“Science for Global Health: Fostering International Collaboration”

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January 11, 2007
Outline

• Global Burden of Disease
• Case Examples
• NIH Structure and Function
• Fogarty International Center
• Research Grant Opportunities
Global Burden of Disease, Reported Mortality by Cause, 2002

World
Pop. ~ 6 billion

- Communicable, Maternal, Perinatal, and Nutritional Conditions: 32%
- Non-Communicable Diseases: 59%
- Injuries: 9%

Africa Region
Pop. ~ 760 million

- Communicable, Maternal, Perinatal, and Nutritional Conditions: 72%
- Non-Communicable Diseases: 21%
- Injuries: 7%

Global Burden of Disease, Reported Mortality by Cause, Africa Region, 2002

Global Burden of Disease, Reported Mortality by Cause: Communicable, Maternal, Perinatal, and Nutritional Conditions (excluding HIV/AIDS), Africa Region, 2002

- Infectious and parasitic diseases: 73%
- Respiratory infections: 15%
- Maternal conditions: 3%
- Perinatal Conditions: 7%
- Nutritional Deficiencies: 2%

*Mal Aria* ("bad air") associated with marshes
Female *Anopheles* mosquito taking blood meal
Malaria: Health and Economic Burden

- Female *Anopheles* mosquito-borne parasite
- Prefers to feed on humans (anthropophilic)
- Parasite has affinity for red blood cells
- Severe anemia, shock, renal and kidney failure, cerebral edema, coma, death
- 300-500 million acute cases annually
- 8 out of 10 cases in Africa
- 1-3 million deaths per year
- Disproportionately affects < 5 yo
- Preventable and treatable
- Economic costs: $12 billion in lost GDP annually in Africa
Malaria: Pathogenesis
Malaria: Prevention and Treatment

- **3 Short-term Tools**
  - Long-lasting insecticide treated bednets

Photo: Chris Herrington
Malaria: Prevention and Treatment

- 3 Short-term Tools
  - Residual indoor spraying with DDT

Photo: World Health Organization
Malaria: Prevention and Treatment

- 3 Short-term Tools
  - Treatment with a new group of antimalarials – the artemisinin compounds, in combination with amodiaquine or sulfadoxine–pyrimethamine

Source: USDA: http://plants.usda.gov/java/profile?symbol=ARAN3
Malaria: Prevention and Treatment

- 3 Long-term Tools:
  - Economic Growth and Poverty Reduction
  - Education
  - Research
Malaria: NIH Collaborative International Research

**GHANA**

- **NIAID: National Institute of Allergy and Infectious Diseases**
- Researchers from the University of Ghana are performing clinical trials of malaria vaccines in endemic areas. *Fiscal Years 2004-2008*
- Michigan State University and the University of Science and Technology are collaborating on the study of redefining Cerebral Malaria. *Fiscal Years 2005-2009*
- **NINDS: National Institute of Neurological Disorders and Stroke**
- Weill Medical College of Cornell University and Noguchi Memorial Institute for Medical Research have ongoing research on endothelial progenitor cells and malaria pathogenesis. *Fiscal Years 2005-2006*

**KENYA**

- **NCRR: National Center for Research Resources**
- University of Miami School of Medicine and the International Centre of Insect Physiology and Ecology will examine the factors that play a role in vector-borne diseases, such as malaria: poverty, urban farming, water and sanitation availability, increased population movement, deteriorating infrastructures, overcrowding in urban areas, and natural disasters. *Fiscal Years 2004-2007*
- **NHLBI: National Heart, Lung, and Blood Institute**
- Investigators from the U.S. Army Medical Research Unit and the Kenya Medical Research Institute are studying the role of immune complex in severe malarial anemia. *Fiscal Years 2002-2005*
- **NIAID: National Institute of Allergy and Infectious Diseases**
- Investigators at Case Western Reserve University, Walter Reed Army Institute of Research, and Kenya Medical Research Institute are conducting seven-year clinical trials of candidate vaccines for malaria. *Fiscal Years 2004-2010*
Disease Control Priorities Project (DCPP)
The 20th Century Take Off in Human Health,
Life Expectancy, 1550-2050

Disease Control Priorities Project (DCPP)

Source: Disease Control Priorities Project. Burden of Disease in China in 2001
(http://www.dcp2.org/pubs/DCP/1/Table/1.1)
Burden of Disease Attributable to Alcohol Among the 10 Leading Risk Factors for Disease In Developed and Developing Countries - % DALYs*

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Developed Countries</th>
<th>Developing Countries with low child and low adult mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>12.2%</td>
<td>6.2%</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>10.9%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Alcohol</td>
<td>9.2%</td>
<td>4.0%</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>7.6%</td>
<td>3.1%</td>
</tr>
<tr>
<td>Overweight</td>
<td>7.4%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Low fruit and vegetable intake</td>
<td>3.9%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Physical inactivity</td>
<td>3.3%</td>
<td></td>
</tr>
<tr>
<td>Illicit drugs</td>
<td>1.8%</td>
<td></td>
</tr>
<tr>
<td>Unsafe sex</td>
<td>0.8%</td>
<td></td>
</tr>
<tr>
<td>Iron deficiency</td>
<td>0.7%</td>
<td></td>
</tr>
<tr>
<td>Alcohol/Tobacco</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blood pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nutrition</td>
<td></td>
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</tr>
</tbody>
</table>

*disability-adjusted life years (years of potential life lost due to death plus years of healthy life lost to disability)

World Health Organization – 2002
Examples of Change in China: Adult Per Capita Alcohol Consumption by Development Status: 1960-2000

Liters of Pure Alcohol Per Person 15+ Years

- Developed countries
- Former Soviet Union
- China (1961-1999)
- Developing countries


NIH National Institute on Alcoholism and Alcohol Abuse (NIAAA) Collaboration with China

Peking University Institute of Mental Health
- Letter of Intent (LOI) April 2004 - a potential collaborative clinical study on use of Kudzu in the treatment of alcoholism

Chinese Institute of Nutritional Science (INS), Chinese Academy of Sciences
- LOI June 2005 - alcohol-related biomedical and behavioral sciences research and related research training
- Co-sponsorship of a workshop “Healthy People 2020: Alcohol, Obesity, and Diabetes” inaugurating formation of an INS Alcohol Research Center, September 2005

The Center for Psychiatric Rehabilitation, Chinese Academy of Sciences
- Beijing Normal University, and Hong Kong Polytechnic University are examining stigma and behavioral health in urban employers. Fiscal Years 2003-2007
Bangladesh

- Population: 134 million
- Density: 930 persons/km² (world average 42 persons/km²)
- Size: slightly smaller than Iowa
- Geographically situated on the deltas of the Ganges and Brahmaputra rivers
- Billions of tons of sediment and rich organic matter carried to Bay of Bengal
- Annual flooding deposits sediment in surrounding flood plains
- 5 feet of rainfall annually
Inorganic Arsenic

- Arsenic is a naturally occurring element that ranks 20th in abundance in the Earth’s crust.
- First identified in 1250 AD, arsenic is colorless, tasteless, and odorless even in heavily contaminated water.
- Arsenic is a virulent poison on ingestion: 76 mg (As$^{+3}$) is considered lethal to adults.
- Difficult to detect and analyze
- Reputed to be the “secret” poison-of-choice throughout history, e.g., King George III of Great Britian, Napoleon Bonaparte, and nicknamed “inheritance powder” in 19th Century
Inorganic Arsenic

Arsenic presents with a dark, brown-black coloration and a dull, matte luster

[Dimensions: 3.4 x 2.3 x 1.3"  Wt: 10.8 oz. (306 g)  Location: Borneo]
Source of Naturally Occurring Arsenic

- High concentrations of arsenic are bound to iron sediments in the organic rich soil.
- As organic matter decomposes, arsenic bound to iron sediments is chemically released (reduced) and dissolves into the water.
- Prevailing hypothesis is that tube wells sunk in the shallow aquifers (<100m) in flood plains 1970s and 80s introduced arsenic-rich water into the diet of residents.
- Previously, population relied on surface water, such as ponds and streams, with consequent high burdens of diarrheal disease.
Upazalia (sub-district) of Muradnagar

Image: Grameen Shikka (an NGO)
<table>
<thead>
<tr>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>417,000</td>
</tr>
<tr>
<td>Unions</td>
<td>22</td>
</tr>
<tr>
<td>Villages</td>
<td>308</td>
</tr>
<tr>
<td>Tube-wells:</td>
<td>30,620</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Tested tube-wells</td>
<td>30,199 (98.6%)</td>
</tr>
<tr>
<td>Contaminated TW</td>
<td>28,234 (93.5%)</td>
</tr>
<tr>
<td>“Safe” (&lt;50 ppb) TW</td>
<td>1,965 (6.5%)</td>
</tr>
</tbody>
</table>
Exposure to As

- 30-60 million (22-45%) Bangladesh population is exposed to well water containing > 50 parts per billion (ppb), maximum permissible exposure limit set by the Bangladesh MOH

- WHO and USA permissible limit is 10 ppb

- Arsenicosis in Bangladesh first described in the early 1990s

- Thailand, Cambodia, Burma, West Bengal (India)

- “Blackfoot disease” in Taiwan in 1950s

- Arizona, Nevada, Montana, southern Alaska samples have >10 ppb in well water
Major dermatological signs of arsenic poisoning are diffuse or spotted melanosis, leucomelanosis, and keratosis.

Chronic arsenicosis is a multisystem disorder involving the lungs, gastrointestinal system, liver, spleen, genitourinary system, hemopoietic system, eyes, nervous system, cardiovascular system and central nervous system.

Photo: J. Herrington
Chronic exposure to ingested arsenic causes hyperkeratic lesions on the planar surfaces of the hands and feet.

Hardening of skin caused by As binding to keratin, a fibrous scleroprotein that occurs in the outer layer of the skin.

Exposure to As

Photo: J. Herrington
Exposure to As

Hyperkeratosis of sole of the foot

Photo: J. Herrington
Exposure to As

Gangrene of the foot

Photo: World Bank
Mitigation: Testing and marking of wells

- Red painted hand pump = contaminated

Photo: Grameen Shikka
Mitigation: Testing and marking of wells

- Green painted hand pump = safe

Photo: Grameen Shikka
Rainwater capture cisterns

• Jumbo Jar holds 3200 liters, enough for a family of six during 8 months at 2L/person/day.
• Advantages:
  • Simple technology
  • Locally made
  • Cost is ~ $90 to construct
  • Sustainable, long term storage
  • Culturally acceptable
• Disadvantages:
  • Contamination may occur during transport to smaller jars in house
  • Potential mosquito egg laying site

Photos: J. Herrington
Pond Sand Filters

- Ponds water pumped by hand into a storage tank through a filter chamber
- Chamber constructed in two parts, the first is a pre-filter packed with coconut fibers to reduce turbidity of the raw water
- Second part consists of layered, sand filter bed,
- Pond water trickles in and impurities, including bacteria, are removed
Flocculation: Proctor and Gamble

- Packet of chlorine and alum granules
- 85% reduction of As
- Cost: $0.10/packet
- Packet treats 10 liters of water
- P&G Health Sciences Institute

Photos: Proctor and Gamble
NIH Collaboration with Bangladesh on Arsenic

NIEHS: National Institute of Environmental Health Sciences

- Columbia University and the National Institute of Preventive and Social Medicine are examining nutritional influences on arsenic toxicity, the health effects and geochemistry of arsenic and lead, and the chemoprevention of arsenic-induced skin cancer.  *Fiscal Years 2003-2006*

- Harvard University and the Dhaka Community Hospital Trust are gathering information on arsenic exposure, genetic susceptibility, and outcome.  *Fiscal Years 2003-2007*

- Texas Tech University and the Institute of Child and Mother Health are studying the use of Selenium against arsenic toxicity and skin lesions.  *Fiscal Years 2004-2007*
20% ($28.9 billion) of total FY 2005 HHS budget ($580 billion) in research
= Institutes and Centers that award grants
National Institutes of Health Main Campus
Bethesda, Maryland, U.S.A.
NIH Mission

• *Uncover New Knowledge That Leads To Better Health For Everyone By:*

  - Supporting peer-reviewed scientific research at universities, medical schools, hospitals, and research institutions throughout United States and overseas
  - Conducting research in its own laboratories
  - Training research investigators
  - Developing and disseminating credible health information based on scientific discovery
National Institutes of Health (NIH)

History

• 1930 - Formally designated by the U.S. Congress as the “National Institute of Health”

• 1948 - Became the “National Institutes of Health” with four Institutes

• 2006 - 27 Institutes and Centers; FY 2005 appropriated budget, $28.6 billion

Mission

Science in pursuit of fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to extend healthy life and reduce the burdens of illness and disability
Contemporary NIH

- NIH creates research laboratories and recruits outstanding scientists from universities and abroad

- Institutes and Centers are created in response to public health needs, most with intramural programs

- Many young trainees join NIH and go on to become leaders in science across the US and around the world

- 117 grantees or trainees become Nobel Laureates*

* as of 2005
NIH Budget in FY 2006 is $28.6 Billion

<table>
<thead>
<tr>
<th>%</th>
<th>Amount</th>
<th>Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>$2.8B</td>
<td>6000 Intramural Scientists &amp; Research Personnel</td>
</tr>
<tr>
<td>3.8%</td>
<td>$1.1B</td>
<td>Research Mgt &amp; Support</td>
</tr>
<tr>
<td>3.2%</td>
<td>$1.0B</td>
<td>NLM, OD, etc.</td>
</tr>
</tbody>
</table>

83% of the total NIH budget supports about 325,000 Extramural Scientists and Research Personnel at 3,000 Institutions Nationwide.

$820 million (~2.8%) of NIH budget is international research and research training awards.
Balanced National Biomedical Research Portfolio

NIH - $28B

Private Sector - $59B
Mission

- Address global health challenges through innovative and collaborative research and training programs
- Support and advance the NIH mission through international partnerships
- “Science for Global Health”
- FY 2005 Appropriation $67 million
Research Grant Opportunities (sample):

1. **Ecology of Infectious Diseases** – multi-year, collaboratively with NSF

2. **Brain Disorders in the Developing World: Research Across the Lifespan** – annually, May (non-AIDS), Aug. (AIDS-related)

3. **Fogarty International Research Collaboration Award (FIRCA)** – annually, Sep.
Research Grant Opportunities (sample):


Research Training Grant Opportunities (sample):


2. Fogarty International Collaborative Trauma and Injury Research Training Program (TRAUMA) – annually, Aug.

Research Training Grant Opportunities (sample):


5. International Clinical, Operational, and Health Services Research and Training Award (ICOHRTA) – tentative 2008

Since 1988, the Fogarty International Center, part of the National Institutes of Health, has published the *Directory of International Grants and Fellowships in the Health Sciences*. This current volume (*NIH Publication 06-3027, February 2006*), a comprehensive compilation of international funding opportunities in biomedical and behavioral research prepared by Ms. Hannah Leslie, should serve the individual or institution who seeks financial support.

This table separates the Grants and Fellowships into different categories. For example, those interested only in grants and fellowships for health professionals should click on the link in column 1 row 2.

<table>
<thead>
<tr>
<th>Pre-doctoral/Graduate</th>
<th>Post-doctoral</th>
<th>Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Professionals</td>
<td>Institutions</td>
<td>Addendum: Travel</td>
</tr>
</tbody>
</table>

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Directory of Grants and Fellowships in the Global Health Sciences

This version of the Directory contains all grant and fellowship opportunities. When possible, grant or fellowship titles have been linked to the full description of the opportunity online.

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Africa-America Institute  
AHA Karen Foundation  
Alliance for Health Policy and Systems Research  
American Association for Cancer Research  
American Association of University Women Educational Foundation  
American Cancer Society  
American College of Physicians  
American International Health Alliance  
American Respiratory Mission  
American Psychological Association  
American Society for Microbiology  
American Society of Tropical Medicine and Hygiene  
Arthritis Foundation  
Arthritis Foundation of Canada  
Association of Public Health Laboratories  
Association of Schools of Public Health  
Australian Research Council  
Biotechnology and Biological Sciences Research Council of the United Kingdom  
Boehringer Ingelheim Fonds Foundation for Basic Research in Biomedicine  
British Columbia Research Institute  
Burroughs Wellcome Fund  
Canadian Institutes of Health Research  
Cancer Research and Prevention Foundation  
Francis Family Foundation  
Francoppo Foundation  
George Institute for International Health  
German Academic Exchange Service  
German Research Society – Deutsche Forschungsgesellschaft  
Global Alliance for TB Drug Development  
Global Development Network  
Harvard Medical School Department of Social Medicine  
Heart and Stroke Foundation of Canada  
Helen Keller Program for Research in Leprosy and Tuberculosis  
Help the Aged Research into Ageing  
Howard Hughes Medical Institute  
The Human Frontier Science Program  
Alexander von Humboldt Foundation  
Huntington’s Disease Society of America  
Indian National Science Academy  
Infectious Diseases Society of America  
Institute of International Education  
The Jacobs Foundation  
James S. McDonnell Foundation  
Medical Research Council  
Medicine for Maladies Venture  
Middle East Cancer Consortium  
Molecular and Cell Biology Network  
Muscular Dystrophy Association  
National Academies (United States)  
National Foundation for Infectious Diseases  
National Institutes of Health  
National Institute of Allergy and Infectious Diseases  
National Institute of Multiple Sclerosis Society  
National Research Foundation (South Africa)  
National Science Foundation (United States)  
Nestle Foundation  
The Netherlands Ministry of Foreign Affairs  
The Novartis Foundation  
The Open Society Institute  
The Organization of American States  
Prizer Inc  
Population Council  
Poverty and Economic Policy  
The Research Council of Norway  
The Rockefeller Foundation  
The Rockefeller Brothers Fund  
The Rockefeller Foundation  
Royal Society  
The Royal Society of Tropical Medicine and Hygiene