

SUNY Stony Brook

**Africa's Water-Borne
Neglected Tropical Diseases:**

**Problems Solved
Innovations Proposed
No Clue**

Peter Hotez MD PhD FAAP

President Sabin Vaccine Institute

**Walter G. Ross Professor & Chair
Microbiology, Immunology,
& Tropical Medicine**

The George Washington University



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. Develop a global partnership for development.



The Neglected Tropical Diseases

Core Group

- **Protozoan Infections**

- Human African Trypanosomiasis
- Chagas Disease
- Leishmaniasis

- **Bacterial & Viral Infections**

- Buruli Ulcer
- Dengue
- Leprosy
- Leptospirosis
- Trachoma

- **Helminth Infections**

- **Soil-Transmitted Helminth Infections**
 - Ascariasis
 - Hookworm Infection
 - Trichuriasis
 - Strongyloidiasis
- Schistosomiasis
- Lymphatic Filariasis
- Onchocerciasis
- FB Trematodiasis
- Taeniasis/Cysticercosis
- Echinococcosis
- Dracunculiasis

Neglected Tropical Diseases (NTDs)

- Most prevalent infections of poor people
- Over **ONE BILLION** people infected worldwide

- **Schistosomiasis** **207 million**
- **Lymph Filariasis** **120 million**
- **Dengue** **50 million**
- **FB Trematodiasis** **40 million**
- **Onchocerciasis** **37 million**
- **Buruli Ulcer** **0.05 million**
- **Guinea Worm** **0.01 million**



Global Burden of NTDs

DISEASE

Lower Respiratory Infections

HIV/AIDS

Unipolar Depression

Diarrheal Disease

Ischemic Heart Disease

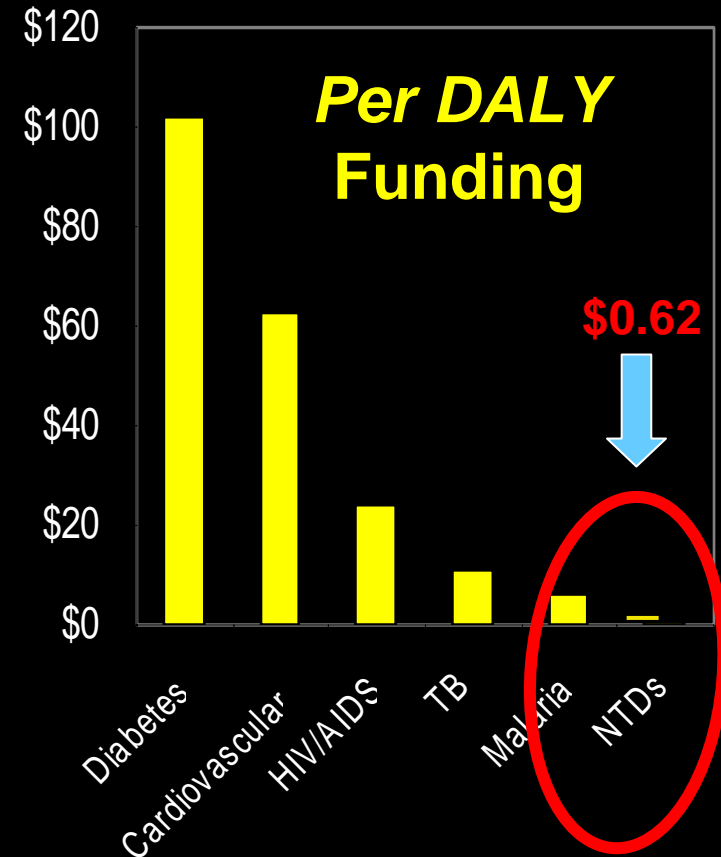
Neglected Tropical Diseases

Cerebrovascular Diseases

Malaria

Road Traffic Accidents

Tuberculosis



NTDs and Poverty

A young child, possibly a boy, is standing in front of a traditional thatched hut. The child is shirtless and has a thoughtful or slightly sad expression, with their hand near their chin. The background shows the texture of the thatched roof and some greenery at the base of the hut.

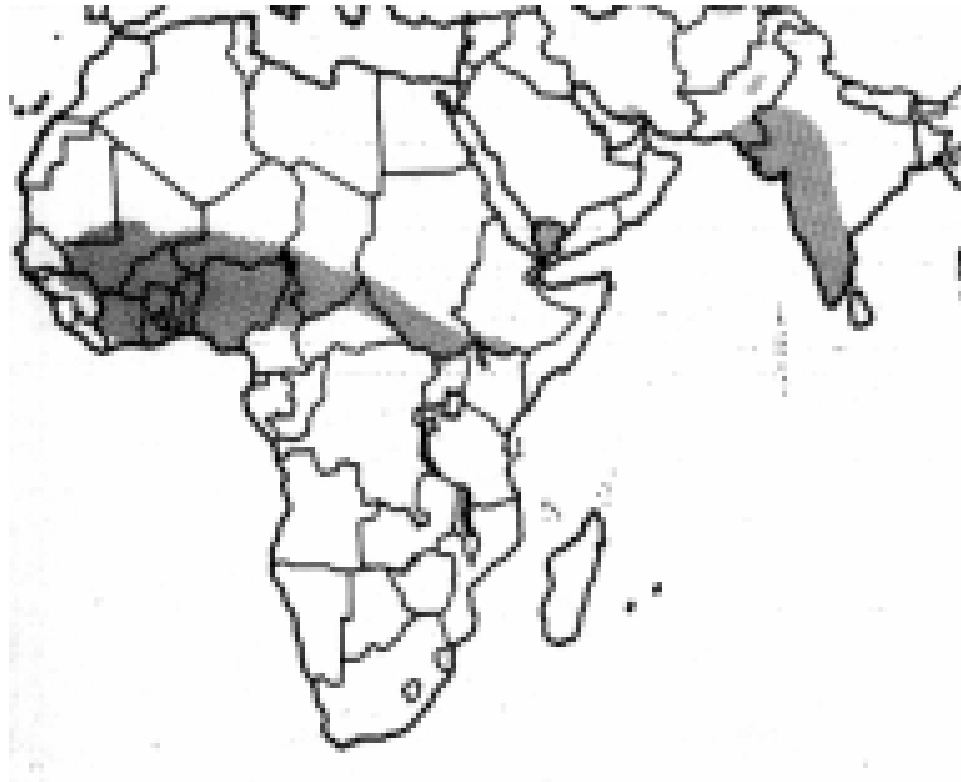
NTD's
PROMOTE
POVERTY

- Impairment of intellectual and physical development in children
- Adverse pregnancy outcome
- Reduced productive capacity/worker productivity

Africa's Major Waterborne NTDs

- Problem Solved – Guinea Worm
- Innovations Proposed – Schistosomiasis
- No Clue – Buruli Disease

Dracunculiasis – Guinea worm – geographical distribution 1980s



Dracunculus medinensis



▪
Release into water of Guinea worm
larvae – *Dracunculus medinensis*





Guinea worm – filtering drinking water to block transmission...the filter removes the copepods, Intermediate hosts

Dracunculiasis Elimination Program

- **The Second Disease to be eradicated**
 - **>99% Reduction in Disease**
 - **3.2 million cases in 1986**
 - **<100,000 cases in 2000**
 - **16,000 cases in 2006**
 - **Sudan and Ghana**

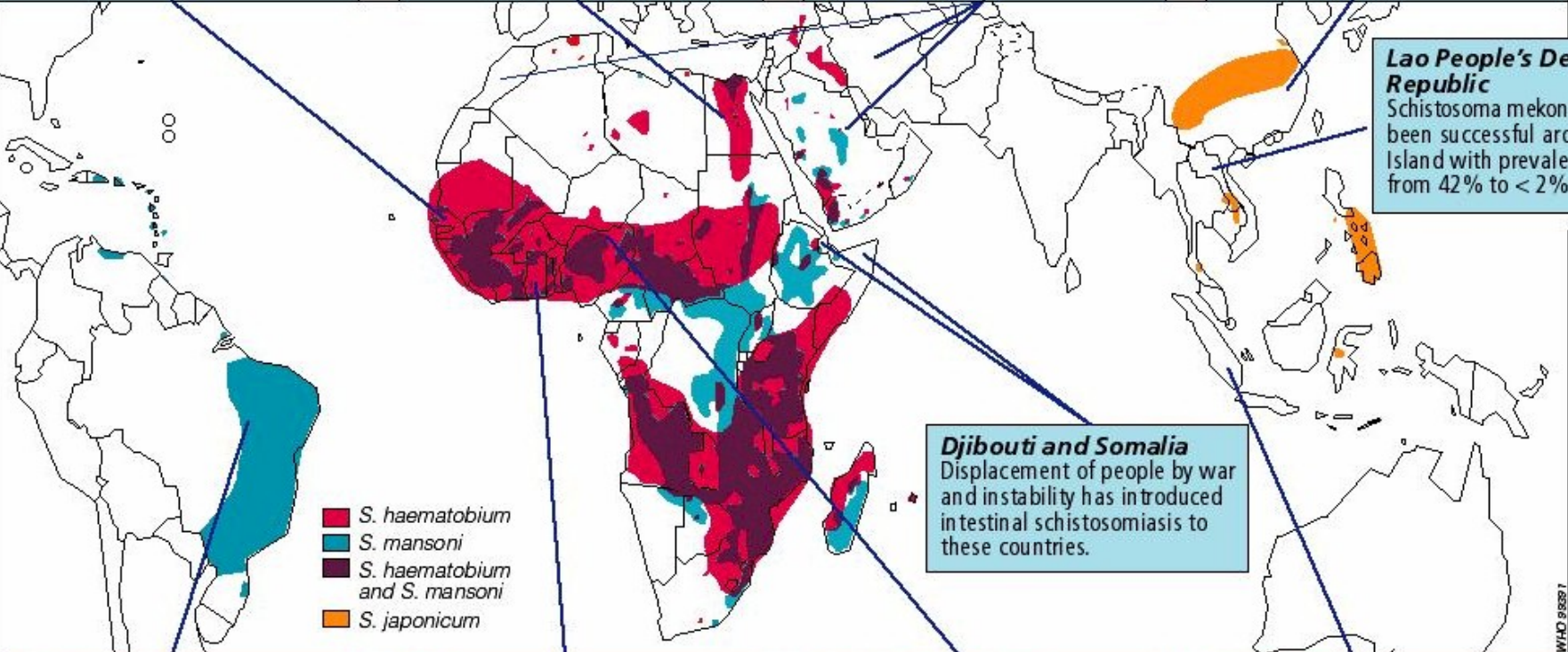
Global distribution of Schistosomiasis

Senegal
An epidemic of schistosomiasis along the senegal river basin caused by water-resource development schemes continues unabated.

Egypt
Praziquantel chemotherapy coupled to a vigorous media campaign has resulted in a significant decrease in the morbidity and prevalence of schistosomiasis infection.

Iran, Morocco, and Saudi Arabia
Schistosomiasis control has been successful in those areas with elimination of the infection contemplated.

China
Schistosoma continues to be a major public health problem in the lake and marshy regions despite successful control in other endemic areas.



Lao People's Democratic Republic
Schistosoma mekongi control has been successful around Khong Island with prevalence reduced from 42% to < 2%.

Djibouti and Somalia
Displacement of people by war and instability has introduced intestinal schistosomiasis to these countries.

North-east Brazil
Urban schistosomiasis now present in and around many major cities

Ghana
Intestinal schistosomiasis has increased due to the construction of the Akosombo Dam and other much smaller dams.

sub-Saharan Africa
More than 85% of the estimated 200 million people globally with schistosomiasis and the majority of patients with severe disease live on this continent.

Indonesia
Schistosomiasis has been controlled in the Lindu region of Sulawesi such that the prevalence of infection is lower than 2%.

Water contact during collective fishing



Blood in urine from African schoolchildren

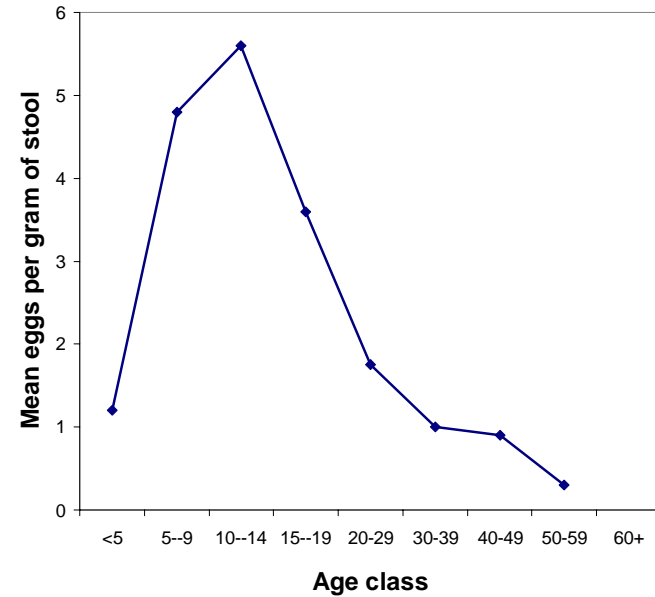


Rapid diagnosis of *S. haematobium*: Blood in urine

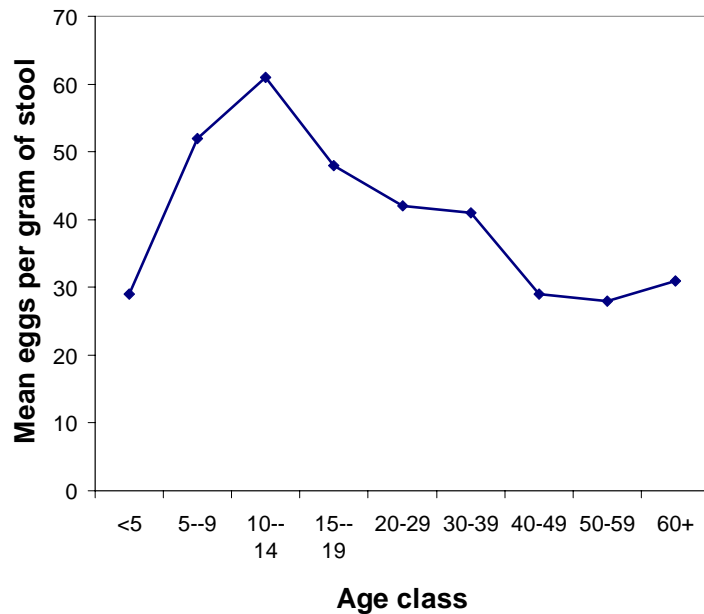


Age intensity profiles for schistosome infection

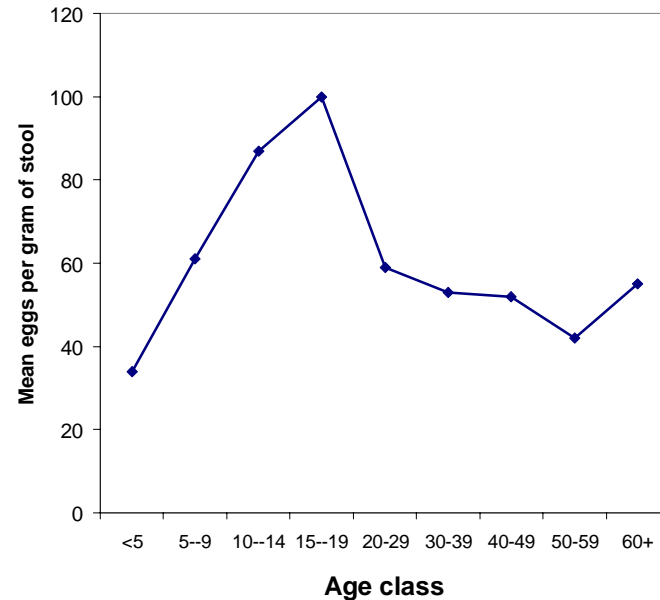
S. haematobium in Zimbabwe



S. mansoni in St. Lucia



S. japonicum in the Philippines



Schistosome Cercaria

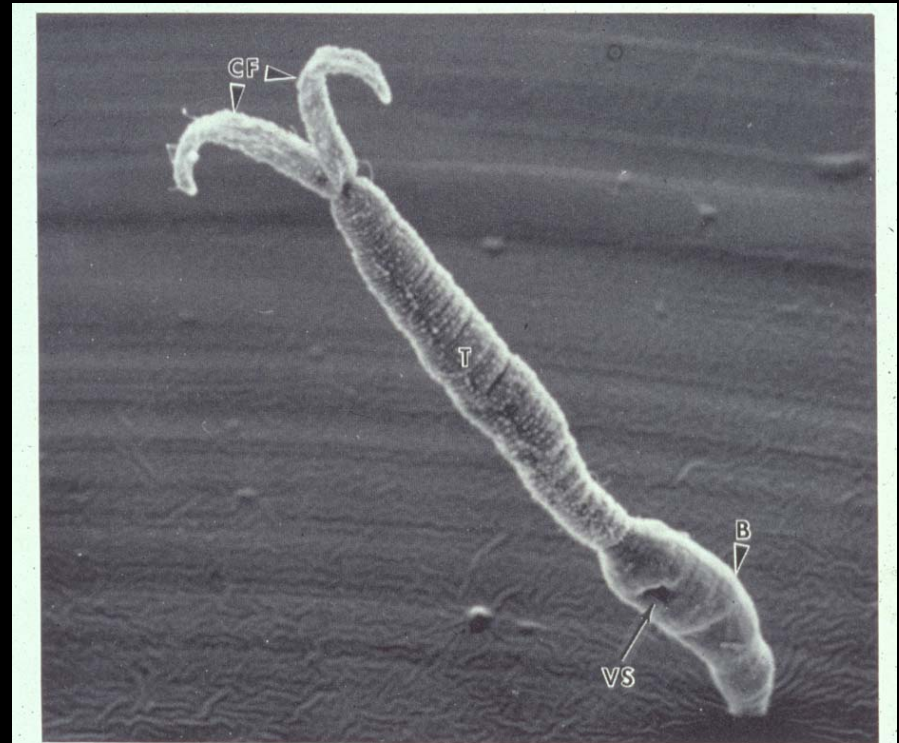
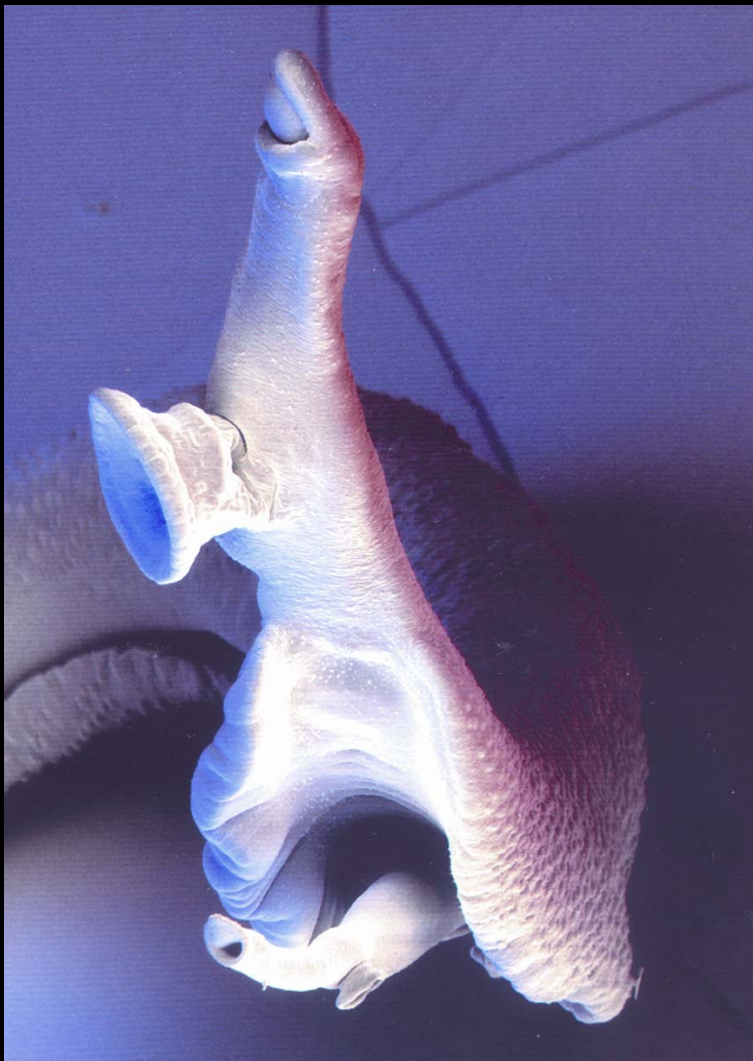
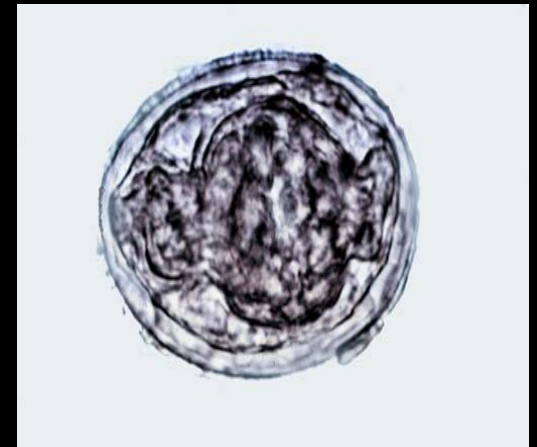
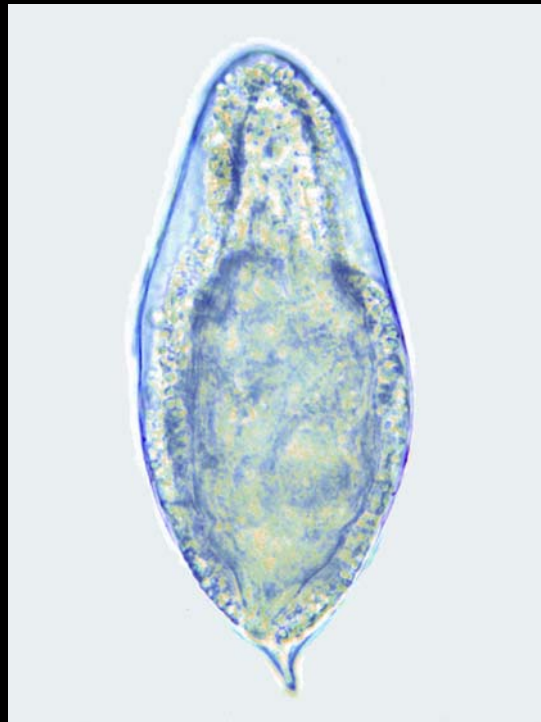
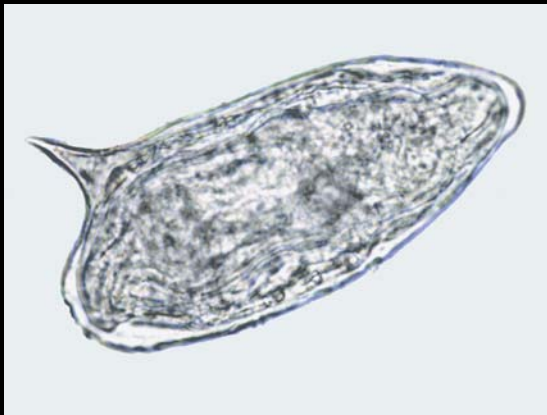


FIGURE 21.1. Cercaria of *Schistosoma mansoni* attached to the substrate by its oral sucker. B, body; VS, ventral sucker; T, tail, CF, caudal furcae. SEM. $\times 200$. (From McLaren, 1980. Original print courtesy of Dr. D. J. McLaren.)



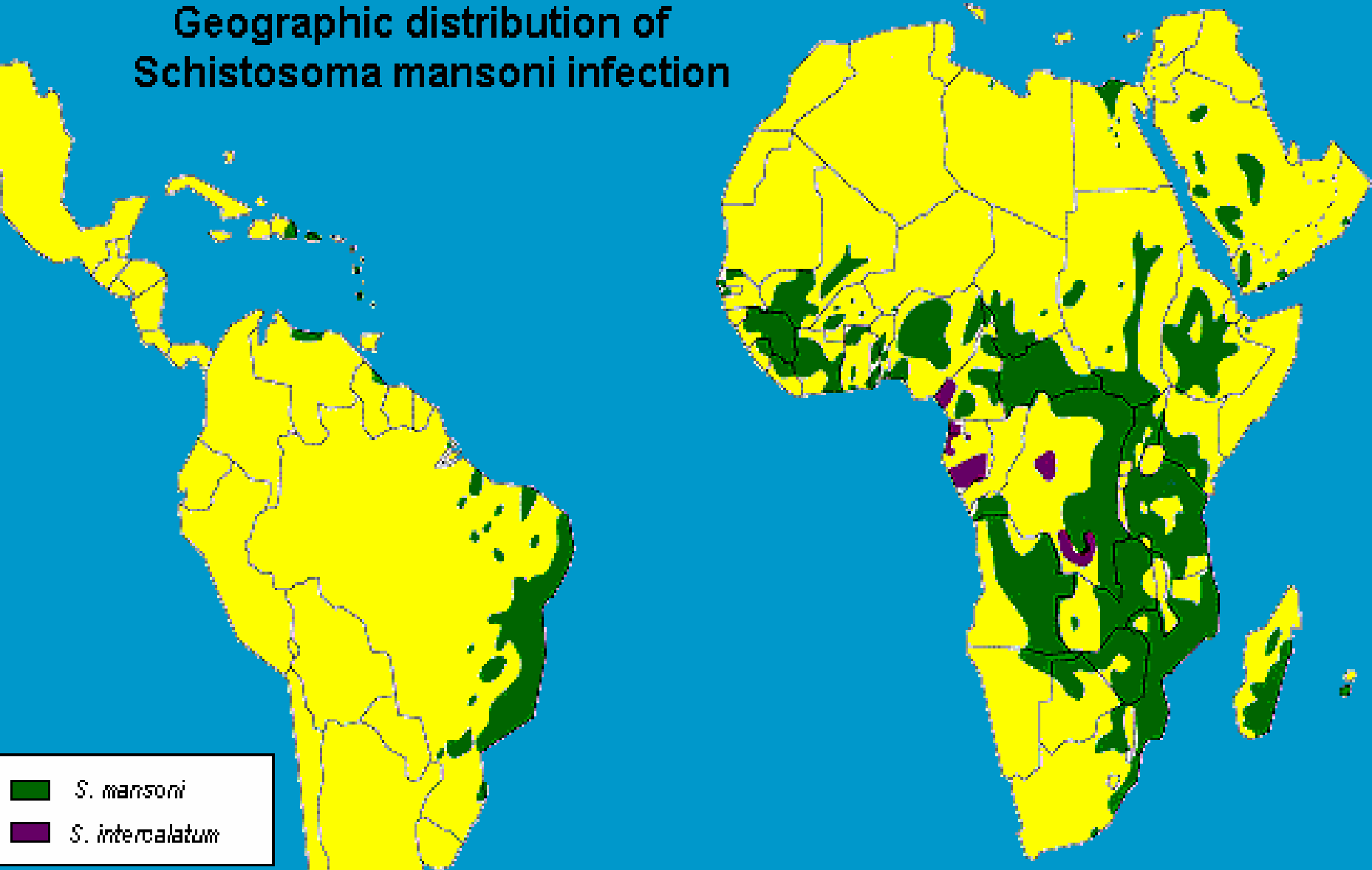
Schistosome Eggs



Infection and disease due to *S. Haematobium* in Sub-Saharan Africa

	Estimated no. (millions)
Infections	111
Haematuria (blood in urine)	70
Major bladder wall pathology	18
Major hydronephrosis	9.6
Death	0.2

Geographic distribution of Schistosoma mansoni infection



- *S. mansoni*
- *S. intercalatum*

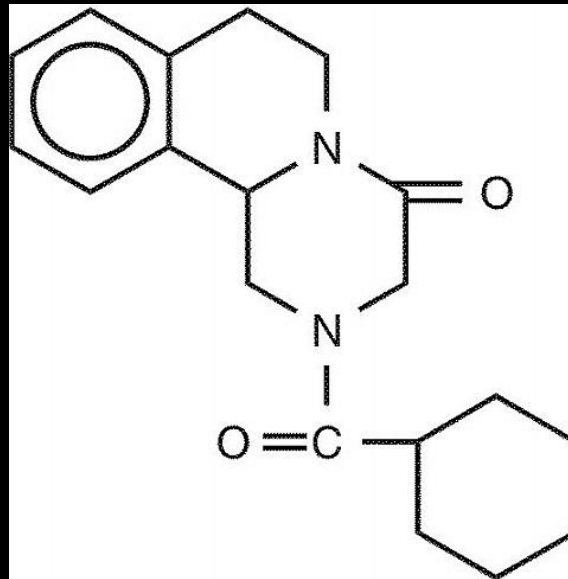


“Hidden” Burden of Disease

- Anemia
- Chronic Pain
- Growth Retardation
- Cognition and Memory Loss
- Impaired Child Development
- Increased Susceptibility to HIV/AIDS
- Rapid Progression of HIV/AIDS

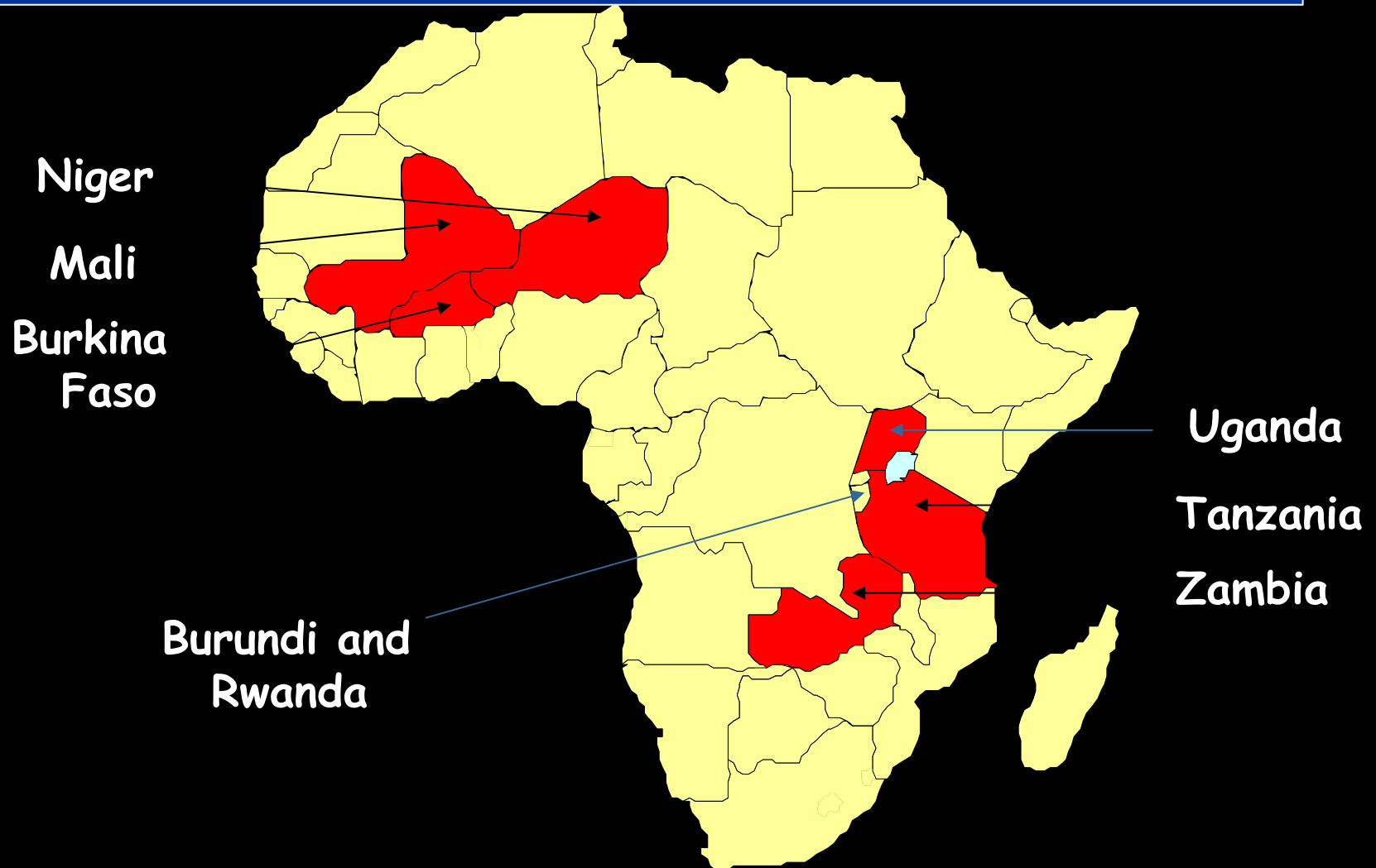
World Health Assembly Resolution 54.19

- **Goal of attaining a minimum target of regular administration of chemotherapy to at least 75% and up to to 100% of all school-age children at risk of morbidity by 2010**



Praziquantel

6 countries receiving SCI support to control
Schistosomiasis and intestinal helminths since 2003
+ Burundi and Rwanda added in 2007



The Partners



The Solution: the Rapid Impact Package

US \$0.50
all inclusive

DRUGS

+ delivery

+equipment

+health education materials

+Training of personnel

+Monitoring and Evaluation

US \$0.50 per person per year

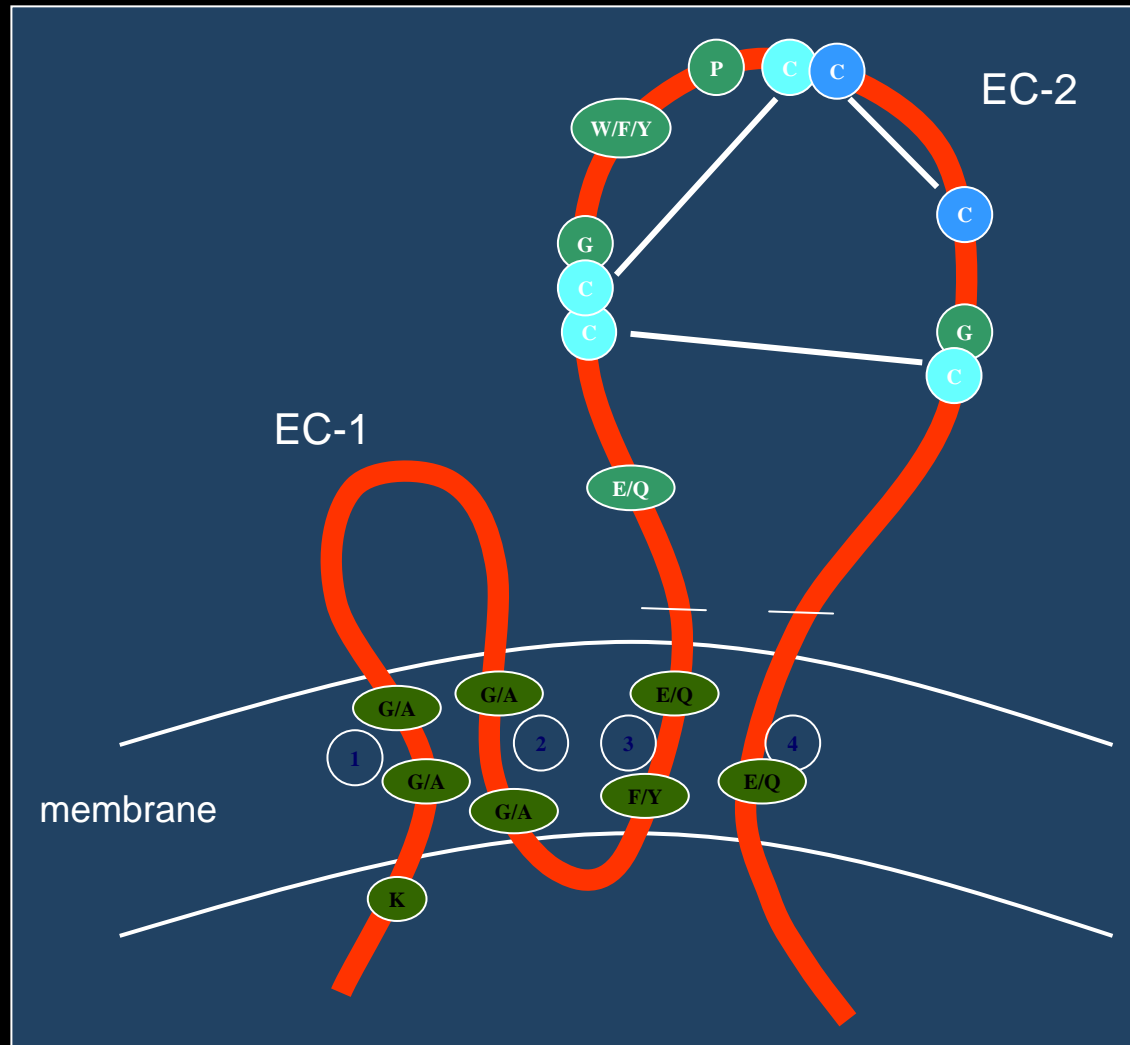
BIG SEVEN NTDs

- Trachomatiasis
- Taeniasis
- Scabies

Completed Genome Projects

- Buruli Ulcer
- Chagas Disease
- Human African Trypanosomiasis
- Leishmaniasis
- Leprosy
- Leptospirosis
- Lymphatic Filariasis
- Schistosomiasis
- Trachoma and Genital Chlamydia

Schistosome Tetraspanin Membrane Topology



TSP-1 - EC2
94 aa, 11kDa
3 S-S

TSP-2 - EC2
78 aa, 9kDa
2 S-S

Expressed and purified extracellular loop 2 as soluble fusion proteins with *E. coli* thioredoxin

Schistosomiasis

207 million cases worldwide
180 million in Africa
4.5 million DALYs
280,000 Deaths Annually

Bilhvax®

Sh28GST + Alum

Institut Pasteur

Clinical Trials Senegal/Niger

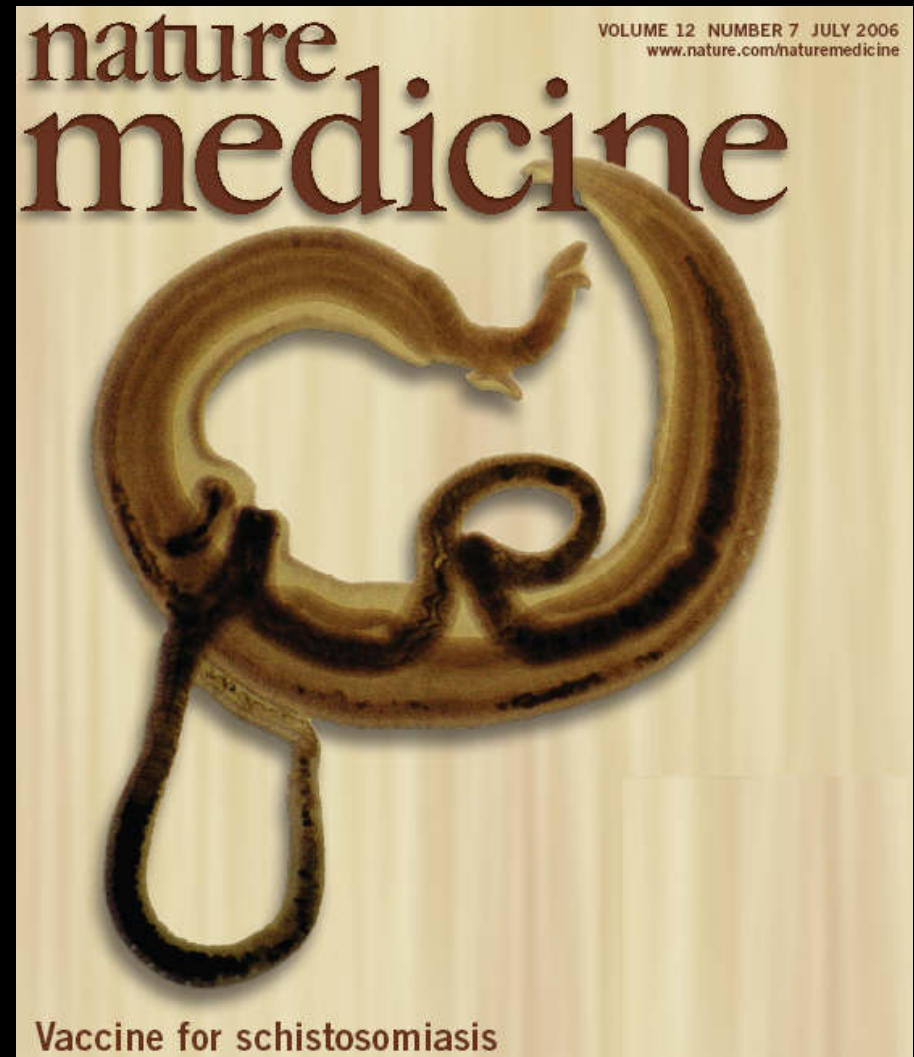
Sm-TSP-2

HHVI

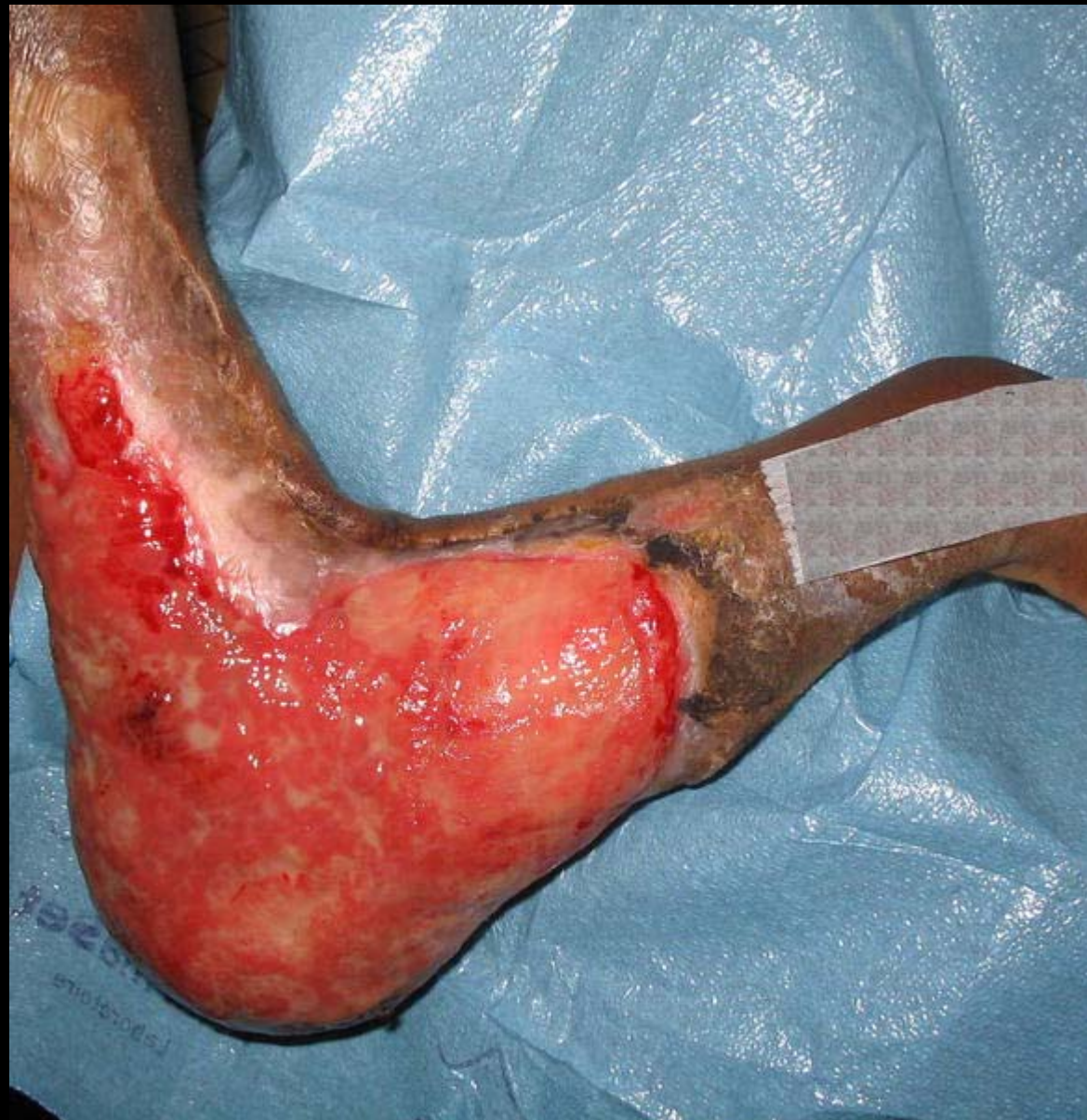
QIMR – Brisbane Australia

GWU-Sabin

FIOCRUZ-Cpqrr



Buruli Ulcer



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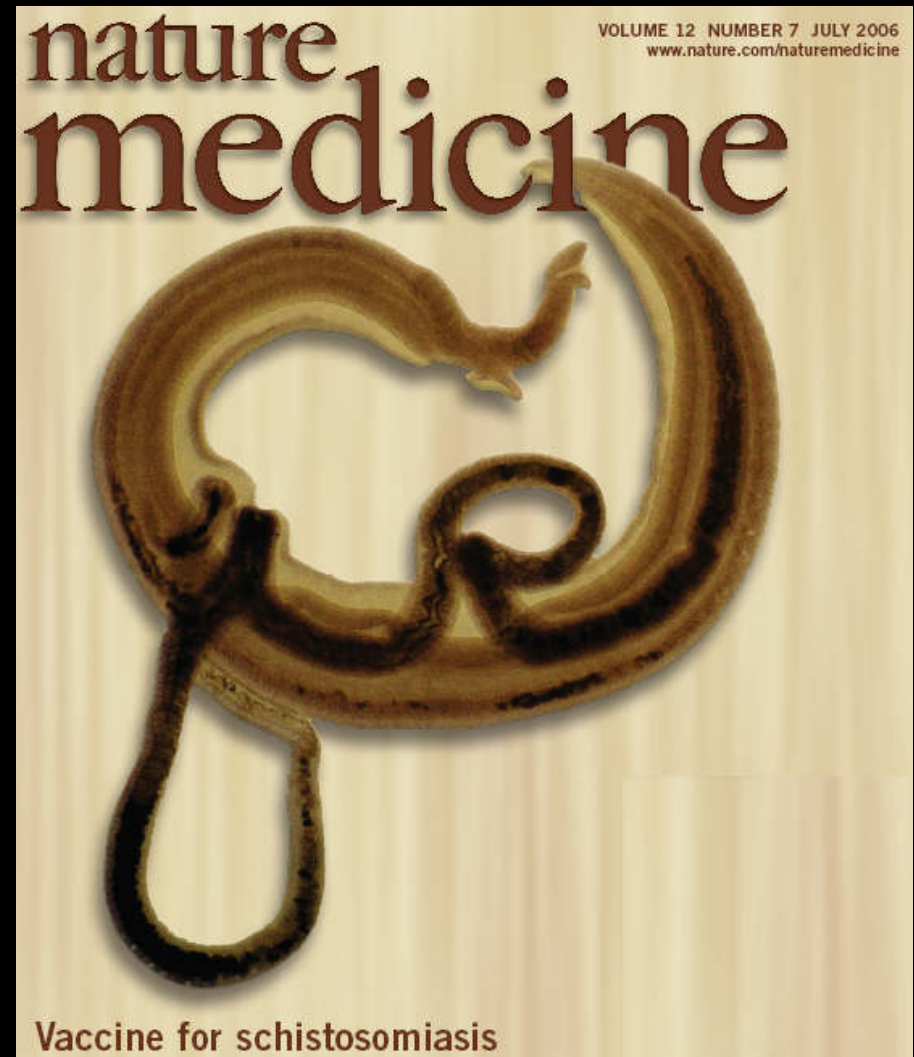
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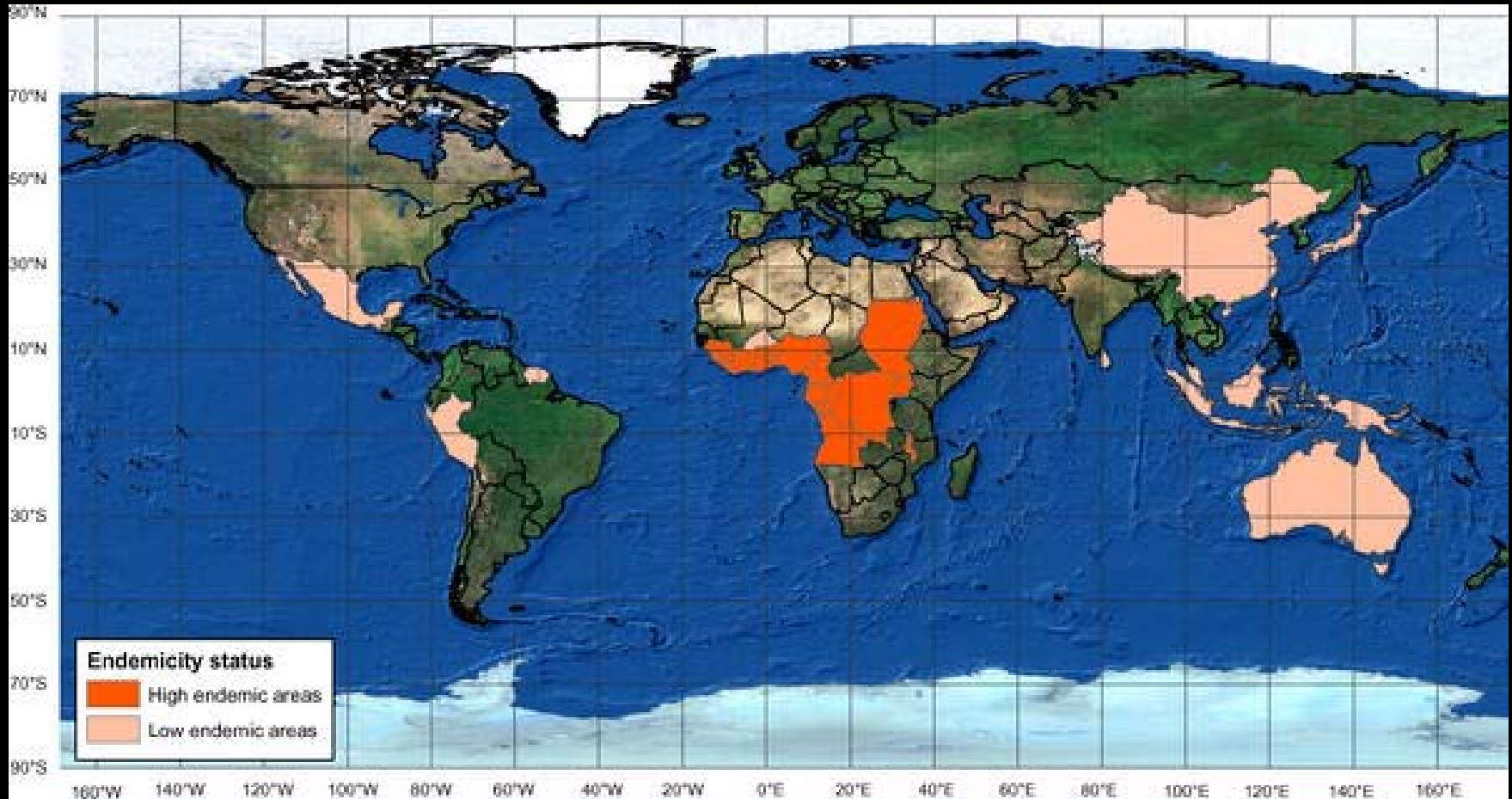
GWU-Sabin

FIOCRUZ-Cpqrr





Distribution of Buruli



Buruli Ulcer

- Vector borne disease?
- Neutralize Mycolactone Toxin?
- Phage display library?
- Vaccine – The ultimate orphan product?