Epidemiology of Infectious Tropical Diseases

François BRICAIRE
Pitié-Salpêtrière Hospital
Pierre et Marie Curie University
Paris - France

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1) Epidemiology of the main infectious tropical diseases
   - WHO priorities: HIV / TB / Malaria
   - Parasitic infections: Schistosomiasis, Leishmaniasis, Trypanosomiasis (Chagas +), Amoebiasis, Others...
   - Viral infections: Arbovirosis (Dengue, YF...)
   - Bacterial infections: Cholera, others...
2) Impacting factors: Natural, Human, Technical...
   Example
3) Vaccine capacity = Conclusion
HIV infected population Worldwide (2007)

Total Worldwide: ~ 33.2 million
About 14000 new HIV infections cases per day

More 95% cases in poor developing countries (DC)
- Women ≈ 60%
- 16-24 years old ≈ 50%

Prevalence in Africa = 6% - Senegal – Benin = 1-2%
- Austral Africa = 17% - 35% (Botswana)

Prevalence in pregnant women =
- Cameroun – Benin = < 5%
- Zambia – Kenya = > 15%

Life expectancy in Botswana =
65 y 1990 - 1995
56 y 1995 - 2000
40 y 2007

HIV infections observed are predominant in non B areas
Discrepancies in availability of first line regimens worldwide

No. of regimens used to treat 90% of patients

<table>
<thead>
<tr>
<th>Region</th>
<th>No. of Regimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>59</td>
</tr>
<tr>
<td>Western Europe</td>
<td>47</td>
</tr>
<tr>
<td>Western, Central &amp; Eastern Africa</td>
<td>3</td>
</tr>
<tr>
<td>South America</td>
<td>11</td>
</tr>
<tr>
<td>Southern Africa</td>
<td>3</td>
</tr>
<tr>
<td>Asia</td>
<td>3</td>
</tr>
</tbody>
</table>

Egger, 2007
Tuberculosis Worldwide

8-10 million cases of TB / year
3 million deaths / year
7% = cause of death in DC
2 Billion people at risk of TB and HIV infection +++

« R » : BMR ; XDR +++ (South Africa…)
500 000 ?
Malaria infected population

- 2 billion exposed people
- 350-550 million clinical cases
- 50% children
- 1.5-2 million death cases

R. Snow 2005

« Yet recently malaria has been dramatically reduced in some parts of Africa by increasing deployment of anti mosquito measures and new artemisinin combined treatment »

BM Greenwood The J. of Clinical Investigation 2008 118-4,1266-1278
Risk of Entomologic inoculation


Malaria transmission: Number of monthly transmission cases over one year period
The national falciparum prevalence (NfP) cartogram for 2002. These continuous area cartograms were generated using MAPresso (http://www.mapresso.com), a public domain Java applet.

Schistosomiasis

- Second endemic parasitosis: dam...
- > 70 countries; > 200 Million infected people
- Mortality: 700,000 - 800,000 / y
- *S. haematobium* = Africa – Middle-East
- *S. mansoni* = Africa – South America
- *S. intercalatum* = Central Africa
- *S. japonicum*; *S. mekongi* = Asia
Schistosomiasis

Schistosomiasis in the World

Schistosoma haematobium et Mekongi

Schistosoma Mansoni
Leishmaniasis

- Leishmania: *L. donovani-infantum*  
  *mexicana-guyanensis*...
- Population at risk = 350 Million
- N cases = 12 Million
- 88 countries: 66 Old World – 22 New World
- Phlebotomes
- Visceral = Kala-azar = 500 000 / y
- Cutaneous = 1-1.5 Million / y
- Tt = Antimoniate – Pentamidine – Ampho B – Itraconazole..
Leishmaniasis

L. Infantum
L. major
L. donovani
L. tropica
L. aethiopica
L. archibaldi

× Coinfection Leishmania - VIH en augmentation
× Coinfection Leishmania - VIH en diminution
A Adénopathie isolée signalée
M Formes muqueuses signalées
D Formes cutanées diffuses signalées
P Formes cutanées post-kala-azar signalées
Leishmaniasis

L. mexicana
L. amazonensis
L. braziliensis
L. panamensis
L. guyanensis
Cas sporadiques
Trypanosomiasis

- Africa: « sleeping sickness » 36 countries
- *T. gambiense* – *T. rhodesiense*
- « Tsé-Tsé fly » - *Glossina*
- 250 000/y?
- Forest
- Arsenic derivatives - Pentamidine - Eflornithine
Trypanosomiasis

- America (Central - South); Chagas
- *T. cruzi*
- Arthropodes: Triatomines
- 16 – 18 million
- 300,000 new cases / Y
Initiative of « south cone » countries

Eradication of the transmission by *Triatoma infestans*

- Uruguay 1997
- Chili 1999
- Brasil 2006
- 6/20 Argentina’s provinces
- 1/12 Paraguay region
- Just a few bolivian areas

Decrease in prevalences in argentin soldiers (18 y)

### Inter-countries Initiatives

#### Central America Countries Initiative, (IPCA)

- Good results on *Rhodnius prolirus*,
- Less good on *Triatoma dimidiata*
- Cover for blood screening = >90%
- Except: Mexico, Panama Costa Rica (< 35%)

#### Andin Countries Initiative (IPA)

- Disappointing results of the anticarrier fight
- Infections rate: not very high among childrens (1 à 4%)
- Cover for blood screening = >99%

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(Guhl F. Mem Inst Oswaldo Cruz 2007; 102(Suppl. 1): 29-37 ; Ponce C. Mem Inst Oswaldo Cruz 2007; 102(Suppl. 1): 41-44)
## Persistence of congenital tract

- **Dominating Transmission tract**: important human source
- **Issue**: birth diagnostic
- **Treatment long, expansive; no pédiatrique presentations**

<table>
<thead>
<tr>
<th>Countries</th>
<th>Samples</th>
<th>Mother's Prévalences</th>
<th>Congenital Transmission rate</th>
<th>Incidence rate / 1 000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina (Blanco, 2000)</td>
<td>16842</td>
<td>5,5%</td>
<td>6,7%</td>
<td>3</td>
</tr>
<tr>
<td>Bolivia (Torrico, 2004)</td>
<td>1606</td>
<td>27,6%</td>
<td>4,9%</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>3879</td>
<td>17,3%</td>
<td>5,9%</td>
<td>10</td>
</tr>
<tr>
<td>Bolivia (Salas, 2007)</td>
<td>2712</td>
<td>42,2%</td>
<td>6,0%</td>
<td>26</td>
</tr>
<tr>
<td>Brasil (Bittencourt, 1985)</td>
<td>2651</td>
<td>8,5%</td>
<td>1,1%*</td>
<td>1*</td>
</tr>
<tr>
<td>Chili (Garcia, 2001)</td>
<td>938</td>
<td>7,8%</td>
<td>1,4%</td>
<td>1*</td>
</tr>
<tr>
<td></td>
<td>5495</td>
<td>1,4%</td>
<td>3,9%*</td>
<td>0,5*</td>
</tr>
<tr>
<td>Paraguay (Russomando, 1998)</td>
<td>1862</td>
<td>9,1%</td>
<td>3,0%</td>
<td>3</td>
</tr>
<tr>
<td>Uruguay (Sarasua, 1986)</td>
<td>2303</td>
<td>8,3%</td>
<td>1,6%</td>
<td>1</td>
</tr>
<tr>
<td>Peru (Mendoza, 2005)</td>
<td>3139</td>
<td>0,7%</td>
<td>0%</td>
<td>-</td>
</tr>
</tbody>
</table>

## Transfusional Transmission

<table>
<thead>
<tr>
<th>Countries</th>
<th>Risk to receive a infected unit / 10 000 donations</th>
<th>Risk to become infected / 10 000 donations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peru</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bolivia</td>
<td>138</td>
<td>28</td>
</tr>
<tr>
<td>Brasil</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Chili</td>
<td>2,5</td>
<td>0,5</td>
</tr>
<tr>
<td>Paraguay</td>
<td>4</td>
<td>0,7</td>
</tr>
<tr>
<td>Argentina</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Uruguay</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

A difficult Eradication

A resisting area

CHACO:

Bad results of anticarriers fight
Residual Resistance
New infestation

(Gürtler R. *PNAS* 2007; 104(41): 16194-16199)
Deaths / y = 50 000

Mortality at 10 y =
High CV risk = 84%
Low CV risk = 10%

Cardiac annual progression rate = 2 à 5%

Annual rate sudden death = 6 à 9/1000

(Rassi A. Arq Bras Cardiol 2001; 76(1): 86-96 ; Rassi A. Circulation 2007; 115(9): 1101-1108)
Treatment Efficacy
Benznidazole vs placebo

Spain:  300,000 immigrants from 8 countries in 2002. Minimum prevalence: 0.87%
240,000 immigrants in 2003 from mainly Bolivia and Paraguay. Minimum prevalence: 2.7%

Illegal immigration: 2002: 550,000 tourists entered from 17 L.A: countries and 86,000 left. 101,432 tourists from Ecuador entered and only 8 left.
Amaebiasis

- Previously = Second parasitic infection after malaria
- = 10% world population
- Today: \( E.\text{histolytica} \neq E.\text{dispar} \)
- Prevalence Africa – Asia- S.America
  \( E.\text{histolytica} = 2\% \)
  \( E.\text{dispar} = 10\% \)
Epidemiology: Other Parasitic Diseases

- Ascaridiosi = 1.5 Billion
- Ankylostomiasis = 1.3 Billion
- Onchocercosis = 18 M (Africa ++ - Central America)
- Lymphatic filariasis = 120 M
- Cysticercosis = ++ , N = 20 M ? , 50 000 deaths
  
Asia - Africa - Central - South America

Cerebral Cysticercosis
Arbovirosis

DENGUES: +++

- Flavivirus: 1 to 4
- Aedes
- Endemo-epidemic intertropical area
  - 60-100 Million/y; 500 000 Serious forms
  - West Indies (2007) –South America
  - Pacific area (Tahiti...)
- Minor ++ but hemorrhagic forms

Chikungunya = India, Malaisia...
Cases of dengue reported in 8 Asian countries 1991-2007

*Birmanie Cambodge Indonésie Laos Malaisie Singapour Thaïlande Vietnam Sources OMS Ministères de la santé des pays concernés
Dengue: Mortality in Cambodia; 1991 - 2004

Source OMS [http://www.wpro.who.int/sites/mvp/epidemiology/dengue/cam_profile.htm]
Monthly cases of Dengue in Thailand 2003-2006

Yellow Fever

- Africa – South-America
- *Aedes aegypti*
- 2005 Africa (12 Countries): 206,000 cases; 52,000 †
  Africa: Liberia, Central african Rep., Ivory Coast
- Just after Monkeys
  epizootye ++
- Mortality: 20-30%
- Vaccine +++
Choléra 2008
Bacterial Infections

- **Cholera**: 
  - Africa ++: Senegal – Ivory Coast (2007)

- **Salmonellosis**: \( \Delta \) «R» FQ +++

- **Cerebrospinal Meningitis**: Africa +++: → Equatorial Africa
  - Burkina Fasso, Mali, Niger...

- «Buruli» ulcer: *M.ulcerans*; 3rd mycobacteriosis infection;
  - Emergence: WHO 1998 ++
  - Intertropical areas
  - Stagnant water contacts; Short clothes
  - Neglected wounds

- .../...
Recurring outbreak: Yellow fever
Extending: Cholera (Africa)
  - Cerebrospinal meningitis
  - Tuberculosis
  - Buruli ulcer
Declining: Filariosis, Onchocercosis
  - Tetanos
  - Leprosis
  - Poliomyelitis
Emerging: HCV
  - Arbovirosis
Impacting Factors

- Natural factors: - Climate (global warming), Disasters...
- Human factors: - Actions: Ecologic: Deforestation, Urbanization ++ Dam construction
  - Breeding, Food manufacturing
  - Wars .../...
  - Host’s predisposition: ID, Malnutrition
  - Political will
- Survey
- Diagnosis means, Screening
- Means to fight:
  - Hygiene measures
  - Vectors: Larval spots, old tyres...
  - Antiinfectious drugs: Antibiotics; Antiparasitics (praziquantel, albendazol, nitroimidazol)...
Arbovirosis - Climate
Malaria Transmission Seasonal - Permanent

Number of months of suitable climate
- No transmission in average year
- 1 - 3 months: Epidemic or strongly seasonal
- 4 - 6 months: Endemic and seasonal
- 7 - 12 months: Endemic and perennial

Lakes
Reaching the people left behind

Bangkok – 1 February 2007

“The fight against neglected tropical diseases is an initiative aimed at the poorest people. A strategy against poverty.”

Dr Margaret Chan
Neglected Tropical Diseases

Innovative and Intensified Disease Management
- African trypanosomiasis
- Chagas disease
- Buruli Ulcer
- Leishmaniasis

Preventive Chemotherapy and Transmission control
- Dracunculiasis
- Lymphatic filariasis
- Onchocerciasis
- Shistosomiasis
- Soil transmitted helminthiasis

Integrated Vector Management
- Dengue
- Others
- Others

Others
Inter-Country Initiatives

**INCOSUR** was created in Brasilia in 1991 by the Ministers of Health of Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay.

**IPA** was created in Bogota in 1997 by the Ministers of Health of Colombia, Ecuador, Peru and Venezuela.

**IPCA** was created in Tegucigalpa in 1997 by the Ministers of Health of Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua and Panama.

**AMCHA** was created in 2005 by the Ministers of Health of Bolivia, Brazil, Colombia, Equator, French Guyana, Guyana, Peru, Surinam, Venezuela.
Chagas Disease

Intensive Actions

- Fights Against Vectors
- Fight against Blood transmission MTCT
- Take care of acute and chronic cases
- Monitoring

Key to success: +++
« Here is a massive destruction weapon that nobody cares about »
Beware of dengue fever

ACT NOW
Available Vaccines

- Virus ++: Poliomyelitis, Yellow Fever
  But: HIV !!!

- Bacteria: more complex = BCG, Cholera, Typhoid

- Parasitic diseases = Highly complex
  - Malaria !...
  - Others = 0
Vaccine against malaria?

- **Anti sporozoïtes, anti hépatic stages?**
  - CSP recombinant or synthétique 1987: no
  - RTS, S/AS02: 1997-2004 (P. Alonso): study ongoing
  - LSA3

- **Anti mérozoïtes?**
  - SPf66 (M. Patarroyo) 1988-1996: no
  - MSP3 LSP (P. Druilhe) 1994-2005: study² ongoing

- **Anti gamétocytes? Altruist...**
  - Pfs25 (R. Carter) 2001

In 5 years? In 10 years? …?

But: « Mosquirix » Phase II: study ongoing

Acknowledgments

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Parasitology – Mycology Unit
Pitié-Salpetrière Hospital-Paris-France