



Infectious Diseases and the Disease Control Priorities Project

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Infectious Diseases and the Disease Control Priorities Project (DCPP)

- Disease Burdens
- Intervention Cost-Effectiveness
- Research and Product Development
- Main Messages





Disease Burden

- **Global**
- **Infectious Diseases**





Leading Causes of Death in High and Low-/Middle-Income Countries (LMICs), 2001 (Total = 56.24 million)

High Income (% total deaths)

(n = 7.89 million (14%))

1. Ischemic heart disease (17.3)
2. Cerebrovascular disease (9.9)
3. Trachea, bronchus, lung cancer (5.8)
4. **Lower respiratory infections (4.4)**
5. Chronic obstructive pulmonary disease (3.8)

LMICs (% total deaths)

(n = 48.35 million (86%))

1. Ischemic heart disease (11.8)
2. Cerebrovascular disease (9.5)
3. **Lower respiratory infections (7.0)**
4. **HIV/AIDS (5.3)**
5. Perinatal conditions (5.1)

Mathers et al., 2006, in Lopez et al, *Global Burden of Disease and Risk Factors*



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Leading Causes of Death in High and Low-/Middle-Income Countries (LMICs), 2001

High Income (% total deaths)
(n = 7.89 million (14%))

6. Colon and rectum cancers (3.3)
7. Alzheimer's and other dementias (2.6)
8. Diabetes mellitus (2.6)
9. Breast cancer (2.0)
10. Stomach cancer (1.9)

LMICs (% total deaths)
(n = 48.35 million (86%))

6. Chronic obstructive pulmonary disease (4.9)
7. **Diarrheal diseases (3.7)**
8. **Tuberculosis (3.3)**
9. **Malaria (2.5)**
10. Road traffic accidents (2.2)

Total: 53.6% (ID = 4.4%)

Total: 55.3% (ID = 21.8%)

Mathers et al., 2006, in Lopez et al, *Global Burden of Disease and Risk Factors*



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Disability-Adjusted Life Years (DALYS)

Burden of Disease on a Defined Population

- Aggregate of **premature mortality, morbidity, and disability**
- Adjustments made for
 - **life expectancy**
 - **long-term disability** (weighted)
- Valid indicator of **population health**
- Tied to effectiveness of **interventions**





Leading Causes of Disability-Adjusted Life Years (DALYs), Globally, 2001 (n = 1.54 billion)

<u>Cause</u>	<u>% total</u>
1. Perinatal conditions	5.9
2. Lower respiratory infection	5.6
3. Ischemic heart disease	5.5
4. Cerebrovascular disease	4.7
5. HIV/AIDS	4.7
6. Diarrheal diseases	3.9
7. Unipolar depressive disorders	3.4
8. Malaria	2.6
9. Chronic obstructive pulmonary disease	2.5
10. Tuberculosis	<u>2.3</u>
Total	(ID= 19.1%) 41.1

Mathers et al, 2006 in Lopez et al, *Global Burden of Disease and Risk Factors*



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Disease Burden by Income, 2001

Disability-Adjusted Life Years (DALYs)

Countries	Population in millions (%)		For all diseases, no. in millions (%)		For infectious and parasitic diseases, no. in millions (%)		Infectious diseases Burden (%)
Low- and Middle-Income	5,219	(85)	1,387	(90)	321	(99)	23
High Income	929	(15)	149	(10)	3	(1)	2
Total	6,148	(100)	1,536	(100)	324	(100)	21

Mathers et al, 2006, in Lopez et al, *Global Burden of Disease and Risk Factors*



Disease Burden, Low and Middle Income Countries, by World Bank Region, 2001

Disability-Adjusted Life Years (DALYs)

Region	Population in millions (%)		For all diseases, no. in millions (%)		For infectious and parasitic diseases, no. in millions (%)		Infectious diseases burden in region, %
Sub-Saharan Africa	668	(13)	345	(25)	173	(54)	50
South Asia	1,388	(27)	409	(29)	88	(27)	22
Middle East/North Africa	310	(6)	66	(5)	7	(2)	11
East Asia/Pacific	1,850	(35)	346	(25)	37	(12)	11
Latin America/Caribbean	526	(10)	104	(8)	10	(3)	10
Europe/Central Asia	477	(9)	117	(8)	5	(2)	4
Total	5,219	(100)	1,387	(100)	320	(100)	23

Mathers et al, 2006, in Lopez et al, *Global Burden of Disease and Risk Factors*



Disease Burden, Low and Middle Income Countries, by World Bank Region, 2001

Disease	Disease Burden		Disease burden by region, %				
	In LMICs DALYs, %	SSA	SA	ME/NA	EA/P	LA/C	E/CA
HIV/AIDS	5.1	79	10	1	4	3	1
Diarrheal disease	4.2	37	38	4	15	4	1
Malaria	2.9	89	6	2	3	1	.1
TB	2.6	22	38	2	30	3	4
Measles	1.7	59	28	2	10	0	1
STD	0.7	40	39	4	9	5	2

SSA = Sub Saharan Africa; SA = South Asia; ME/NA = Middle East/North Africa; EA/P = East Asia/Pacific;
LA/C = Latin America/Caribbean; E/CA = Europe/Central Asia

Mathers et al, 2006, in Lopez et al, *Global Burden of Disease and Risk Factors*



Cost-Effectiveness Analyses

- CEA
- Best Buys
- Higher Cost Buys
- One Million Dollar Investment



Incremental Cost-Effectiveness Ratio of an Intervention

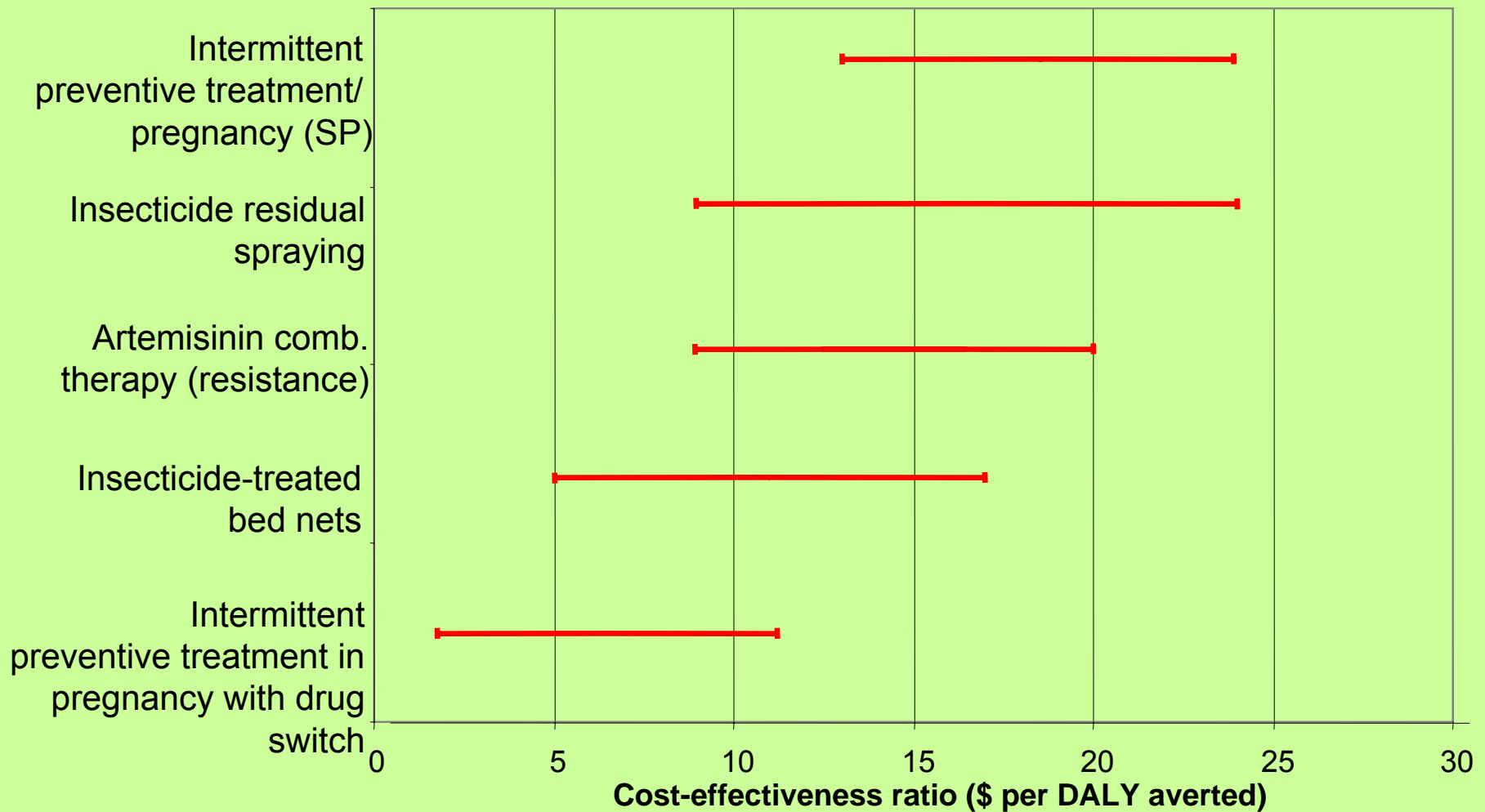
$$\frac{\text{Costs}_B - \text{Costs}_A}{\text{Effectiveness}_B - \text{Effectiveness}_A}$$

Interventions studied:

- personal = 204
- population = 115



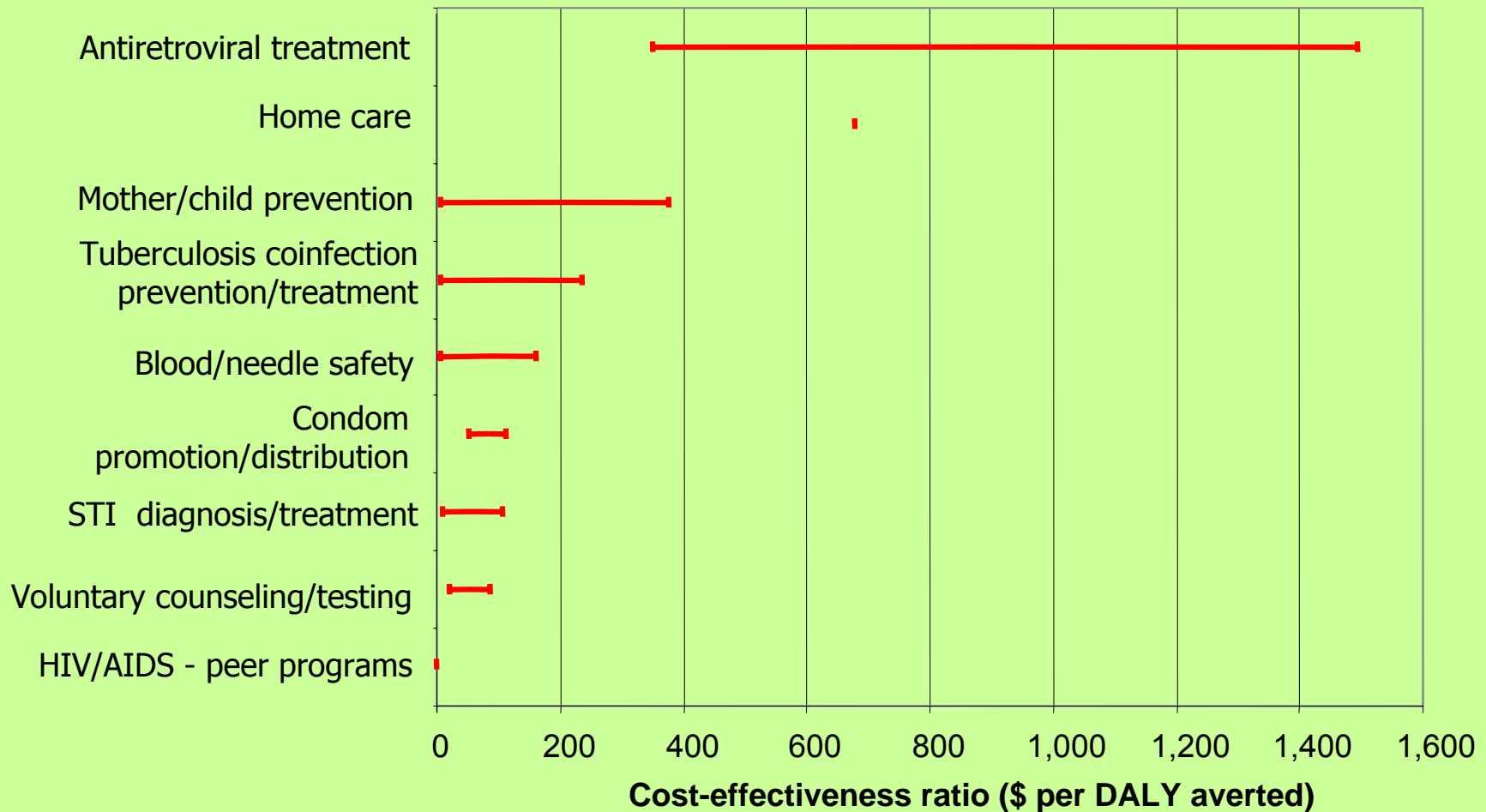
Cost-Effectiveness of Interventions Against Malaria in Sub-Saharan Africa



Laxminarayan et al (DCPP authors), 2006, in Jamison et al, *Disease Control Priorities in Developing Countries*, 2nd ed.



Cost-Effectiveness of Interventions Against HIV/AIDS in Sub-Saharan Africa

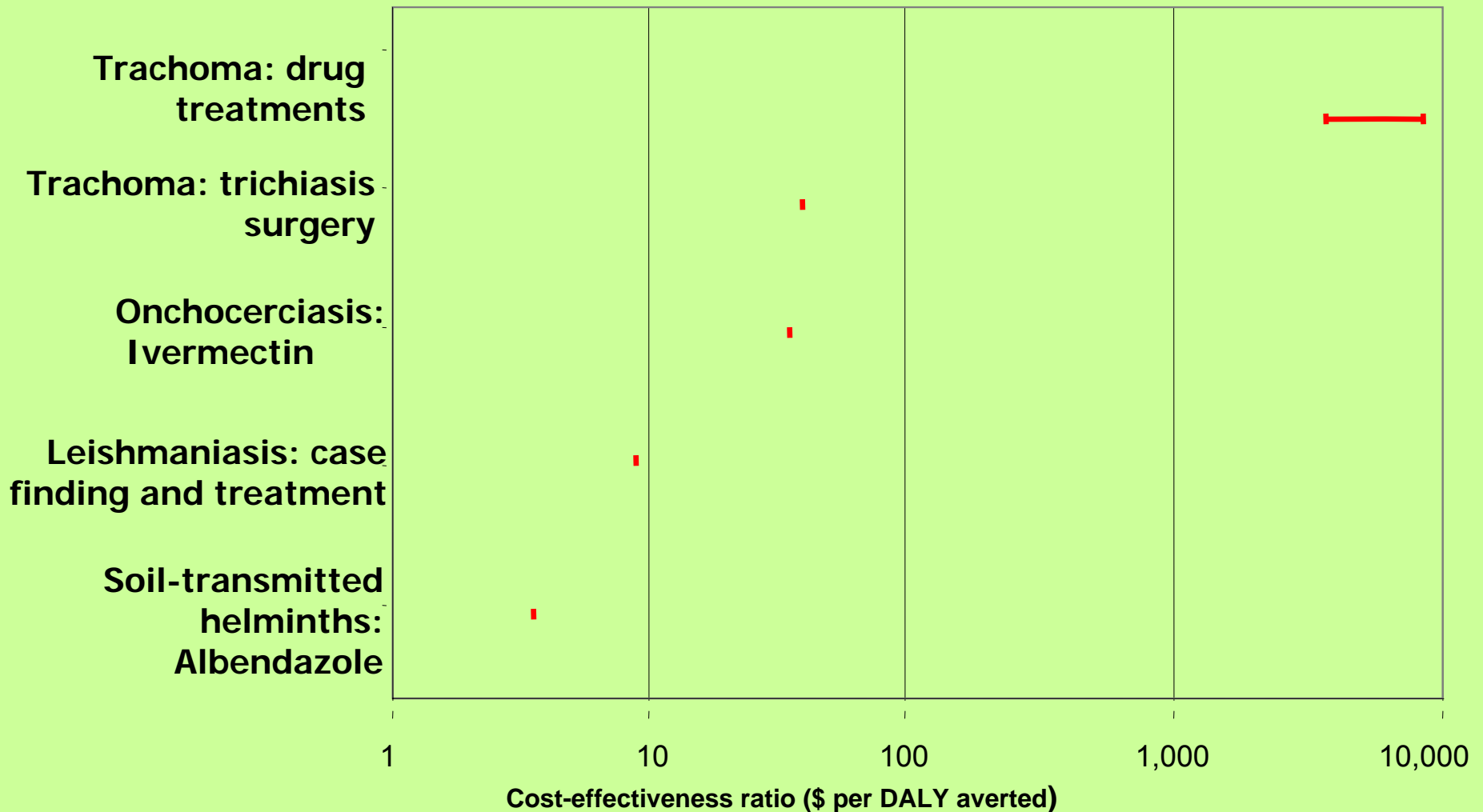


Laxminarayan et al (DCPP authors), 2006, in Jamison et al, *Disease Control Priorities in Developing Countries*



Cost-Effectiveness of Interventions

Related to Low-Burden Diseases in LMICs; Helminths, Leishmaniasis, Onchocerciasis, Trachoma



Laxminarayan et al (DCPP authors), 2006, in Jamison et al, *Disease Control Priorities in Developing Countries*



“Best Buys” Neglected Opportunities





"Best Buys"

Neglected Opportunities in Sub-Saharan Africa (SSA) and South Asia (SA) (1)

<u>Low Cost Opportunity</u>		<u>Cost per DALY averted (\$)</u>	<u>DALYs averted per 20% coverage increase (10³)</u>	<u>Burden of disease DALYs (10⁶)</u>
• Childhood Immunization	SSA	1 – 5	not evaluated	13.5 – 31.3
- Second measles vaccination	SA	8	not evaluated	28.4
- Increase coverage				
- DTP, polio, measles, BCG				
• Traffic Accidents	SSA	2 – 12	not evaluated	6.4
- Increase speeding penalties	SA	not evaluated	not evaluated	not evaluated
- Speed bumps				

Laxminarayan et al (DCPP authors), 2006, in Jamison et al, *Disease Control Priorities in Developing Countries*



"Best Buys"

Neglected Opportunities in Sub-Saharan Africa (SSA) and South Asia (SA) (2)

<u>Low Cost Opportunity</u>		<u>Cost per DALY averted (\$)</u>	<u>DALYs averted per 20% coverage increase (10³)</u>	<u>Burden of disease DALYs (10⁶)</u>
• Malaria	SSA	2 – 24	20.8 – 37.6	35.4
- Insecticide treated nets	SA	not evaluated	not evaluated	not evaluated
- Residual household spraying				
- IPT, pregnancy				
• Surgical Services and Emergencies	SSA	7 – 215	1.6 – 21.2	25 – 134.2
	SA	6 – 212	>18	48 – 146.3
- Ward in district hospital				
- Ambulance				
- Lay responders, paramedics				

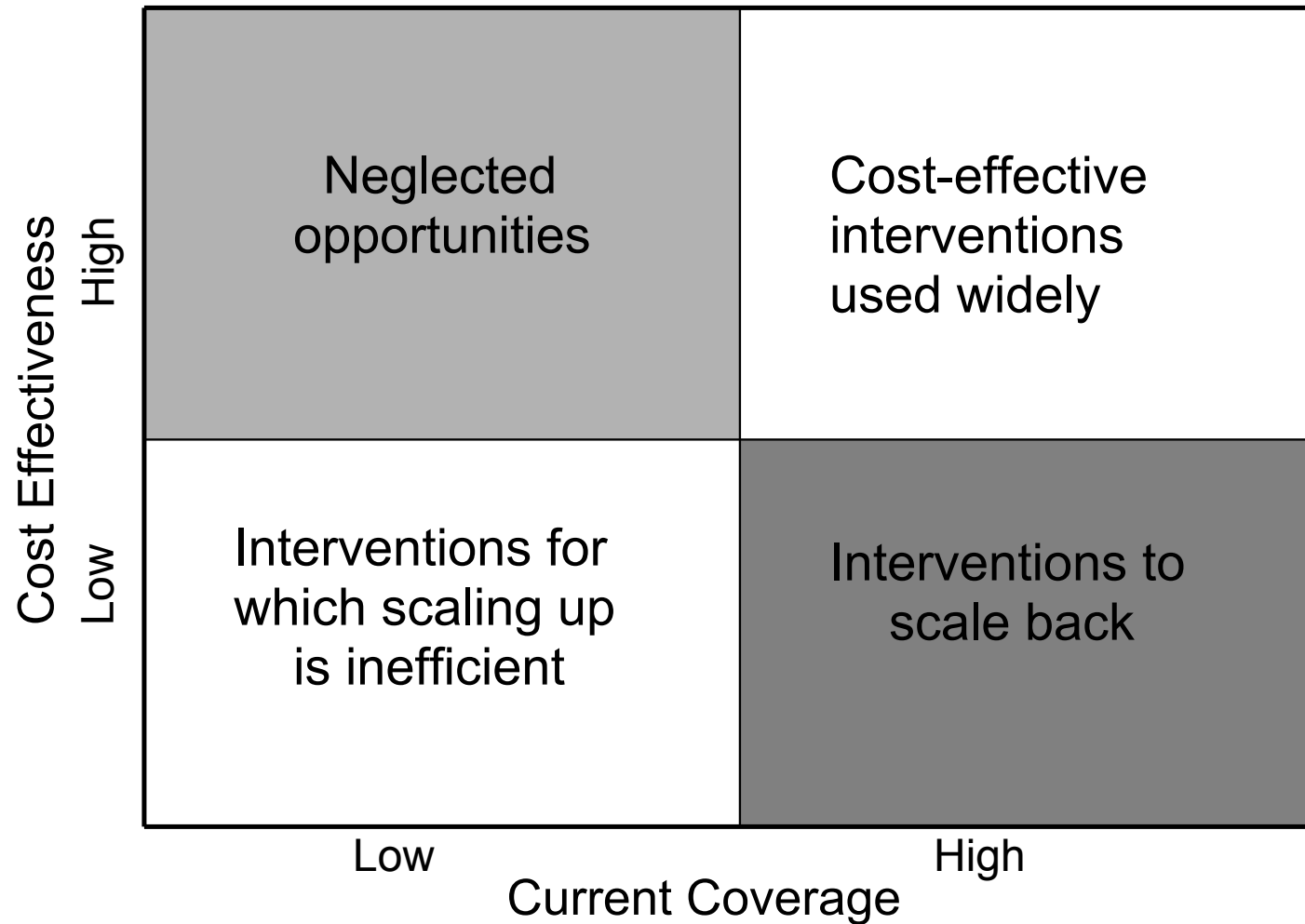
Laxminarayan et al (DCPP authors), 2006, in Jamison et al, *Disease Control Priorities in Developing Countries*



Higher Cost Buys



Perspective: Cost-Effectiveness and Coverage



Laxminarayan et al, 2006, in Jamison et al, *Disease Control Priorities in Developing Countries, 2nd ed.*



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Higher Cost Interventions in Sub-Saharan Africa (SSA) and South Asia (SA)

<u>Intervention</u>		<u>Cost per DALY averted (\$)</u>	<u>DALYs averted per 20% coverage increase (10³)</u>	<u>Burden of disease, DALYs (10⁶)</u>
• HIV and AIDS	SSA	673 – 1,494	not evaluated	56.8
	SA	not evaluated	not evaluated	not evaluated
- Homecare Rx				
- ARV, low adherence				
• Tuberculosis	SSA	4,129 – 5,506	not evaluated	8.1
	SA	5,588 – 9,189	not evaluated	13.9
- INH Rx, latent form, no HIV				

Laxminarayan et al (DCPP authors), 2006, in Jamison et al, *Disease Control Priorities in Developing Countries*



A Million Dollars Invested





How Much Health Will a Million Dollars Buy?

Service or Intervention

DALYs Averted (\$ per DALY)

➤ **Reducing under-5 mortality**

- Expanding immunization coverage (EPI diseases)
- Switch to artemisinin-combination therapy (ACT) where malaria is drug-resistant
- Improved neonatal care (newborn resuscitation)
- Adding vaccines to EPI (Hib and hepatitis B)

50,000-500,000 (\$2-20)

50,000-125,000 (\$8-20)

2,500-100,000 (\$10-400)

4,000-24,000 (\$40-250)

Laxminarayan et al (DCPP authors), 2006, in Jamison et al, *Disease Control Priorities in Developing Countries*



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How Much Health Will a Million Dollars Buy?

Service or Intervention

DALYs Averted (\$ per DALY)

➤ Preventing and Treating HIV/AIDS

- | | |
|--|--|
| ■ STI treatment to interrupt HIV transmission | 10,000-100,000 (\$10-100) |
| ■ Prevention of mother-to-child transmission | 5,000-20,000 (\$50-200) |
| ■ ARV treatment achieving high adherence for a <i>large</i> percentage of patients | 2,000-3,000 (\$350-500) |
| ■ ARV treatment achieving high adherence for a <i>small</i> percentage of patients | Very limited gains by individual patients and potentially adverse changes in population behavior might result in more life years lost than saved |

Laxminarayan et al (DCPP authors), 2006, in Jamison et al, *Disease Control Priorities in Developing Countries*



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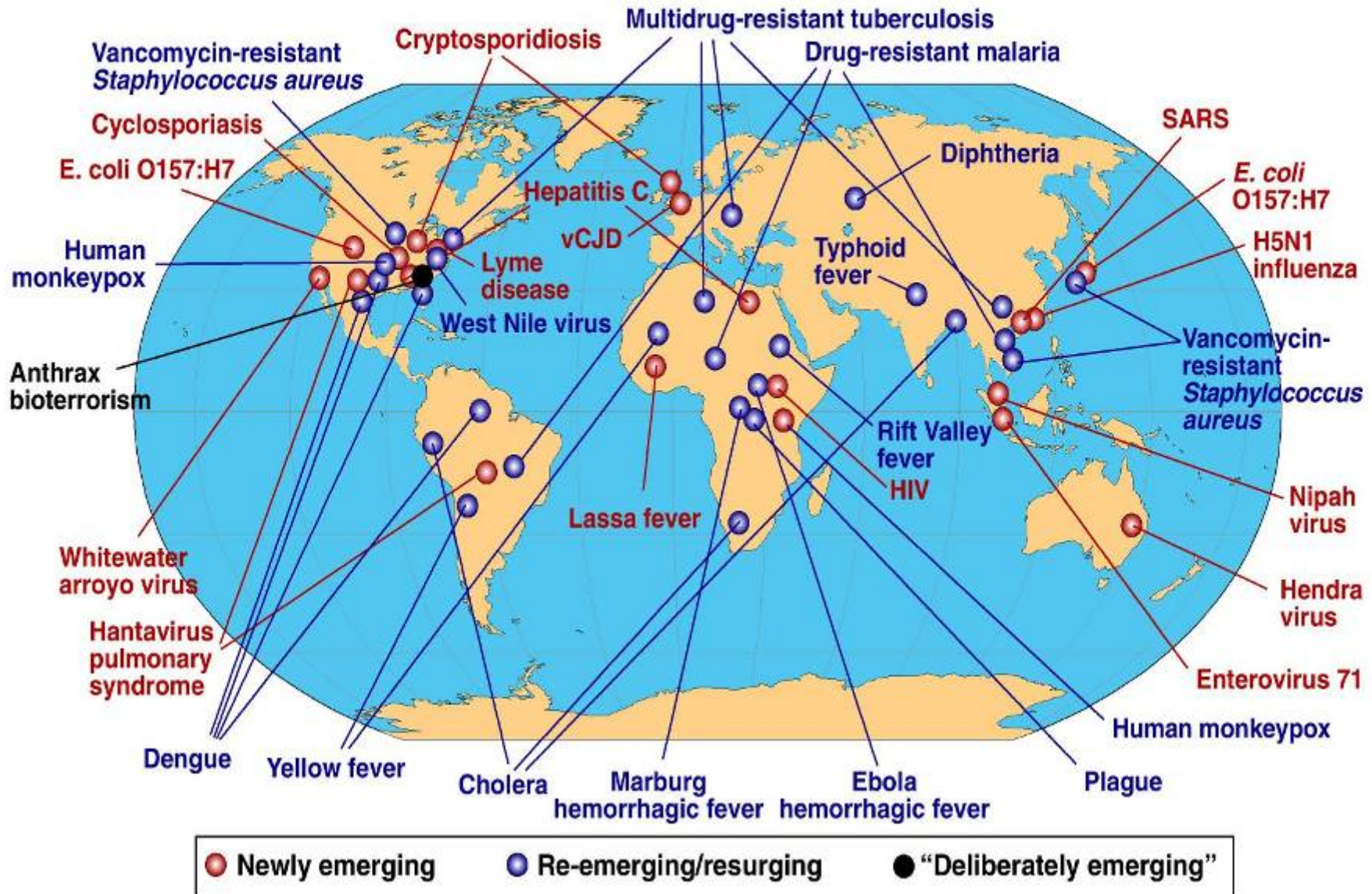


Research and Product Development

- **Goals**
- **Investments**



Global Examples of Emerging and Re-Emerging Infectious Diseases





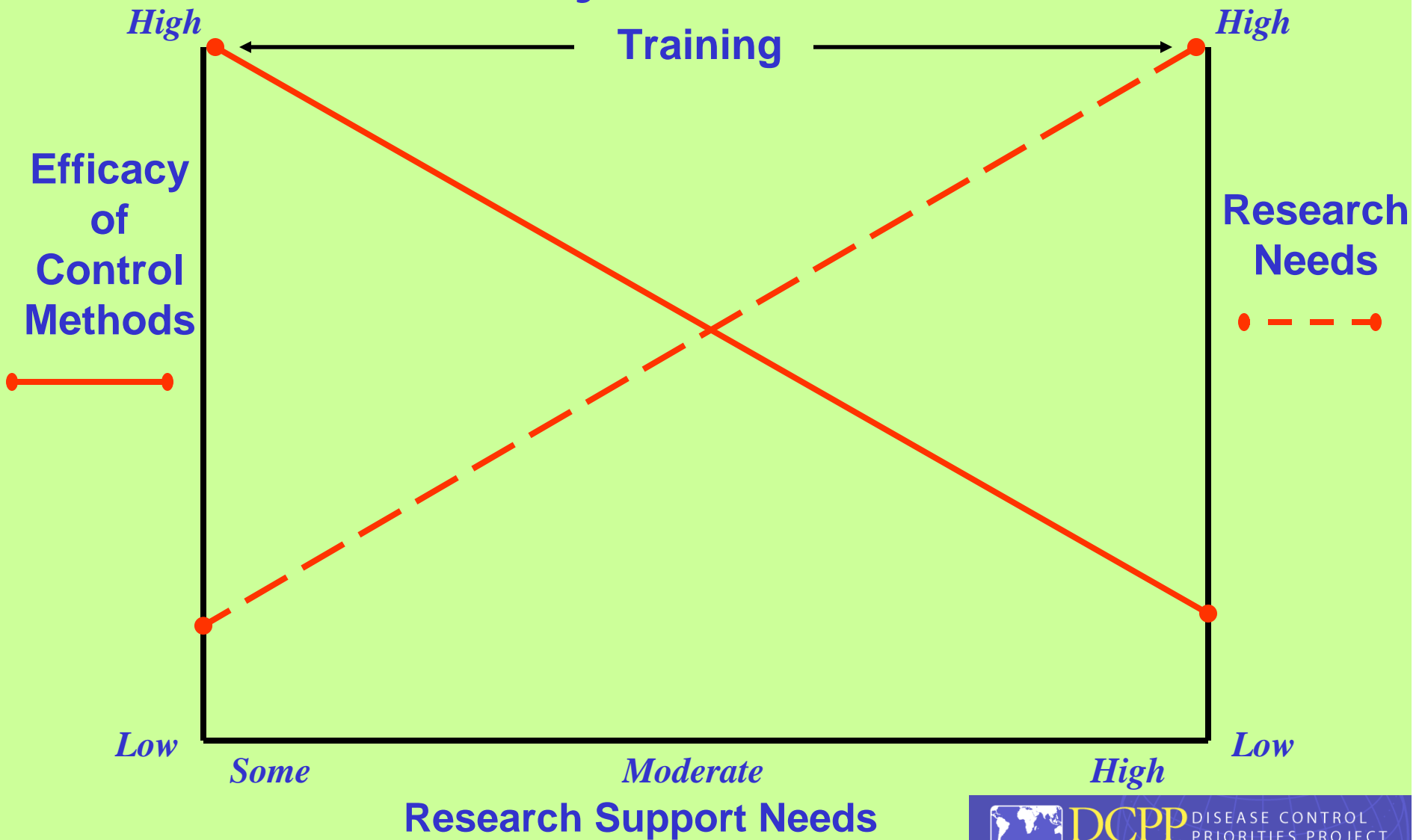
Expected Results of Research and Product Development

- **New basic knowledge**
- **New and improved interventions**
- **New and improved delivery systems**
- **Disseminate information**



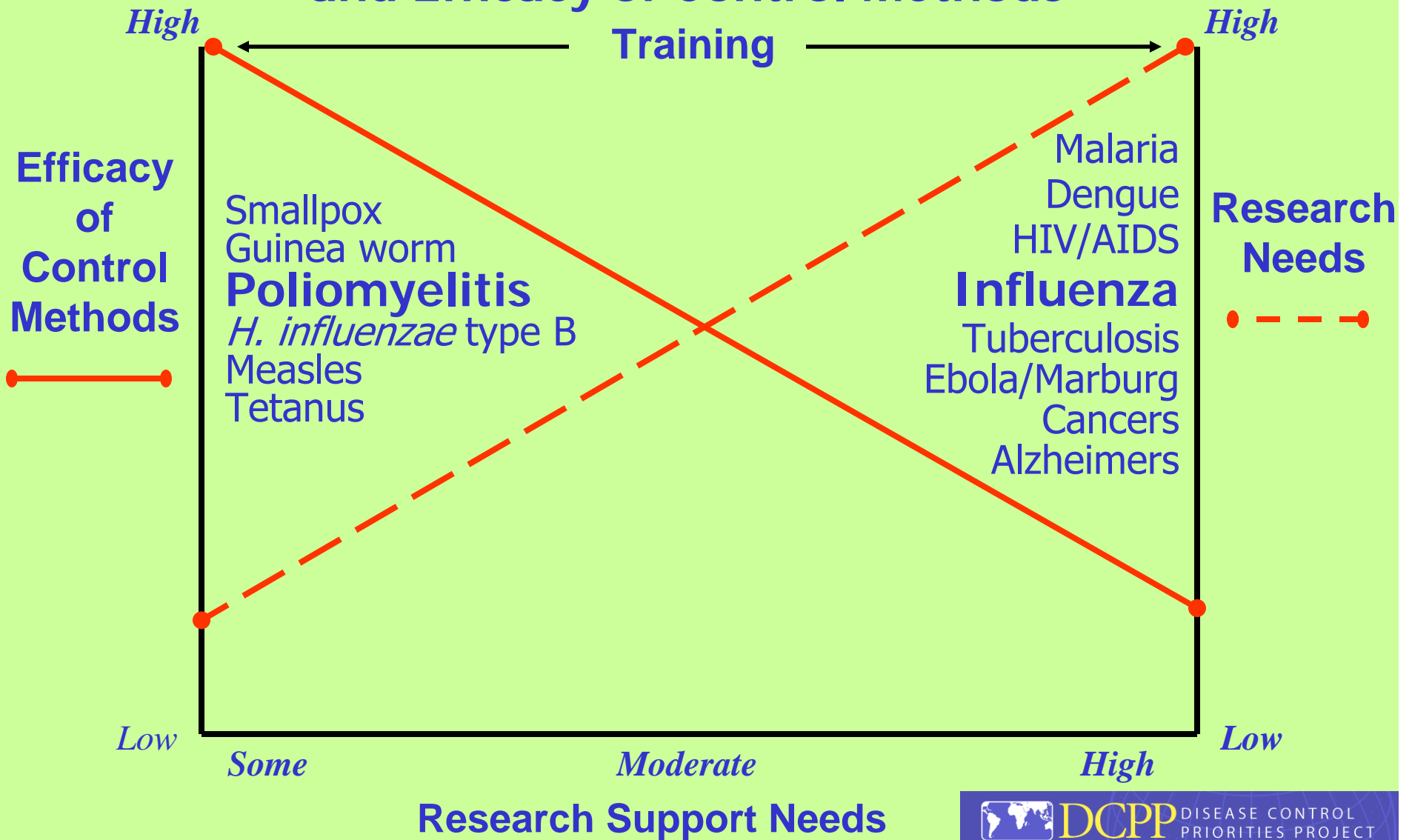


Research, Training, and Support Needs According to Understanding of Diseases and Efficacy of Control Methods





Research, Training, and Support Needs According to Understanding of Diseases and Efficacy of Control Methods





Disease Burden and Research and Development Funding

CONDITION	GLOBAL DISEASE BURDEN (million) DALYs*	R&D FUNDING (\$Millions)	R&D FUNDING per DALY*
Cardiovascular	148.190	9402	\$63.45
HIV/AIDS	84.458	2049	\$24.26
Malaria	46.486	288	\$6.20
Tuberculosis	34.736	378	\$10.88
Diabetes	16.194	1653	\$102.07
Dengue	0.616	58	\$94.16

Malaria and R&D Alliance: *Science*, 13 January 2006: *Disability-Adjusted Life Year.

DCPP estimates in millions are: cardiovascular = 208.8; HIV = 71.5; malaria = 40.0; tuberculosis = 36.1;

Diabetes = 20.0; dengue = 0.5





Main Messages

[Better Data are Needed]



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Main Messages

1. Unfinished infectious diseases agenda.

- **IDs predominate in Sub-Saharan Africa and South Asia**
- **Children under five years suffer preventable IDs in all regions**
- **All countries have vulnerable groups (immunodepressed, metabolic disorders, aged, etc)**





Main Messages

2. Four critical ID challenges are facing developing countries and the world:

- **Preventable levels of mortality and disability from malaria, TB, diarrhea, and pneumonia.**
- **Unchecked HIV/AIDS pandemic.**
- **Emerging Infections**
 - Infectious causes of “non-communicable diseases”.
 - Be prepared for an influenza pandemic due to a novel virus.



Main Messages

3. "Very good buys", infectious disease control/prevention

- Vaccination
- Malaria control
- HIV prevention

4. "Not so good buys"

- Treatment of latent TB, no HIV
- Treatment of HIV/AIDS if poor adherence



Main Messages

5. Continued generation and diffusion of new knowledge and products are key to improvements in health in the 21st century. Future investment is needed:

- **Research and development**
- **Training leaders in research and operations; strengthening institutions**
- **Focus on low- and middle-income countries**
- **Collaboration and shared goals**



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