

Engineering World Health and The Role of BME in Global Health

Robert Malkin
Duke University
Engineering World Health

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May 18, 2007

UW taps Harvard professor to run new global health institute

The Associated Press

The former director of Harvard's institute for public health has agreed to run a similar institution at the University of Washington. Christopher Murray was selected to lead the Ellison Institute for World Health at Harvard until last year, when he moved to Harvard.

The University of Washington's new Health Metrics Institute, which would study how health care is delivered, is named in honor of Melinda Gates Foundation.

The Seattle school is about a week away from completing its agreement with the world's largest pharmaceutical company. Murray joined the UW on May 1 and the university's Board of Regents approved his appointment last week.

Information from: Seattle Post-Intelligencer, <http://www.seattle-pi.com/>

[Coffee Exposed](#) -> A shocking secret coffee co's don't want you to know www.coffeefool.com

[Bellingham Airfare Deals](#) Seven tips to find the best fares. Search all major sites in one place. www.smartertravel.com

[Bellingham](#) Very Ch... Save 65 www.ch...

Global Health

Health

msnbc.com

Global Health Care Is Fashionable, But Falls Short

Robert Bazell
NBC News

POSTED: 9:42 am EDT April 24, 2007
UPDATED: 9:43 am EDT April 25, 2007

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I've never met Bill Gates. I have heard he is a tyrant in business negotiations and I resent the decades I've struggled with Microsoft operating systems. MSNBC.com, by the way, is a joint venture of Microsoft and NBC Universal.

But the man deserves the Nobel Prize, many prizes - sainthood, perhaps - for his global health programs. He also merits sympathy and support in the face of growing criticisms about the effectiveness of his giving.

g



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BUDGET

Print Email Article Tools

Page 1 of 1

- log
- Message Board
- CC College Headlines
- Living Guide
- evilNet
- Local Network

The Board of Trustees approved a \$1.8-billion budget during their May meeting this weekend that will bring some major goals of the University's new strategic plan to fruition.

The fiscal year 2007-2008 budget, which sees revenues jump 9.9 percent and expenditures increase 8.5 percent, will fund the new DukeEngage initiative and Duke's Global Health Institute, among other projects.



\$29 billion



\$31 billion

Printed from

THE TIMES OF INDIA The Times of India -Breaking news, views, reviews, cricket from across India

Gates gives \$9.7m for AIDS research

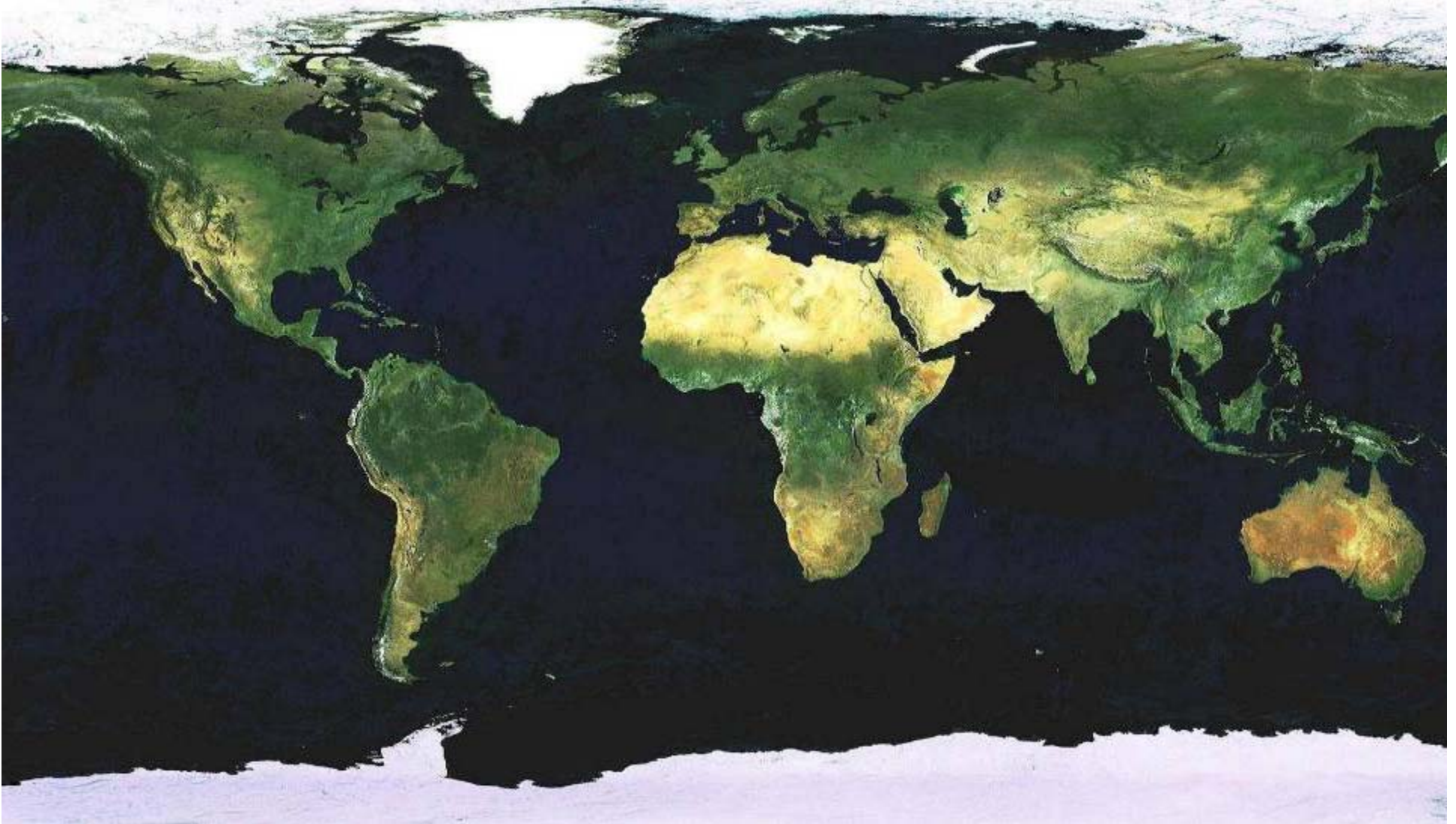
19 May, 2007 | 0250 hrs IST | AP

SMS NEWS to 8888 for latest updates

SEATTLE: The Bill & Melinda Gates Foundation will give a \$9.7 million grant to the Elizabeth Glaser Pediatric AIDS Foundation to study ways to prevent HIV/AIDS transmission to children via breast milk.

What are they all talking about?
What is Global Health?

What is global?



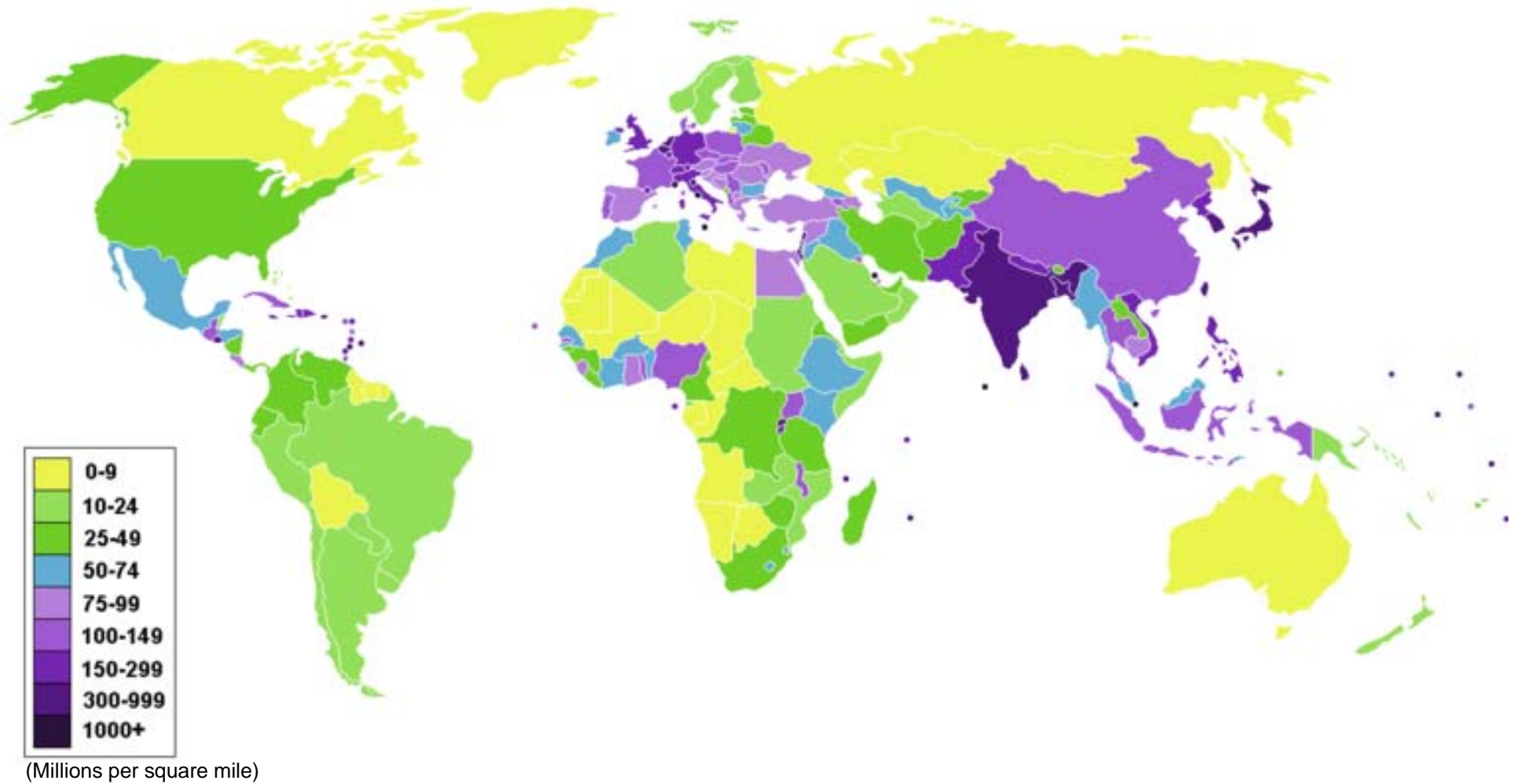
Dry, ice and green on earth

What is Global?



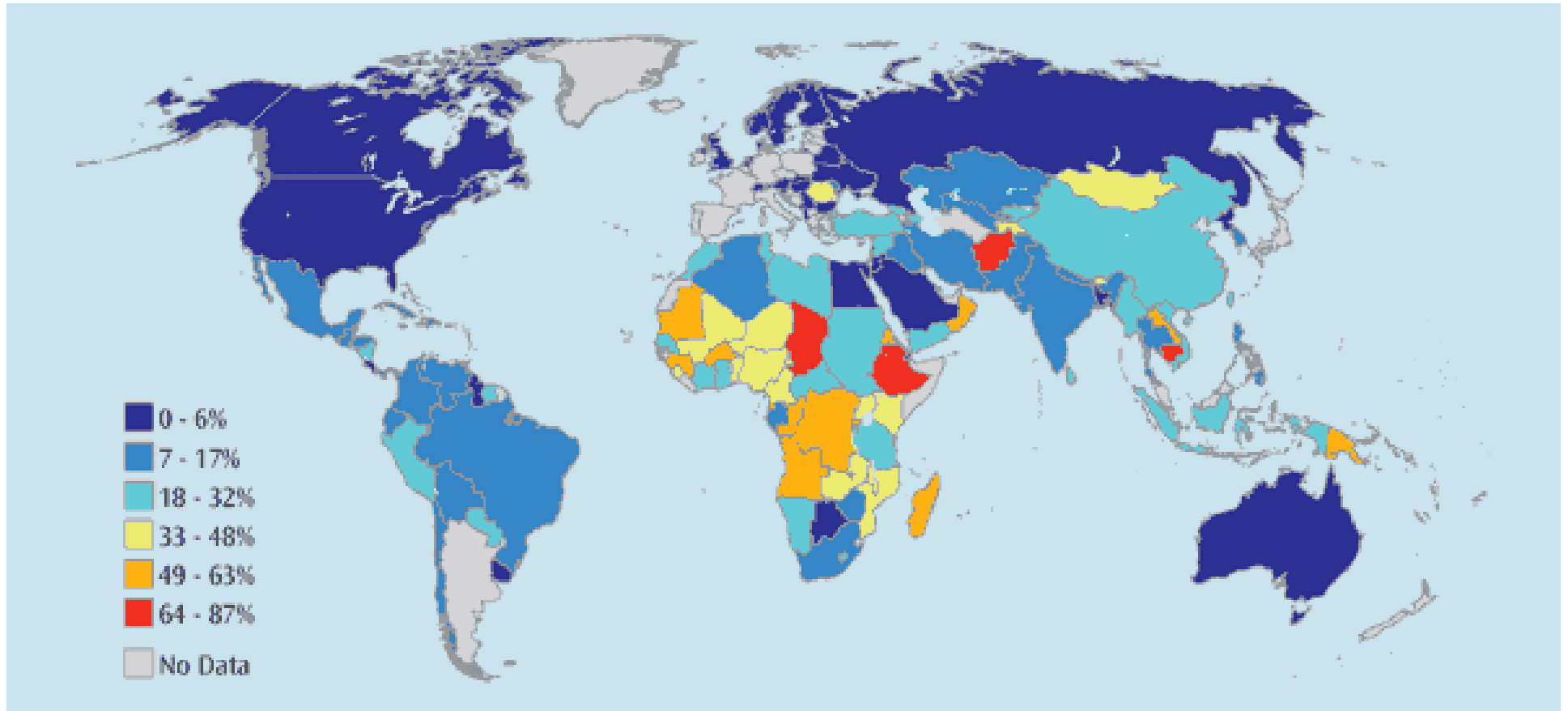
Earth at Night

What is Global?



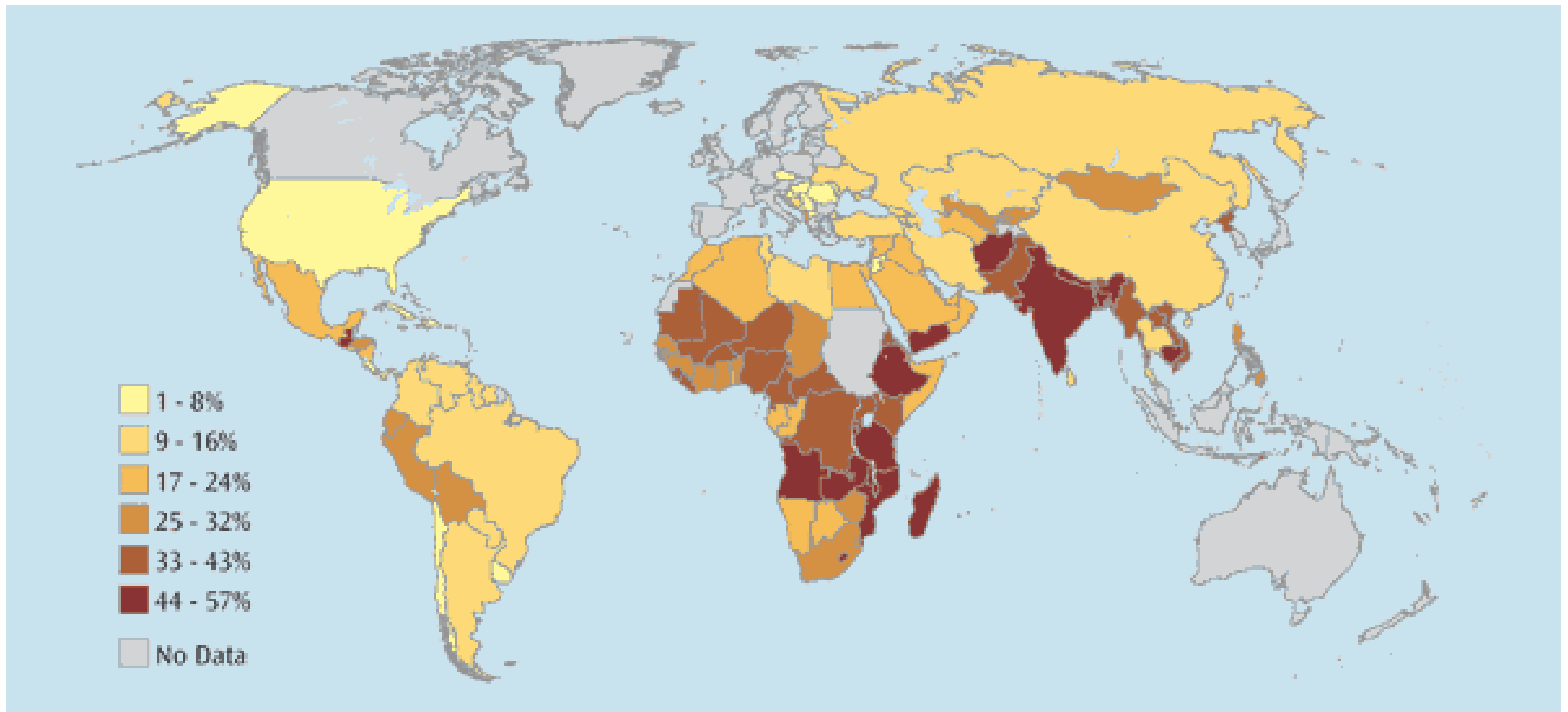
Population Density

What is Global Health?



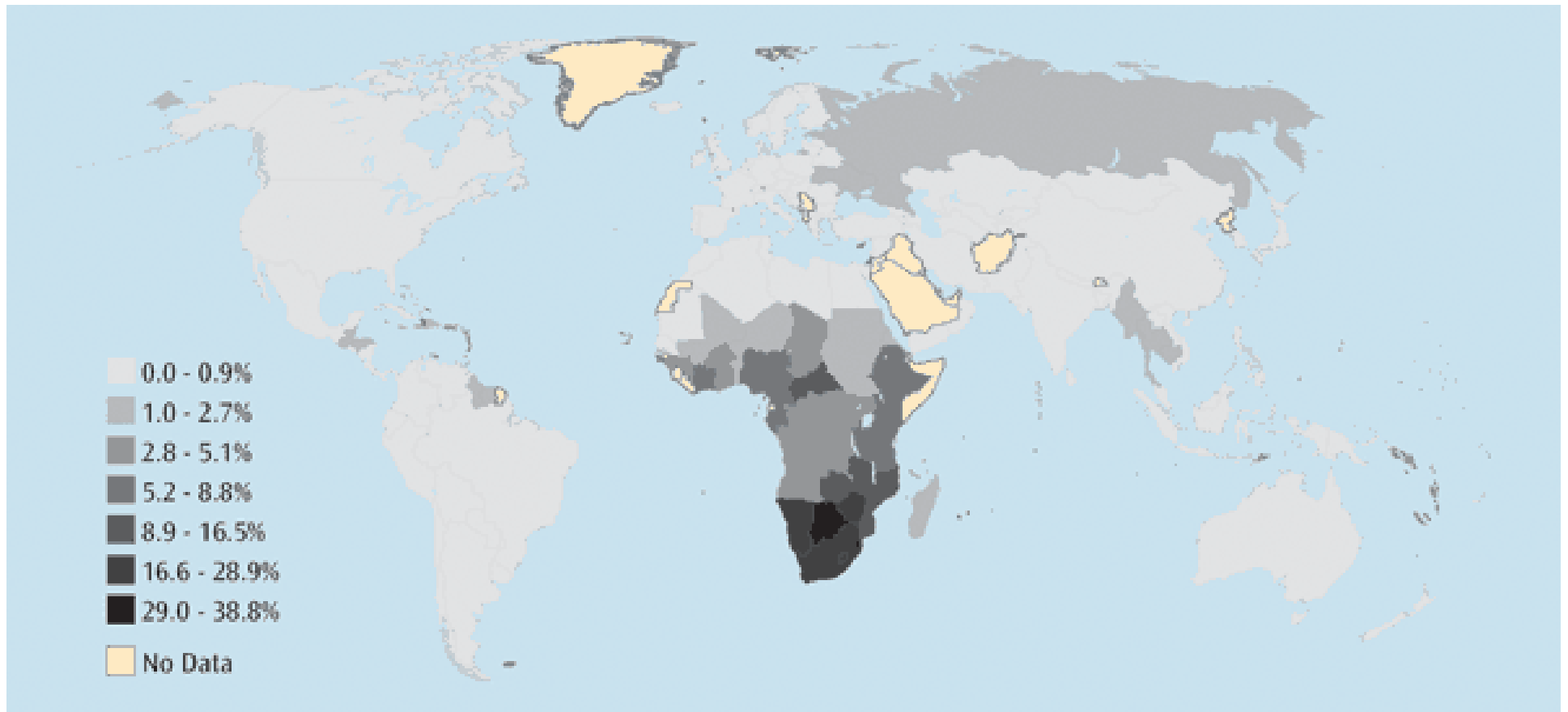
% Without safe water

What is Global Health?



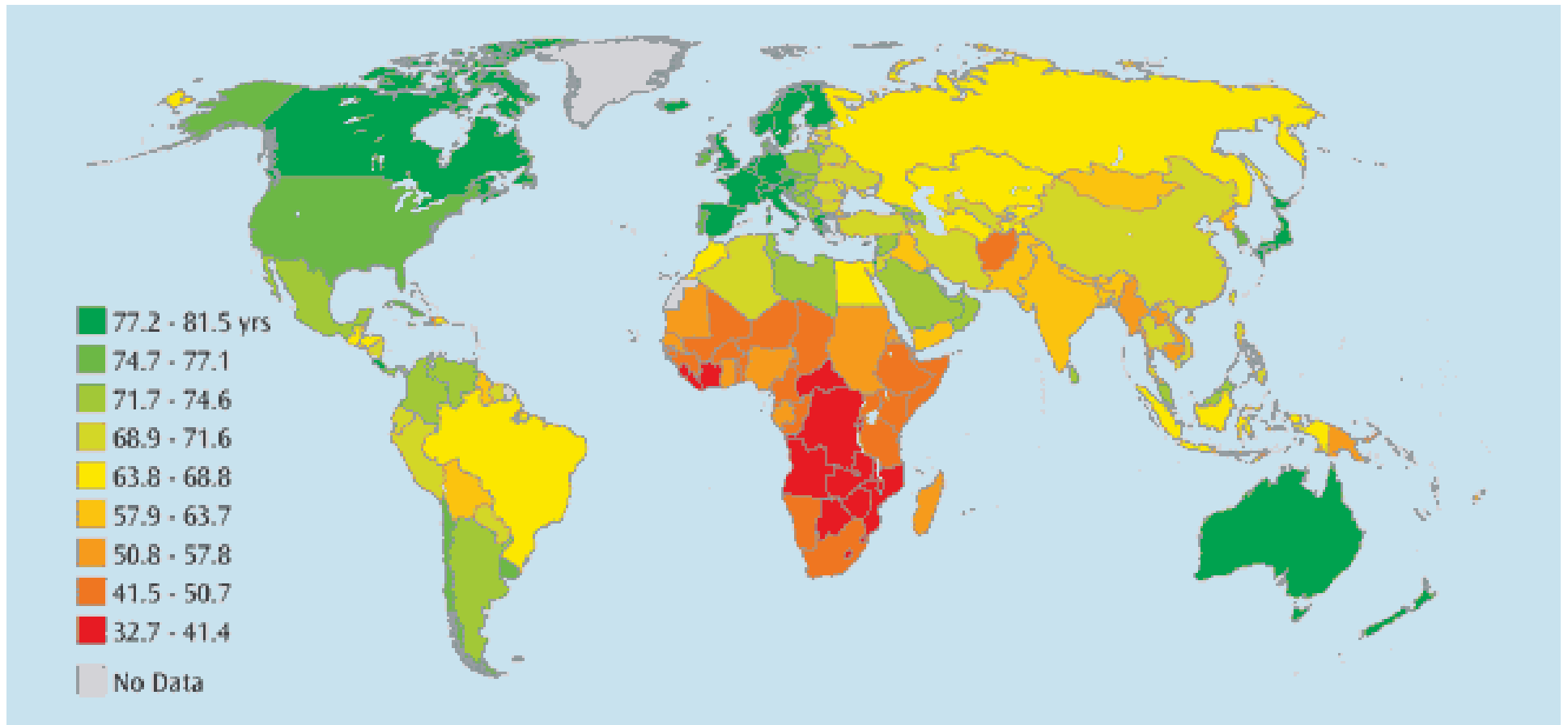
% Stunting

What is Global Health?



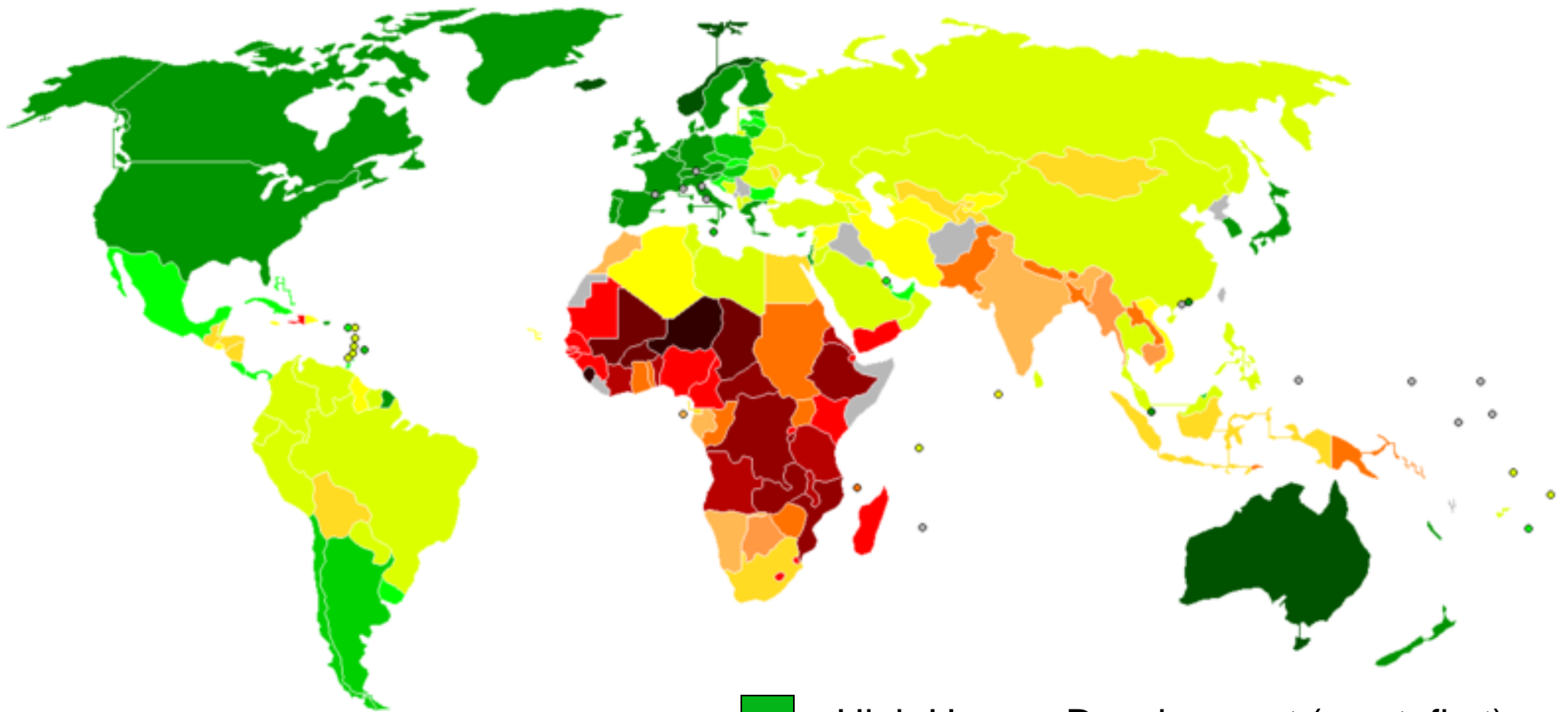
% HIV Positive




What is Global Health?



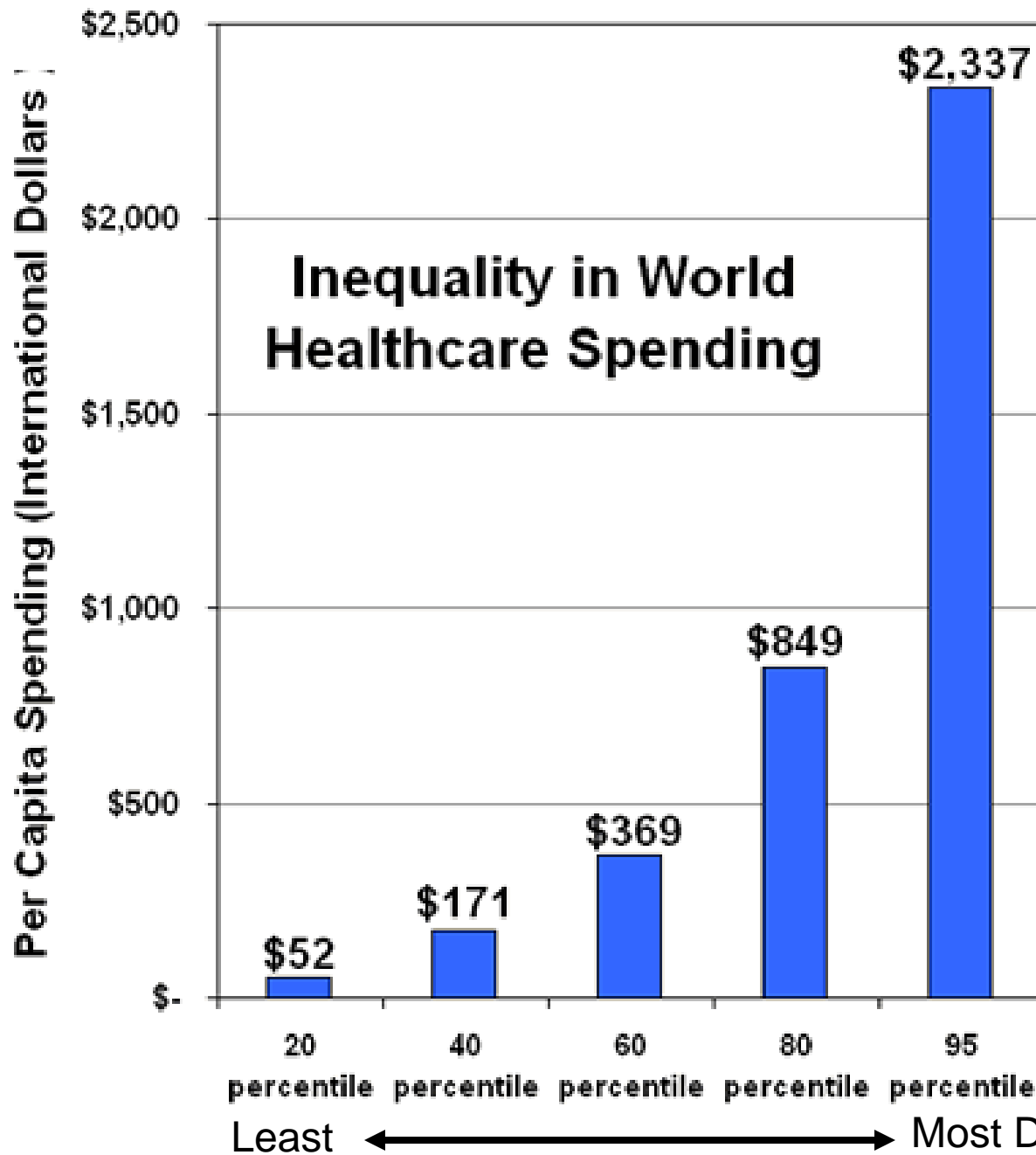
Life Expectancy

What is Global Health?



-  High Human Development (most, first)
-  Medium Human Development
-  Low Human Development (least, third)

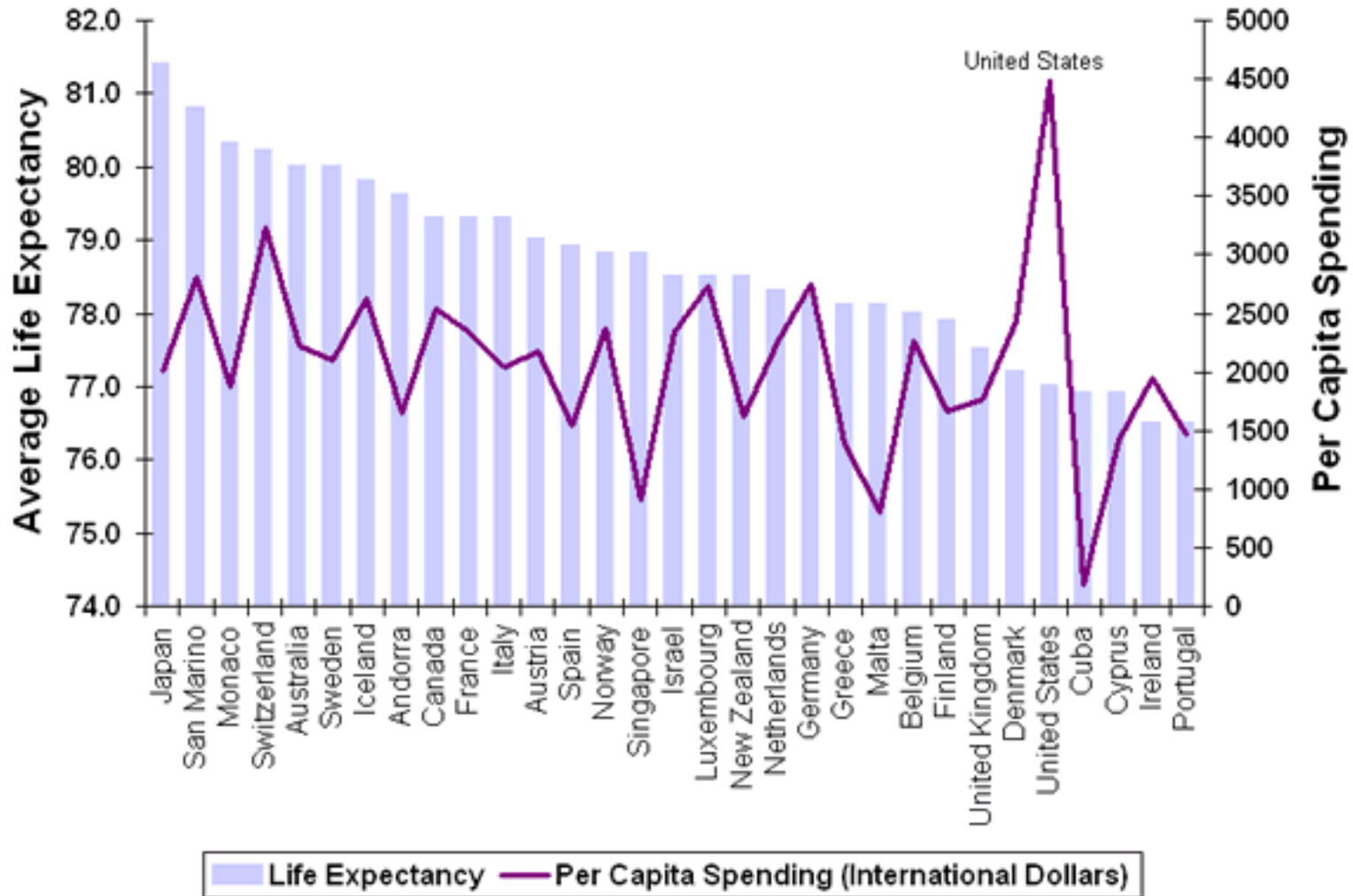
UN Human Development Index



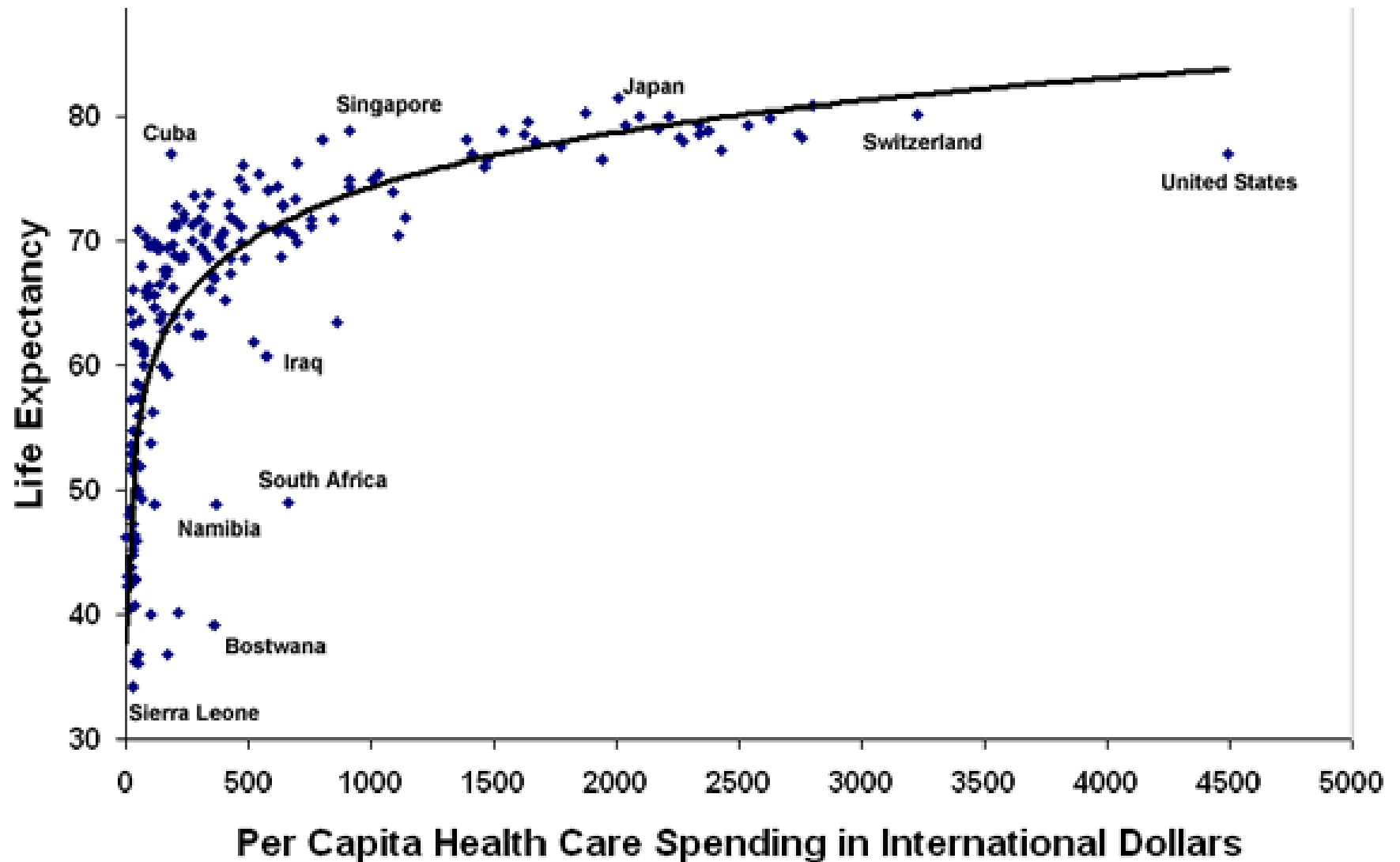
So, what
can we
do?

Conclusion:
Send \$\$

Not so fast!



Not so fast!



Just Sending \$ Won't Work

Corruption
Brain Drain
Infrastructure

Conclusion:
Send Stuff



Savannah Carson, EWH volunteer with new friends in Tanzania

80%

of hospital
equipment in least
developed nations
is donated

WHO Guidelines for Medical Equipment Donations

WHO Essential Health Care Technology: http://www.who.int/medical_devices/en/index.html

My Experience at Kissy Eye Clinic

Freetown, Sierra Leone

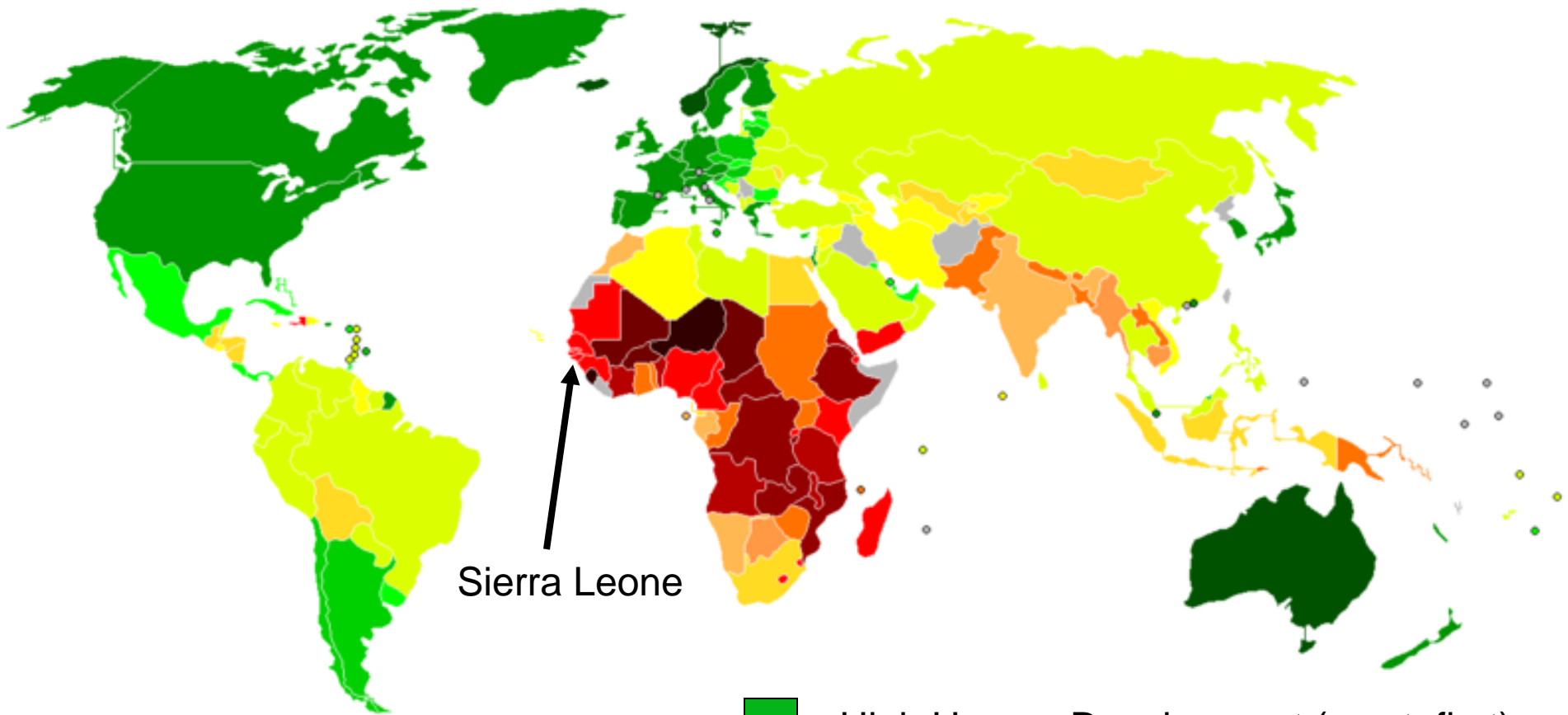


Arrival with cataract surgeon






At the end of the day, this girl was waiting

Where Sierra Leone?



Sierra Leone

-  High Human Development (most, first)
-  Medium Human Development
-  Low Human Development (least, third)

UN Human Development Index

Sierra Leone



Ingrid



BB



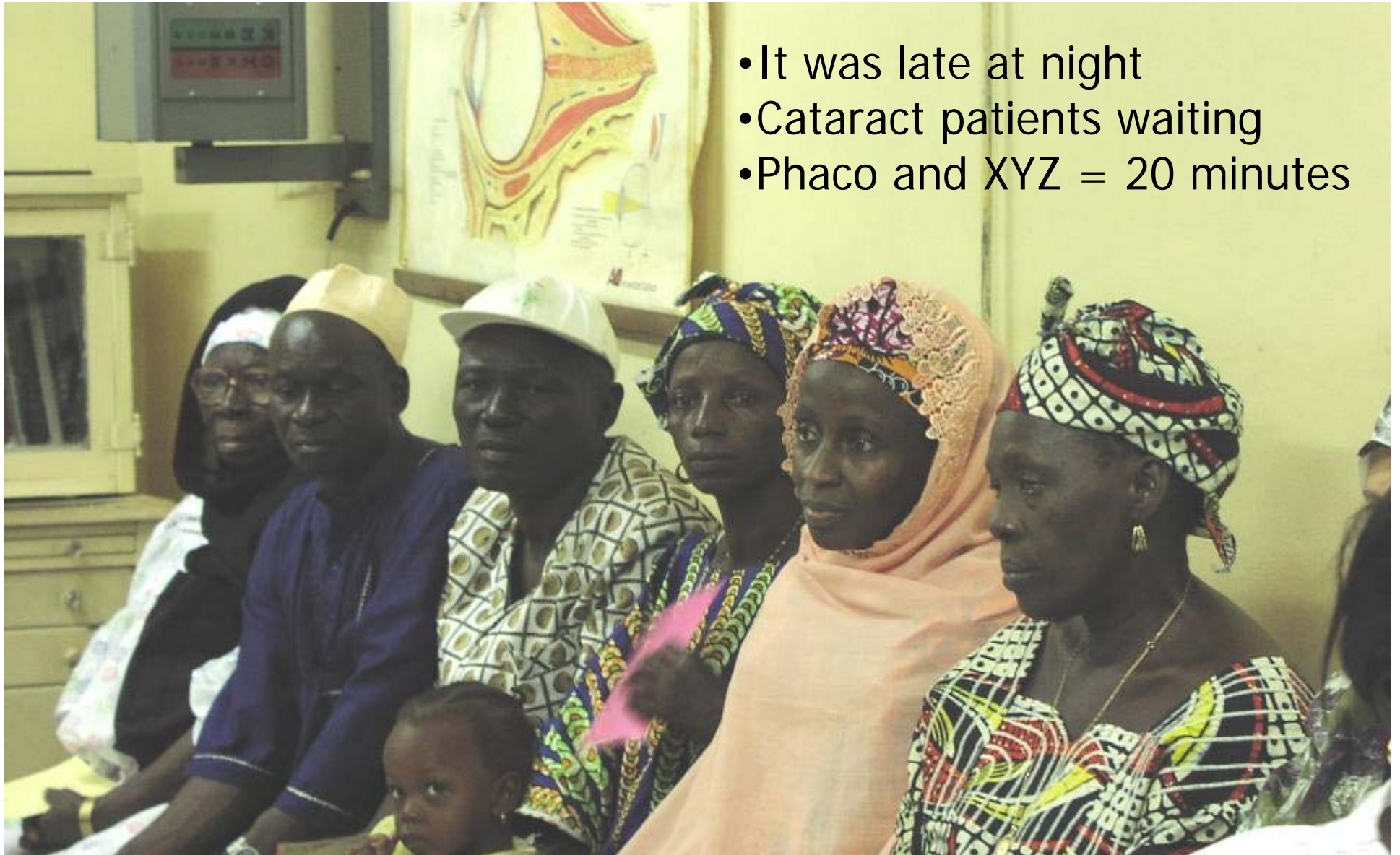
Cindy



Adolfo

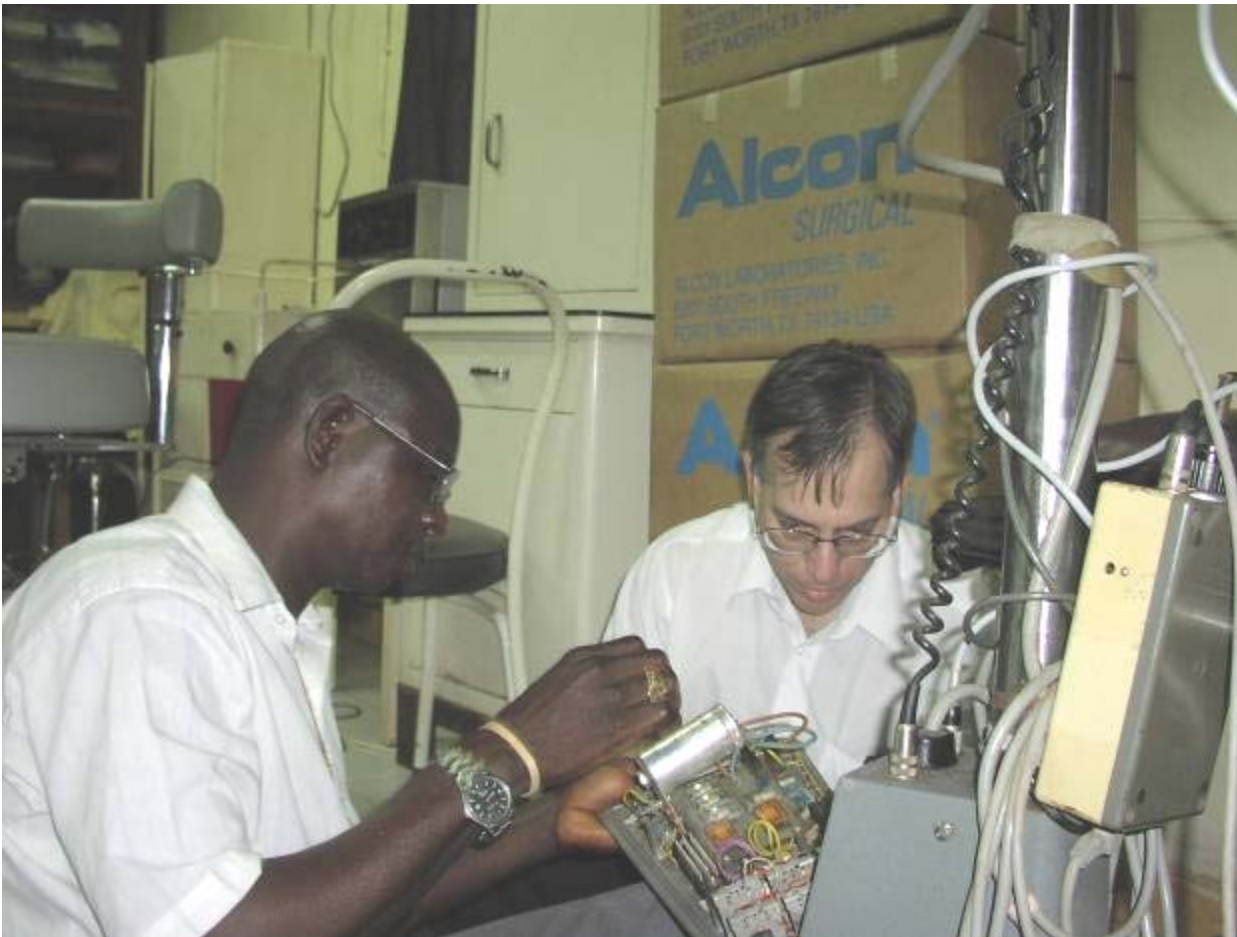
- Life Expectancy - 38 years
- Safe Drinking Water - 54%
- Infant Mortality - 170/1000
- Under Five Mortality - 286/1000

Something Was Wrong



- It was late at night
- Cataract patients waiting
- Phaco and XYZ = 20 minutes

Got to Work



Training Paul to work on XYZ Scope

- In 30 minutes
- Fixed the XYZ
- All Patients Treated

Needed

- Spare parts
- Tools
- Knowledge

EWH Experience

with donated medical equipment

- 62 Hospitals in 18 Countries
 - (almost all low HDI)
- 1710 Failure Analyses
- 176 compliant long interviews
- About 1500 short interviews
- About 450 reported long interviews



Spare Parts

Parts (29% power supply)*

Training/Installation (24% -
incl. user error)*

Training



O2 sensor
Needs replacement

Tracy Lipps with donated Siemens Ventilators
Worked for 4 months, then stopped

Jinotepe, Nicaragua

Sidelined due to consumables



Needles

Electrodes

Sensors

Test strips

Reaction Cartridges

Blood Pressure Cuffs

Printing Paper

Sterilization Check strips

IV Pump Cartridges

Reagent Packs

Bovie Pens

Tubing

Canulae

Consumables

70%

of all donated medical
equipment does not work*

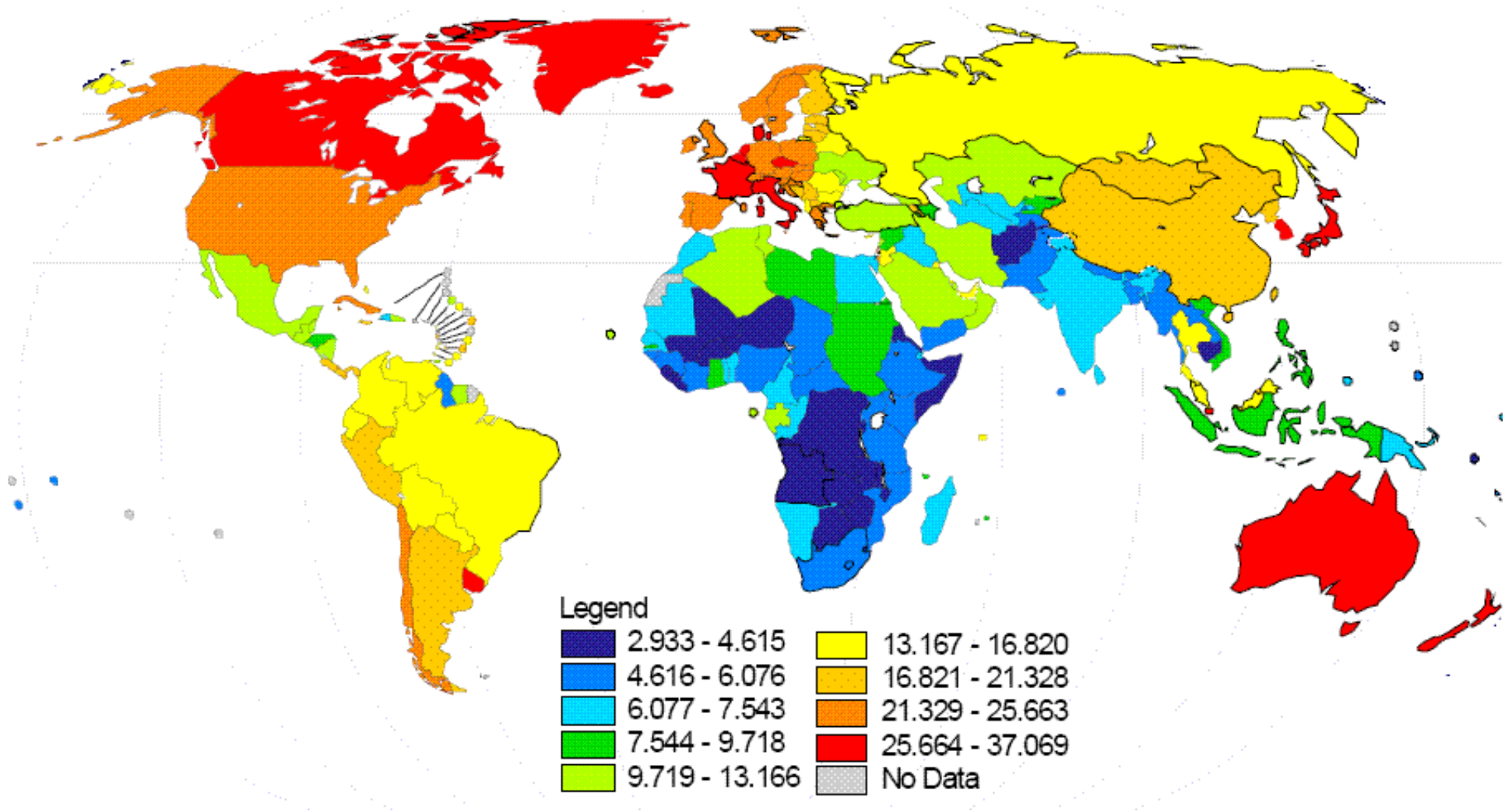
Mostly due to **

- lack of spare parts
- consumables
- Training/installation

*WHO Guidelines for Medical Equipment Donations

** Malkin, Annual Review of Biomedical Engineering, 2007

Wrong Stuff



Malignant neoplasm, % of population

Leading Causes of Mortality

Most Developed Nations	% of total deaths	Least Developed Nations	% of total deaths
1 Ischaemic heart disease	23.3%	1 Ischaemic heart disease	9.2%
2 Cerebrovascular disease	13.4%	2 Cerebrovascular disease	8.4%
3 Trachea, bronchus, lung cancers	4.4%	3 Lower respiratory infections	7.9%
4 Lower respiratory infections	3.6%	4 Perinatal conditions	6.0%
5 COPD	3.2%	5 HIV/AIDS	6.0%
6 Colon and rectum cancers	2.3%	6 COPD	5.2%
7 Self-inflicted injuries	1.8%	7 Diarrhoeal diseases	4.6%
8 Diabetes mellitus	1.7%	8 Tuberculosis	3.6%
9 Stomach cancer	1.7%	9 Malaria	2.7%
10 Hypertensive heart disease	1.7%	10 Road traffic accidents	2.4%

WHO data 2003 (COPD= chronic obstructive pulmonary disease)

Leading Causes of Morbidity

(loss of quality of life - DALY)

5 Most Developed Nations	% DALY loss	5 Least Developed Nations	% DALY loss
1 Malignant neoplasms	16	1 Lower respiratory infections	14
2 Unipolar depressive disorders	9	2 Malaria	8
3 Ischaemic heart disease	7	3 HIV/AIDS	8
4 COPD	4	4 Diarrhoeal diseases	8

All Causes of Morbidity

All Significant Causes of Morbidity	% of Total DALY's	
	5 Most Developed Nations	5 Least Developed Nations
1 Lower respiratory infections	0.9	14.1
2 Malaria	0.0	8.4
3 HIV/AIDS	0.2	8.3
4 Diarrhoeal diseases	0.2	8.1
5 Birth asphyxia and birth trauma	0.4	3.6
6 Maternal conditions	0.4	3.5
7 Nutritional deficiencies	0.7	3.4
8 Perinatal Low birth weight	0.3	3.2
9 Other unintentional injuries	1.8	2.8
10 Measles	0.0	2.6
11 Road traffic accidents	1.9	2.2
12 Tuberculosis	0.0	2.0
13 Malignant neoplasms	15.9	1.0
14 Unipolar depressive disorders	9.2	0.9
15 Ischaemic heart disease	7.1	0.7
16 Chronic obstructive pulmonary disease	4.5	0.2
17 Cerebrovascular disease	4.3	0.8
18 Alzheimer and other dementias	4.1	0.1
19 Alcohol use disorders	4.0	0.1
20 Hearing loss, adult onset	3.6	0.4
21 Osteoarthritis	2.4	0.2
22 Diabetes mellitus	2.2	0.2
23 Self-inflicted injuries	2.1	0.2

Significant ($\geq 2\%$)

Insignificant ($\leq 1\%$)

What is Everyone Talking About?

- Global Health = not us
 - prototype = Africa
- Sending \$\$ is NOT the answer
 - Only medium human development
- Sending stuff is NOT the answer
 - Spare parts, training, consumable
 - wrong stuff
- There is no silver bullet

What is the answer?

The word "BME" is rendered in a bold, 3D font with a yellow-to-orange gradient. The letters are slightly tilted and have a dark orange shadow on their bottom and back faces. Six red lines radiate from the letters: three on the left and three on the right, pointing outwards. The lines on the left are longer and more widely spaced, while the lines on the right are shorter and more closely spaced.

BME

Develop a lot of new stuff

Why should you care

Buffet and Gates know this too

\$60
billion

What is Engineering World Health doing?



EWH is
TN-based
Non profit
Delivering
healthcare
technology to those
in need



Duke-EWH Summer Institute



50 Participants in 2008

**1 Month Training in
Costa Rica/Tanzania**

**1 Month in a poor Hospital
Nicaragua, Honduras, Tanzania,
Kenya**



Month Training: Intense Study



- Daily Language
- Daily Culture
- Daily Lecture
- Daily Lab
- Additional Training





Duke-EWH
Summer Institute



Then The Trip Starts!

Analysis Failures Repairing Equipment



29% Spare Parts for
the Power Supply





Inventory

What do they have?

Training

24% training including user error and installation



Identifying Needs “The Long Interview”



Health Impact

- 2003-2007: 1130 pieces placed into service
- \$2-\$3 million worth



Training Global Engineers



Trip Profile: Stephanie Patnode
University of Southern California, UC Berkeley
"I'd go back tomorrow. I ... for once, felt like an engineer."

Special Features

- Family Program (day care, family housing)
- Open Internationally
- 1-Year Experiences
 - Engineering Volunteer - domestic
 - One-Year Internship - abroad
- Graduate Fellowships (MEM, MS)



Trip Profile

Jody Riskowski

University of Wyoming

IU-PUI

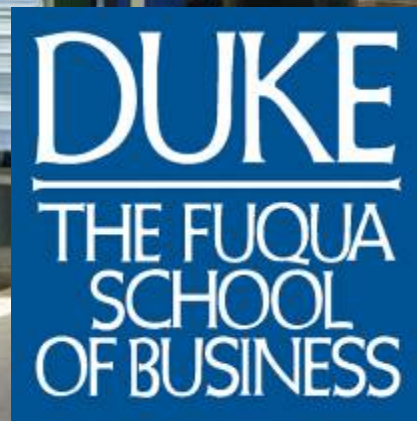
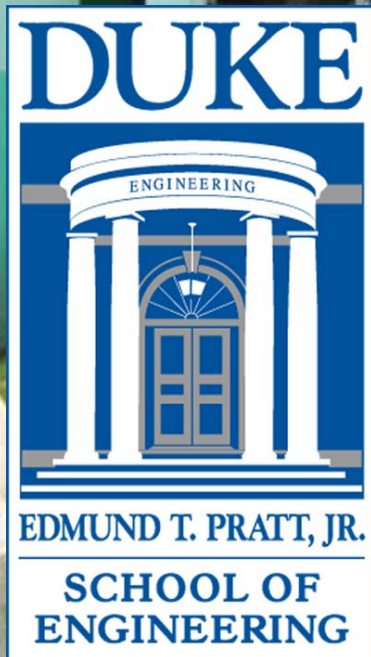
“When we arrived, a nurse produced three ‘broken’ ECG machines. This was in a ward where not one patient was being monitored. We quickly discovered that the machines worked, but hadn’t been set-up correctly. We set them up and before we left, we saw patients being properly monitored for the first time.”

“The summer was an amazing experience, and one I will never forget. I grew and changed. It was the best time of my life.”

HOSPITAL ESCUELA

CUREs

A non-profit business program



Duke
University
School of
Medicine

Program takes advantage of three prominent institutions within Duke

CUREs

Non-Profit Business Incubation

Duke Bus/Mgmt Students
create

bootstrapped start-ups
earned-income
non-profit,
healthcare technology
business plans

Examples:

BP Assist Device Project

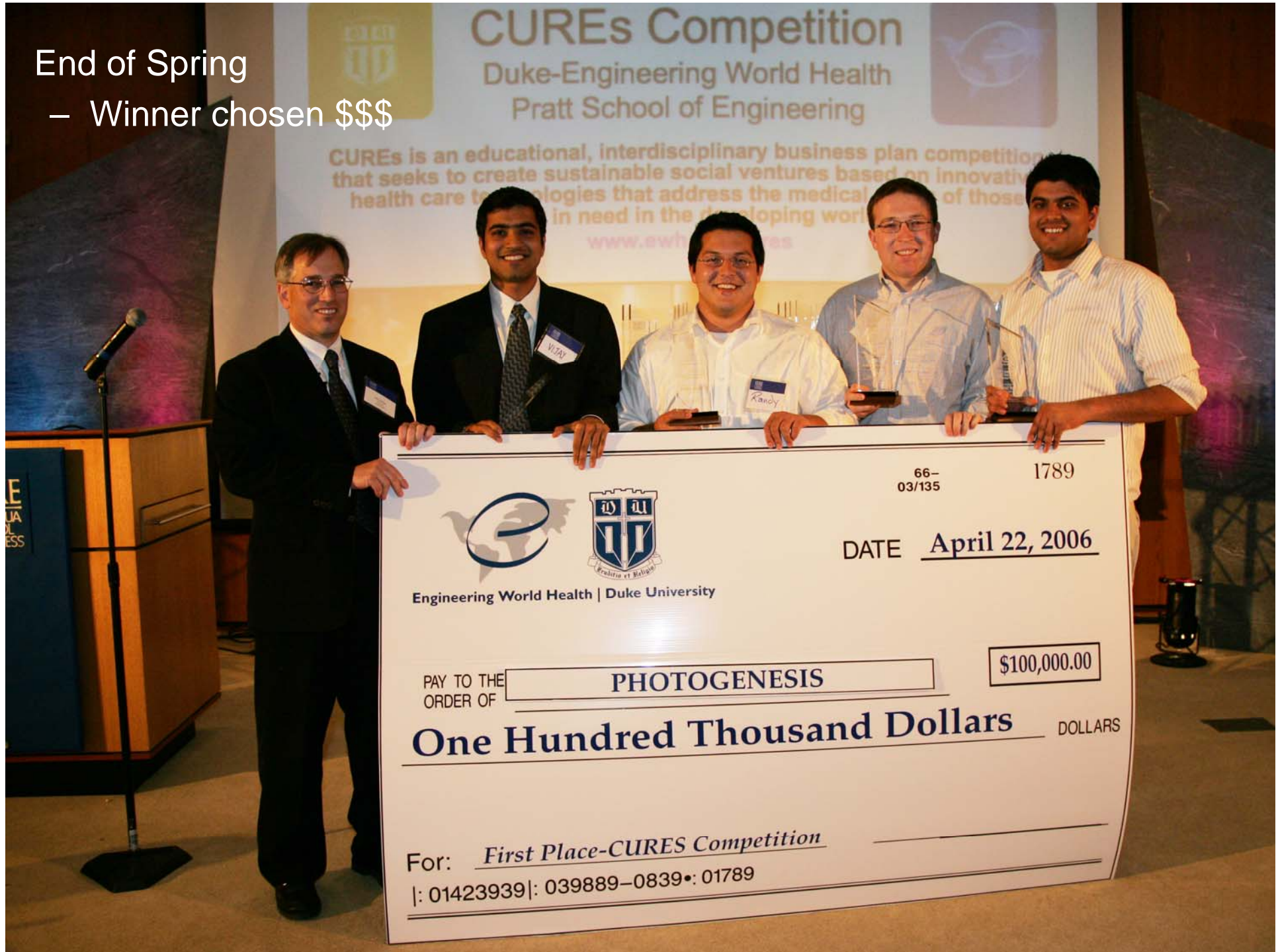
Cervical Cancer Screening/Detection/Treatment

Bilirubin treatment device



End of Spring

– Winner chosen \$\$\$



Steps

- Needs Finding
- Business Plan
- Engineering Prototyping
- “Winning”
- Redesign/Testing
- Initial Clinical Trials (Duke)
- Field Trials (40 units)
- Redesign/Testing
- Launch – first sales order



30,000
Children

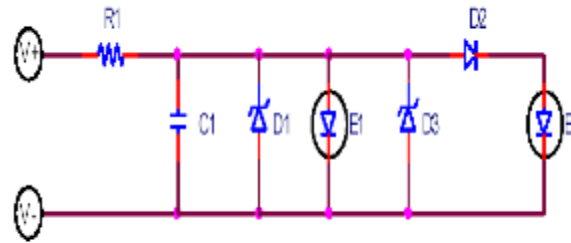
Senior Design Projects that Matter Design for the Developing World



- Web Site: www.ewh.org/youth
- Lists about 20 Identified Needs
- Anyone can design solutions
 - EWH will pay for prototyping
 - Local manufacturability (new for 2006-2007)
 - May enter distribution system



Vanderbilt Defibrillation Tester

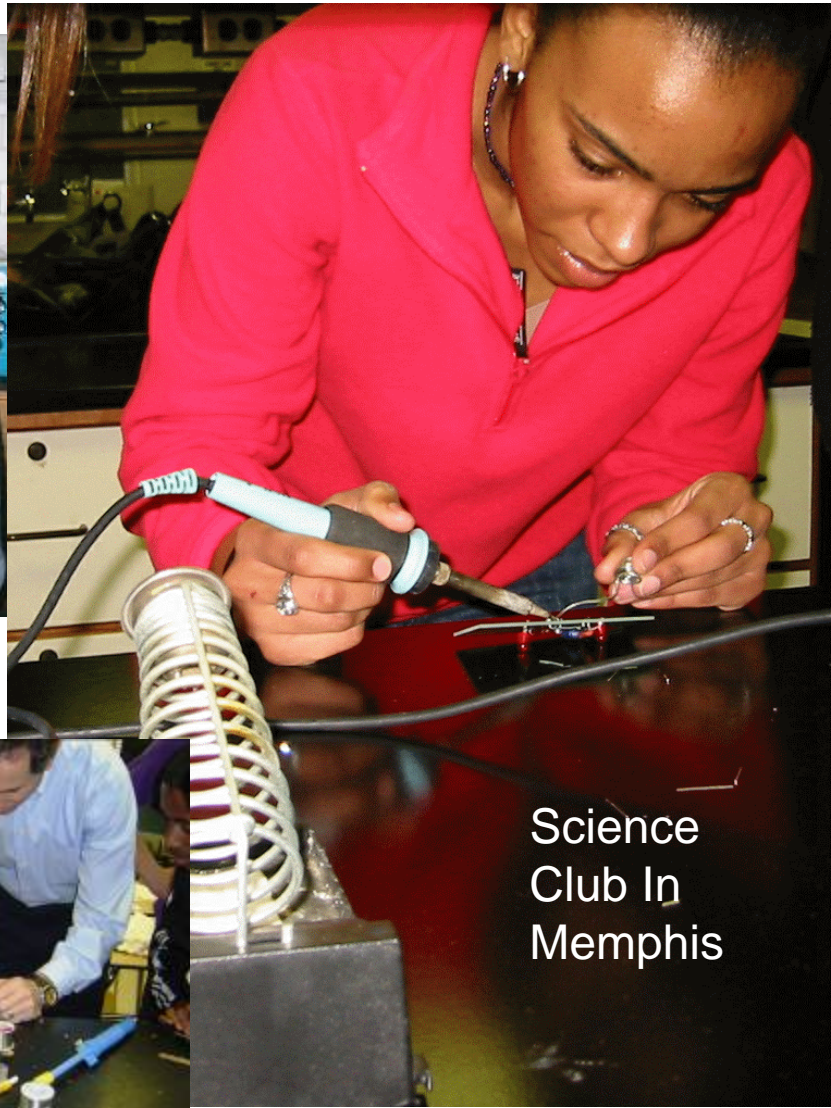


NO.	DESCRIPTION	DATE	DRAWN	PHS/NE
1	Defibrillator Tester	8/18/03	CHECKED	BAS
			ENG. APPD.	BAS





High School
in Nashville



Science
Club In
Memphis



Summer Camp in Durham



LA Tech

Kits
coming
soon

High School, Middle School, Clubs, EWH Chapters
and individuals purchase parts and build equipment

- >1000 pieces delivered
- >\$1 Million (replacement value)



Sudan



El Salvador



Nicaragua



Philippines



Indonesia

EWH Chapters



Cambridge University, England ... and others



EWH Chapters

5 Core Activities

- 1) **Repair Sessions**
- 2) **Designing New Equipment**
- 3) **Attending/Hosting Conferences**
- 4) **Builds**
- 5) **Fellowship Raising**



Summer Program: Fellowships, financial aid set-asides

EWH Chapters

- Meet Weekly or Bi-Weekly
- 10-15 Students per meeting



UNC/NC State/Duke EWH Chapters building phototherapy devices



Congressman Price, the Mayor of Durham, Chuck Messer

Guidelines available from info@ewh.org

BME potential not fully realized

- Spare Parts
- Training programs
 - BME, BMT
- Information networks
 - Manuals
 - Tech support
- Donation Guidance
 - Testing, Consumables, Supplies



U. Houston EWH Chapter
In MedicalBridge's Warehouse

EWH: Succeeds Through Generous Support of our Partners



ANTHONY & CO.
ONCOR INTERNATIONAL



Duke University

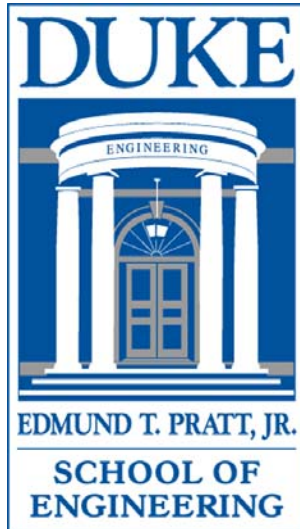
Hamilton Roddis
FOUNDATION



Gift of Life

Leonard M.
Foundation





BME Has a Unique *Role*
You must make that *Role* a **Reality**

www.ewh.org