

Vector Borne Infectious Diseases

Vectors Of Disease

Arthropods

Arachnids

Acarina

Insects

Diptera

Hemiptera

Anoplura

Siphonaptera



Ticks and Mites



Bugs



Fleas



Flies



Lice

Agents Transmitted By Vectors

Viruses

Rickettsia

Bacteria

Protozoa

helminths

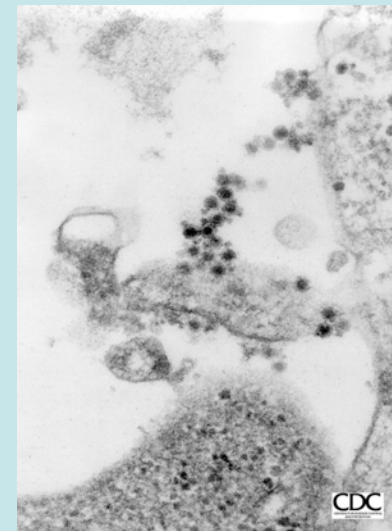
Agents Transmitted By Vectors:

Viruses

*More Than 600 Different
Viruses Are Transmitted
By Arthropods*



Culex pipiens



West Nile Virus

Diseases Transmitted By Arthropods

Viruses

Yellow Fever

Dengue Fever

Rift Valley Fever

Encephalidides:

Japanese Encephalitis

Dengue Fever

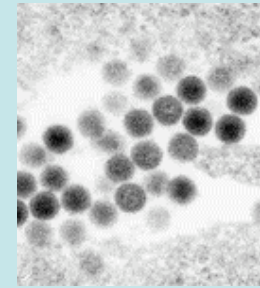
West Nile Encephalitis

Eastern Equine Encephalitis

Western Equine Encephalitis

La Crosse Encephalitis

St. Louis Encephalitis

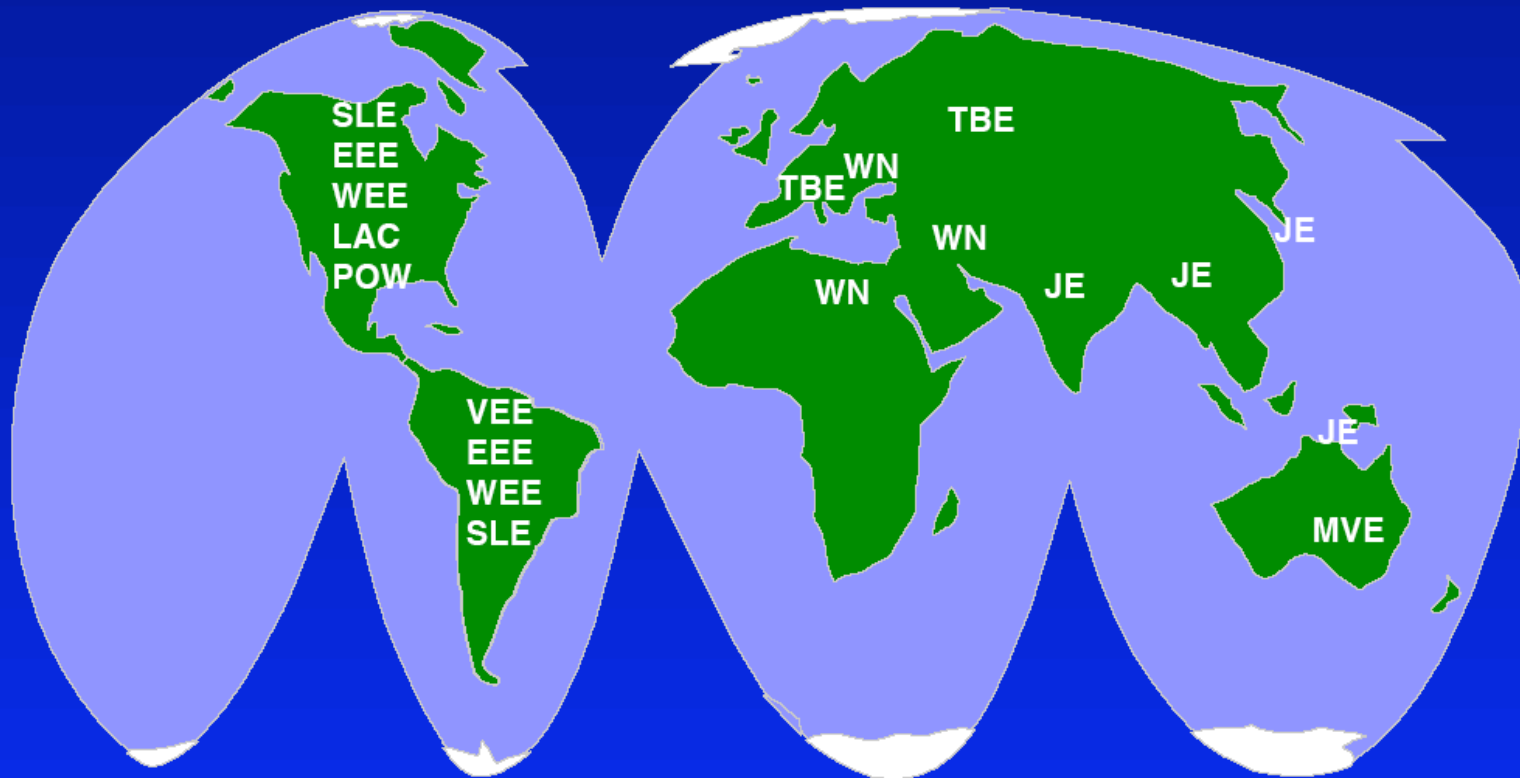


Rift Valley Fever Virus



Anopheles stephensi

Worldwide Distribution of Major Arboviral Encephalitides



EEE: Eastern equine encephalitis
JE: Japanese encephalitis
LAC: LaCrosse encephalitis
MVE: Murray Valley encephalitis
POW: Powassan encephalitis

SLE: St. Louis encephalitis
TBE: Tick-borne encephalitis
WEE: Western equine encephalitis
WN: West Nile encephalitis
VEE: Venezuelan equine encephalitis

Agents Transmitted By Vectors:

Rickettsia And Bacteria

Bacteria And Rickettsia*



Pediculus humanus humanus



Ixodes scapularis

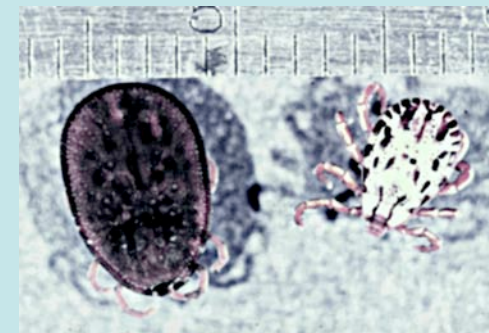
- Rickettsia akari*
- Rickettsia mooseri*
- Rickettsia prowazokii*
- Rickettsia rickettsia*
- Rickettsia typhi*
- Rickettsia tsutsugamuchi*
- Ehrlichia sp*
- Yersinia pestis*
- Borrelia burgdorferi*
- Borrelia recurrentis*



Trombicula alfreddugesi



Xenopsyla cheopis



Soft Tick

Hard Tick

*Many are zoonotic infections

Agents Transmitted By Vectors:

Protozoa

Protozoans

Babesia microti

Babesia divergens

Plasmodium falciparum

Plasmodium malariae

Plasmodium ovale

Plasmodium vivax

Leishmania braziliensis

Leishmania chagasi

Leishmania donovani

Leishmania infantum

Leishmania major

Leishmania mexicana (many subspecies)

Leishmania tropica

Trypanosoma cruzi

Trypanosoma brucei gambiense

Trypanosoma brucei rhodesiense

Mosquitoes



Anopheles stevensi



Anopheles freeborni



Anopheles dirus

Kissing Bugs



Rhodnius prolixus

Protozoans

Babesia microti

Babesia divergens

Plasmodium falciparum

Plasmodium malariae

Plasmodium ovale

Plasmodium vivax

Leishmania braziliensis

Leishmania chagasi

Leishmania donovani

Leishmania infantum

Leishmania major

Leishmania mexicana (many subspecies)

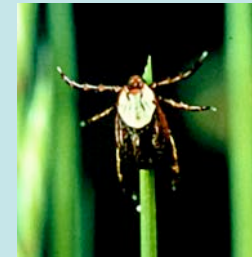
Leishmania tropica

Trypanosoma cruzi

Trypanosoma brucei gambiense

Trypanosoma brucei rhodesiense

Ticks



Dermacentor andersoni

Sandflies



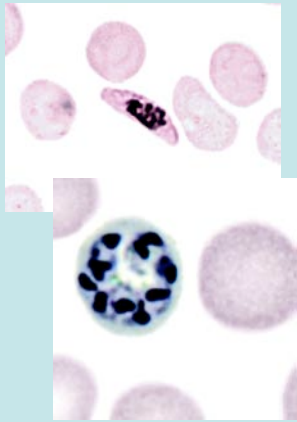
Phlebotomous papatasi

Tsetse Flies



Glossina palpalis

Protozoans



Babesia microti

Babesia divergens

Plasmodium falciparum

Plasmodium malariae

Plasmodium ovale

Plasmodium vivax

Leishmania braziliensis

Leishmania chagasi

Leishmania donovani

Leishmania infantum

Leishmania major

Leishmania mexicana (many subspecies)

Leishmania tropica

Trypanosoma cruzi

Trypanosoma brucei gambiense

Trypanosoma brucei rhodesiense

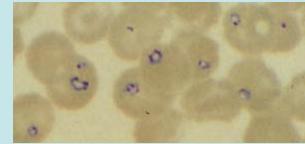
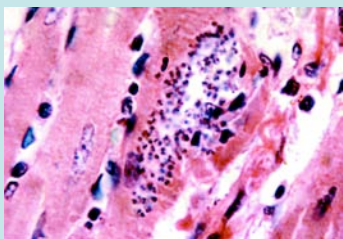


Photo: CDC



Agents Transmitted By Vectors:

Helminths

Helminths

Wuchereria bancrofti

Brugia malayi

Mansonella ozzardi

Mansonella perstans

Mansonella streptocerca

Onchocerca volvulus

Loa loa

Helminths



← *Wuchereria bancrofti*

Brugia malayi →

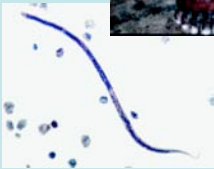
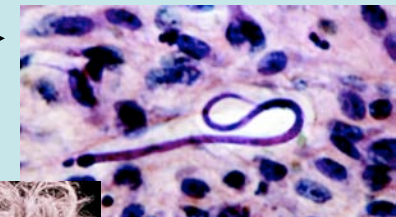
Mansonella ozzardi

Mansonella perstans

Mansonella streptocerca

Onchocerca volvulus →

Loa loa



Helminths



Mosquitoes



Biting Midges

Wuchereria bancrofti

Brugia malayi

Mansonella ozzardi

Onchocerca volvulus

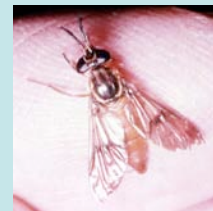
Mansonella perstans

Mansonella streptocerca

Loa loa



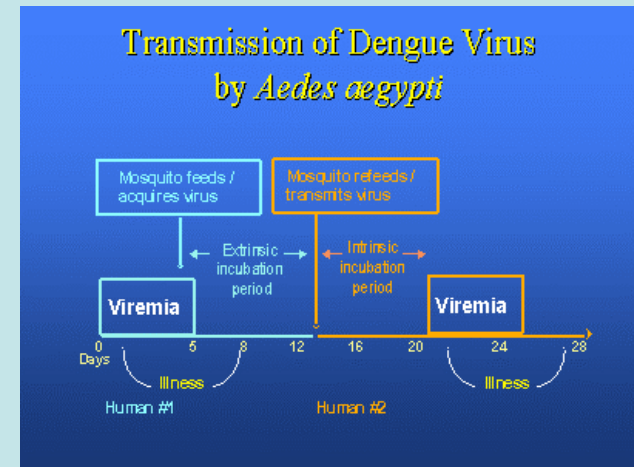
Blackflies



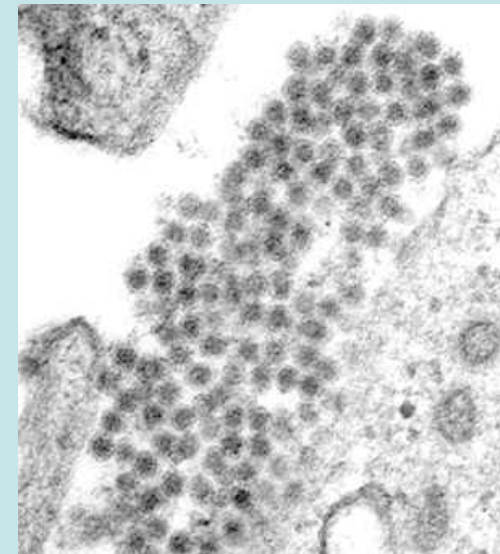
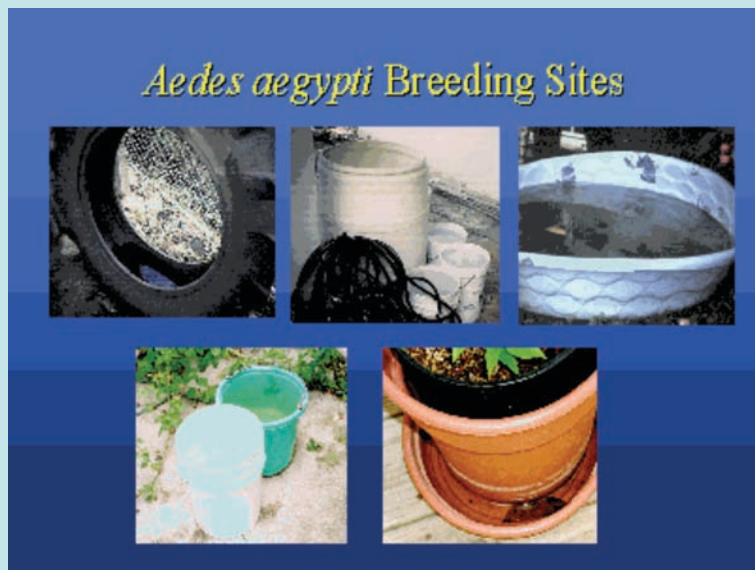
Tabanid Flies

Agents Transmitted By Vectors:

Viruses



Dengue Fever



World Distribution of Dengue - 2000

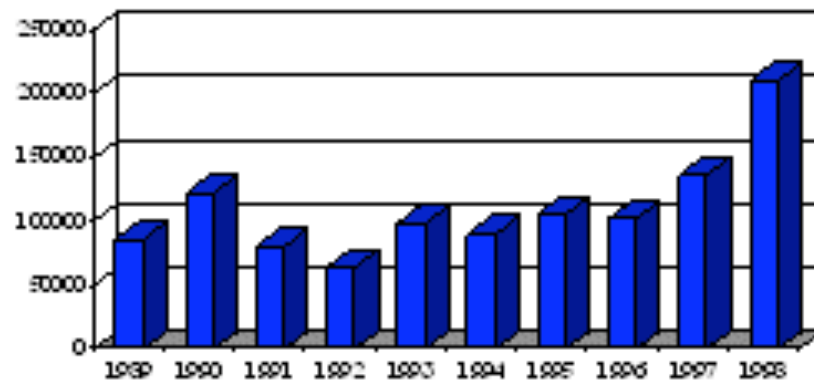


- Areas infested with *Aedes aegypti*
- Areas with *Aedes aegypti* and dengue epidemic activity

Dengue Is On The Rise

Reported Cases of Dengue/DHF

South-East Asia Region*

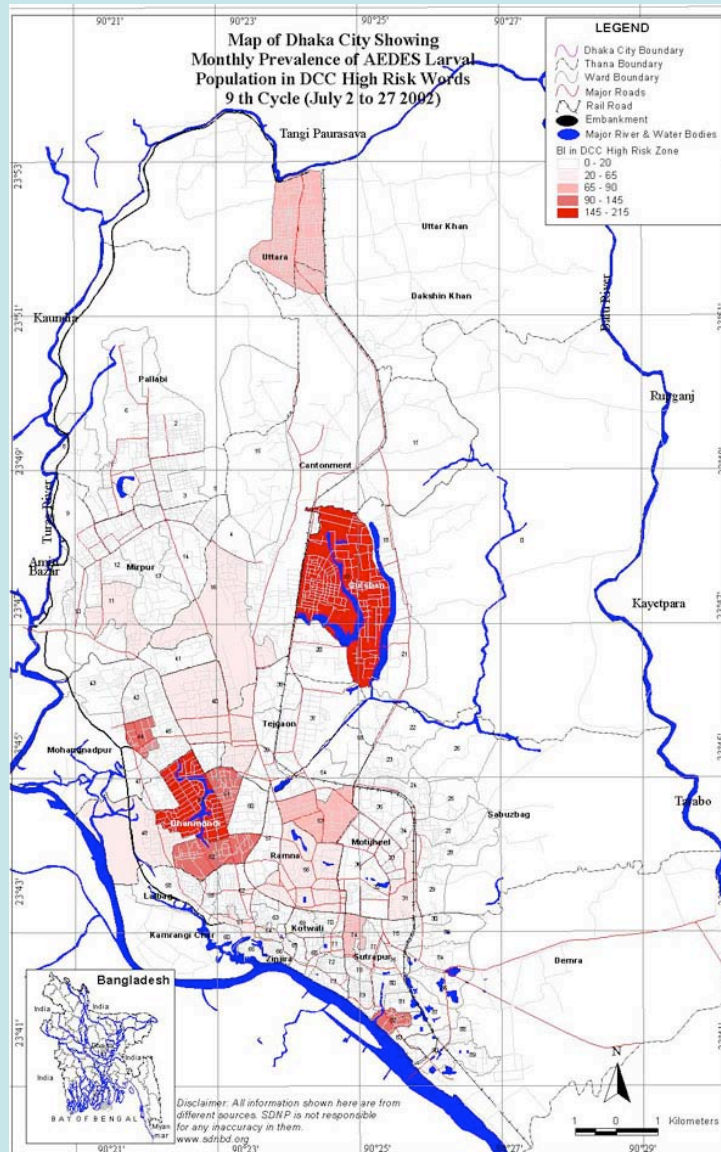


*Countries included in this WHO region (SEARO)

Bangladesh, Bhutan, Democratic People's Republic of Korea, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand



Distribution Of Dengue Transmission In Dhaka



Aedes aegypti

Dengue Outbreak 2000 in Bangladesh Urban Areas

- Death: over 100 including doctors
- Affected: over 10,000
- Risk: those affected in 2000 are likely to be vulnerable to other 3 serotypes in 2001...
- Prevention: collective and not individual effort in each locality
- Clinical Guide: WHO Guidelines

Vector control

Environmental management

1. Environmental modification
2. Environmental manipulation
3. Changes to human habitation or behaviour

Environmental management

- Improvement water supply
- Solid waste management
- Modification man-made larvae habitats
- Chemical control
- Biological control

Protozoans

Babesia microti

Babesia divergens

Plasmodium falciparum

Plasmodium malariae

Plasmodium ovale

Plasmodium vivax

Leishmania braziliensis

Leishmania chagasi

Leishmania donovani

Leishmania infantum

Leishmania major

Leishmania mexicana (many subspecies)

Leishmania tropica

Trypanosoma cruzi

Trypanosoma brucei gambiense

Trypanosoma brucei rhodesiense

The Malarias

Plasmodium falciparum

Plasmodium vivax

Plasmodium ovale

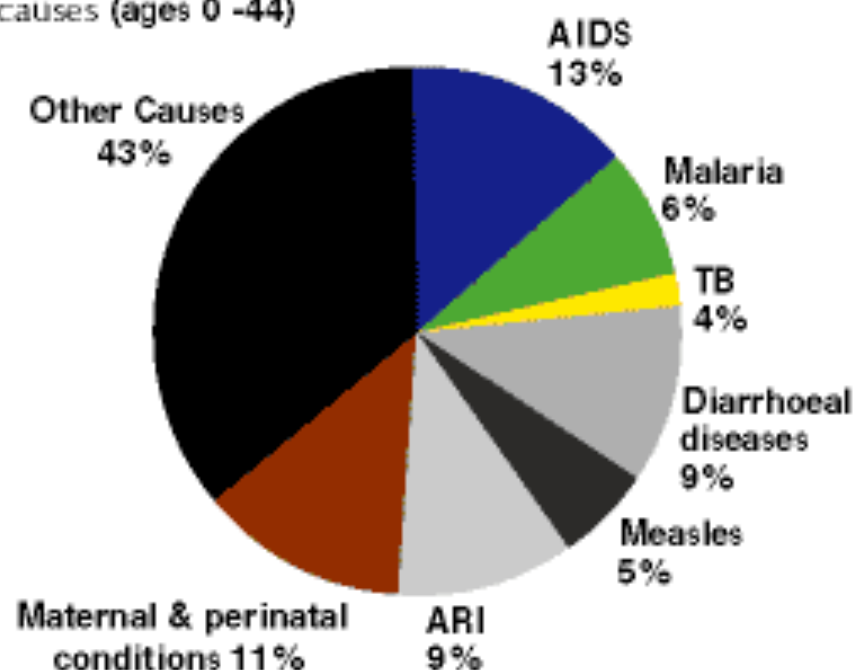
Plasmodium malariae

*Within The Last 100 years, As
Many People Have Died
Throughout The World From
Malaria As Now Live Within The
United States*



DEATHS IN DEVELOPING COUNTRIES

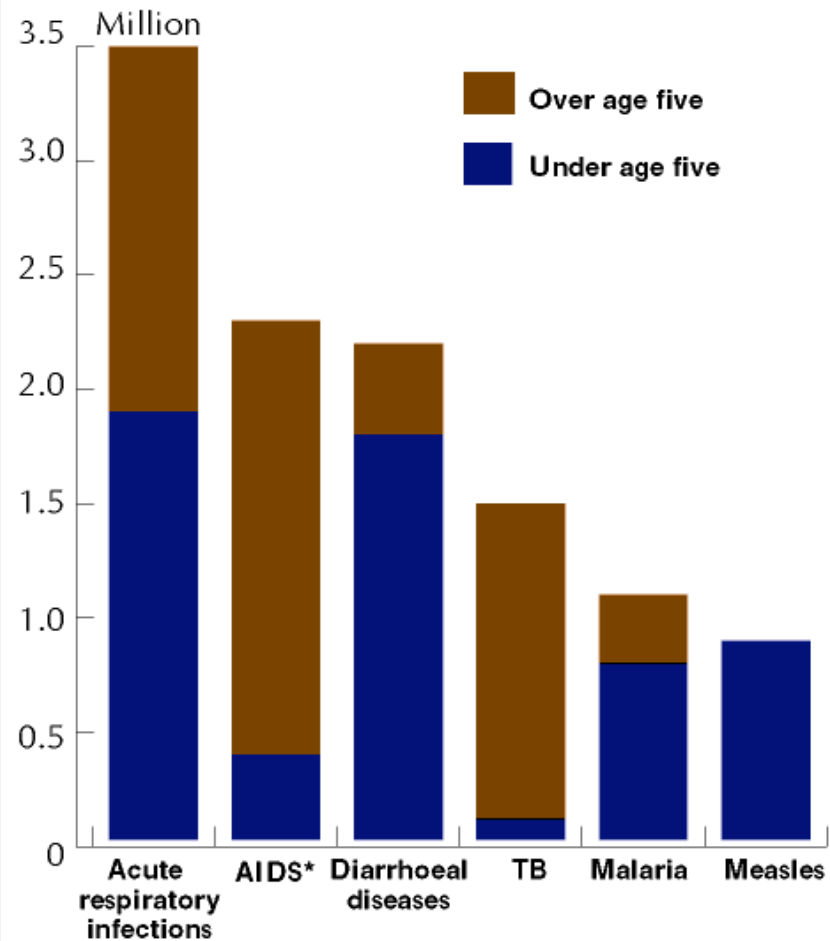
Two out of three deaths among children and young adults in Africa and Southeast Asia are due to seven causes (ages 0 -44)



Source: World Health Organization/CDS

LEADING INFECTIOUS KILLERS

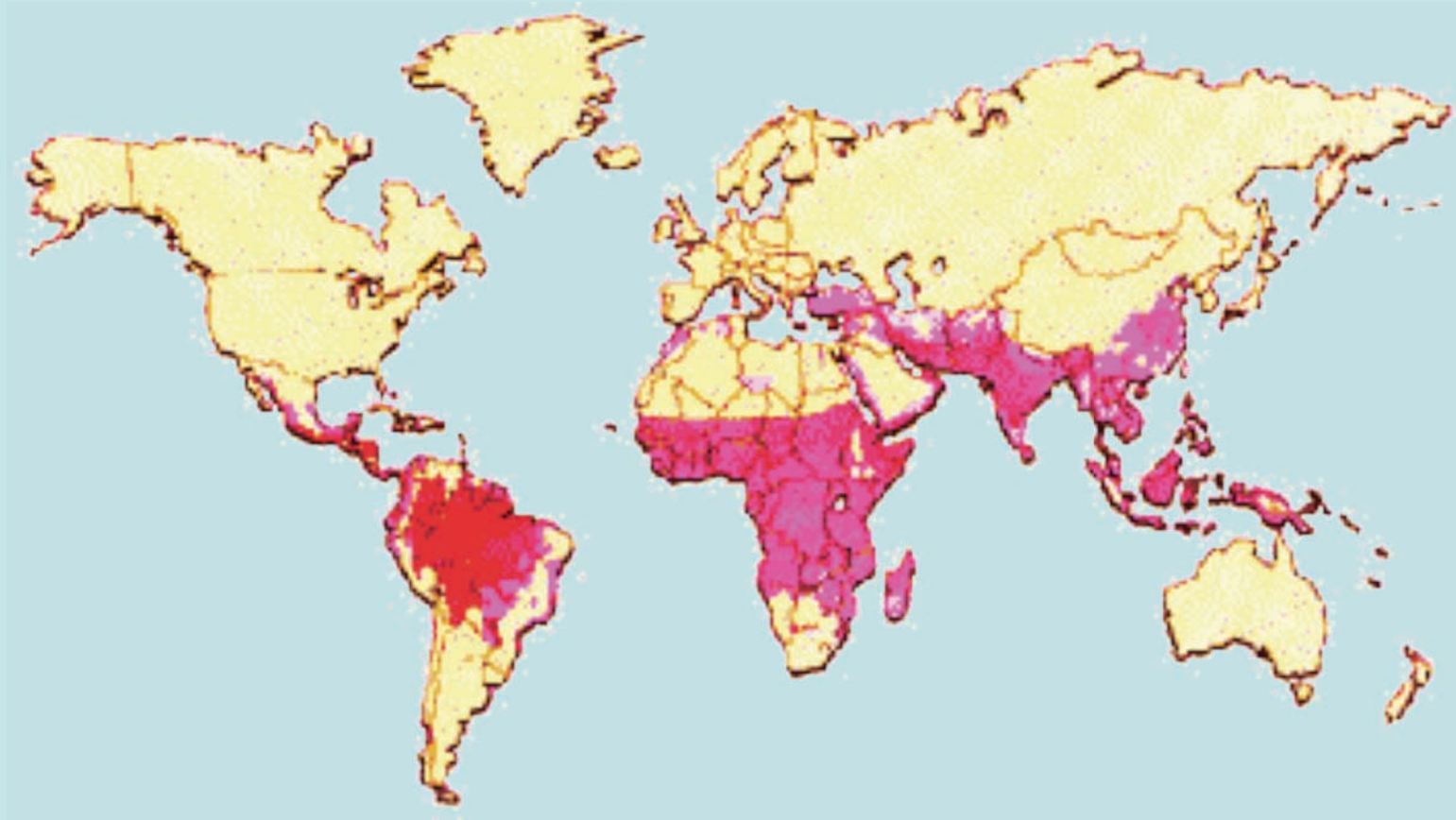
Six high-burden diseases cause
90% of total disease deaths



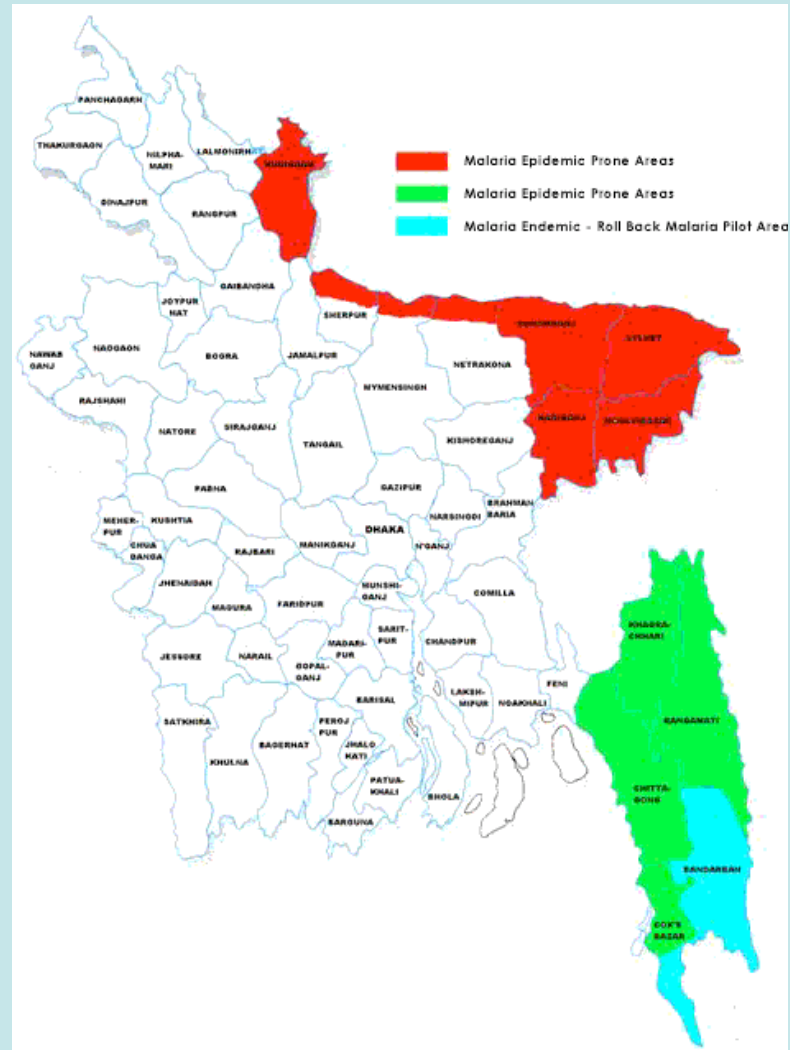
*HIV-positive people who have died with TB
have been included among AIDS deaths

Source: World Health Organization/CDS 1999

World Distribution Of Malaria



Distribution Of Malaria In Bangladesh



Dominant Mosquito Vector Species In Bangladesh

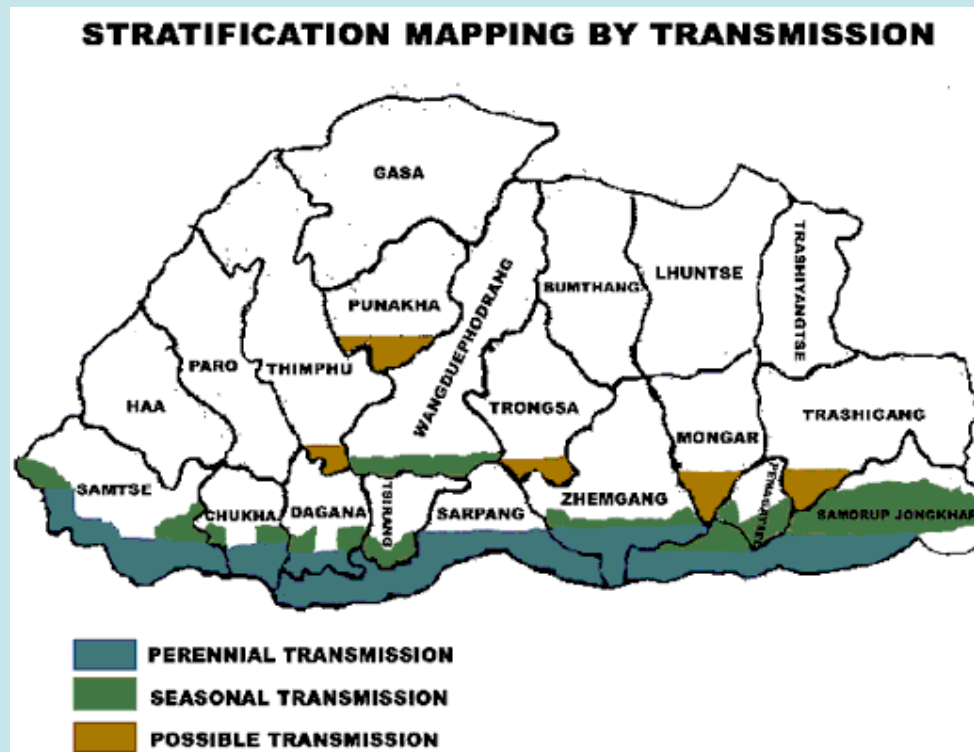
An. dirus
An. minimus
An. philipinensis
An. sondaicus
An. aconitus
An. anularis
An. vagus



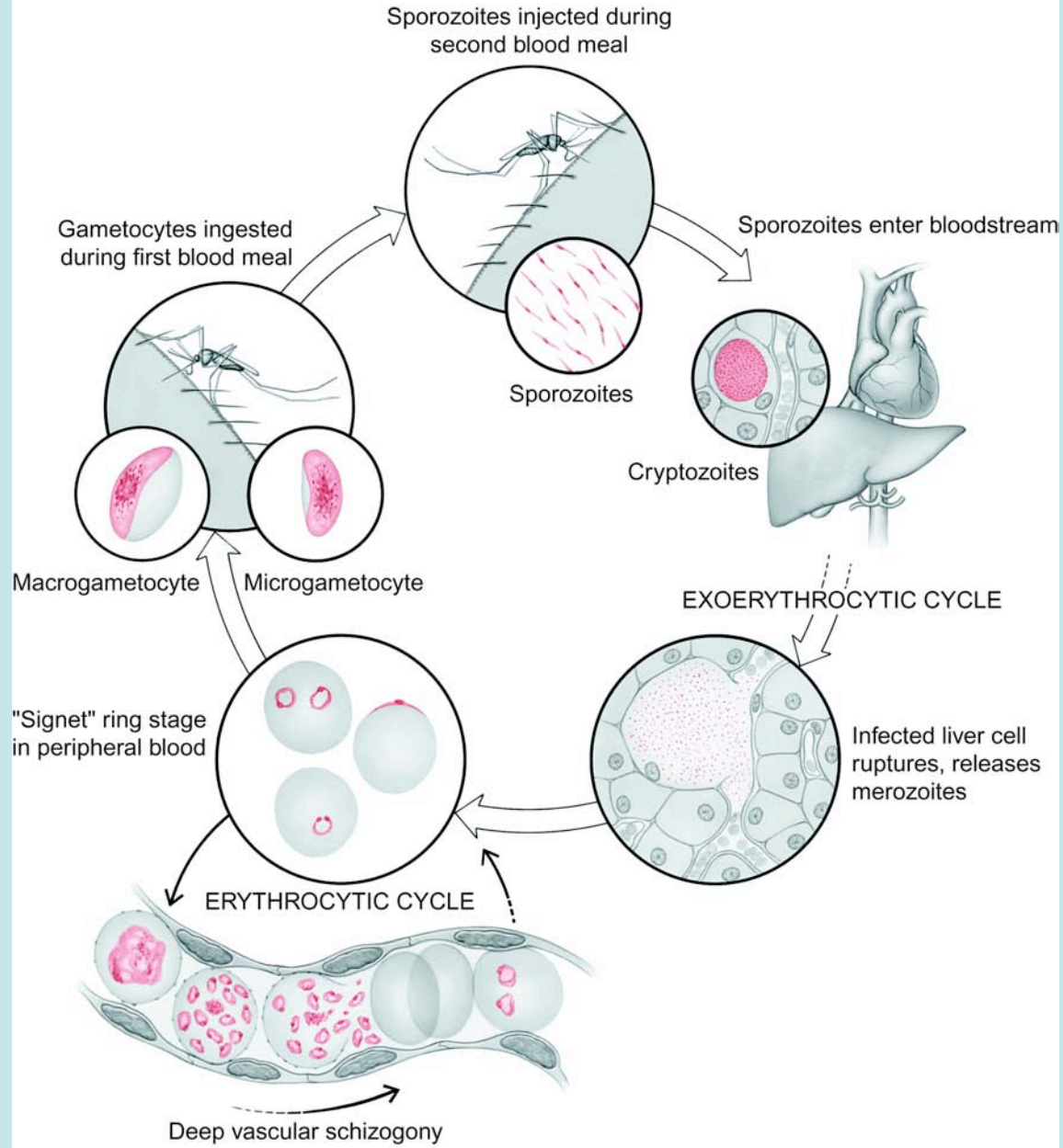
Anopheles dirus



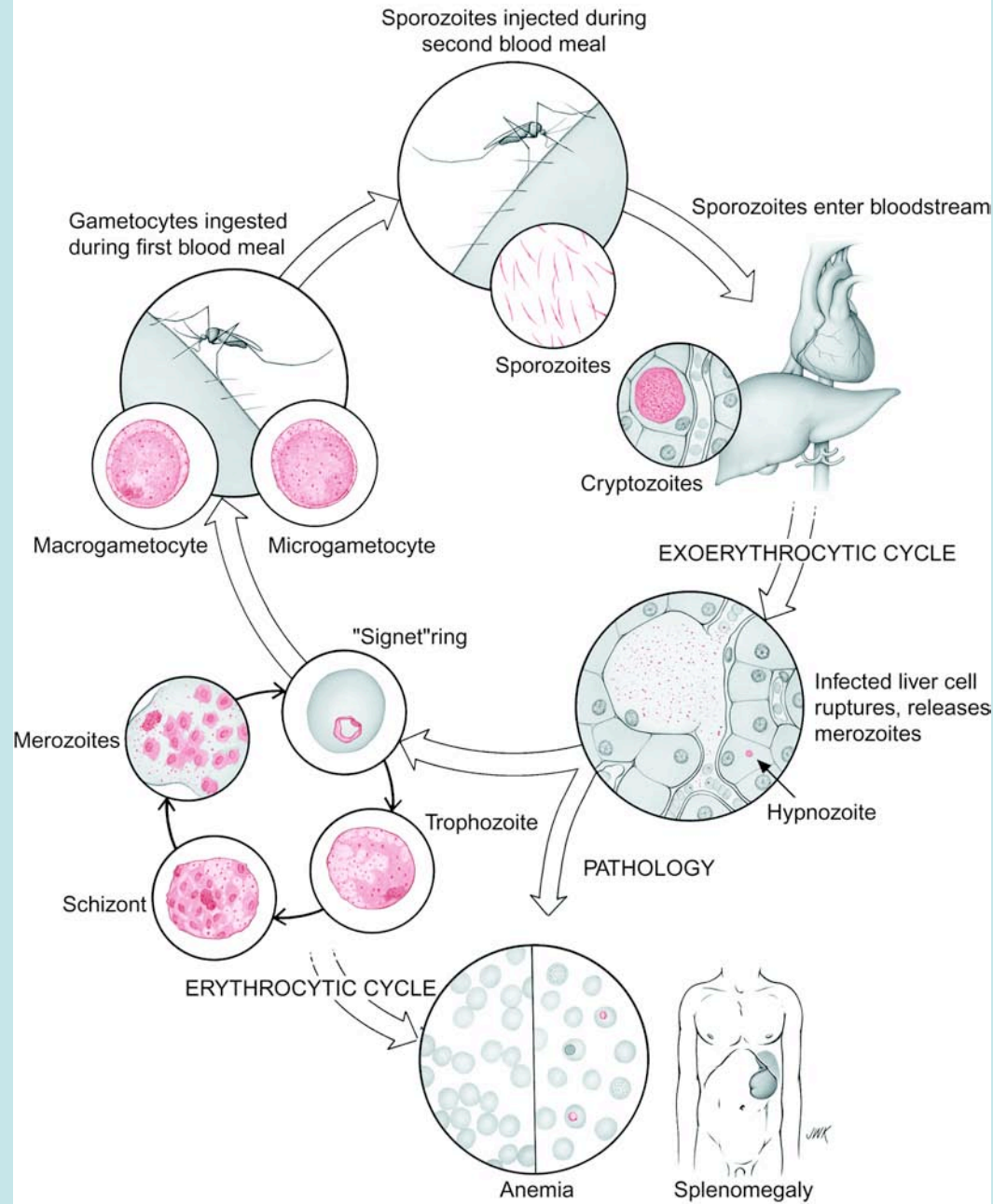
Distribution Of Malaria In Bhutan



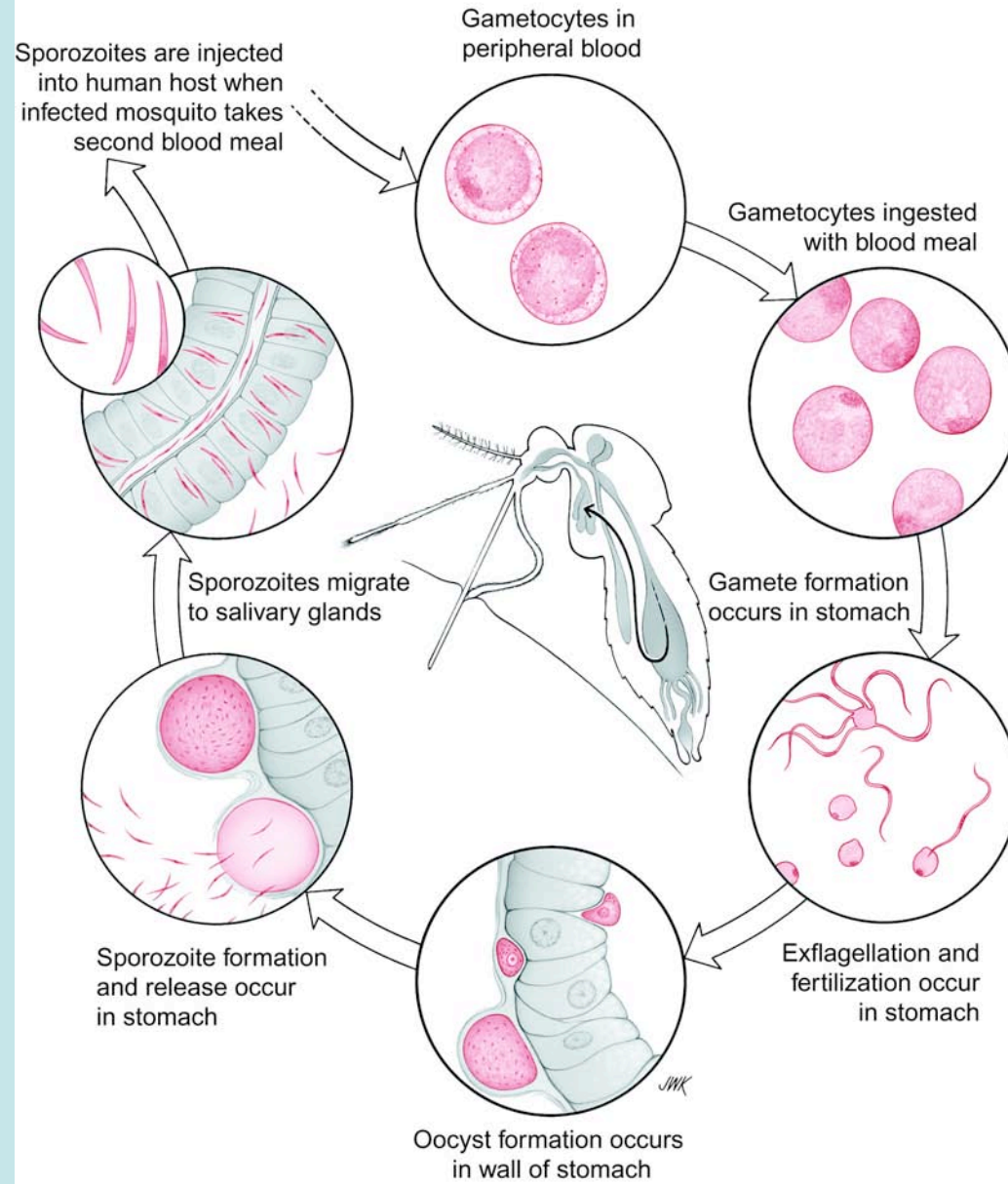
Plasmodium falciparum

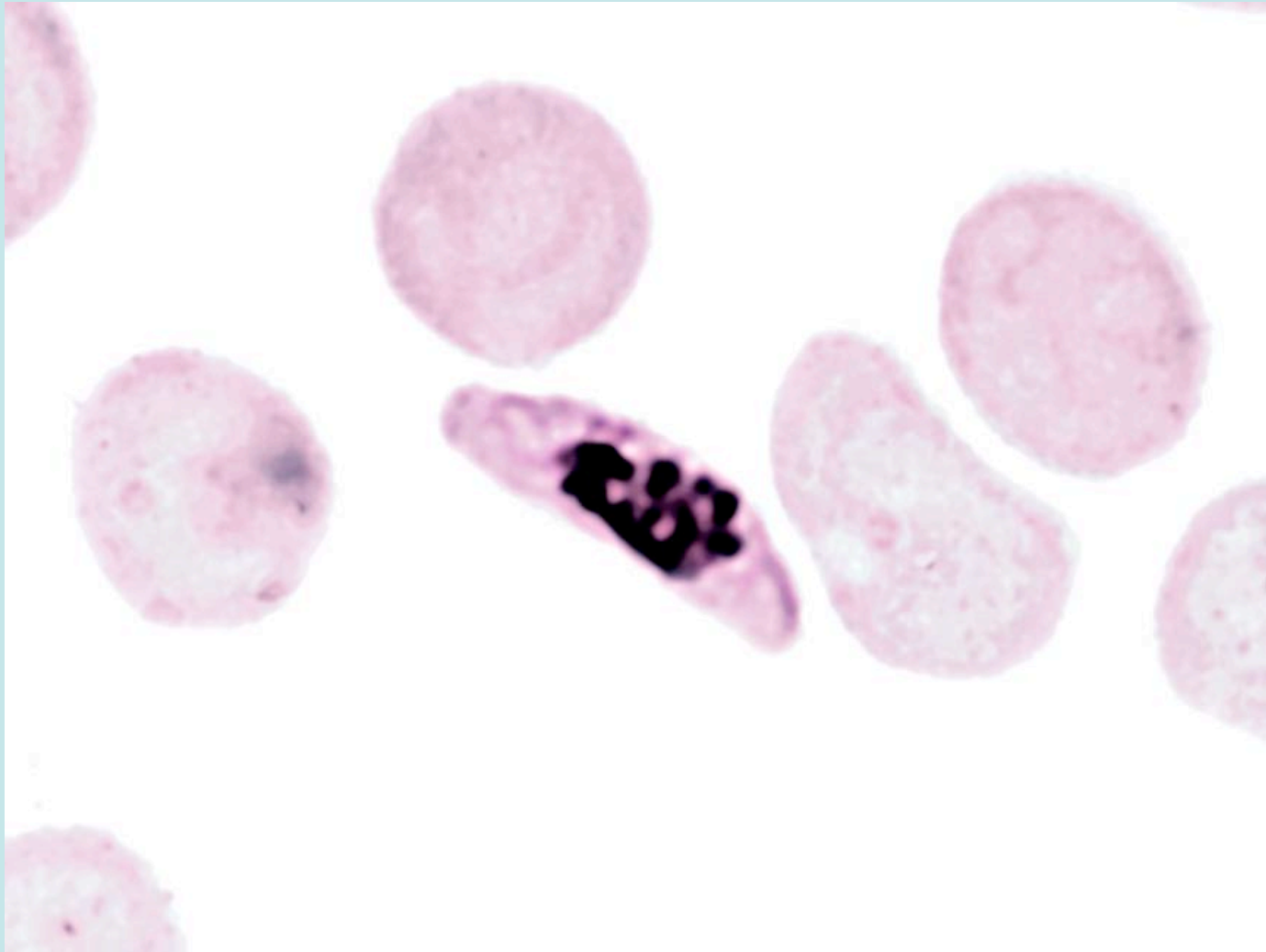


Plasmodium vivax



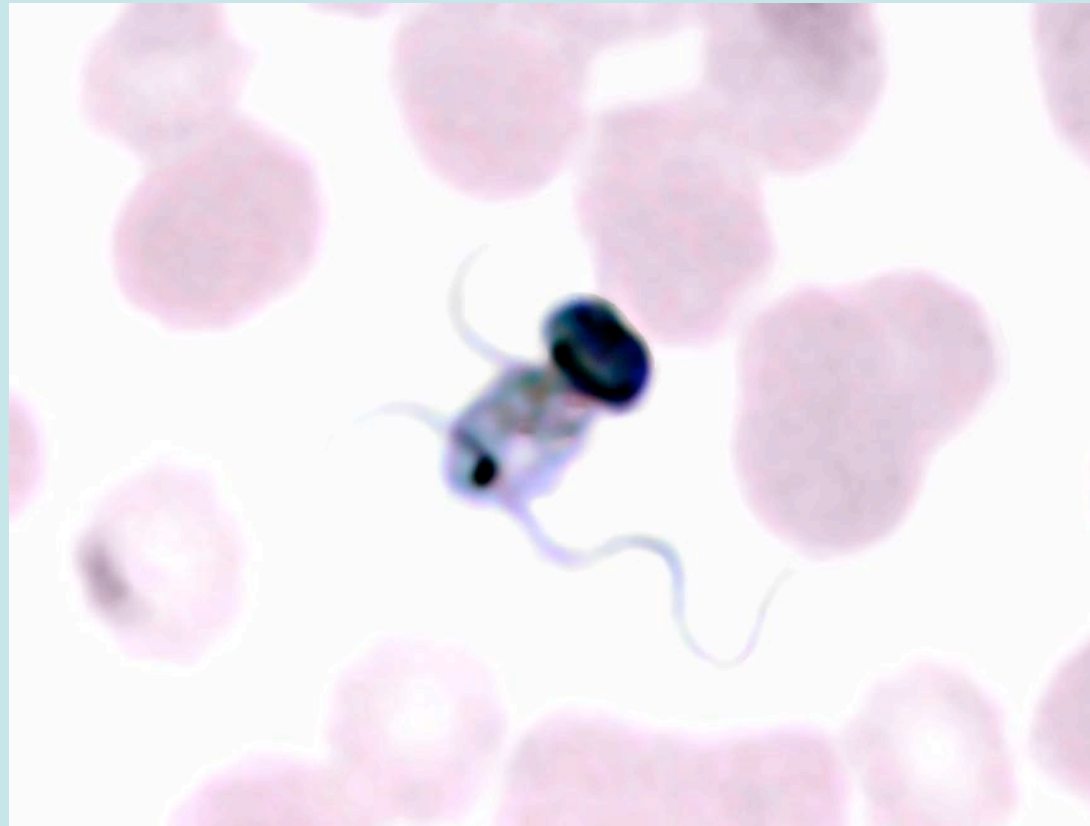
Mosquito Cycle (Sporogony)



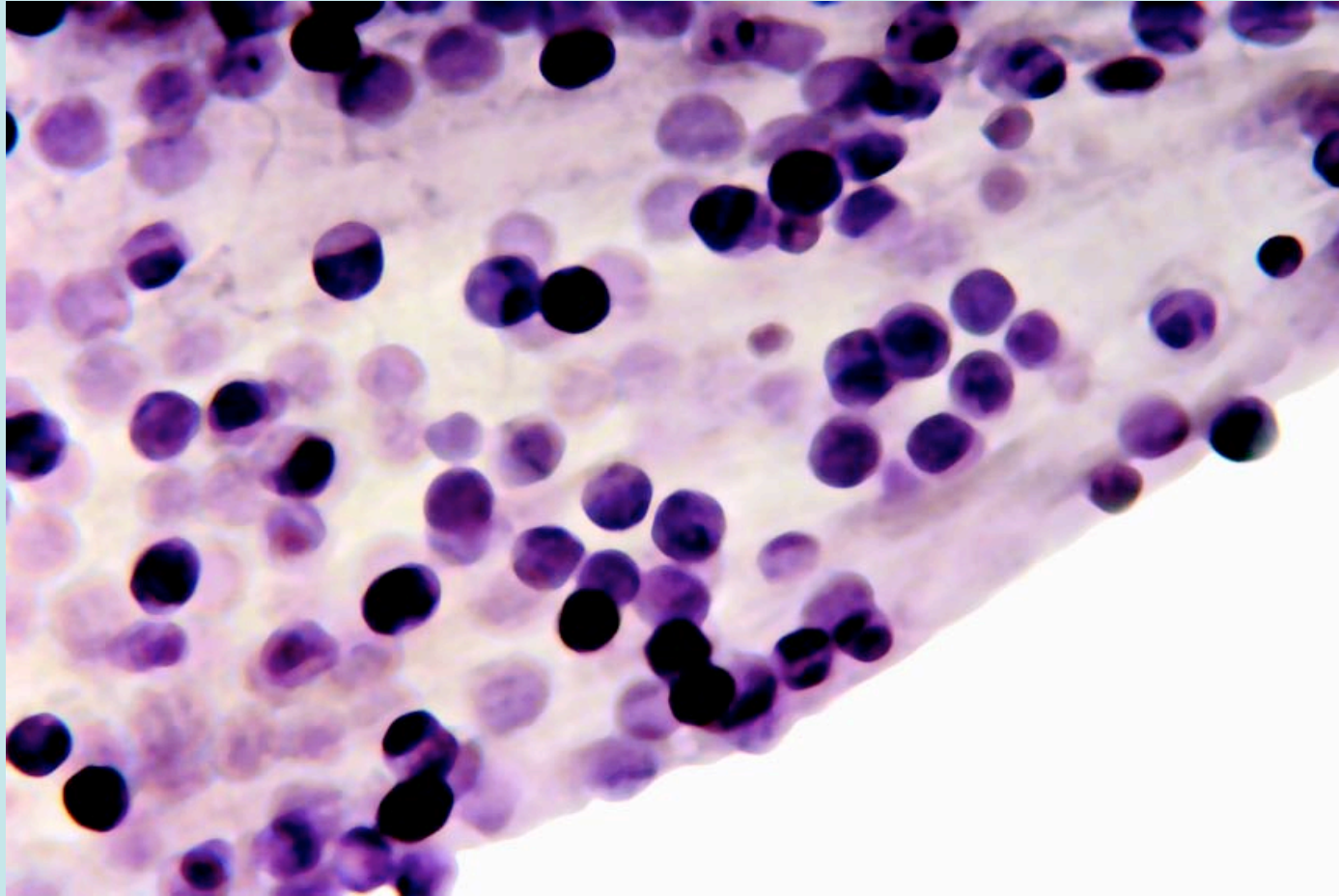




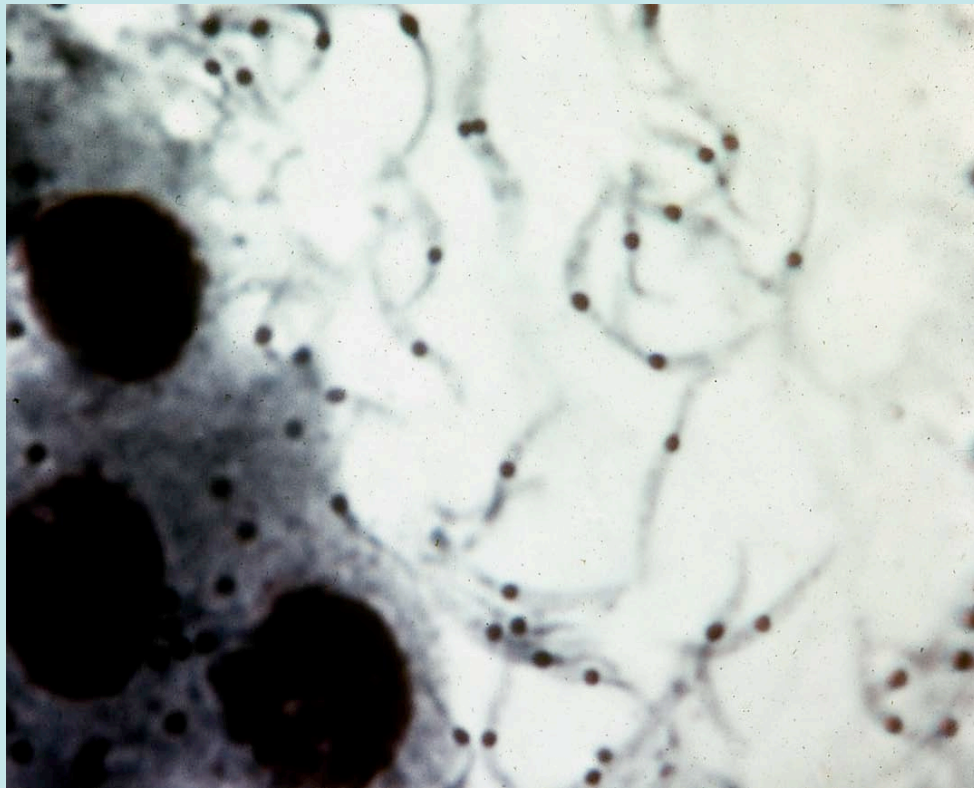
Exflagellation of the microgametocyte of a malaria parasite



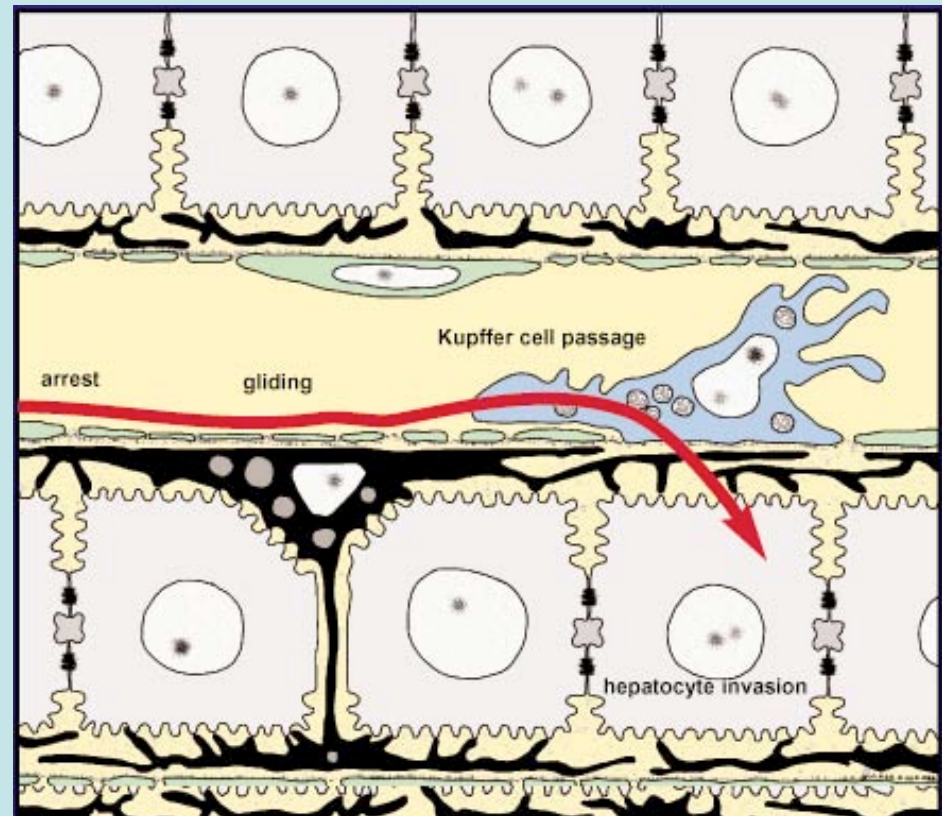
Portion of an infected mosquito stomach.
Note numerous oocysts on outer wall.



The Sporozoite Stage Of Malaria

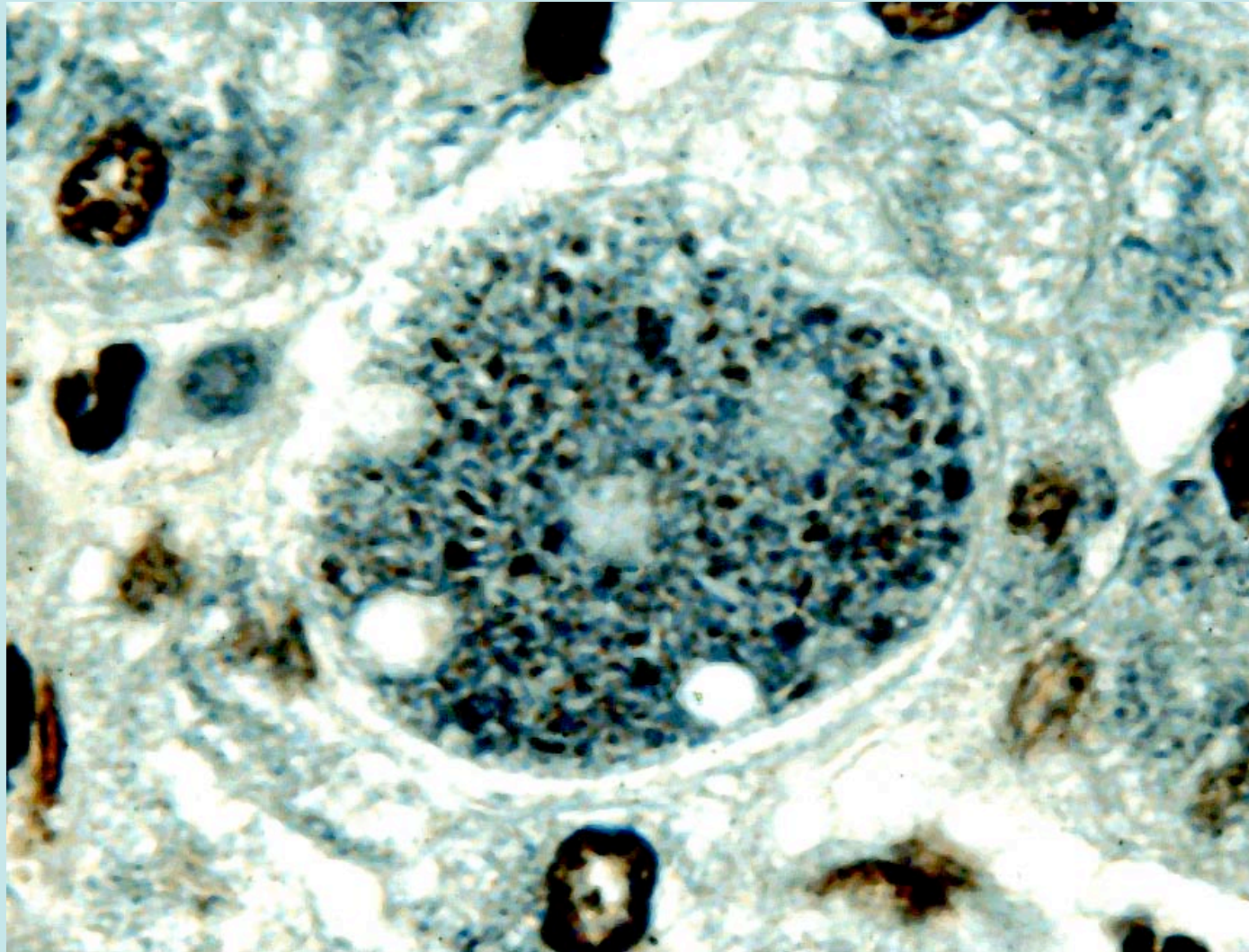


Entry Of Sporozoites Into Parenchymal Cells Of The Liver



From: Ute Frevert
NYU School of Medicine

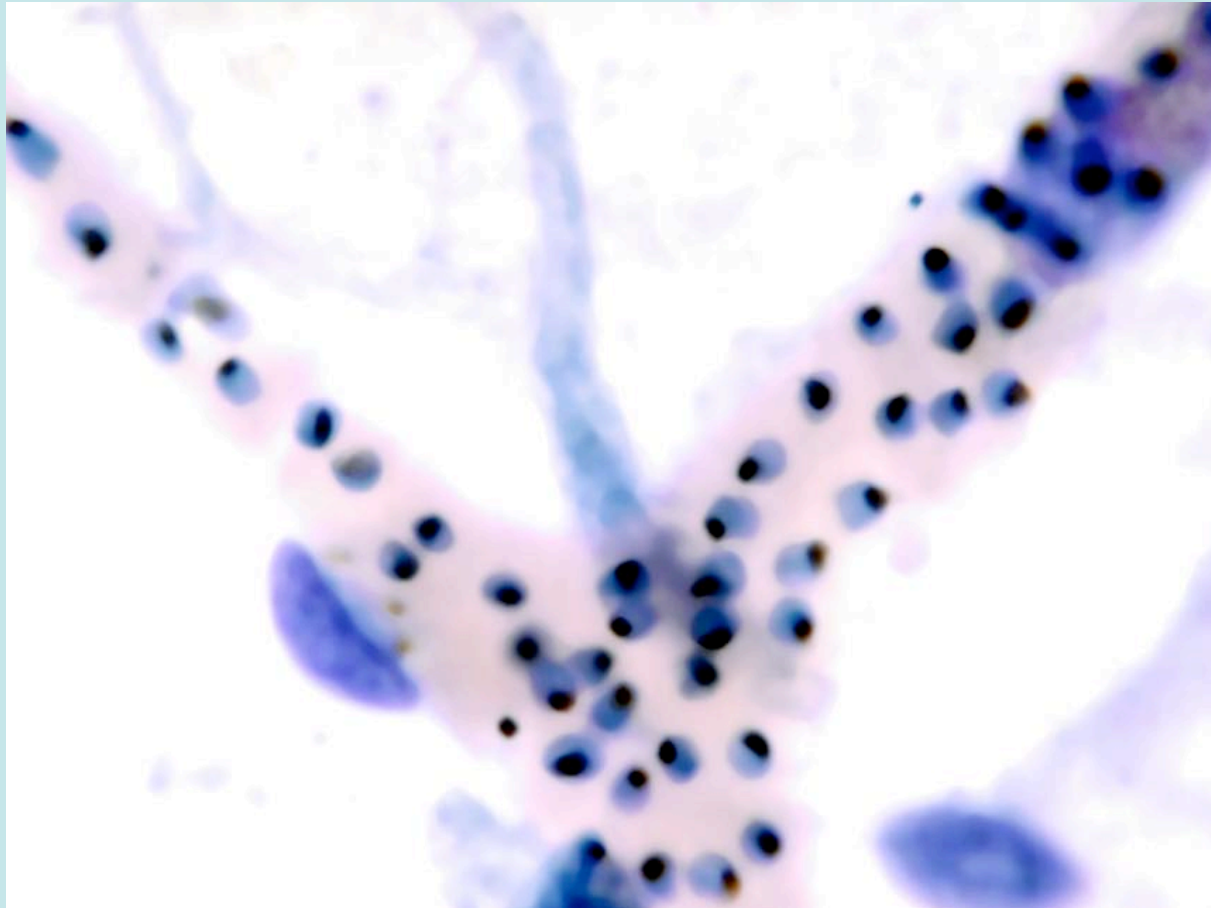
Exoerythrocytic stages of malaria
in liver parenchymal cell



Child infected with malaria, probably *P. malariae*. Note enlarged spleen.

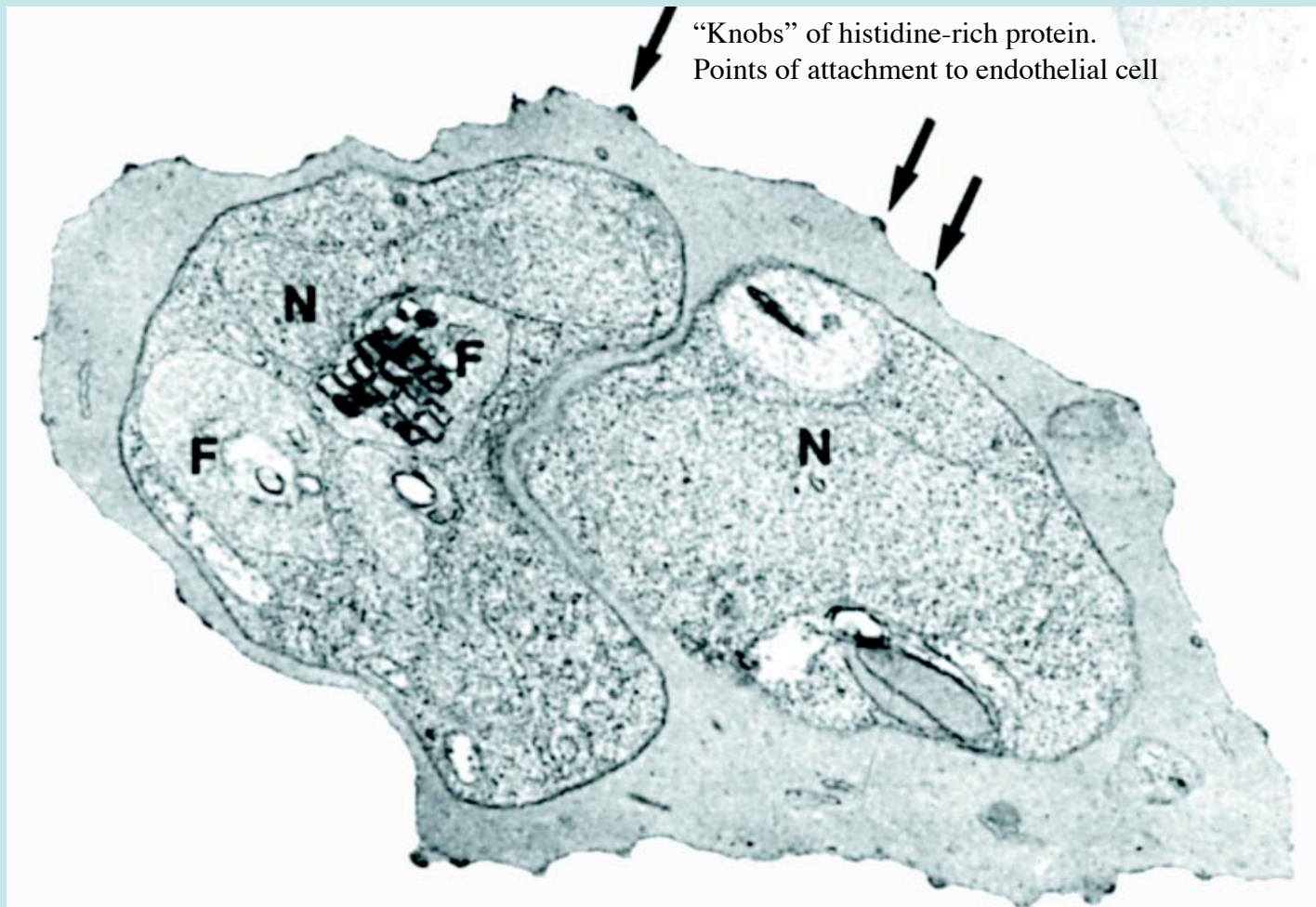


Cerebral malaria: experimental infection in monkey

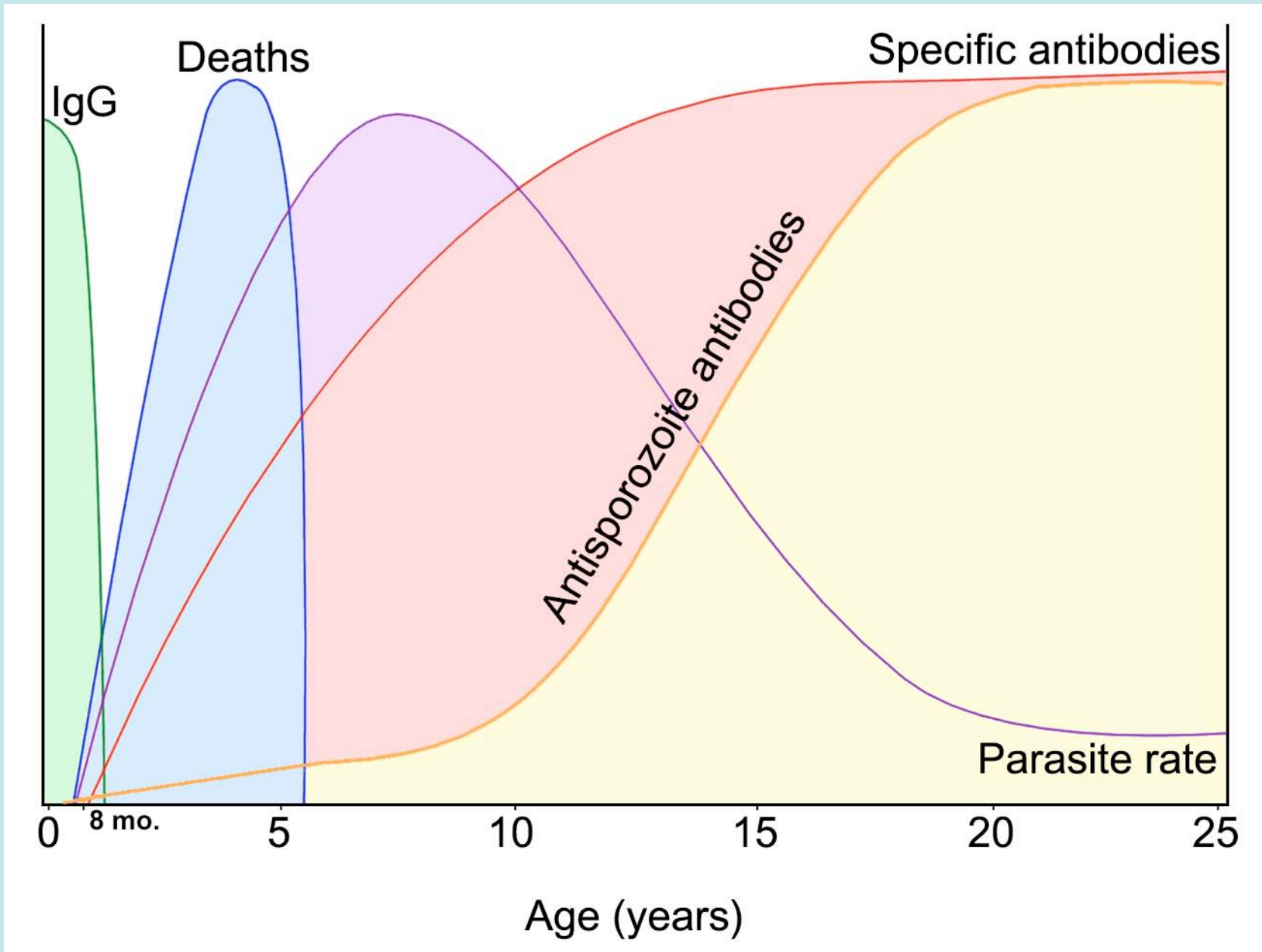


stain: tissue Giemsa

TEM of RBC infected with *Plasmodium falciparum*

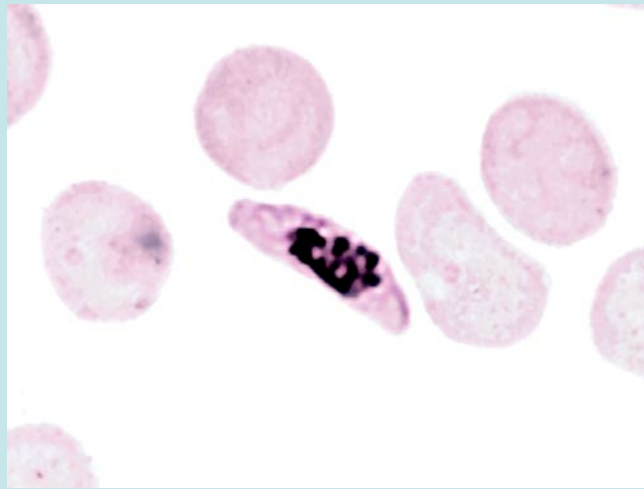


N = Nucleus; F = food vacuole

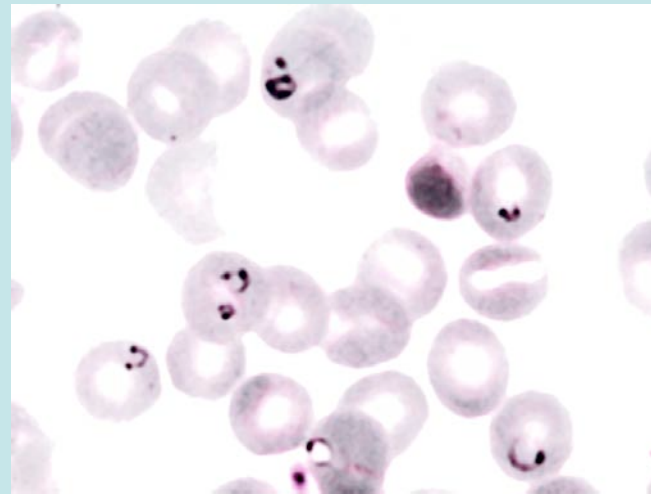


Diagnosis

Diagnosis of *Plasmodium falciparum* by blood smear

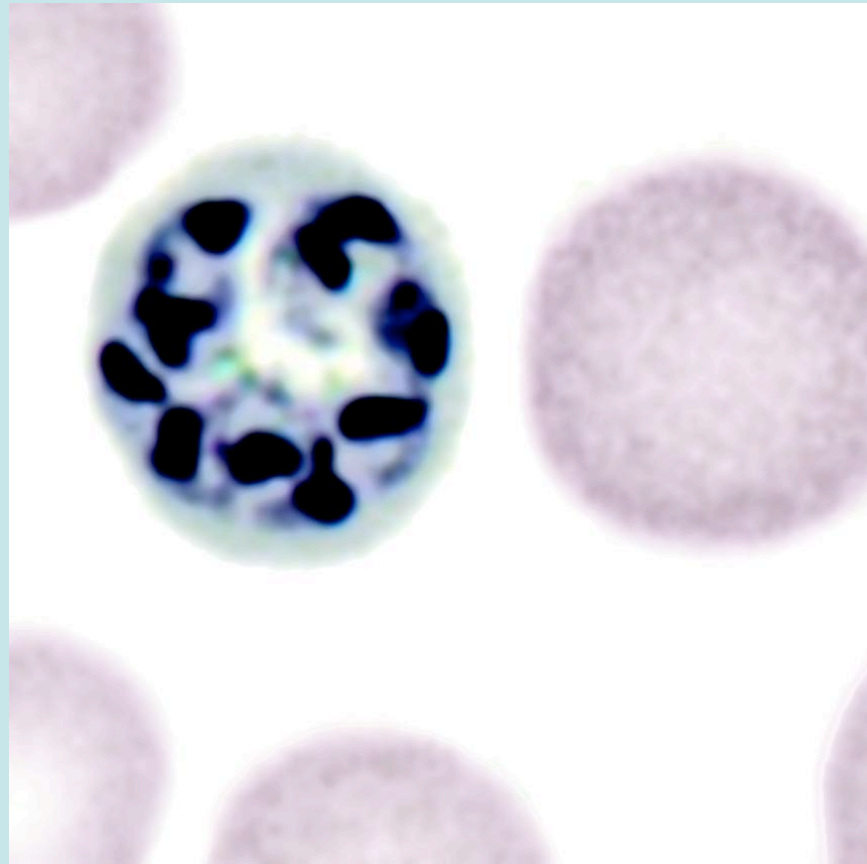


Gametocyte stage



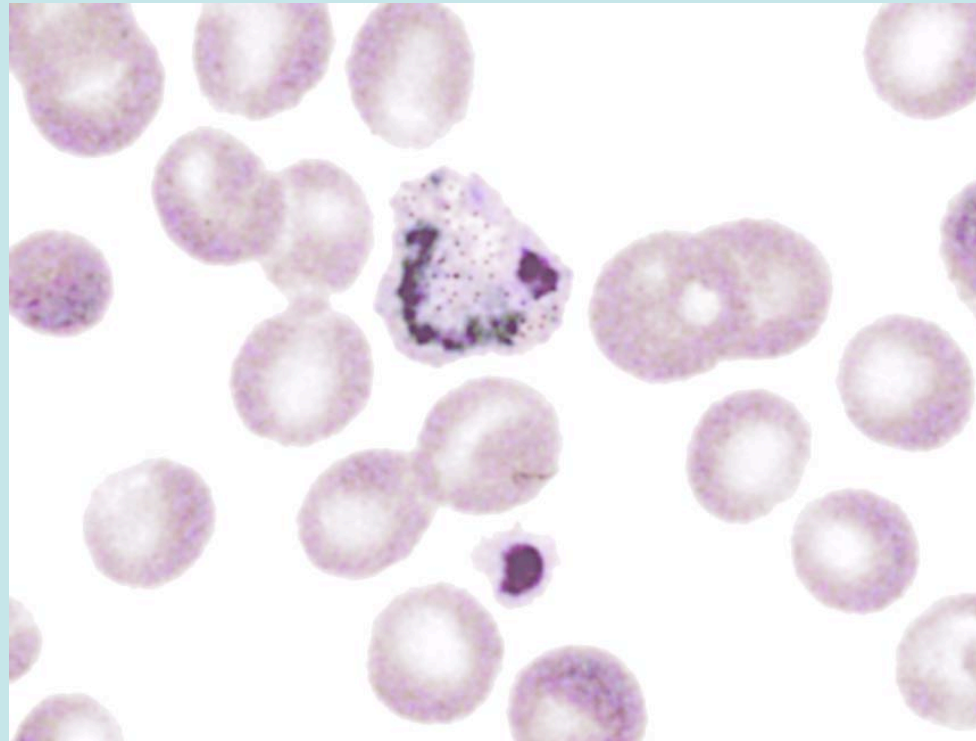
Signet Ring Stage

Diagnosis of *Plasmodium malariae* by blood smear



Note infected RBC is about the same diameter as non-infected cells

Diagnosis of *Plasmodium vivax* by blood smear

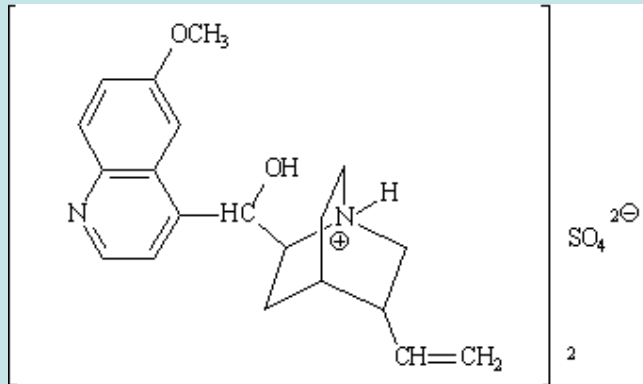


Note infected RBC is larger in diameter than non-infected RBCs.

Treatment

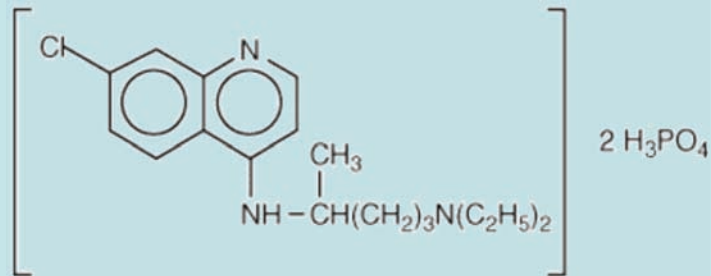
Drugs Of Choice:

A. Parent Compound



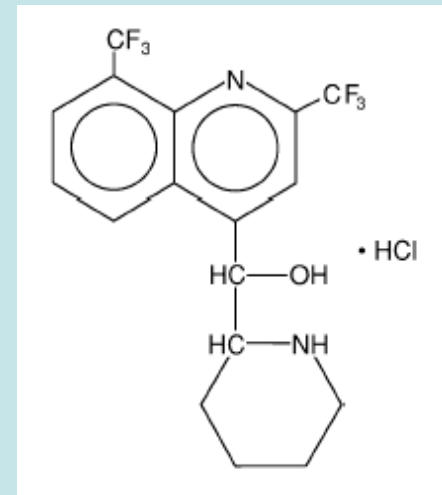
Quinine

B. Older Derivative



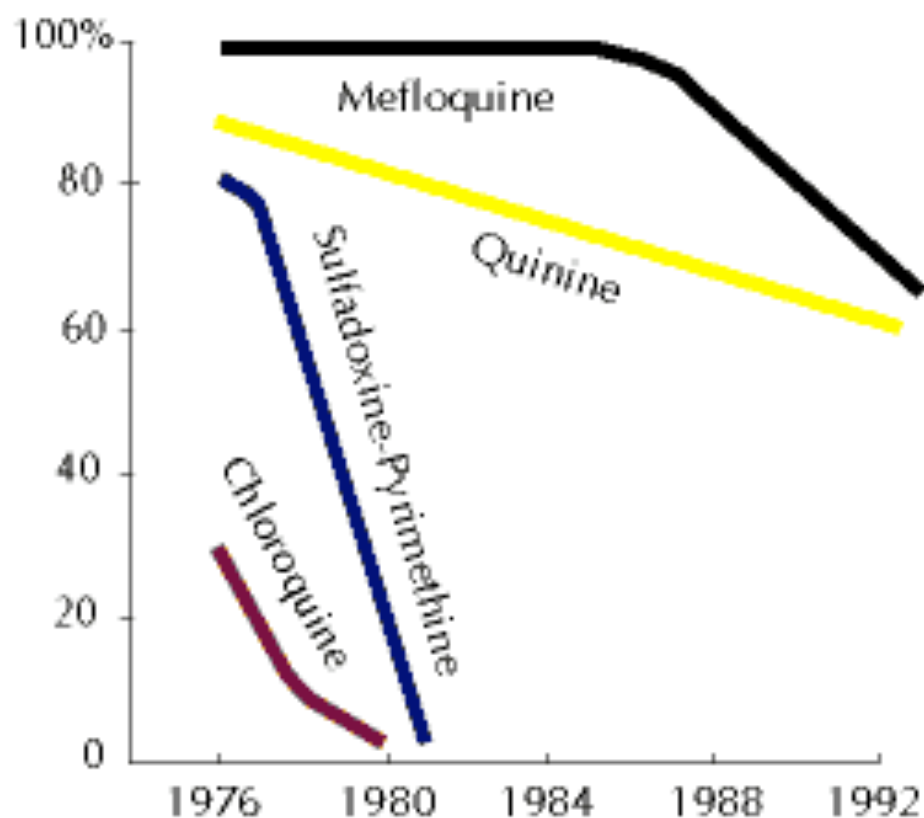
Chloroquine

C. Newer Derivative



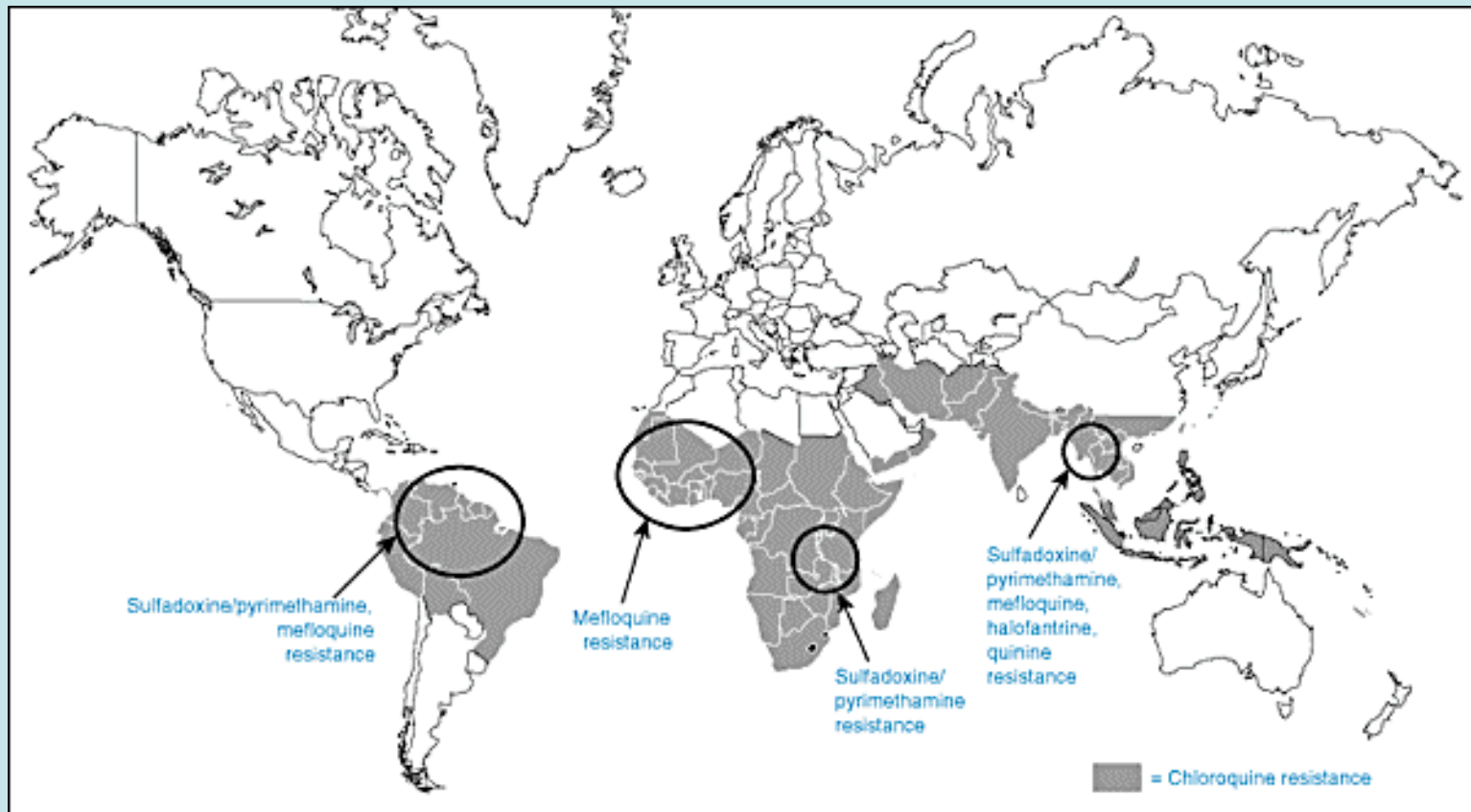
Mefloquine

DECLINING RESPONSE TO ANTIMALARIAL DRUGS



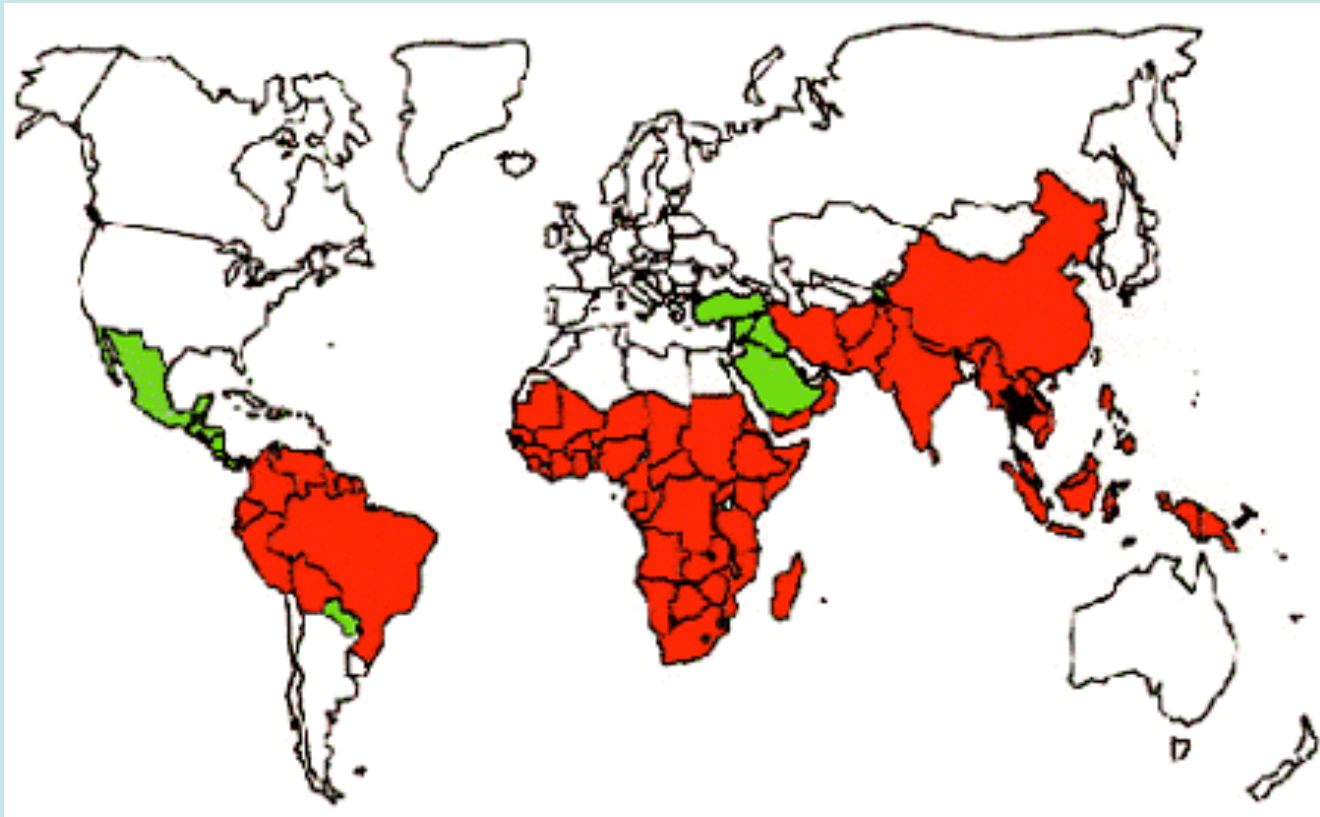
*The Southeast Journal of Tropical Medicine and Public Health,
Mekong Malaria, Volume 30, Supplement 4, p 68, 1995*

Drug-resistant Malaria



From: CDC

Drug-resistant Malaria



Red - chloroquine resistant

Green - chloroquine sensitive

Black - chloroquine and mefloquine resistant

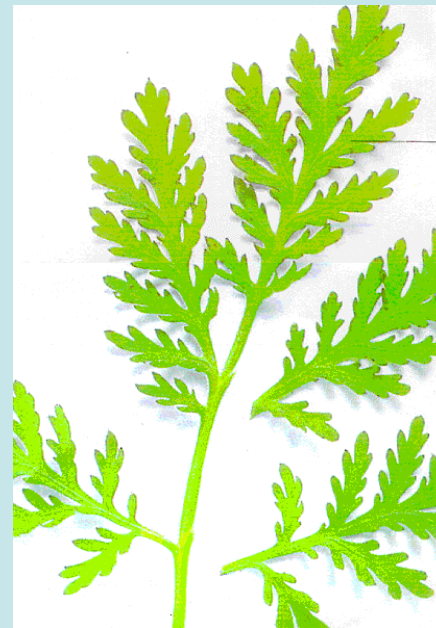
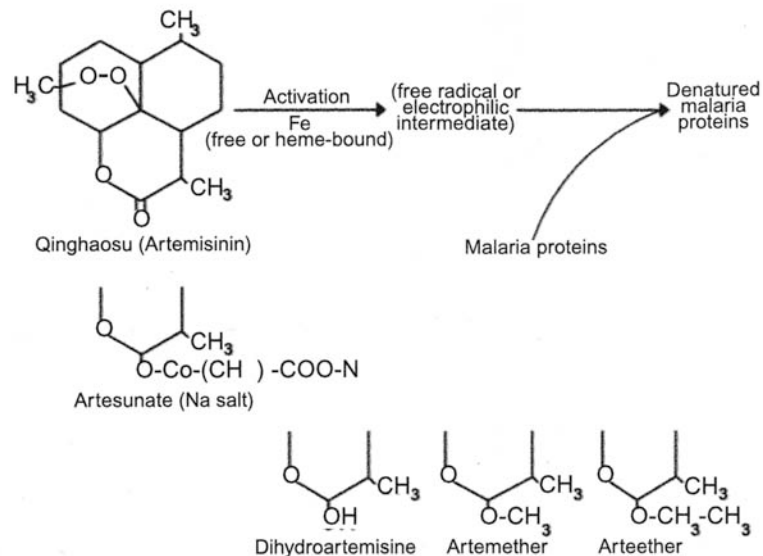
Artemisinin

ANTIMICROBIAL AGENTS AND CHEMOTHERAPY, May 2002, p. 1510-1515
0066-4804/02/804.00+0 DOI: 10.1128/AAC.46.5.1510-1515.2002
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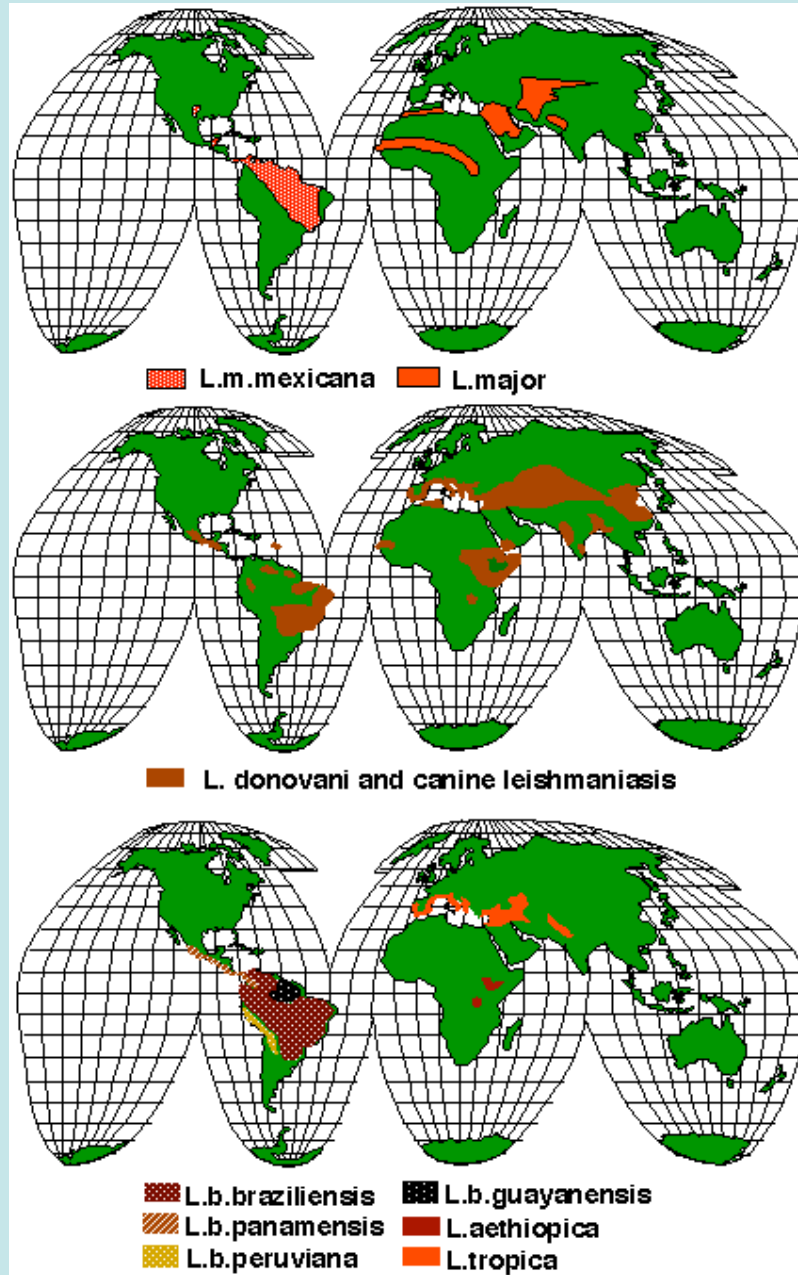
Vol. 46, No. 5

In Vitro Interactions of Artemisinin with Atovaquone, Quinine, and Mefloquine against *Plasmodium falciparum*

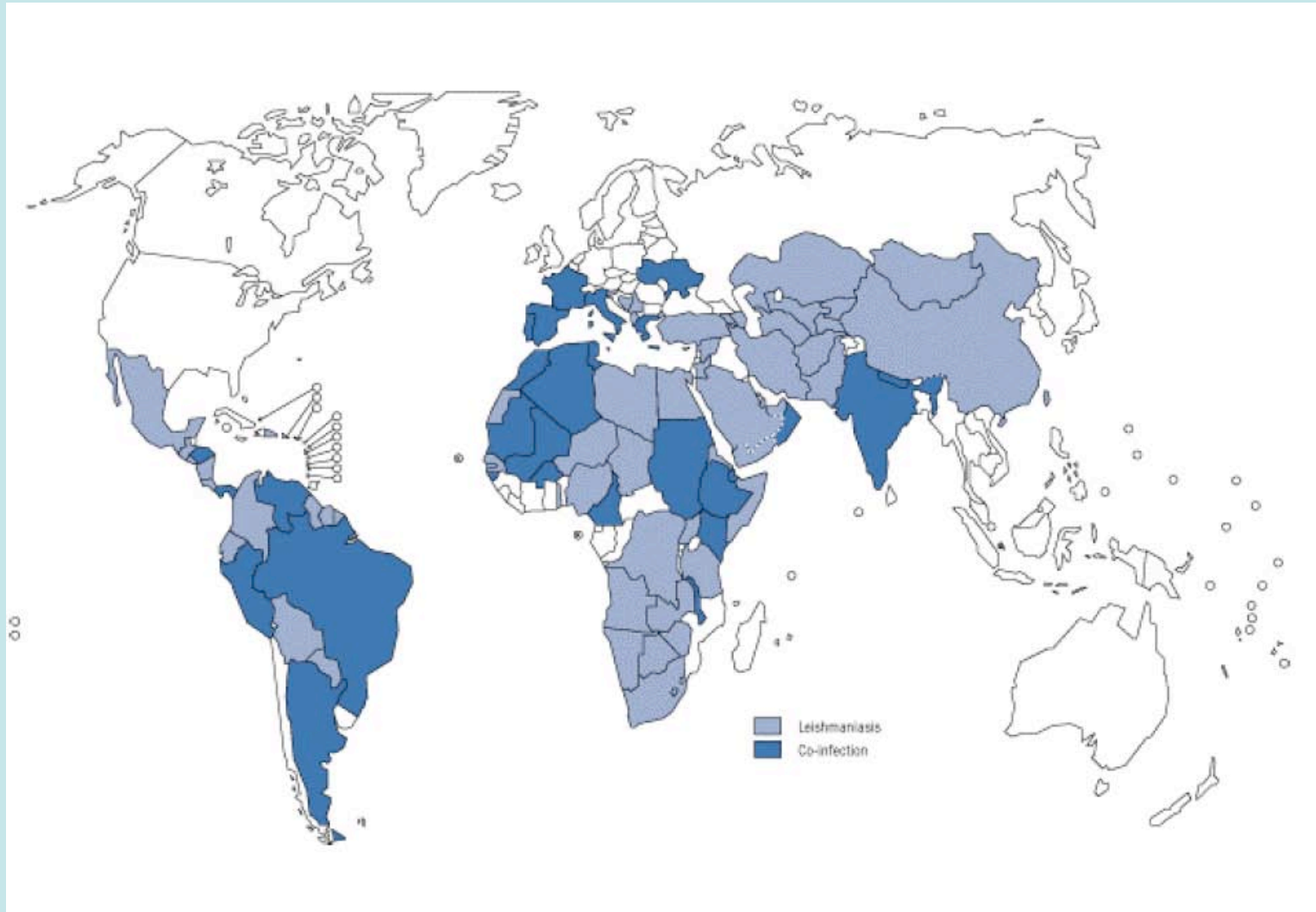
S. Gupta,¹ M. M. Thapar,¹ W. H. Wernsdorfer,² and A. Björkman^{1*}



Leishmaniasis

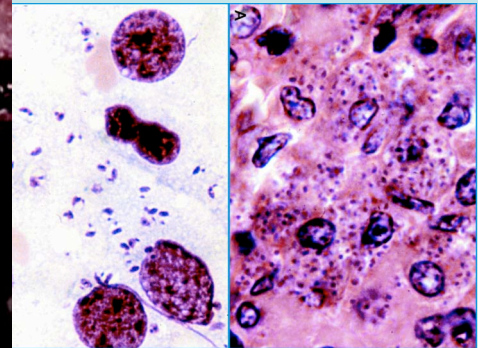


Co-distribution Of Leishmaniasis and HIV/AIDS



Map: WHO

Leishmania donovani
Leishmania tropica
Leishmania major

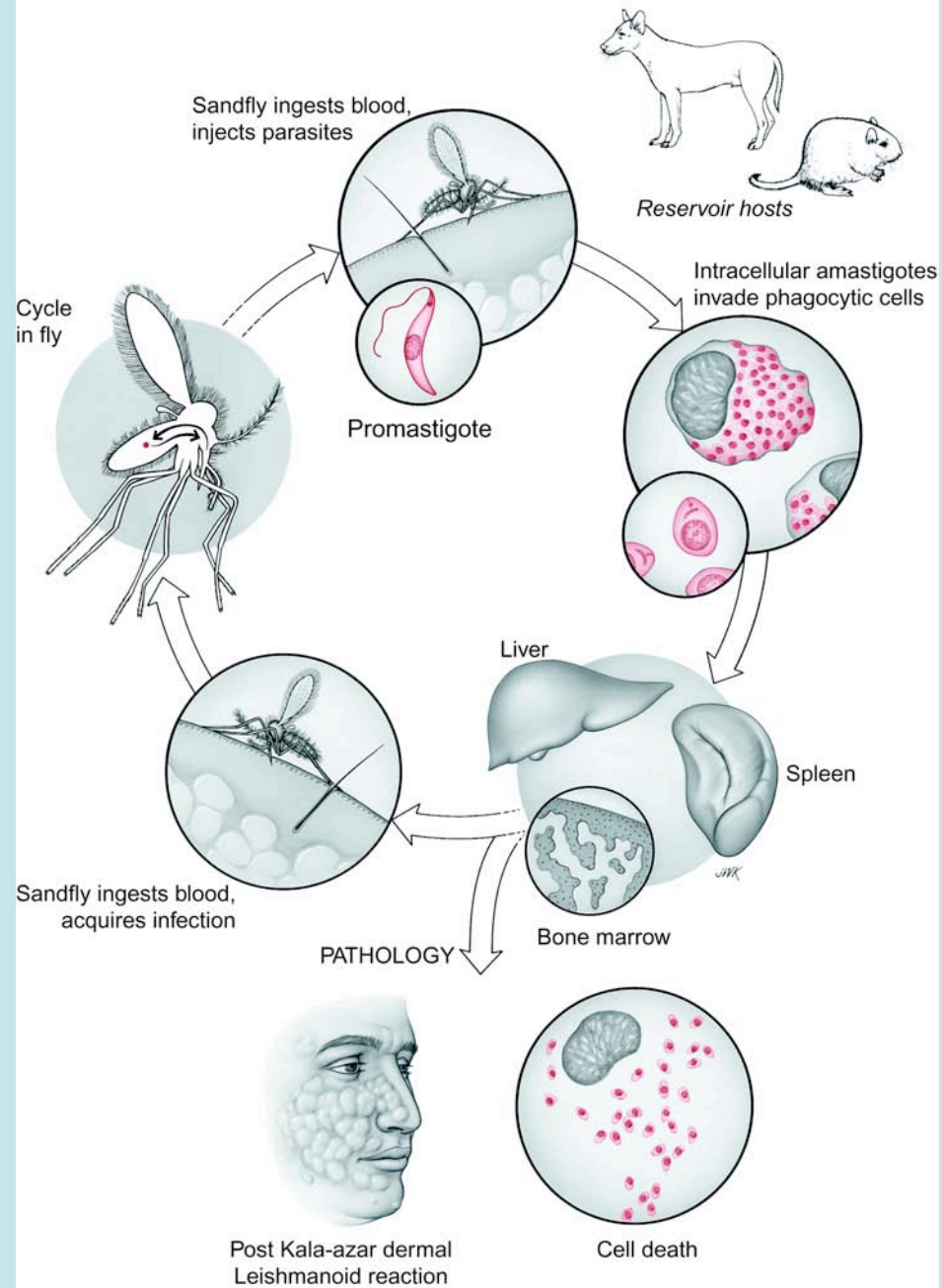


Macrophage With Two Promastigotes

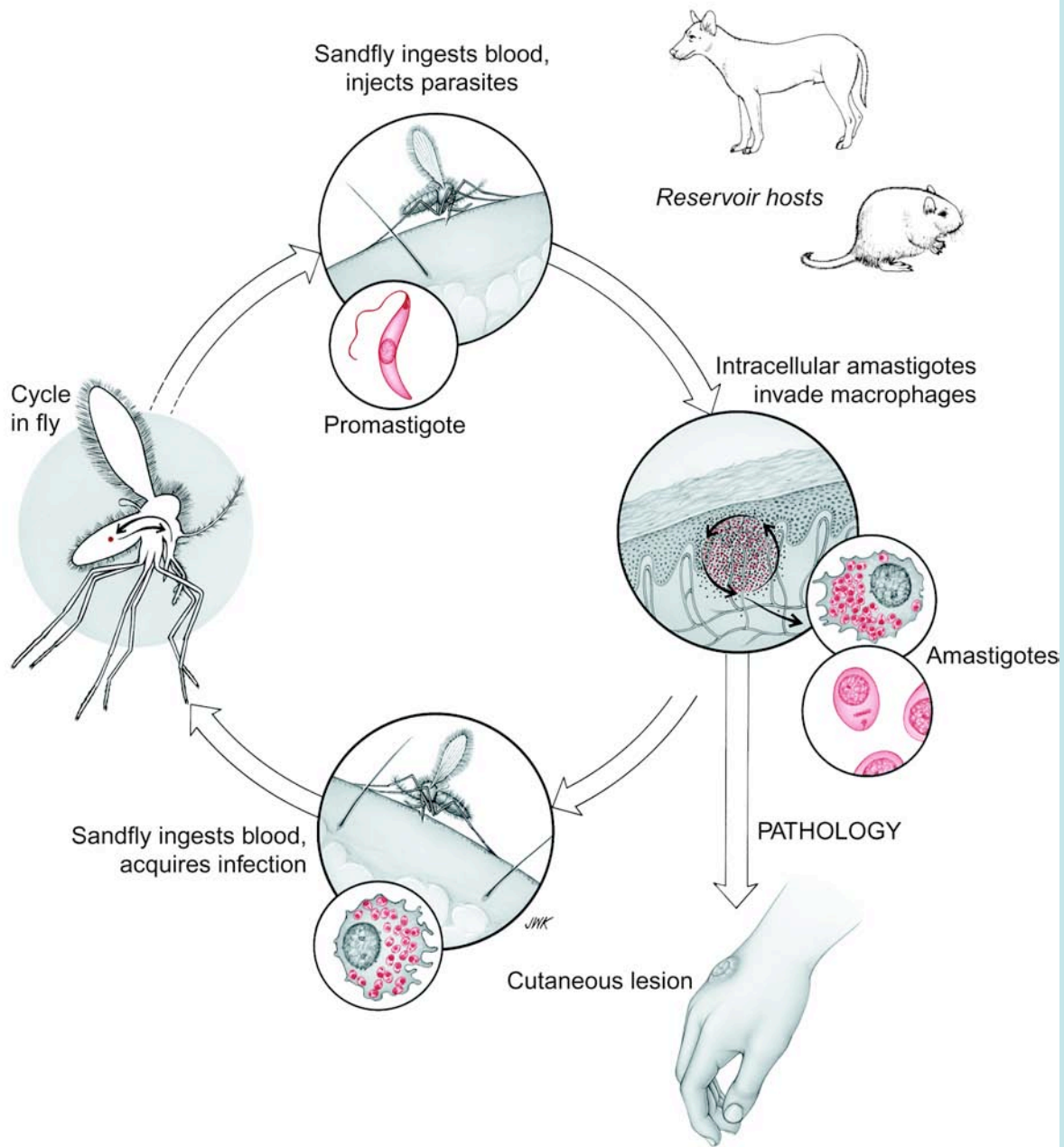


Photo: K. P. Chang

Leishmania donovani



Leishmania tropica



Feeding Sandfly



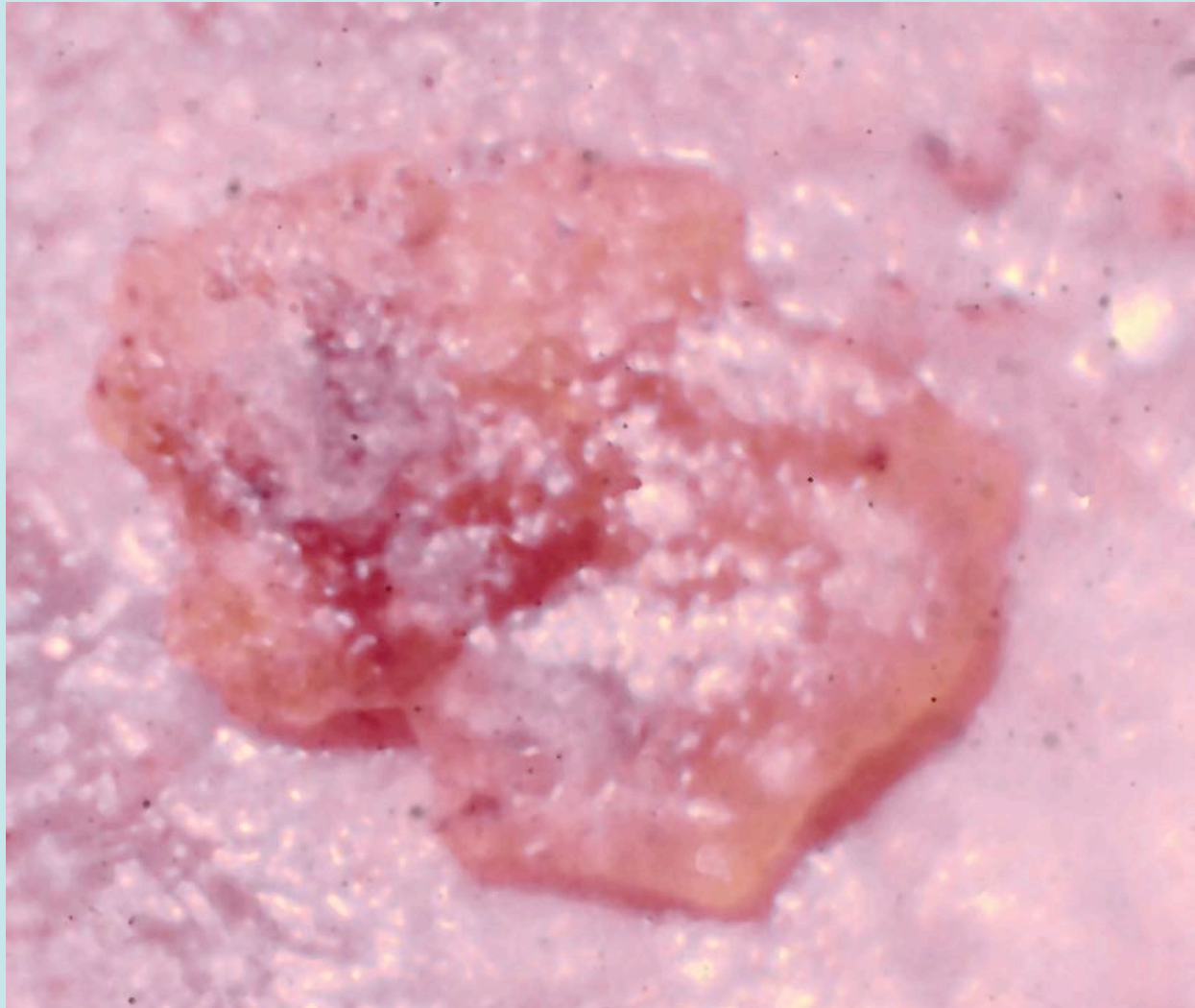
Multiple Lesions Of Leishmania tropica



*Single Resolving Lesion
Of Leishmania tropica*



Resolved Lesion Of *Leishmania tropica*



“Chichlero’s” Ulcer



Hepatosplenomegaly From Leishmania donovani

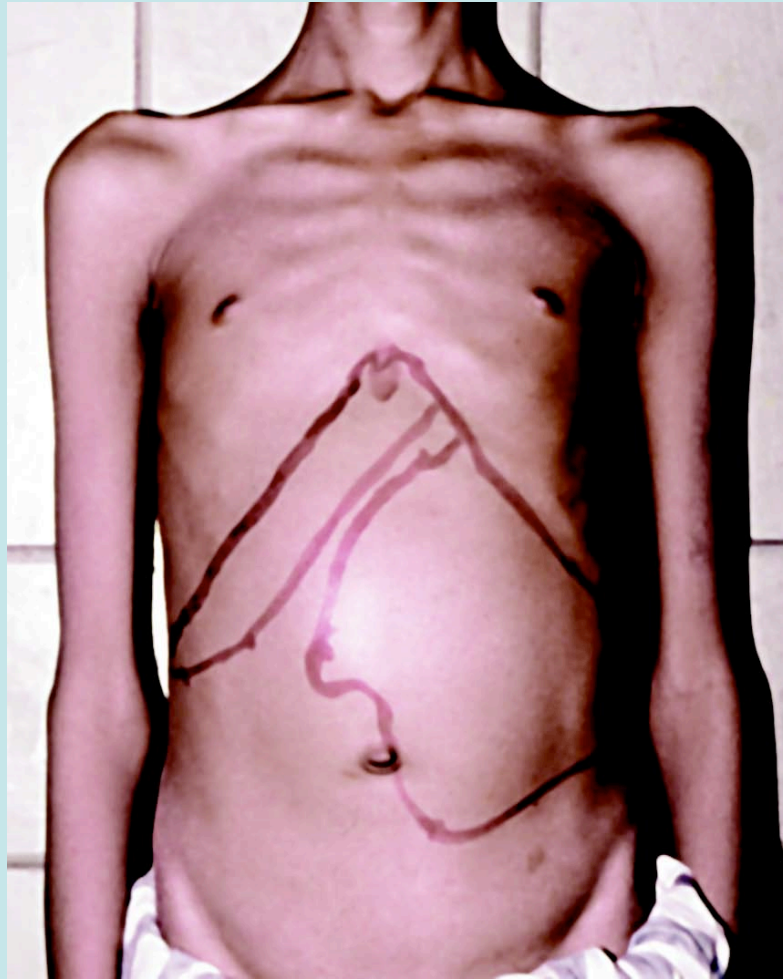


Photo: WHO

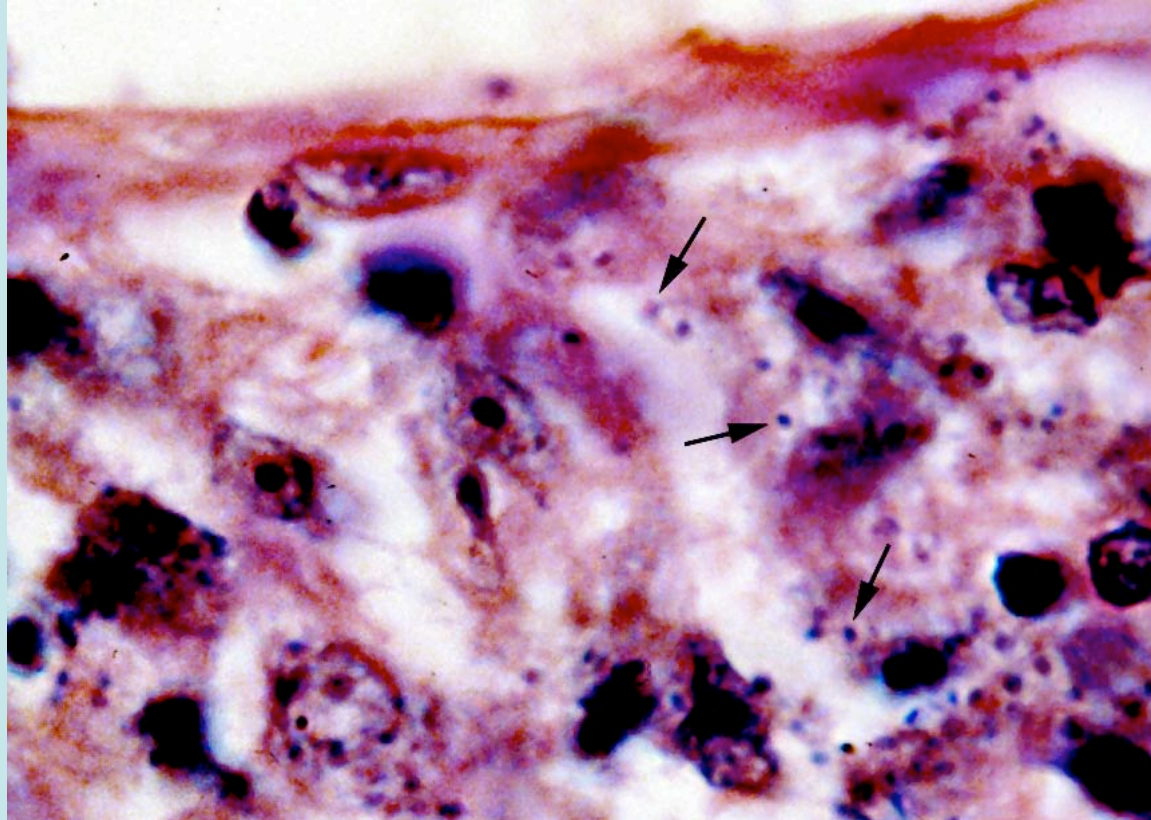
Macrophage With Two Promastigotes



Photo: K. P. Chang

Diagnosis

Biopsy



Bone Marrow Aspiration Stained With Giemsa

Amastigote Stage
In Macrophage

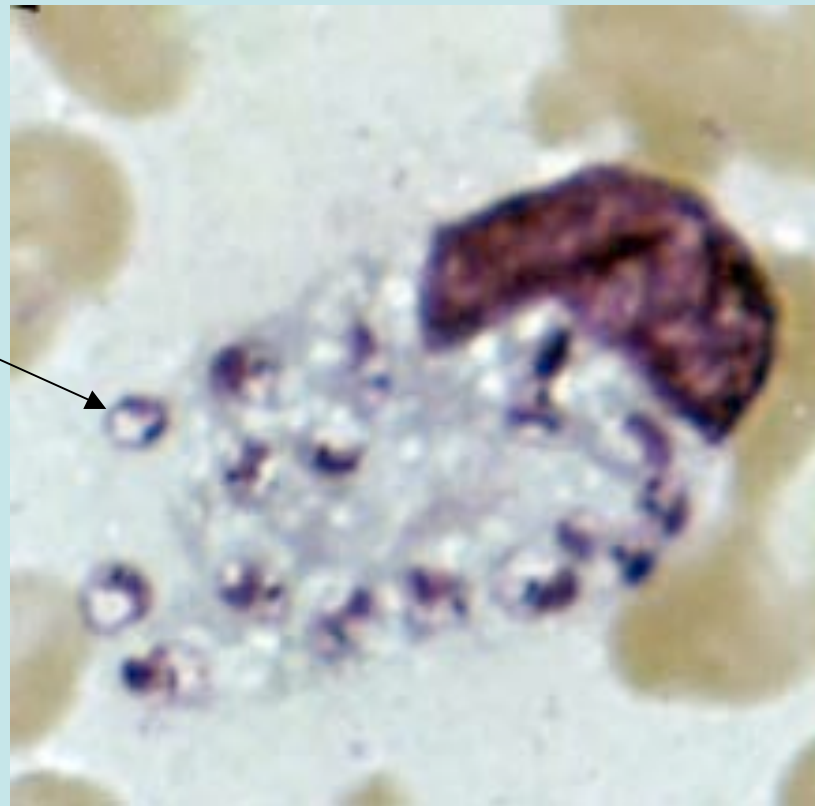


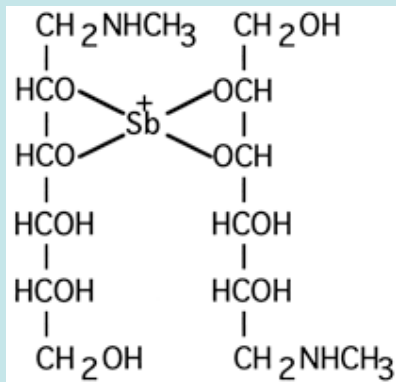
Photo: CDC

Culture Promastigotes In Insect Culture Medium

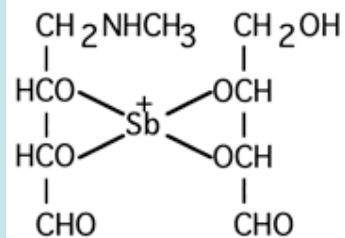


Treatment

*Drug Of Choice:
Sodium Stibogluconate
And Derivatives*



Structure 1 MW 507



Structure 2 MW 370

Antimony meglumine

Post-Kala Azar Dermal Leishmanoid

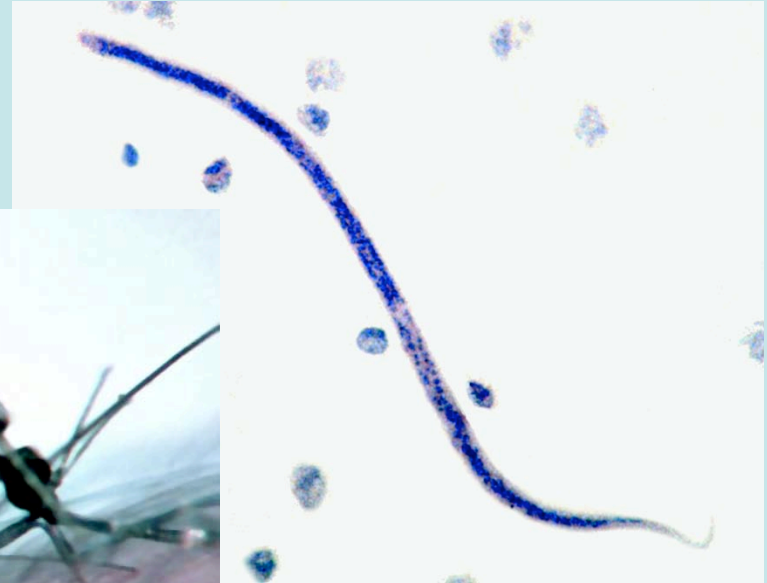


Photo: F. Opperdos

Filariasis

Morbidity and Mortality

Parasitic Disease	Number of Infections (millions)	Morbidity (%)	Mortality (number) (%)
<u>Ascariasis</u>	1,472	23	60,000 0.004
<u>Hookworm infections</u>	1,298	12	65,000 0.005
<u>Lymphatic filariasis</u>	120	37	
<u>Onchocerciasis</u>	18	4.2	45,000 0.25
<u>Schistosomiasis</u>	200	10	20,000 0.01
<u>Trichuriasis</u>	1,049	21	10,000 0.001

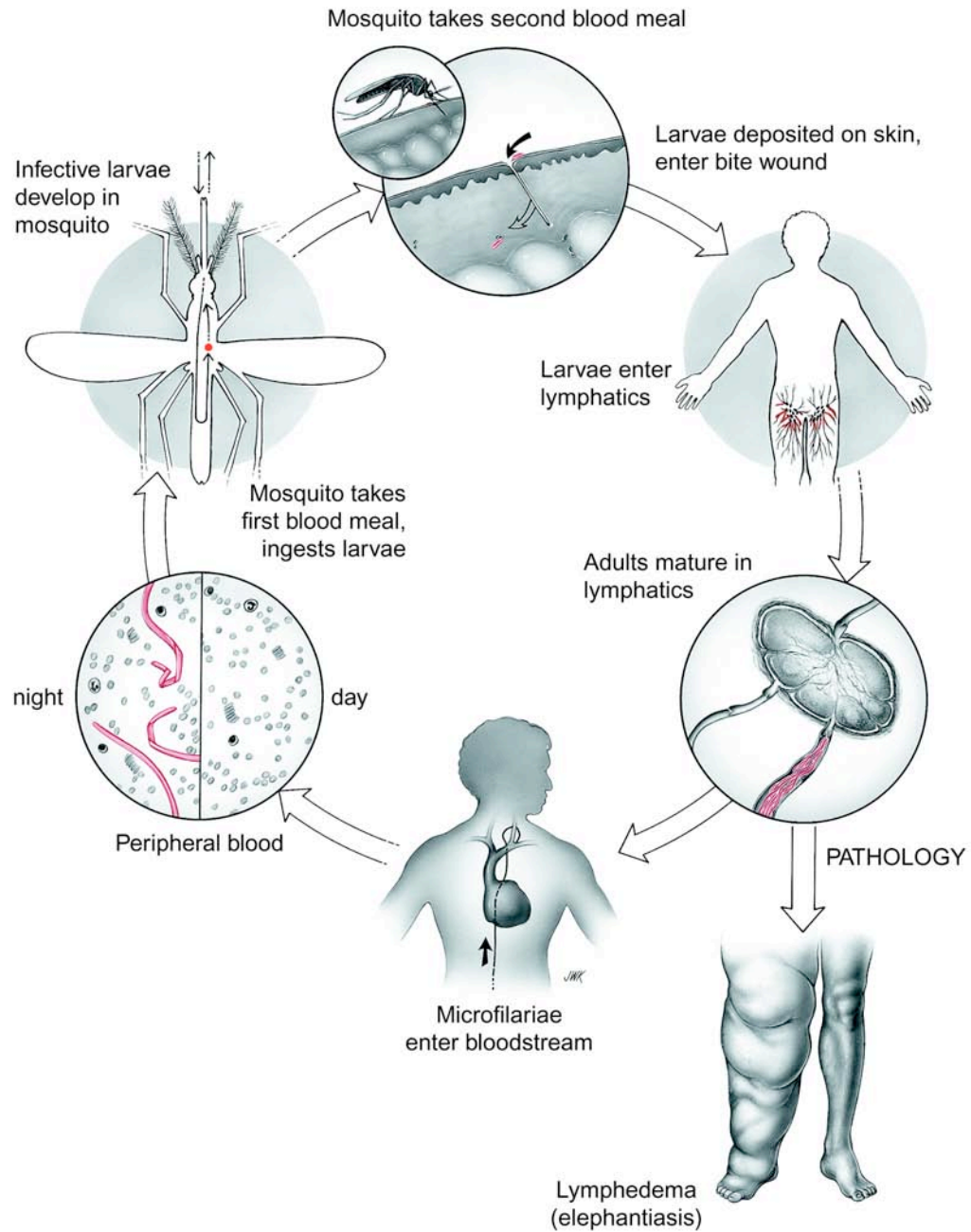




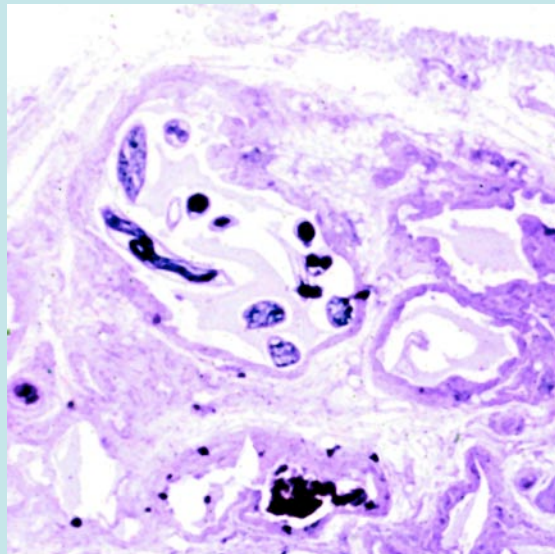
Lymphatic Filariasis In South Asia



Wuchereria bancrofti

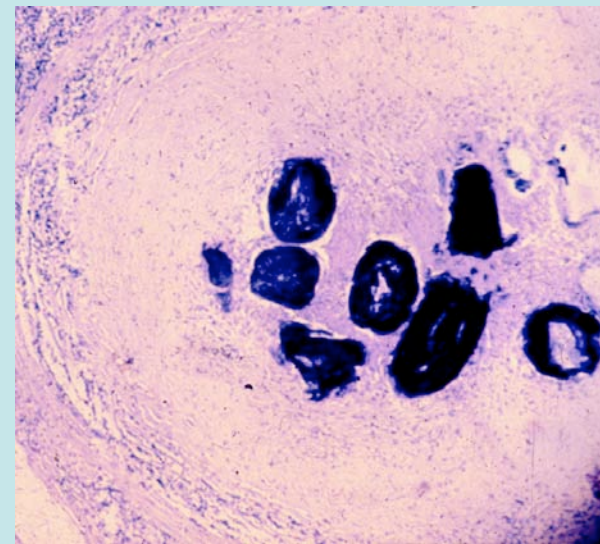


*Pathogenesis**



Live Worms

10 years
→



Dead Worms

*or so we thought!

Wolbachia sp. of bacteria cause the pathology associated with filariasis

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***Wolbachia* in the Inflammatory Pathogenesis of Human Filariasis**

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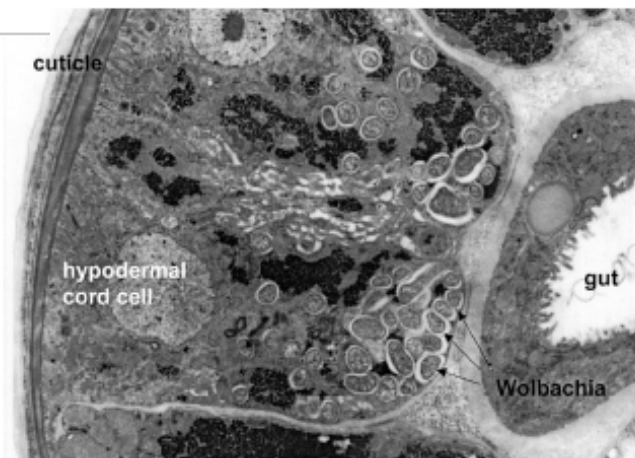
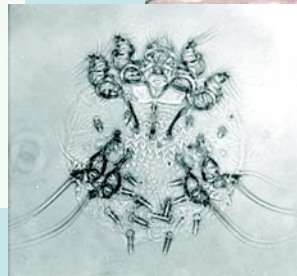


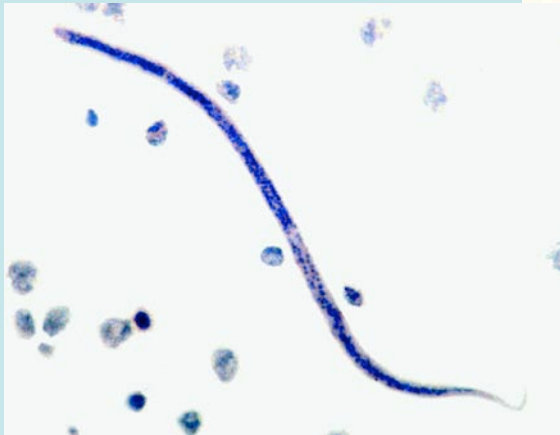
FIGURE 2. Ultrastructure of *Wolbachia* in the hypodermal lateral cord cell of *Brugia malayi*.

Wolbachia Info

Wolbachia are gram-negative bacteria that form intracellular inherited infections in many invertebrates. They are extremely common with 20-75% of all insects being infected. In addition, nematodes, mites, and spiders harbor this symbiotic infection.



Diagnosis



An analysis of the safety of the single dose, two drug regimens used in programmes to eliminate lymphatic filariasis

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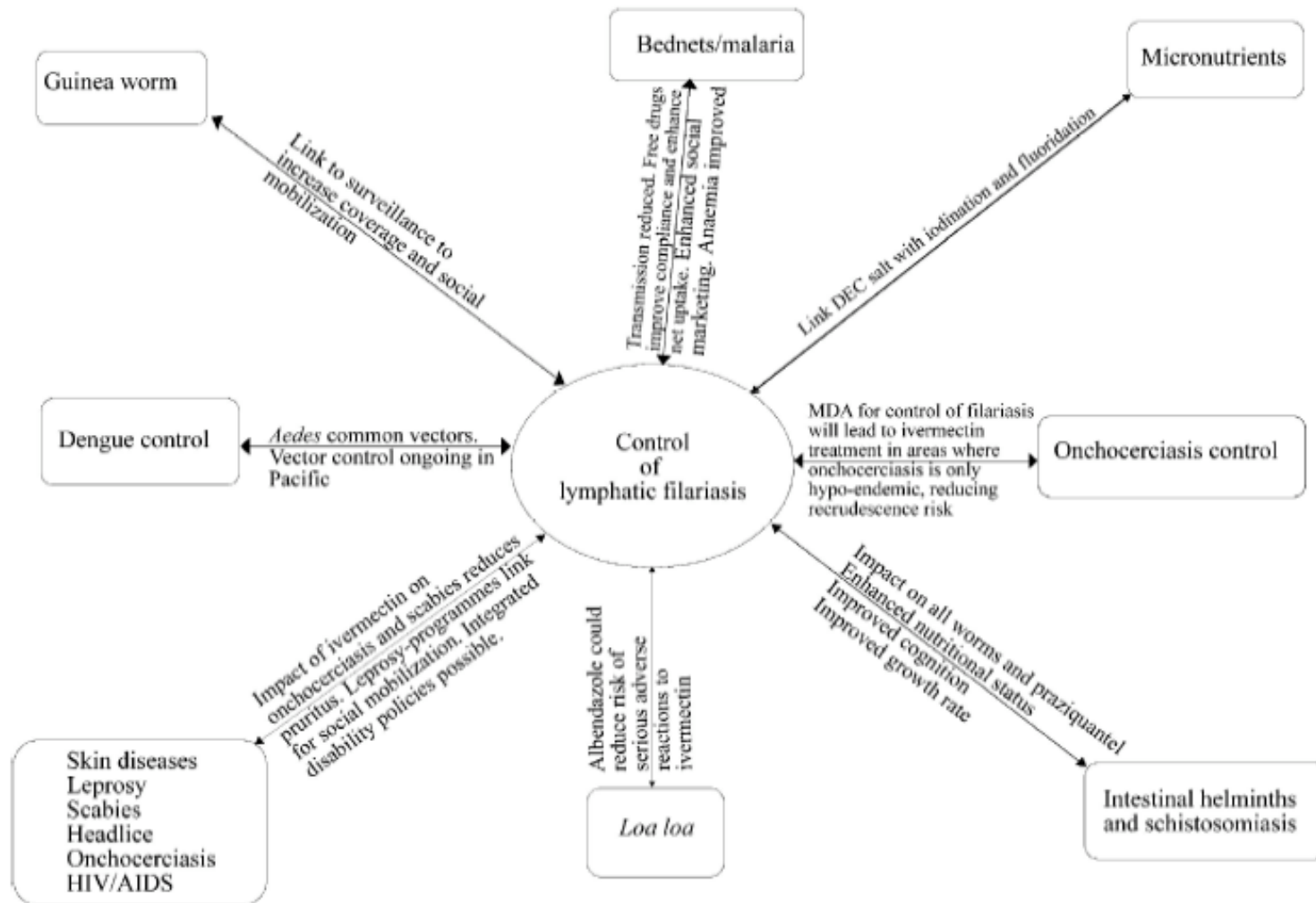


FIG. 1. The multifactorial benefits and linkage potentials of the Global Programme to Eliminate Lymphatic Filariasis, which is based on mass drug administrations (with albendazole–ivermectin or albendazole–dithethylcarbamazine), use of salt fortified with diethylcarbamazine (DEC salt), and, in limited settings, vector control.

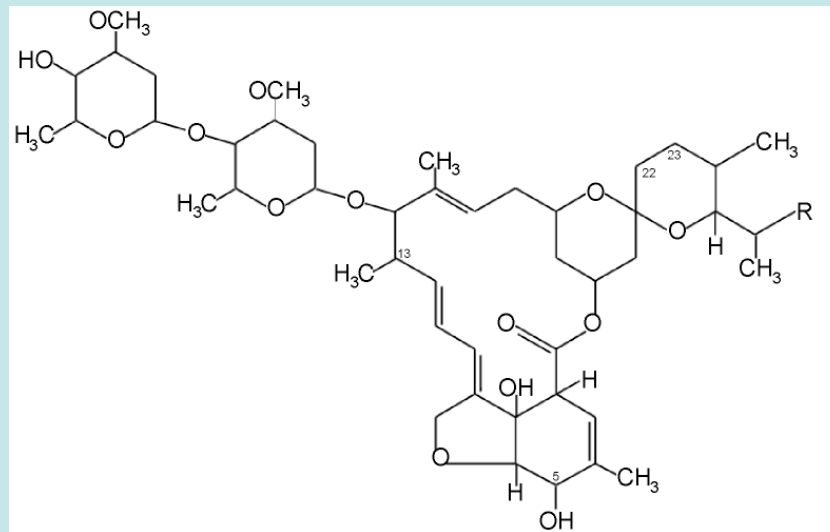
TABLE 2. *The broad anti-parasite effectiveness of two of the drugs used to control lymphatic filariasis (Ottesen et al., 1999)*

Disease/parasite	% of cases cured after treatment with:	
	Ivermectin	Albendazole*
<i>Ascaris</i>	100	100
<i>Strongyloides</i>	95	45
<i>Enterobius</i>	85	85
<i>Trichuris</i>	10–50	40–60
Hookworm	0–20	95
Larva migrans	100	80
Onchocerciasis	95	0
Lice	100	0
Scabies	100	0

*Multiple doses of albendazole are also effective against cysticercosis, echinococcosis, giardiasis, trichomonads, Microsporidia and *Cryptosporidium*.

Drug of choice:

Ivermectin



Mode of Action:

Blocks Cl⁽⁻⁾ ion channels, inhibits γ -aminobutyric acid receptor complex.

Vector Control

Vaccine Development

