

Knowledge to Action: Malaria

Reducing morbidity and mortality

National Research Council

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Malaria –

a bio-clinico-epidemiology-socio-geopolitical-economical-socio-cultural-human and vector behavioral issue

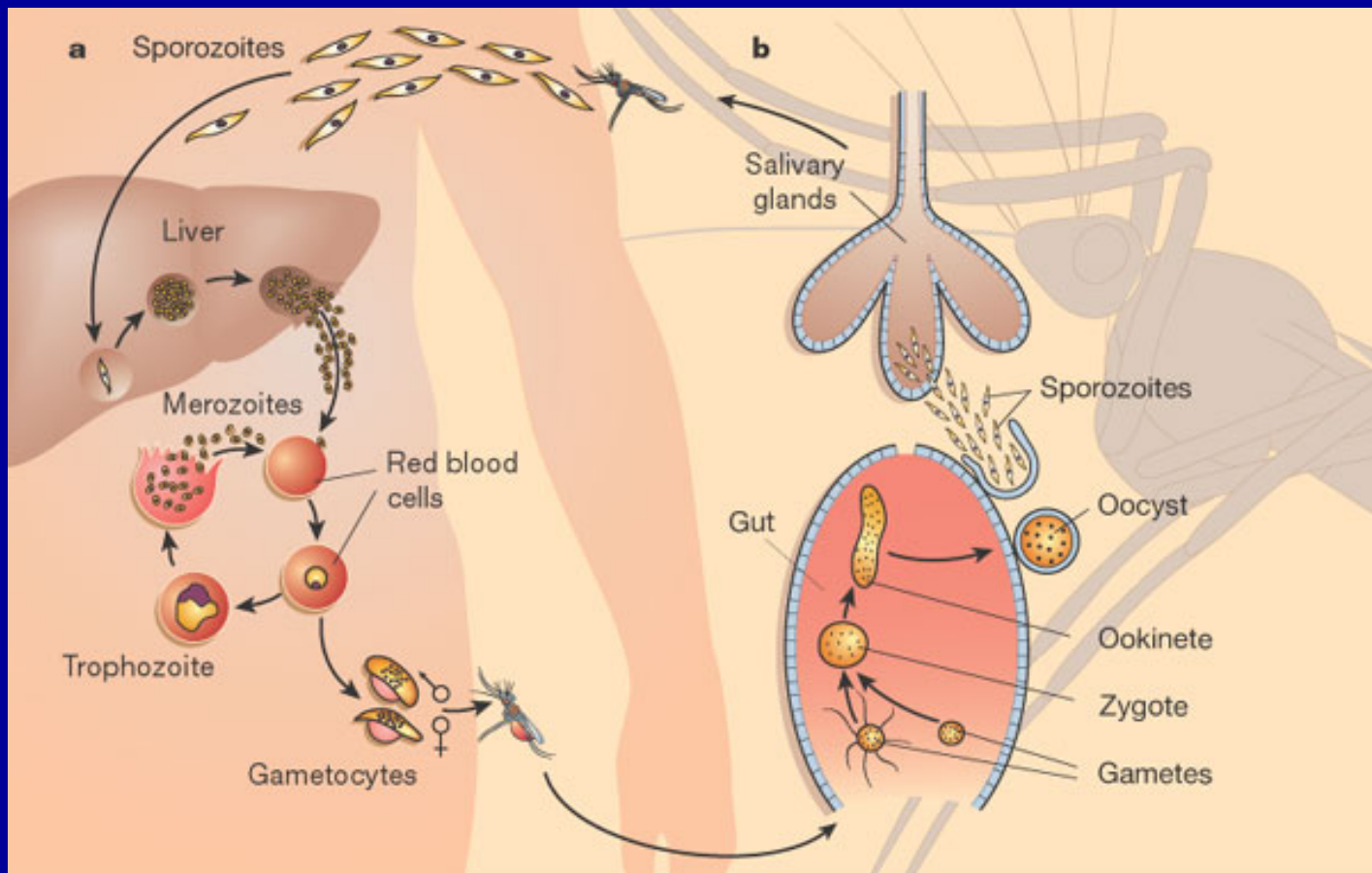
mosquito-parasite-environment-human exposure-case management-drug resistance-immunity interaction

Malaria begins and ends with the female Anopheline mosquito



There are hundreds of anopheline mosquitos; only 60 or so can transmit malaria and only half are efficient enough to be of concern – each has its own habitat, range, transmission dynamics

Malaria – life cycle



Infected red blood cells



- Plasmodium falciparum accounts for most of the mortality; P. vivax is a major cause of morbidity
- Specific diagnosis - stained blood smear; parasites have distinctive physical features readily identified by experienced technicians - but you need techs & microscopes.
- Clinical disease is due to lysis of infected red blood stage
- In some cells gametes develop, are transferred to mosquitos during blood meal

What determines transmission?

- There are principal determinants
 - **density (#) of mosquitos** - directly proportional
 - **human biting habits** - #bites/day/insect squared
 - **mosquito longevity** - proportional to 10th power
- **Mosquito longevity is the most vulnerable**
 - Parasites take 8-30 days to mature within the mosquito; maturation is temperature dependent
 - mosquito must survive long enough to bite a 2nd time
 - most effective vectors are long lived, are present in high density, breed readily, strongly prefer humans

“The Ears of the Hippopotamus”

Where Malaria Patients are Managed ... and Die

Hospital

5%

Dispensary

15%

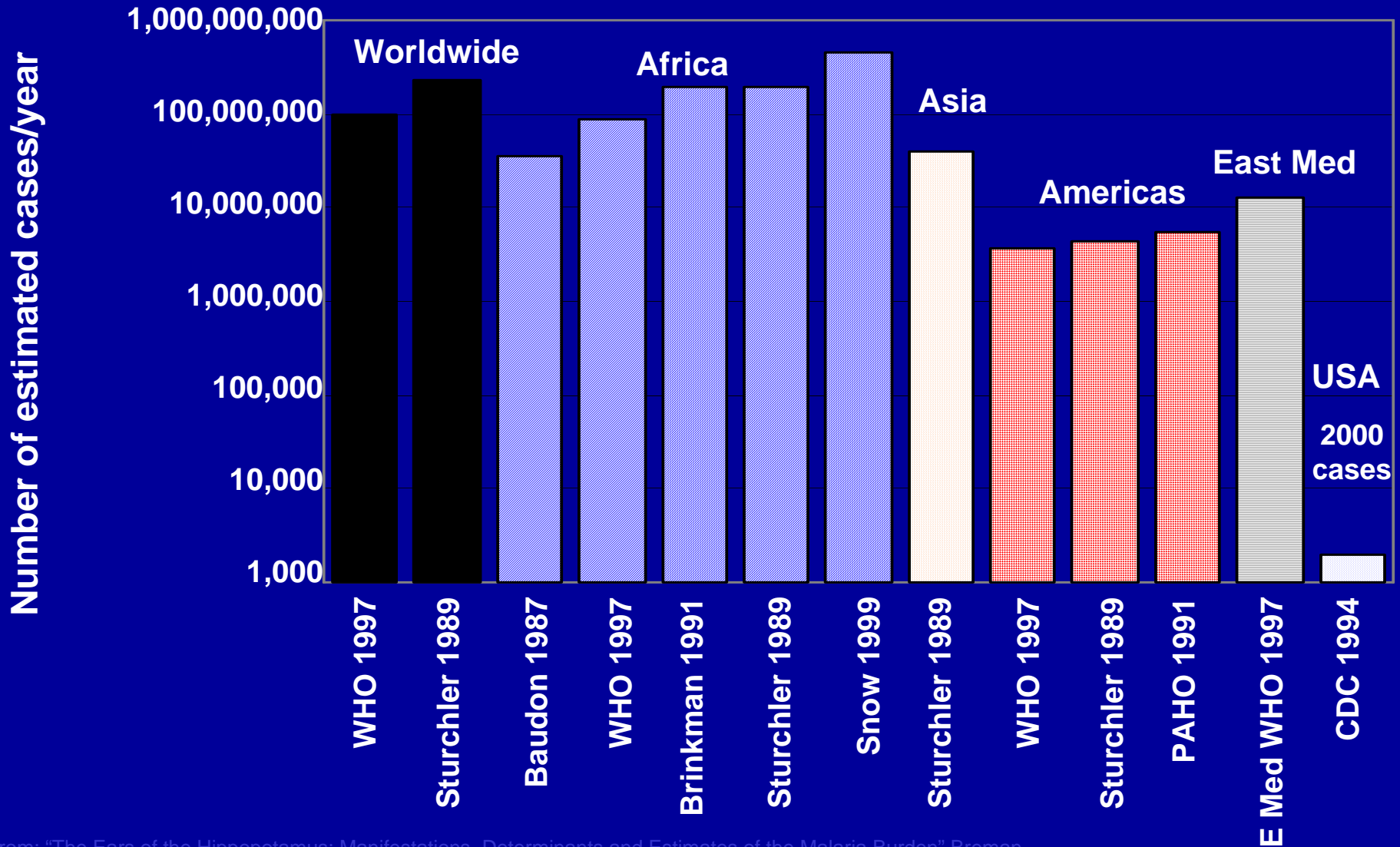
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>80%

Global Burden – Episodes per year

- Data are inadequate, not systematically collected or verified, are largely from research studies in a few countries, and typically are from hospitals and not the community where most cases occur
- Global estimates in < 5yo based on 4-9 febrile events per year, of which ~50% (30-60% are parasitemic) are due to malaria; these numbers suggest there are 200-450 million episodes/year in this age group
- Episodes in older children and adults are fewer (1-2/year; 0.4-1 true malaria) but given the number of people at risk they add 1.5 billion episodes/year
- Global burden approaches 2 billion infections/year

Estimated World and Regional Malaria Cases 1987-1999



Estimated Malaria Deaths and DALYs

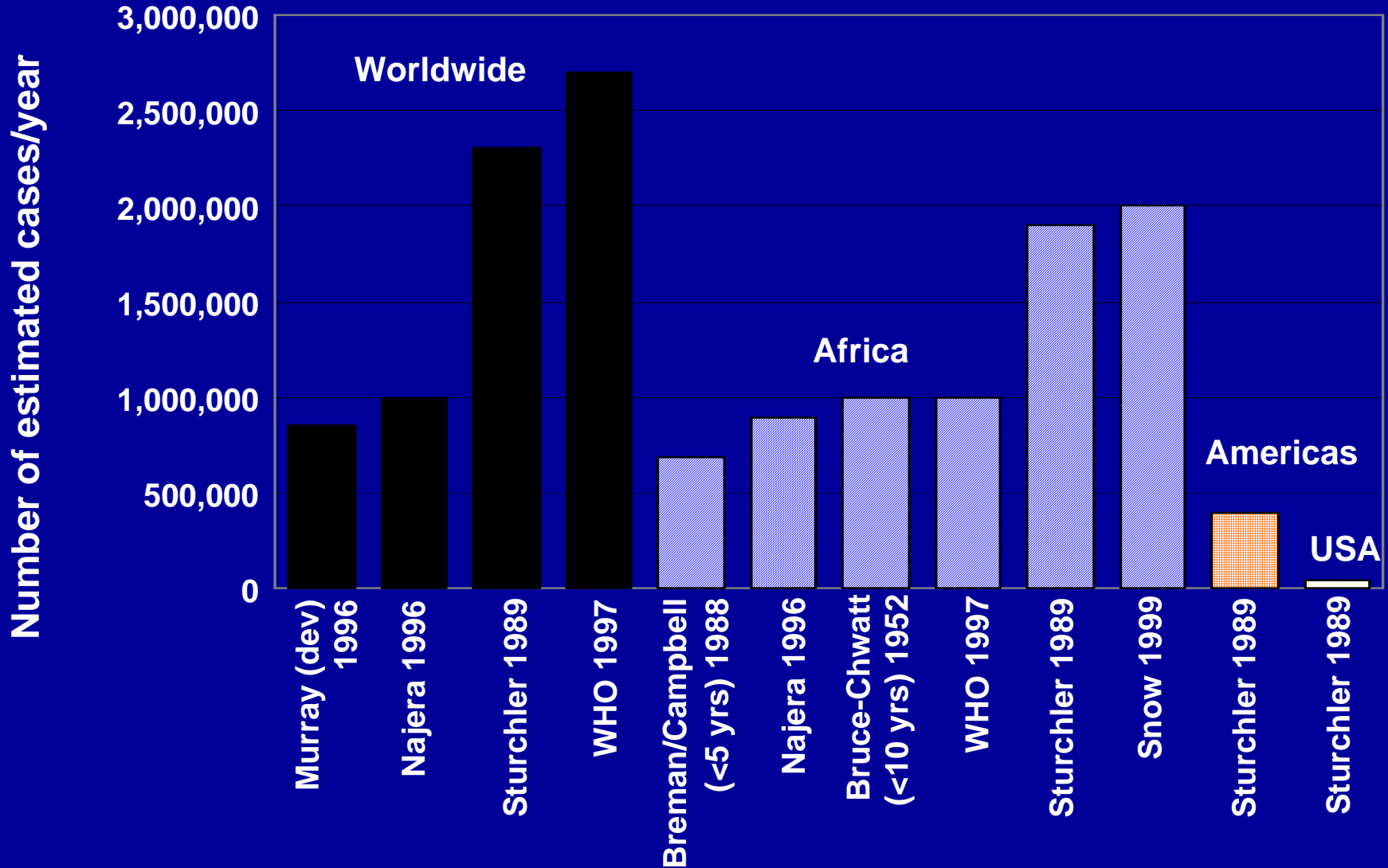
(Disability adjusted life years = # yrs lost due to premature death + # yr lived with disability)

	Total Pop	Deaths	% Total	Dalys	% Total
World	6.2b	1.1 m	100	42 m	100
Africa	.66b	.96 m	86	36 m	85

Updating Malaria Mortality

- Autopsy data updated ~ 1 million deaths/year
 - malaria attributable death rates in < 5yo in Africa are 25-30% based on ↓ mortality with effective therapy
- Malaria in pregnancy/placental infection (severe anemia, lbw, stillbirth) in ~ 1 million, CFR 40%;
- Cerebral malaria - 500,000 episodes, CFR = 15%;
4-5 fold increase in cognitive defects in survivors
- Other major complications (hypoglycemia, ARDS, others) occur in ~2 million, CFR 20%
- **GRAND TOTAL MORTALITY ~ 2.7 million**
75% in children in Sub-Saharan Africa

Estimated World and African Malaria Deaths 1952-1999



Interventions:

- Prevent mosquito bites –
 - Vector control, bednets, repellents
- Prevent infection
 - Vaccine, human behavior
- Reduce reinfection of mosquitos
 - Case management; appropriate chemotherapy; diagnosis; clinical infrastructure
- Environmental management –
 - Integrated pest management
 - Eliminate breeding sites – wet rice cultivation, bromeliads, construction sites, old tires etc.