The Long-Run Impacts of Improving Child Health: The Case of Deworming

Child Health – Children’s Life Journeys and Critical Inflection Points
University of Zurich | March 2018

Michael Kremer
Harvard University
Health Human Capital Theory

• Grossman (1972): health investments increase future endowment of healthy time

• Bleakley (2012): allocation of time to education versus work depends on how health investment affects relative productivity in education and in labor

• Pitt, Rosenzweig, and Hassan (2012) [PRH]: time allocation depends on the labor market valuation of human capital and raw labor, possibly varying by gender
  - In low-income contexts, males may use extra healthy time to increase labor supply and females for schooling
Evidence of Long-Run Effects of Child Health Investments

• Evidence that health shocks in utero can have long-run effects on health, education, and economic outcomes (Currie, 2009; Almond and Currie, 2011)
  - fasting/nutrition, iodine fortification, infectious diseases, maternal stress

• What is the impact of health investments in school-age children?

• Methodological challenges
  - Non-random child health investments (i.e., sick children may have other disadvantages, such as poverty)
  - Few longitudinal (panel) datasets tracking children into adulthood in poor countries
The Case of Intestinal Helminths
Number of Infections Globally

Transmission
- STH: ingestion of eggs deposited in feces
- Schistosomiasis (bilharzia): contact with contaminated fresh water

* = not included in the WHO’s NTD portfolio
Health Impacts and Treatment

• Large health literature provides evidence of impact on: nutrition, cognition, immune function

• Pathways affecting nutrition (WHO, 2017)
  - Hookworm causes blood loss and is among leading five causes of anemia globally (Kassebaum et al., 2014)
  - Dysentery/diarrhea (whipworm)
  - Impairment of nutritional intake and absorption (roundworm)

• Effects depend on intensity of infection
  - Intensity is highly skewed
  - Correlated with prevalence

• Treatment is clinical standard of care
  – Efficacious and safe
  – Inexpensive (~$0.30 per treatment fully costed in India, but variation)
Deworming Mass Drug Administration

- Diagnosis requires lab testing of a stool sample
  - expensive (4-10x the cost of treatment itself)
  - imprecise
  - logistically difficult

- WHO has long recommended mass drug administration (MDA) in endemic areas (recently renewed recommendation)
  - annual MDA where prevalence >20%
  - twice annual MDA where prevalence >50%

- MDA rated as highly cost effective based on health impact
  - Disease Control Priorities Project
  - World Bank’s 1993 World Development Report
This Talk

• Long-run education and economic impacts
• Meta-analysis of short-run effects on child nutrition
• Cost-effective scale-up
Evidence From Kenya: Primary School Deworming Project (PSDP)

• 75 primary schools (30,000 children aged 6-18)

• 92% prevalence

• Deworming treatment phased in to 25 schools at a time over four years
Short-run effects: 
Miguel and Kremer (2004); Hamory Hicks et al. (2015)

• After one year, rates of serious worm infections fell by half, from 52% to 25%. There were also gains in height, self-reported health, not weight

• Increased school participation, with absenteeism falling by one quarter, or 6 percentage points

• Externality effects on worm infection and school participation
  – Within school serious worm infection fell by 21pp among untreated children
  – Cross school (out to 4km after correcting for coding error)

• No cognitive gains in school-age population, but Ozier (2017) finds cognitive gains among young children in the area
Measuring Cross-School Spillover Effects

Saturation
• Proportion of children assigned to treatment within d km
• Provides exogenous variation to identify externalities in the short-run
Measuring Cross-School Spillover Effects

Saturation
- Proportion of children assigned to treatment within d km
- Provides exogenous variation to identify externalities in the short-run
- Epidemiological dynamics imply that saturation differences fade over time
Assessing Long-Run Impacts

• The Kenya Life Panel Survey (1998-2014) data project

• A representative sample of 7,530 of the roughly 33,000 individuals in the baseline deworming sample were tracked over time to assess long-run impacts on income, living standards, other life outcomes.

• Unusual element: KLPS individuals “tracked” as they move throughout Kenya and East Africa (and surveyed by phone if abroad)

• Effective tracking rates of >80%, 10 and 15 years later
Educational and Economic Effects 10 Years Later (Baird et al., 2016)

• Education
  - Males: 0.24 years (p<0.05) increase in primary school enrollment from a base of 4.4 years, but no change in school attainment.
  - Females: 9.6 percentage points more likely to pass secondary school entrance exam (base rate=41%, p<0.05)

• Labor hours and occupation
  - Males: 17% increase in hours worked (p<0.05) and are more likely to work in manufacturing on small base (p<0.05)
  - Females: shift from agriculture to non-agricultural self-employment (p<0.05), mainly retail
Educational and Economic Effects 10 Years Later (Baird et al., 2016)

• Living standards
  - Increase in meals eaten per day of 0.125 for males (p<0.01)
  - Among wage earners, incomes rose >20% in the treatment group (p<0.01), with similar gains for females and males.

• Limitations
  - Selected sample for labor market outcomes: nearly one in four children still in school
  - Rough measure of consumption
Economic Effects 15 Years Later
(Baird et al., 2018)

• KLPS 3: 15 year follow-up
  - More detailed measurement of subsistence agriculture productivity
  - Inclusion of a full Consumption Expenditure Module for a random subset of respondents.

• Total earnings increased by 15% (p<0.05), mainly among men

• Total consumption expenditures increased by 30% (p<0.01)

• Likelihood of migrating to an urban locality increased by 7pp, mainly among women (p<0.05)
Educational and Economic Impact: Historical Evidence from U.S. South

• Hookworm rates of 40% among school-aged children

• Traveling dispensaries administered treatment and educated people about prevention in 1910’s

• Bleakley (2007) difference-in-differences analysis finds:
  – increase in school enrolment of 3-5% and increase in attendance of 6-8% (for a county with a 1910 infection rate of 50%)
  – 43% increase in adult wages among those infected as children
  – Some recent discussion of these results
Question for Policy Makers

• Do expected benefits of mass deworming outweigh the cost?

\[ \sum_{d=1}^{K} \alpha_d \ E[\theta_d] > C \]

\( d \) indexes dimension; \( \theta_d \) is the treatment effect of deworming MDA on outcome \( d \); \( \alpha \) the value of change in outcome \( d \); and \( C \) is cost
J-PAL: Additional Years of Student Participation per $100

- Deworming through primary schools, Kenya, 1: 12.50 yrs
- Free primary school uniforms, Kenya, 2: 0.71 yrs
- Merit scholarships for girls, Kenya, 3: 0.16 yrs
- Girls' CCT (Minimum amount), Malawi, 4a: 0.09 yrs
- Girls' CCT (Average amount), Malawi, 4b: 0.07 yrs
- Girls' UCT (Average amount), Malawi, 4c: 0.02 yrs

Program achieves multiple outcomes
J-PAL: Additional Years of Student Participation per $100

South Asia

<table>
<thead>
<tr>
<th>Program</th>
<th>Country</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron fortification and deworming in preschools</td>
<td>India, 5</td>
<td>2.73 yrs</td>
</tr>
<tr>
<td>Building village-based schools</td>
<td>Afghanistan, 6</td>
<td>1.51 yrs</td>
</tr>
<tr>
<td>Fellowship schools</td>
<td>Pakistan, 7</td>
<td>0.34 yrs</td>
</tr>
<tr>
<td>Camera monitoring of teachers' attendance</td>
<td>India, 8</td>
<td></td>
</tr>
<tr>
<td>Computer assisted learning curriculum</td>
<td>India, 9</td>
<td></td>
</tr>
<tr>
<td>Remedial tutoring by community volunteers</td>
<td>India, 10</td>
<td></td>
</tr>
<tr>
<td>Menstrual cups for teenage girls</td>
<td>Nepal, 11</td>
<td></td>
</tr>
</tbody>
</table>

Program achieves multiple outcomes
Cost-benefit analysis (Baird et al., 2018)

• NPV of future earnings (net of increased schooling costs) > 150 times cost

• Implies NPV of tax revenue >> cost of program

• Caveats:
  - external validity given high prevalence
  - selection on cost effectiveness
  - but expected benefit > cost even with substantial uncertainty
Multiple Organizations Identify Deworming MDA as Highly Cost-Effective

- World Bank
- Disease Control Priorities Project
- Copenhagen Consensus
- GiveWell
- J-PAL
Cochrane Meta-Analysis: An Apparent Paradox?

• Taylor-Robinson et al. (2015), henceforth TMSDG
  - Endorses treatment of those known to be infected: estimated significant (p<0.01) gains on weight [0.75kg], MUAC [0.49cm], height [0.25cm], among other outcomes
  - However, “in mass treatment of all children in endemic areas, there is now substantial evidence that this does not improve average nutritional status...”: an unusually strong statement

• Engendered considerable controversy in health community (Campbell et al., 2016; De Silva et al., 2015; Montesor et al., 2015; WHO, 2017)

• Two paradoxes:
  - Reconciling results on test-and-treat and MDA samples
  - Reconciling results presented earlier with those on short-run nutritional impact
TMSDG: Statistical and Methodological Issues

- Does not report test of common zero effect
- Underpowered to test if expected MDA benefits > cost; or if consistent with effects on infected populations
  - Omits many studies
  - Does not follow Cochrane procedures (i.e., for imputing standard errors from p-values)
  - Sacrifices statistical precision by not using baseline data
  - Includes studies where STH prevalence < 20%
  - Changes inclusion criterion from own 2012 review to re-categorize study with high prevalence with large estimated effect (Stephenson et al. 1993)
    - No recategorization of study with similar prevalence and low effect
Croke et al. (2016) Addresses These Issues

- Following TMSDG, meta-analysis of the effect of multiple-dose deworming MDA on four child nutrition outcomes
  - Caveat: Hb sample: only 1 study with over 20% hookworm prevalence
- Reject hypothesis that MDA has a common zero effect (p<0.001)
- Focus on studies with > 20% prevalence

<table>
<thead>
<tr>
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<th>Weight (kg)</th>
<th>Height (cm)</th>
<th>MUAC (cm)</th>
<th>Hb (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE estimate</td>
<td>0.156</td>
<td>0.100</td>
<td>0.198</td>
<td>0.054</td>
</tr>
<tr>
<td>p-val</td>
<td>0.001</td>
<td>0.013</td>
<td>0.022</td>
<td>0.319</td>
</tr>
<tr>
<td>N</td>
<td>19</td>
<td>14</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>
Implied Effects on Infected Children

• If worm-free children are not affected by deworming, one can retrieve the **effect of deworming on infected children** rescaling by worm prevalence

• Can include test-and-treat trials

• Can estimate mean effect of deworming on infected children
Average Effect on Infected Children

<table>
<thead>
<tr>
<th>Panel</th>
<th>Weight (kg)</th>
<th>Height (cm)</th>
<th>MUAC (cm)</th>
<th>Hb (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: MDA trials</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE estimate</td>
<td>0.262***</td>
<td>0.111*</td>
<td>0.238**</td>
<td>0.114</td>
</tr>
<tr>
<td>p-val</td>
<td>0.007</td>
<td>0.063</td>
<td>0.043</td>
<td>0.202</td>
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<tr>
<td>N</td>
<td>25</td>
<td>20</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>B: Test-and-treat trials</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE estimate</td>
<td>0.646**</td>
<td>0.287*</td>
<td>0.401***</td>
<td>-0.400</td>
</tr>
<tr>
<td>p-val</td>
<td>0.047</td>
<td>0.054</td>
<td>0.008</td>
<td>0.356</td>
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<tr>
<td>N</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>C: MDA and test-and-treat trials</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE estimate</td>
<td>0.327***</td>
<td>0.172***</td>
<td>0.270***</td>
<td>0.093</td>
</tr>
<tr>
<td>p-val</td>
<td>0.001</td>
<td>0.008</td>
<td>0.006</td>
<td>0.287</td>
</tr>
<tr>
<td>N</td>
<td>29</td>
<td>24</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

Panel D: Test of the hypothesis that the average effect of deworming on infected children is the same between MDA and test-and-treat trials

| Difference | -0.397 | -0.201 | -0.117 | 0.514 |
| p-val      | 0.348  | 0.153  | 0.682  | 0.270 |

- Larger effects for infected children
- Effects from MDA trials consistent with test-and-treat
Accounting for Infection Intensity

• Role of worm load: impact of deworming depends on infection intensity, which is positively correlated with prevalence
  – Typically much higher intensity in test and treat studies

• Estimating effect per worm?
  – Effects not likely proportional to total worm count
  – But this may be a better model than assuming effects are independent of worm count

• Scarce data on measures of infection intensity
  - We estimate the number of worms in each study population based on reported worm prevalence (using standard assumption of negative binomial distribution with parameter 0.8 from Elkins, 1986)
### Average Effect per Worm

<table>
<thead>
<tr>
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<th>Weight (kg)</th>
<th>Height (cm)</th>
<th>MUAC (cm)</th>
<th>Hb (g/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel A: MDA trials</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE estimate</td>
<td>0.030***</td>
<td>0.004</td>
<td>0.031**</td>
<td>0.016</td>
</tr>
<tr>
<td>p-val</td>
<td>0.002</td>
<td>0.162</td>
<td>0.030</td>
<td>0.239</td>
</tr>
<tr>
<td>N</td>
<td>25</td>
<td>20</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td><strong>Panel B: Test-and-treat trials</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE estimate</td>
<td>0.011**</td>
<td>0.006***</td>
<td>0.006***</td>
<td>-0.009</td>
</tr>
<tr>
<td>p-val</td>
<td>0.028</td>
<td>0.006</td>
<td>0.003</td>
<td>0.356</td>
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<tr>
<td>N</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Panel C: MDA and test-and-treat trials</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RE estimate</td>
<td>0.018***</td>
<td>0.005***</td>
<td>0.013**</td>
<td>0.000</td>
</tr>
<tr>
<td>p-val</td>
<td>0.001</td>
<td>0.005</td>
<td>0.020</td>
<td>0.954</td>
</tr>
<tr>
<td>N</td>
<td>29</td>
<td>23</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>RE estimate * mean No. worms</td>
<td>0.246</td>
<td>0.071</td>
<td>0.187</td>
<td>0.007</td>
</tr>
</tbody>
</table>

**Panel D: Test of the hypothesis that the average effect of deworming on infected children is the same between MDA and test-and-treat trials**

| Difference | 0.014 | -0.002 | 0.024 | 0.025 |
| p-val      | 0.538 | 0.677  | 0.164 | 0.163 |

- Mean number of worms across trials 14 (s.d. 22)
- Effects from MDA trials consistent with test-and-treat
Are expected benefits > cost?

- Previous analysis suggests channels exist for measured educational, economic benefits
- To assess nutritional cost effectiveness, compare to widespread program targeting similar population with meta-analysis based cost effectiveness analysis

Outcome per $1,000 spent

<table>
<thead>
<tr>
<th></th>
<th>Deworming MDA &gt;20% Prev.</th>
<th>School-feeding* Ages 5y-19y</th>
<th>Pre school-feeding** Ages 3m-5y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>170.5</td>
<td>6.2 (x27)</td>
<td>4.9 (x35)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>108.6</td>
<td>6.1 (x18)</td>
<td>11.1 (x10)</td>
</tr>
<tr>
<td>MUAC (cm)</td>
<td>188.6</td>
<td>3.3 (x57)</td>
<td>NA</td>
</tr>
</tbody>
</table>

Notes: * Treatment effect estimates of the effect of school feeding programs are from Kristjansson et al. (2007). ** Treatment effect estimates of the effect of pre school feeding programs are from Kristjansson et al. (2015). Cost estimates are from (Kristjansson et al., 2016).
Economics of Delivery Cost

• Charging dramatically cuts take up (Kremer and Miguel, 2007)
  - Take-up of deworming treatment declined from 75% (free provision) to 18% when charging a fee of $0.30
  - Similar effects found in many other preventive and non-acute care contexts, consistent with present bias

• Epidemiological externality

• Fiscal externality
Costs

• Since many people will not travel to obtain STH medicine, costs sensitive to whether already an existing touch point

• Health care system touch points: pregnant women; young children; integrated NTD campaigns in areas with other NTDs

• But these leave out a key population: school-age population in areas with STH, not other NTD
  – STH much more widespread than LF, schistosomiasis
  – Many LF programs being scaled back
School-based deworming

• School-age children critical
  – large population, critical to reaching WHO coverage target
  – high worm burden
  – key role in transmission
  – treatment generates large educational and economic impacts

• School-based deworming cost effectively leverages existing touch point

• Drug donations available for school-age children

• Typically also reaches out-of-school children and younger children
Implementation: Lessons from Kenya and India

• Cross-sector collaboration is key
  – Strong MOE support for concept based on results on education impact, cost effectiveness
  – Working group combining ministries, WHO endorsement of teacher role in distributing pills, World Bank role

• Technical support on implementation: prevalence mapping, training for teachers, procurement, budgets, timelines, fiscal management
  – Role of Deworm the World, Evidence Action

• India: lessons learned from Kenya, technical support, initial programs at state level, rapid adoption afterwards
Conclusions

• Deworming has both short and long-run impacts, cost effective on multiple dimensions
• Much more relevant area for future discussion is appropriate cutoff for MDA, not whether MDA is justified
• Early-life investments can have large long-run effects
• Full benefits are unlikely to be obtained unless these cost-effective interventions are provided for free
• Meta-analysis for policy purposes should explicitly consider statistical power, cost-effectiveness or cost-benefit analysis
  – Particularly important for low-cost public-health measures
Appendix slides
The Case of Nigeria: Prevalence of intestinal worms and Lymphatic Filariasis

STH or Schistosomiasis
- Prevalence: >0%, ≤20%
- Prevalence: >20%

Lymphatic Filariasis
- Prevalence: ≥20%
India
Expect 10 year commitment

• In long run, economic development reduces worm burden. More shoes, latrines, etc.
• Some epidemiologists believe that if prevalence falls below cutoff level, does not come back
• India case suggests potential for national support
• But
  – PSDP found no effect on education campaign on various prevention behaviors; no interaction with sanitation
  – Sanitation investments are expensive
  – Permanent effect on those dewormed
840 Million Children Need Treatment for STH

Proportion of children (PSAC and SAC) in the country requiring treatment for soil-transmitted helminthiases, worldwide, 2016

Deworming Treatment Coverage

Coverage is calculated as the share of people in need of treatment that were treated.
Note: Number of endemic countries moved to post-treatment surveillance stage is not included in total

Source: WHO Weekly Epidemiological Records (http://www.who.int/neglected_diseases/preventive_chemotherapy/resources/wer/en/)
Welch et al. (2016) Meta-analysis

- Does not report test of common zero effect
  - Identifies omitted studies and new studies
  - Follows Cochrane procedures
  - Increases statistical precision by using baseline data
- Conducts meta-analysis for narrow categories, depending on
  - Deworming drugs used
  - Drug dosage frequency
  - Existence of co-interventions (e.g., vitamin A, iron)

>> The tests of policy-ineffectiveness by Taylor-Robinson et al. (2015) and Welch et al (2016) have insufficient statistical to detect effects that would be expected given prevalence and intensity or that would be cost effective
Welch et al, (2016)

• Estimated treatment effect of 0.05 SMD, 95%CI: -0.02 to 0.11; 11 trials.
  – Note that outcome measured as standardized mean difference (SMD) rather than in kilograms
  – 0.05 SMD≈0.09 kg for this sample
  – Only 11 studies because they compare albendazole 2x/year to control
    • Restricting to 1 drug and 1 frequency reduces sample size
• If include other drugs, other frequencies, the results change
Testing robustness of Welch et al (2016)

• Impact of adjusting these restrictions by:
  – Examining all drugs at 2x/year frequency:
    • Effect size 0.06 SMD, p=0.024
  – Examining albendazole at all frequencies:
    • Effect size 0.07 SMD, p=0.034
  – Including trials that compare deworming plus Vit A to Vitamin A alone:
    • Effect size 0.047 SMD, p=0.06
  – Eliminating all 3 restrictions:
    • Effect size 0.054 SMD, p=0.006
Welch et al. (2016)

• Adding all additional trials from full Welch et al. sample to the Croke et al. sample, we find an effect size of 0.043 SMD, p=0.015

• Similar results are also presented (but not emphasized) in Welch et al.
  – Combining all trials, Welch et al find an effect of 0.03 SMD (95% CI 0.00-0.06)
Three meta-analyses

Source: Roodman (2017)
National prevalence alone can hide populations requiring more intensive MDA strategies

School-based deworming

• Requires strong collaboration between education and health sectors to ensure all materials and knowledge reach from the national level to frontline workers.

• Governments contribute significant in-kind resources to programs:
  – Teacher time, and health and education personnel responsible for program delivery.
  – These costs are estimated to be 40% of total program cost, when opportunity costs are included.
School-based deworming

• Mass drug administration is the only cost-effective and operationally feasible way to make sure that all infected kids receive treatment

• School-based deworming is a cheap and effective way to administer treatment

• Hygiene and sanitation part of long-run solution
  – Yet, practices can be difficult to change; infrastructure can be expensive to build
The landscape
# The landscape

<table>
<thead>
<tr>
<th>Preschool-age children (1–4 years)</th>
<th>AFR</th>
<th>AMR</th>
<th>EMR</th>
<th>EUR</th>
<th>SEAR</th>
<th>WPR</th>
<th>GLOBAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of countries requiring PC(^1)</td>
<td>42</td>
<td>25</td>
<td>7</td>
<td>5</td>
<td>8</td>
<td>14</td>
<td>101</td>
</tr>
<tr>
<td>Number of people requiring PC</td>
<td>101.6M</td>
<td>12.6M</td>
<td>23.2M</td>
<td>856K</td>
<td>107.4M</td>
<td>23.2M</td>
<td>268.8M</td>
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<tr>
<td>Number of countries implemented and reported</td>
<td>21</td>
<td>8</td>
<td>4</td>
<td>1</td>
<td>9</td>
<td>13</td>
<td>56</td>
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<tr>
<td>Number of people treated</td>
<td>61.8M</td>
<td>7.6M</td>
<td>14.8M</td>
<td>&lt;1K</td>
<td>56M</td>
<td>10.1M</td>
<td>150.4M</td>
</tr>
<tr>
<td>Coverage (%)(^2)</td>
<td>44.7</td>
<td>40</td>
<td>56.6</td>
<td>&lt;1</td>
<td>52.1</td>
<td>43.7</td>
<td>48.2</td>
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<table>
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<th>School-age children (5–14 years)</th>
<th>AFR</th>
<th>AMR</th>
<th>EMR</th>
<th>EUR</th>
<th>SEAR</th>
<th>WPR</th>
<th>GLOBAL</th>
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<tr>
<td>Number of people requiring PC</td>
<td>190.6M</td>
<td>32.1M</td>
<td>51.2M</td>
<td>1.5M</td>
<td>247.5M</td>
<td>48.5M</td>
<td>571.4M</td>
</tr>
<tr>
<td>Number of countries implemented and reported</td>
<td>29</td>
<td>11</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>13</td>
<td>67</td>
</tr>
<tr>
<td>Number of people treated</td>
<td>107.5M</td>
<td>28.5M</td>
<td>5.7M</td>
<td>2.6M</td>
<td>254M</td>
<td>23.4M</td>
<td>421.8M</td>
</tr>
<tr>
<td>Coverage (%)(^2)</td>
<td>54.2</td>
<td>63.9</td>
<td>11.2</td>
<td>36</td>
<td>86.8</td>
<td>45</td>
<td>64.2</td>
</tr>
</tbody>
</table>

Source: WHO

\(^1\)Number of endemic countries moved to post-treatment surveillance stage is not included in total
\(^2\)Coverage is calculated as the number of people in need of PC and treated out of population requiring PC.
The landscape

<table>
<thead>
<tr>
<th></th>
<th>STH (2015)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-SAC</td>
</tr>
<tr>
<td>Number of countries requiring PC*</td>
<td>102</td>
</tr>
<tr>
<td>Number of people requiring PC</td>
<td>268.8M</td>
</tr>
<tr>
<td>Number of countries implemented and reported</td>
<td>56</td>
</tr>
<tr>
<td>Number of people treated</td>
<td>150.4M</td>
</tr>
<tr>
<td>Coverage (%)**</td>
<td>48.2</td>
</tr>
</tbody>
</table>

Source: WHO

*Number of endemic countries moved to post-treatment surveillance stage is not included in total

**Coverage is calculated as the number of people in need of PC and treated out of population requiring PC.
The landscape

Global status of preventive chemotherapy in 2015 – Soil-transmitted helminthiases

Source: WHO

Note: Number of endemic countries moved to post-treatment surveillance stage is not included in total

1 Coverage is calculated as the number of people in need of PC and treated out of population requiring PC.
The countries listed have a population of >10M SAC requiring STH treatment. China and Pakistan met the 10M threshold, but were excluded due to lack of reported treatment data. Sudan data is referring to the Republic of Sudan, also known as North Sudan, after South Sudan split off. *Pakistan and China do not have treatment numbers available. The numbers listed for these 2 countries are # of SAC requiring STH treatment, not numbers untreated.

Policy overview

• Global landscape: infection and treatment
• Program considerations
• Role for school-based deworming
• Challenges
• Opportunities
• Potential role for the World Bank