labor Background Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Average Annual Wage in All Sectors</td>
<td>$1,489</td>
<td></td>
</tr>
<tr>
<td>10. National Labor Participation Rate</td>
<td>77.3%</td>
<td></td>
</tr>
<tr>
<td>11. Economic Productivity Loss Projections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Reduction in future productivity in all sectors due to anemia</td>
<td>2.50% Horto</td>
<td></td>
</tr>
<tr>
<td>13. NPV Economic Loss (12.5 years to workforce entry)</td>
<td><strong>$16,512,430</strong> Calculated</td>
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<tr>
<td>15. 10 Year Status Quo Losses at Current Population Growth</td>
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<tr>
<td>16. 2014</td>
<td>$16,512,430</td>
<td></td>
</tr>
<tr>
<td>17. 2015</td>
<td>$16,842,679</td>
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<tr>
<td>A</td>
<td>B</td>
<td>C</td>
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<td>--------------------</td>
</tr>
<tr>
<td>Summary Economic Consequences for All Indicators</td>
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<tr>
<td></td>
<td>Lost Workforce</td>
<td>Lost Future</td>
</tr>
<tr>
<td></td>
<td>000,000/yr</td>
<td>000,000/yr</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Maternal Mortality</td>
<td>$5.3</td>
</tr>
<tr>
<td>4</td>
<td>Neo Natal Mortality</td>
<td>$8.2</td>
</tr>
<tr>
<td>5</td>
<td>Birth Defect NTD</td>
<td>$5.2</td>
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<tr>
<td>6</td>
<td>Childhood IDA</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Vitamin A Def</td>
<td>$19.6</td>
</tr>
<tr>
<td>8</td>
<td>IDA in Adults</td>
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<td>9</td>
<td>Total</td>
<td>$38.3</td>
</tr>
<tr>
<td>10</td>
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</tr>
<tr>
<td>11</td>
<td></td>
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</tbody>
</table>
Session 1D: Consider & Discuss 1 hour

☐ How would you communicate these results?
   ■ Balance of mortality, human impacts and economics

☐ Will policymakers and colleagues consider the outputs credible?
   ■ What can you do to make them more credible?

☐ How would you frame & present these results?
   ■ First part of Thursday’s Presentation.

☐ Continue to consider these projections during the week.