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Malaria: moving on from the 1950s?

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Malaria Eradication

Vision or Strategy?

Definitions

- Eradication
  - Permanent reduction to zero of the worldwide incidence of infection, as a result of time-bound, deliberate efforts. Intervention measures are no longer needed once eradication has been achieved
- Elimination
  - Reduction to zero of the incidence of infection in a defined geographical area as a result of deliberate efforts. Continued measures to prevent re-establishment of transmission are required
- Control
  - Reduction of disease incidence, prevalence, morbidity or mortality to a locally acceptable level as a result of deliberate efforts

Why is malaria different from smallpox or polio?

- No single magic bullet
- Case detection
- Dependence on vectors and their ecology
- R_0 and heterogeneity

Case detection

- **Prompt diagnosis of outbreaks is essential for any program for elimination of a pathogen**
- Smallpox, polio, measles
  - Clinical diagnosis is specific
  - Minimal local infrastructure needed for diagnosis
  - Feasible to pick up sporadic cases in remote areas and "mop-up" with vaccine
- Malaria
  - Clinical cases confused with respiratory infections, meningitis, sepsis.
  - Diagnosis needs microscopy or RDTs
  - Elimination can only be confirmed by diagnosing large numbers of suspected cases (most will be negative)
  - **Repair or construct a well-functioning health system before you even think about it.**

Dependence on vectors and their ecology

- As a vector-borne disease, malaria is extremely sensitive to environmental changes
- In general, urbanisation/modernisation reduces human-vector contact
- This greatly facilitated elimination in industrialised countries
- Encourages optimism about other places

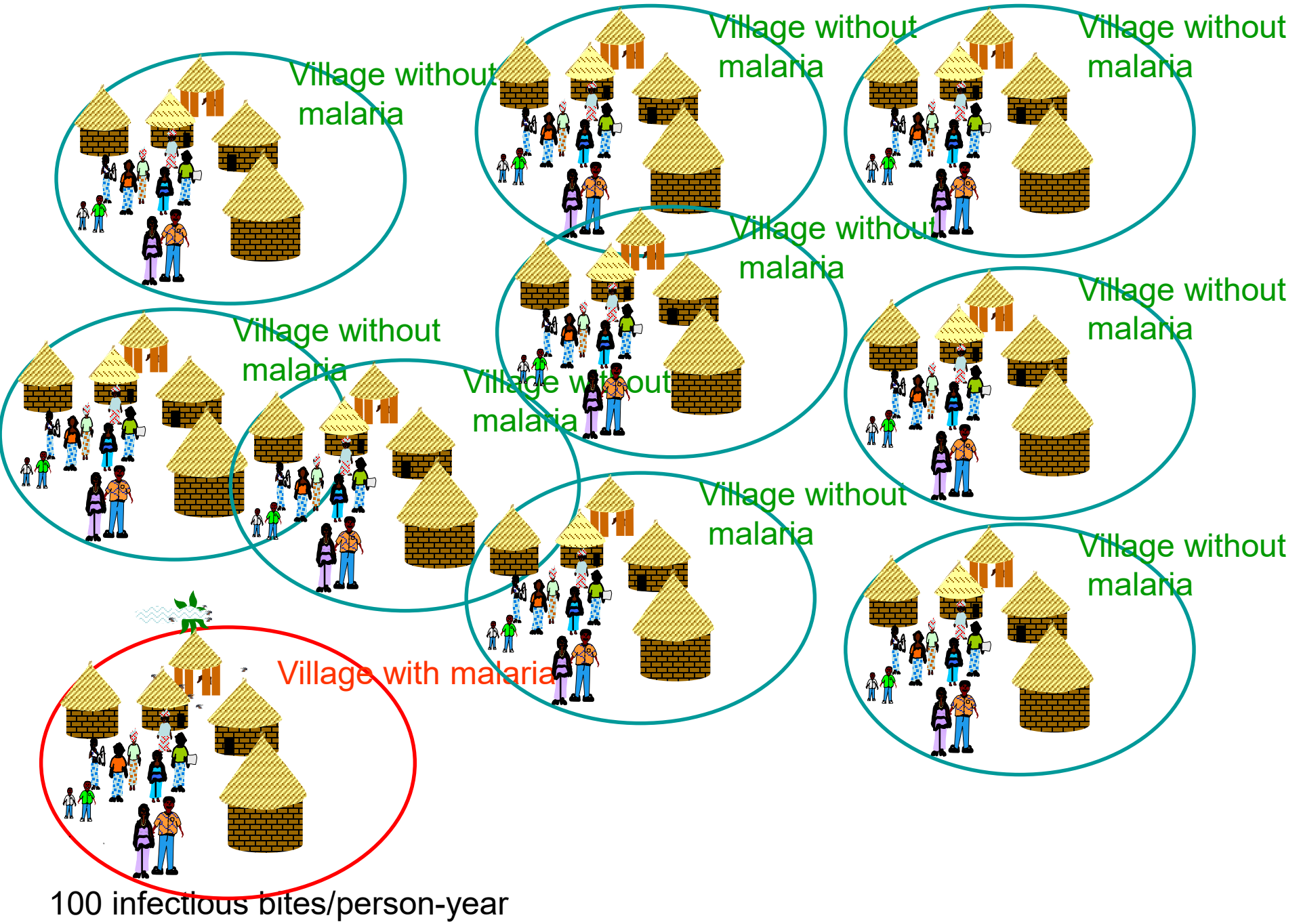


Figure modified from Paul Libiszowski

Average exposure 10 infectious bites/person-year

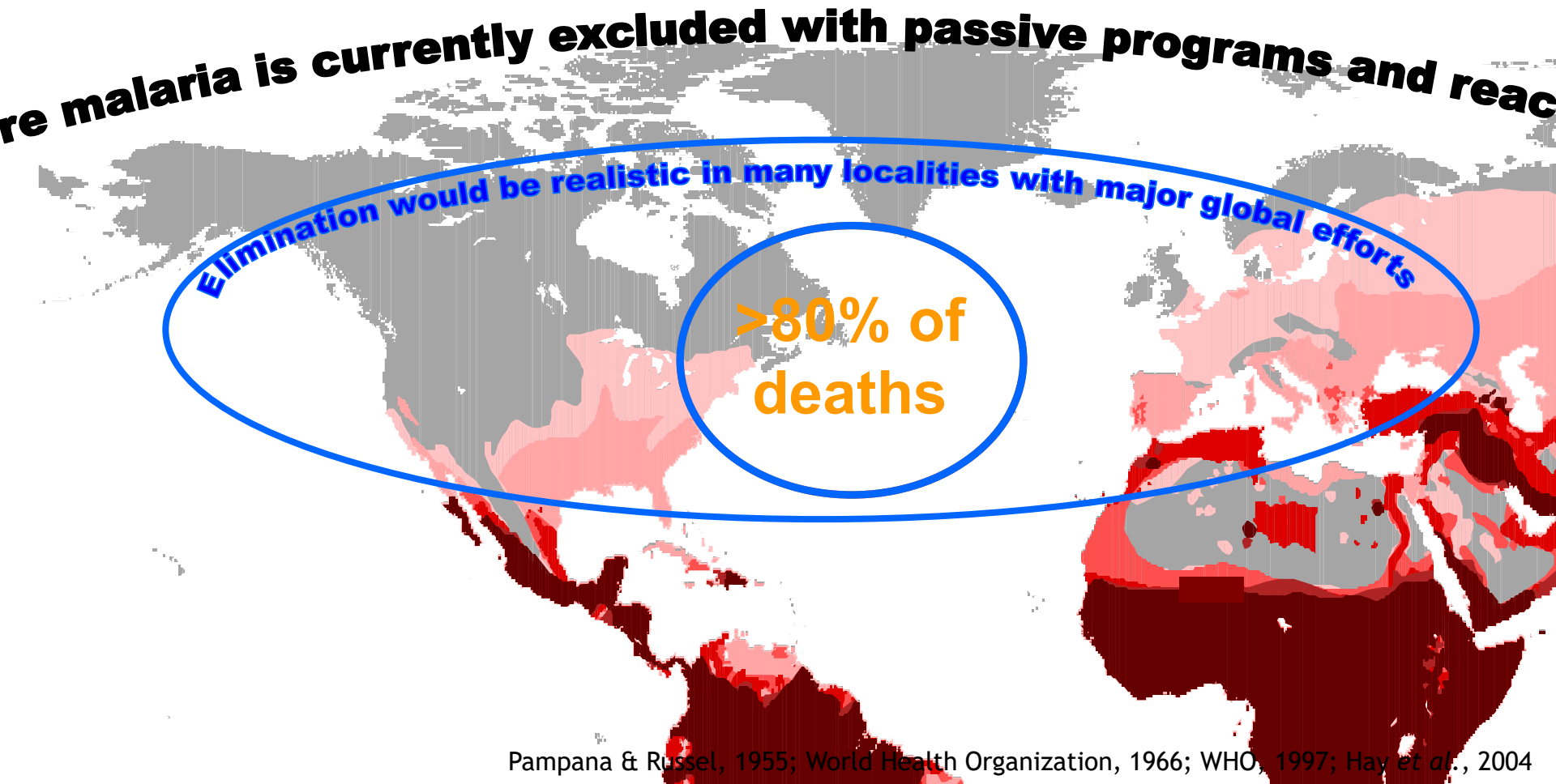
Heterogeneity

- heterogeneity makes it easier to eliminate a pathogen if you can target interventions
- heterogeneity makes it harder to eliminate a pathogen if you can't target
- **With malaria, targetting is relatively difficult because of the difficulty of diagnosis**

Heterogeneity

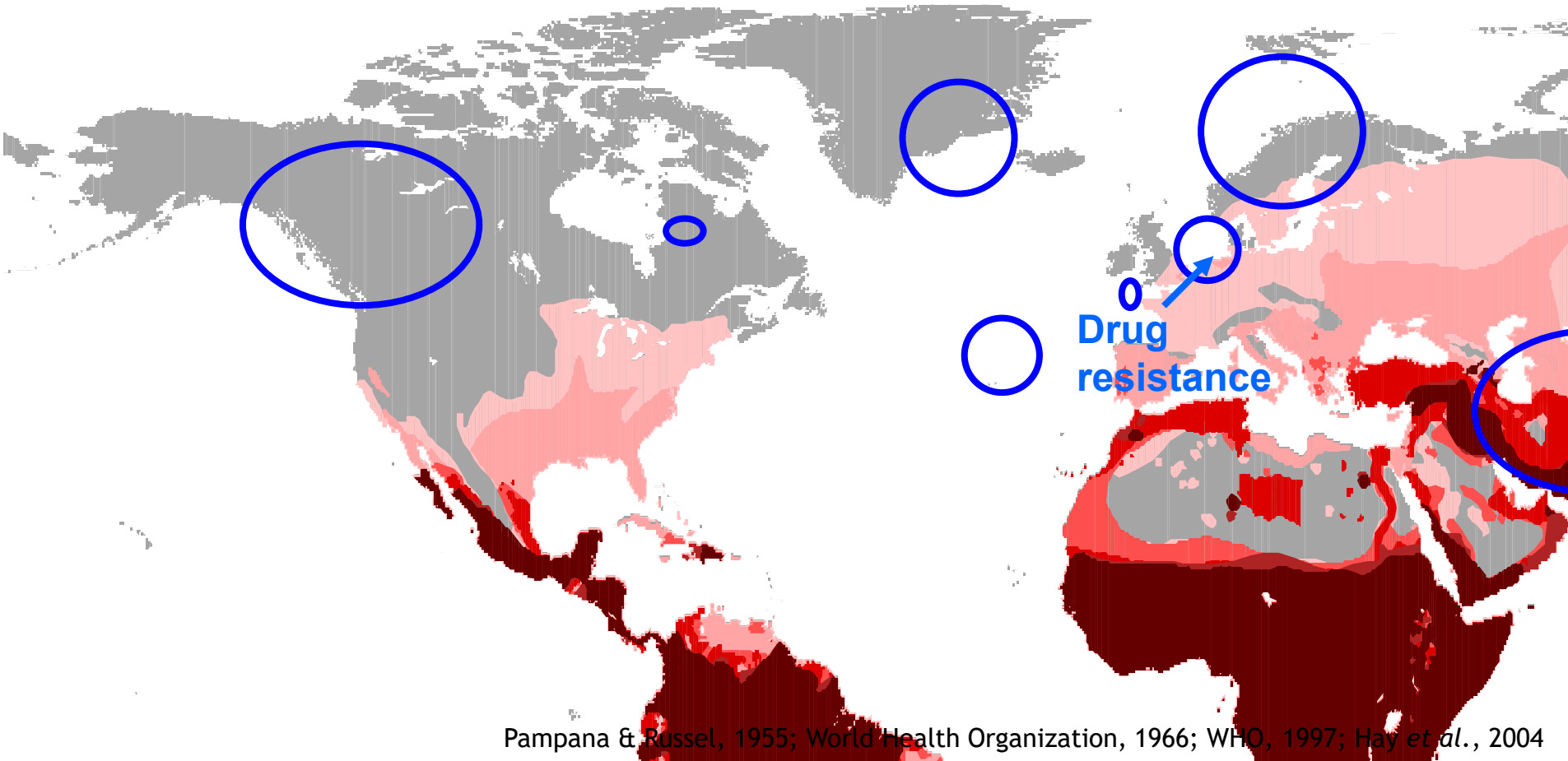
- Acquired immunity to typical viral pathogens is long-term and prevents reinfection
- In small populations, the reservoir of susceptibles is rapidly "used up".
- Such viruses therefore need a minimum size of host population to persist
- Acquired immunity to malaria controls disease but does not prevent reinfection
- Everyone remains susceptible to reinfection
- **There is therefore no theoretical minimum host population for the persistance of *P. falciparum***
- ***P. falciparum*** can persist undetected in small pockets

The geographical distribution of malaria infections



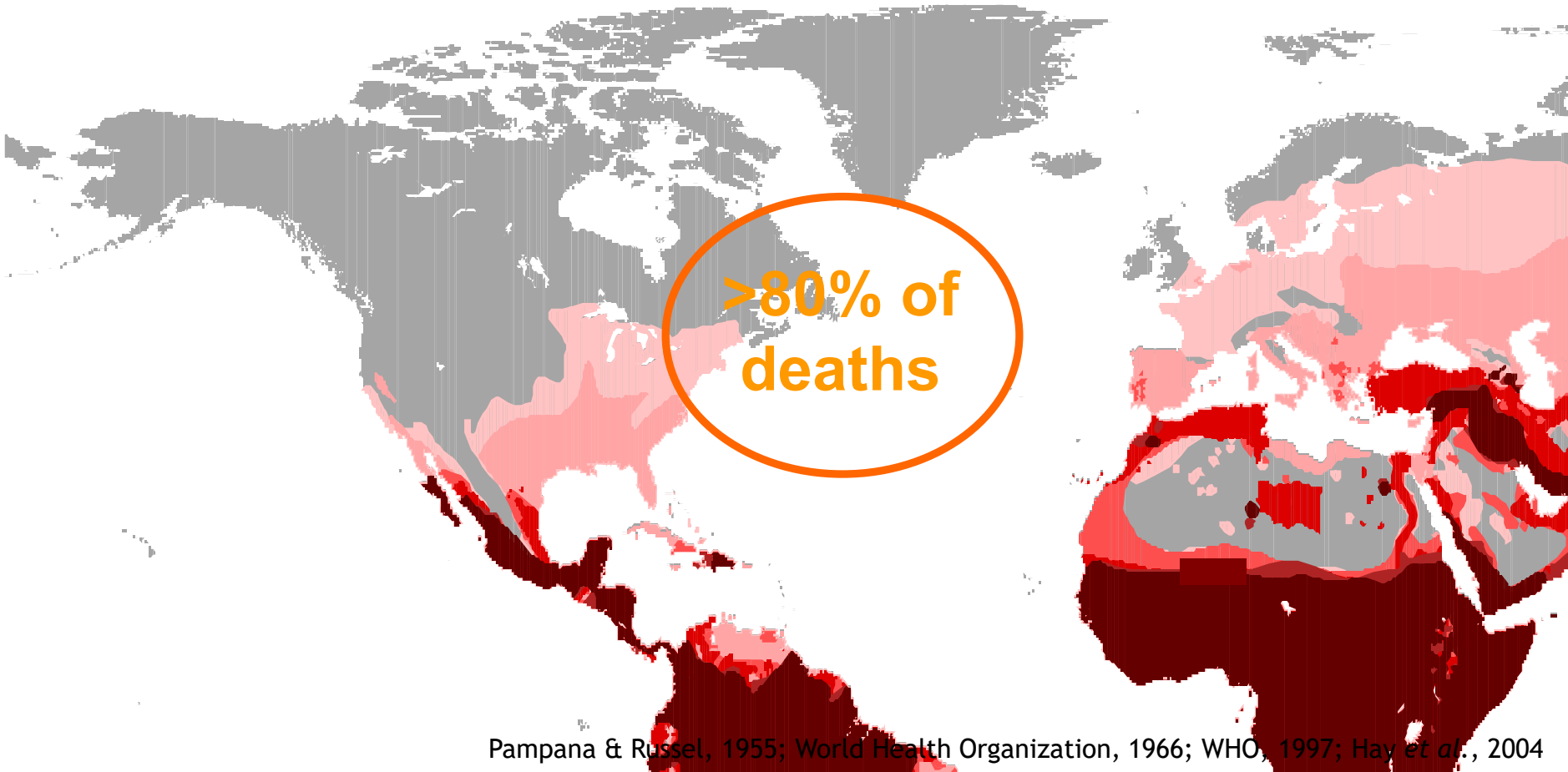
Pampana & Russel, 1955; World Health Organization, 1966; WHO, 1997; Hay *et al.*, 2004

In some places it makes good sense to focus on elimination now



Pampana & Russel, 1955; World Health Organization, 1966; WHO, 1997; Hay *et al.*, 2004

The geographical priority for global malaria control



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