Global Health Technologies
Innovative and multidisciplinary public-private partnership approaches to combat neglected tropical diseases

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The Millennium Development Goals

2000 - 2015

Millennium Development Goals

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Global partnership for development

Progress on Millennium Development Goal 4

Expanded use of vaccines
- 83% reduction in measles deaths
- 82% reduction in tetanus deaths
- 57% reduction in diphtheria/pertussis deaths
- 45% reduction in Hib deaths

Development of new vaccines
- Pneumococcal disease (36% reduction in deaths)
- Rotavirus (63% reduction in deaths)

2.5 million childhood lives saved through these initiatives
Progress on Millennium Development Goal 6

- 19 million lives saved from AIDS
- 30% reduction in Malaria

Global, regional, and national incidence and mortality for HIV, tuberculosis, and malaria during 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013

Global Health WHACK-A-MOLE V.1.0

The Rise of the Non Communicable Diseases

Non-communicable diseases

HIV/AIDS & Malaria
How Three Scientists ‘Marketed’ Neglected Tropical Diseases And Raised More Than $1 Billion

By Amy Nordrum (@amynordrum)

on May 14 2015 1:55 PM EDT
The Neglected Tropical Diseases (NTDs)

17 diseases or tropical infections:
- 149 endemic countries worldwide
- Highly prevalent among the poor
- Endemic in rural areas
- Ancient afflictions
- Chronic
- Disabling (growth delays, blindness or disfigurement)
- High morbidity but low mortality
- Stigmatizing
- Poverty promoting

http://www.who.int/neglected_diseases/about/en/
## The Global Burden of Disease Study 2010: Interpretation and Implications for the Neglected Tropical Diseases

Peter J. Hotez 1,2,3,*, Miriam Alvarado 4, Maria-Gloria Basañez 5, Ian Bolliger 6, Rupert Bourne 6, Michel Boussinesq 7, Simon J. Brooker 8, Ami Shah Brown 9, Geoffrey Buckle 10, Christine M. Budke 11, 

<table>
<thead>
<tr>
<th>Disease</th>
<th>DALYs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrheal</td>
<td>89 million</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>82 million</td>
</tr>
<tr>
<td>Malaria</td>
<td>82 million</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>49 million</td>
</tr>
<tr>
<td>Meningitis</td>
<td>29 million</td>
</tr>
<tr>
<td>NTDs</td>
<td>26 million</td>
</tr>
</tbody>
</table>

Disability-adjusted Life Years

$$\text{DALYs} = \text{YLLs} + \text{YLDs}$$

Bar chart showing the Disability-adjusted Life Years (DALYs) for various diseases and conditions.
The World has Changed since the Year 2000

**NTDs V.2.0: “Blue Marble Health”—Neglected Tropical Disease Control and Elimination in a Shifting Health Policy Landscape**

Peter J. Hotez

Abstract: The concept of the neglected tropical diseases (NTDs) was established in the aftermath of the Millennium Development Goals. Here, we summarize the emergence of several new post-2010 global health documents and policies, and how they may alter the way we frame the world’s major NTDs since they were first highlighted. These documents include a new Global Burden of Disease 2010 Study that identifies visceral leishmaniasis and food-borne trematode infections as priority diseases beyond the seven NTDs originally targeted by preventive chemotherapy. Moreover, their public health importance (measured in disability-adjusted life years [DALYs]) was determined to be constructed on a foundation of several key global health policies and documents that were advanced in the first few years of the 21st century.
We’re Really Playing “Global Health WHACK-A-MOLE”!

Millennium Development Goals

- AIDS
- TB
- Malaria
- 6-10 NTDs
- Childhood diseases

Sustainable Development Goals

- NTDs V.2.0
- Vector-borne NTDs
- Zoonotic NTDs

Deforestation

Population Growth

Urbanization
10 Major Successes + Big Gains!

Mass Drug Administration (MDA)
- Lymphatic filariasis -52% (2005-15)
- Onchocerciasis -52% (1990-2013)
- Trachoma -65% (1990-2013)
- Ascariasis -20% (2005-2015)
- Yaws Not determined

Case detection + Rx + Vector control

WASH
- Dracunculiasis -99% (1990-2013)

Other approaches
- Rabies (Canine) -53% (2005-2015)
- Cysticercosis -21% (2005-2015)
- Leprosy

Elimination targets:
- LF
- Trachoma
- Yaws
- African trypanosomiasis
- Dracunculiasis
- Leprosy (Hansen’s Disease)

Source: GBD 2015 and GBD 2013
# 9 Failures or Minimal Gains!

## Mass Drug Administration (MDA)
- Schistosomiasis: +30% (1990-2013)
- Hookworm: -5% (1990-2013)
- Trichuriasis: -12% (1990-2013)

## Case detection + Rx + Vector control
- Leishmaniasis: +174% (1990-2013)
- Chagas disease: +22% (1990-2013)
- Dengue + Other Arbovirus Infections: +610% (1990-2013)

## WASH
- Coronaviruses

## Other approaches
- FB Trematodiases: +51% (1990-2013)

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Source: GBD 2015 and GBD 2013

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**Losing the Battle:**
- Vector-borne Neglected Diseases
- Arthropods
- Snails
- Zoonotic Neglected Diseases
- Viral Diseases

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## Four Buckets of R&D Needs

<table>
<thead>
<tr>
<th>Implementation Science</th>
<th>Endgame Science</th>
<th>New/improved control tools</th>
<th>Product delivery science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximize access to essential NTD PRND medicines</td>
<td>Elimination &lt;10 yrs</td>
<td>Drugs</td>
<td>Folding in new tools into current control or elimination strategies</td>
</tr>
<tr>
<td>Enhance delivery</td>
<td>MDA LF Onchocerciasis Trachoma Yaws</td>
<td>Diagnostics</td>
<td></td>
</tr>
<tr>
<td>Improve performance</td>
<td>Other approaches HAT Leprosy</td>
<td>Vaccines</td>
<td></td>
</tr>
<tr>
<td>Co-morbidity management</td>
<td></td>
<td>Vector Control</td>
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</tbody>
</table>
Advancing knowledge from basic sciences to the application in clinical & community settings

**SUSTAINABLE DEVELOPMENT GOALS**

**Population Health**

**INNOVATION**

- T0: Basic and applied science research
  - Preclinical and animal studies
  - Defining mechanisms, targets and lead molecules

- T1: Translation to humans
  - Proof of concept Phase 1 clinical trials
  - New methods of diagnosis, treatment and prevention

**IMPLEMENTATION**

- T2: Translation to patients
  - Phase 2 clinical trials
  - Controlled studies leading to effective care

**IMPACT**

- T3: Translation to practice
  - Phase 4 clinical trials and clinical outcomes research
  - Delivery of recommended and timely care to the right patient

- T4: Translation to community
  - Population level outcome research
  - True benefit to society

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- T0: Translation from basic science to human studies
- T1: Translation of new data into the clinic
- T2: Translation and health decision making
The Reality of Product Development for NTDs

Do you feel rich?

Or...

Do you feel lucky?

How confident are you in the reality of your portfolio of change initiatives and their business case cost and benefit modelling?

The Societal Benefit: Creating Incentives for Partners

High social impact, negative to neutral financial returns

Social impact, positive financial returns

Financial Return on Investment
New Trends in NTD Research & Development

- Price Discrimination
- Tiered Pricing
- R&D Costs built into price of medicine
- De-linkage of R&D Costs

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Solution</th>
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<tbody>
<tr>
<td>Scarce statistical information on the performance of vaccinations</td>
<td>Shared performance indicators</td>
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<tr>
<td>Growing disparities between countries and within countries</td>
<td>Referential schemes of vaccination</td>
</tr>
<tr>
<td>Inadequate or insufficient training programs for human resources</td>
<td>Professionalization of vaccination policies and practices</td>
</tr>
<tr>
<td>Lack of national homogenous, autonomous, and expert vaccination bodies</td>
<td>Creation of Vaccine Advisory Committees</td>
</tr>
<tr>
<td>Insufficient options of financial support for the introduction of new vaccines in the region</td>
<td>Design of innovative financing schemes</td>
</tr>
<tr>
<td>Excessive regulatory barriers for the certification, acquisition and introduction of new vaccines</td>
<td>Elaboration of a common regulatory framework</td>
</tr>
<tr>
<td>Meager collaboration among vaccine producers in Latin America</td>
<td>Public-private partnerships for the production of vaccines</td>
</tr>
</tbody>
</table>
Innovative Models of R&D for NTD Vaccines

Catalytic & Funding Role

Leading research institutions
World-wide
- Expertise
- Know-how
- Technology

Knowledge and technology transfer

Leading research institutions
In Mexico
- Expertise
- Local knowledge and experience

Co-ownership of intellectual rights
SOCIAL PATENTS
Researchers maintain their inventor rights

- Development of state-of-the-art prevention/treatment tools relevant to local and regional needs
- Creation of local R&D platforms

- Licensing to Pharma companies
- Establishing of a PPP
- Development of a NewCo
Biotechnology alliance with U.S. and Mexican institutions

Development of vaccines against Chagas disease.

Develop a new generation of vaccines against neglected tropical diseases for Mexico, Mesoamerica and Latin America.

Strengthen local capacity in Mexico to research and produce new vaccines.
Chagas disease in Mexico

No official reporting system → Underestimation of the true impact of Chagas

- 21 species of T. cruzi-transmitting Triatomine
- 16 million stray dogs, Infection rate: 20-25%

- MX ranks No.1 in Latin America for congenital transmission rate (1 in 10 (Jalisco, 2012))
- No screening
- Poor education/ awareness

- 5.5 million people infected (2010)
- <0.5% of the infected receive treatment
- Poor access to drugs
- Drugs are toxic
- Prolonged treatment needed

- Prevalence in blood banks (up to 51%, Bolivia)
- MX: not all samples screened
- No consensus on diagnosis of chronic and acute Chagas

(data from: Carabarín-Lima et al., 2013, Manne et al., 2013)
Prospects of a Therapeutic Chagas Vaccine

Could an immuno-therapy be used to modulate and/or balance the host immunological response against chronic Chagas?

Could an immuno-therapy contribute to bridging the drug efficacy gap?

Could an immuno-therapy benefit drug treatments by bridging their tolerability gap?
A Vaccine for Chagas disease would be cost effective and cost-saving: ECONOMICALLY DOMINANT

Based on the considerable magnitude of the Net Present Value, even averting a fraction of this NPV (via a therapeutic vaccine) would be quite beneficial.
Chagas Vaccine Development Timeline

2011
- Descubrimiento de antígenos
- Investigación y desarrollo

2015
- Estrategia de desarrollo de producto
- Transferencia de tecnología
- Inicio de Producción

Fase 2: 2016-2018

Ensayos clínicos – Fases I a IV

>16 peer-reviewed articles, 11 newspaper and OpEd articles, > 100 press citations; scientist exchange training program: 6 MSc/PhD and Postdocs
Innovative Investment Mechanisms

- Prepare Health Technology Assessments (including predicted costs, affordability and health gain)
- Complete business case for large investments in downstream development (production and phase II/III studies) – NPV Model Simulations (probability adjusted and non-adjusted)
- Engage in partnership discussions with Vaccine Manufacturer Network
- Prepare for Global Access Strategy: Define initial target market and advance WHO/GAVI discussions to encourage prioritization of NTD vaccine uptake
Thank You

“Product development says it's based on the latest technology.”