The burden of lymphatic filariasis in Africa for 2000, 2020 and 2025

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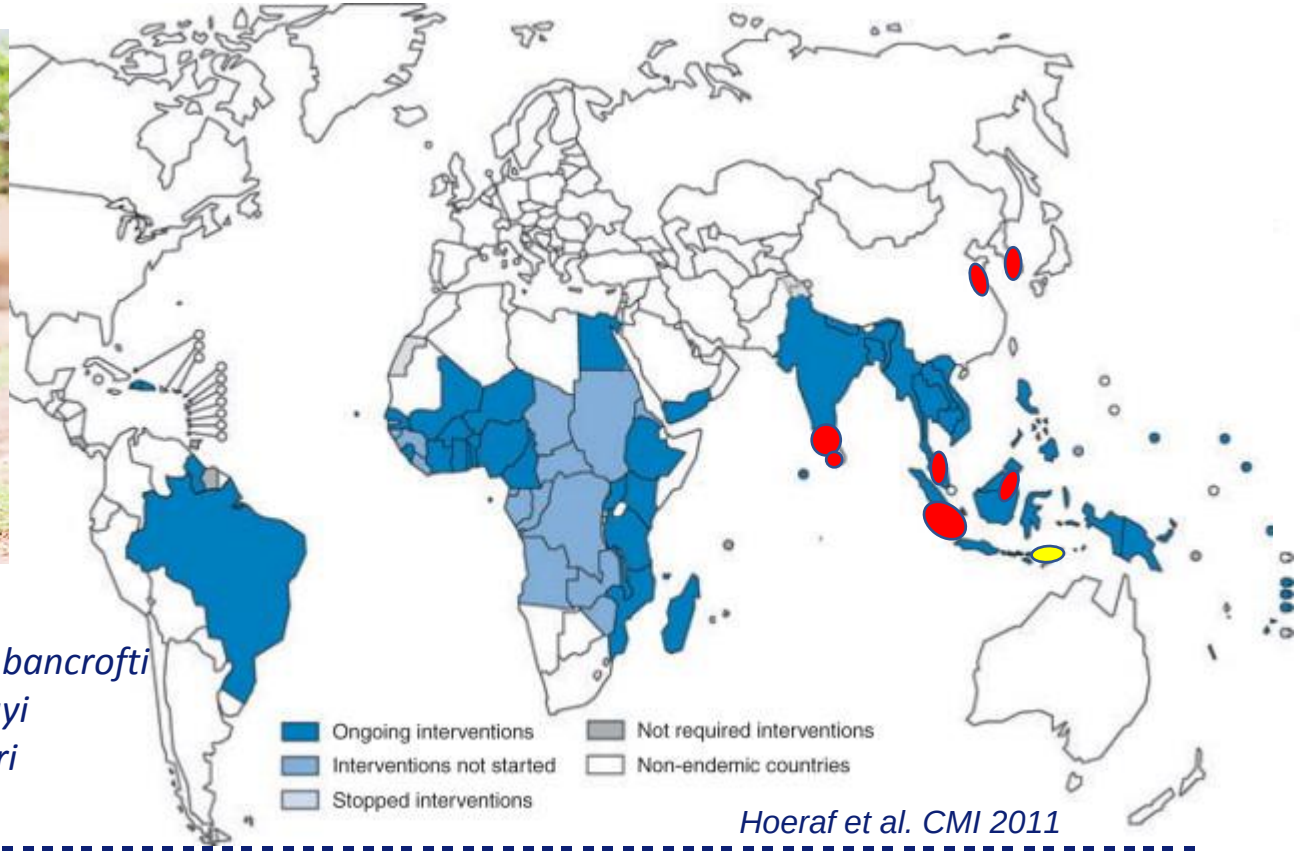
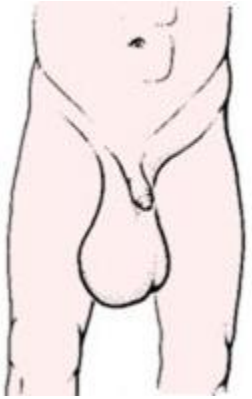
COR-NTD 2019
National Harbor, Maryland USA
November 2019
Breakout session 2E

Erasmus MC
University Medical Center Rotterdam

Global lymphatic filariasis endemicity





Wuchereria bancrofti
Brugia malayi
Brugia timori

Hoeraf et al. CMI 2011

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Objectives

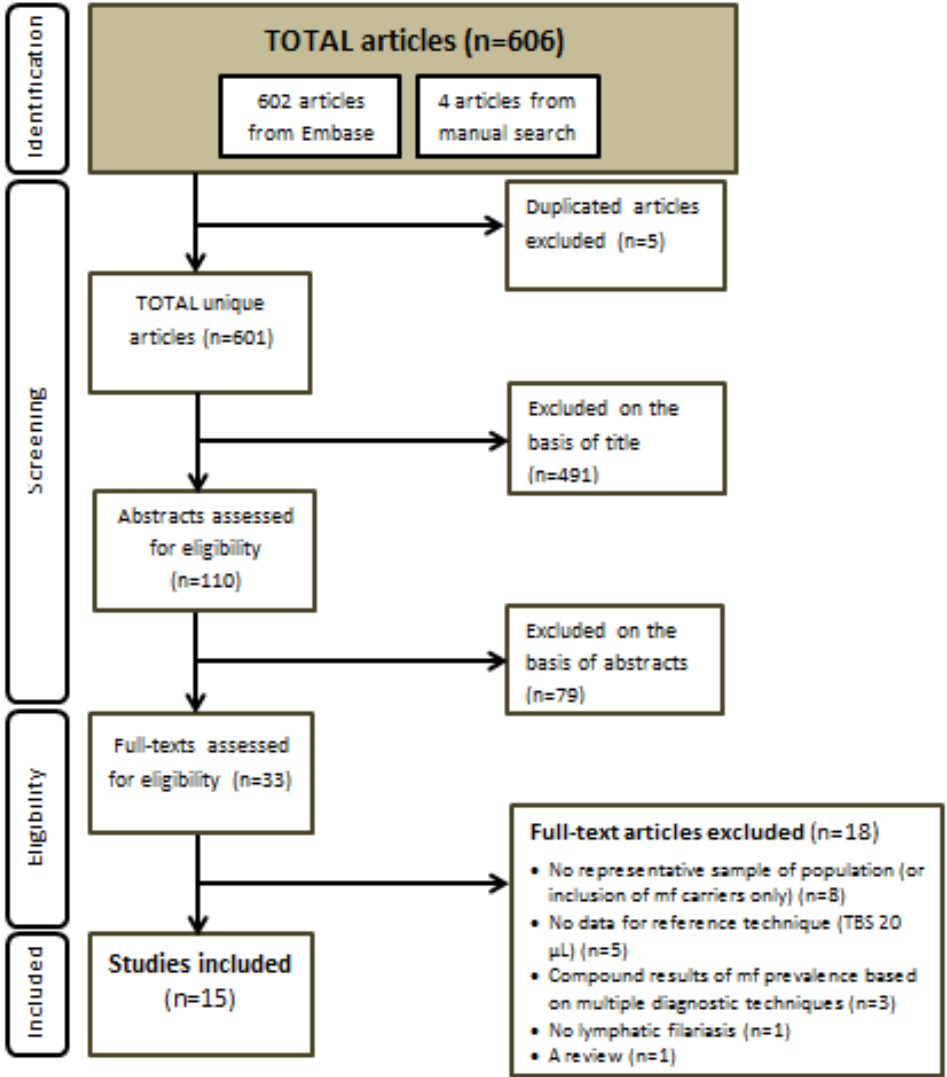
- To estimate the burden of lymphatic filariasis in Africa for 2000, 2020, 2025, in terms of:
  - Number of cases with clinical manifestations:
    - Lymphoedema/elephantiasis
    - Hydrocele
  - Disability-adjusted life years (DALYs)

Methodology

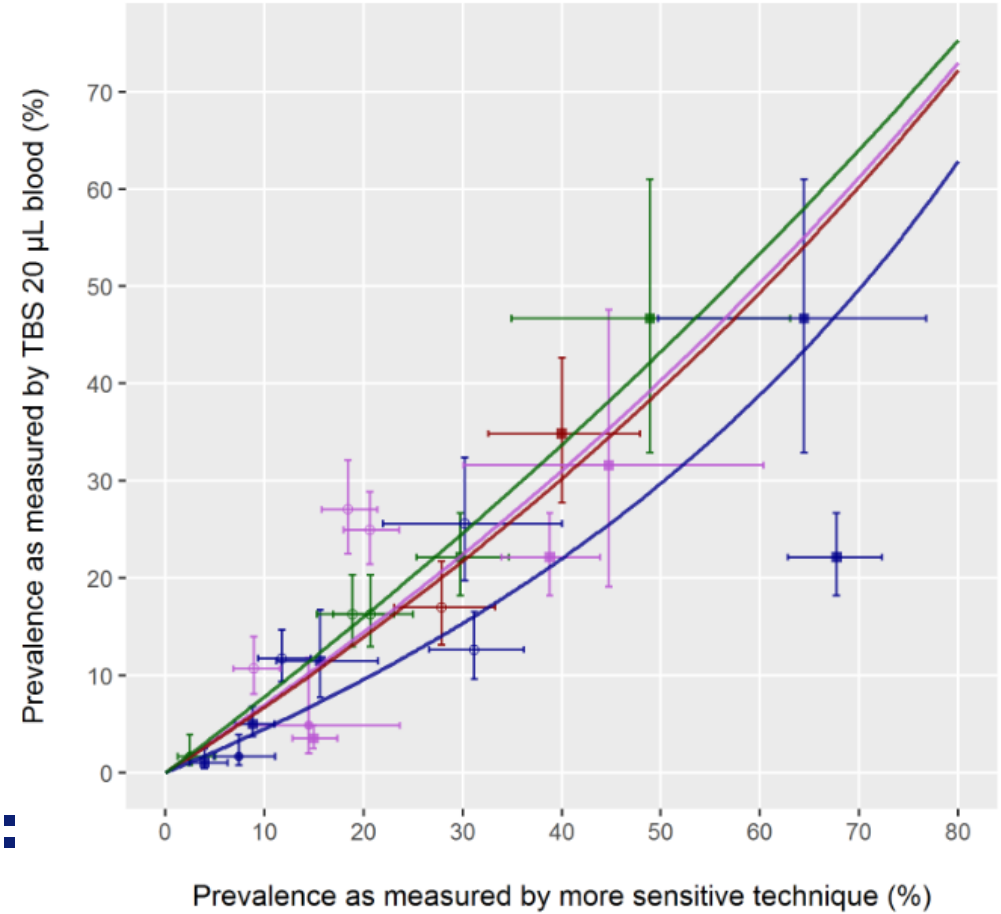
Step 1	• Develop methods to **standardise mf prevalence** measured with different diagnostic tests
Step 2	• Quantify the **pre-control association between mf and disease prevalence**
Step 3	• Use existing maps of mf prevalence in Africa and the associations under 2) to **estimate pre-control disease prevalence**
Step 4	• **Project trends in disease prevalence** since start of MDA

Step 1. Standardise mf prevalence

- Literature review: identify studies comparing mf prevalence measured by TBS-20µL and another diagnostic technique



Step 1. Standardise mf prevalence (cnt'd)



Vinkeles Melchers *et al.*
Submitted Lancet ID 2019

Reference technique	Diagnostic techniques
TBS (20 µL)	Knott's (1 mL)
TBS (20 µL)	TBS (≥40 µL)
TBS (≥20 - ≤60 µL)	CCT (≥20 µL)
TBS (20 µL)	MFT (1 mL)

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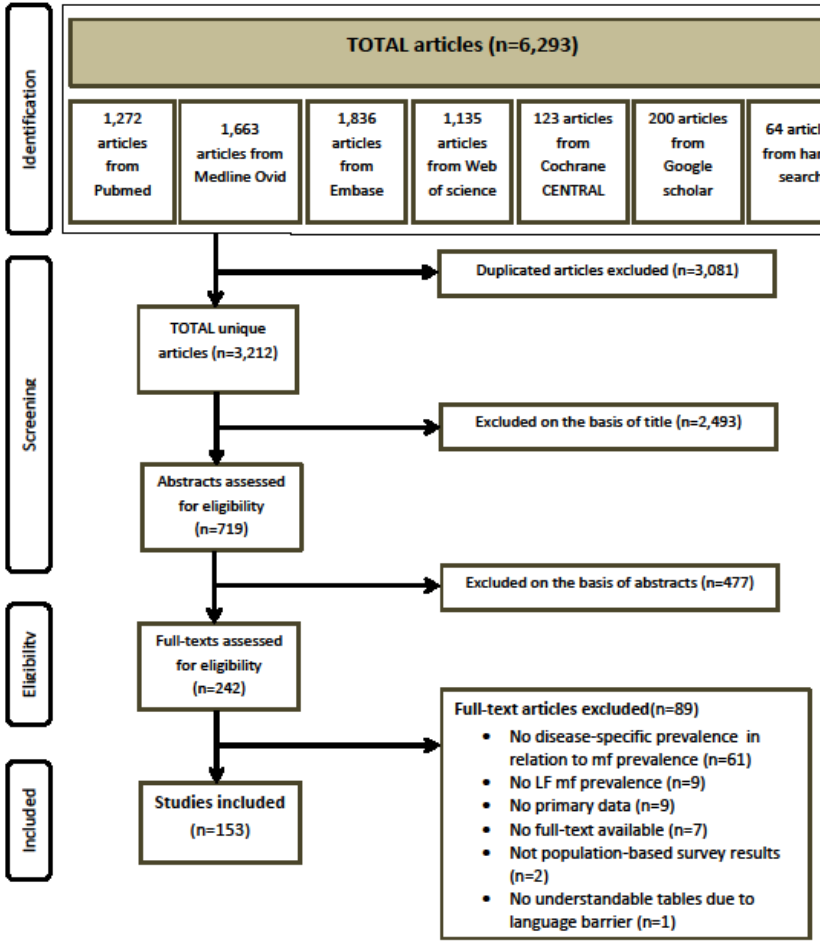
Step 2. A … norbidity

- Systematic l … enting estimates of mf and disease … d sex
  - Morbidi … ephantiasis, hydrocele
  - Data ext …)



Step 2. Association between mf and morbidity

- Systematic literature review to identify papers presenting estimates of mf and disease prevalence at population level, by age and sex
  - Morbidity outcomes of interest: lymphoedema/elephantiasis, hydrocele
  - Data extracted from 153 papers (out of 3,212 hits)

- Plot pre-control prevalence of standardised mf infection vs morbidity to identify key influential variables (age, sex, parasite species, geographical region)
  - Age standardisation of mf and morbidity prevalence to UN Population Division data of Africa

- Associations between infection and morbidity prevalence, described by non-linear functional relationship of infection *x* and morbidity *y*:

$$y = (a + b*x^c)/(1 + b*x^c)$$ *(vd Werf et al. 2002, schisto)*

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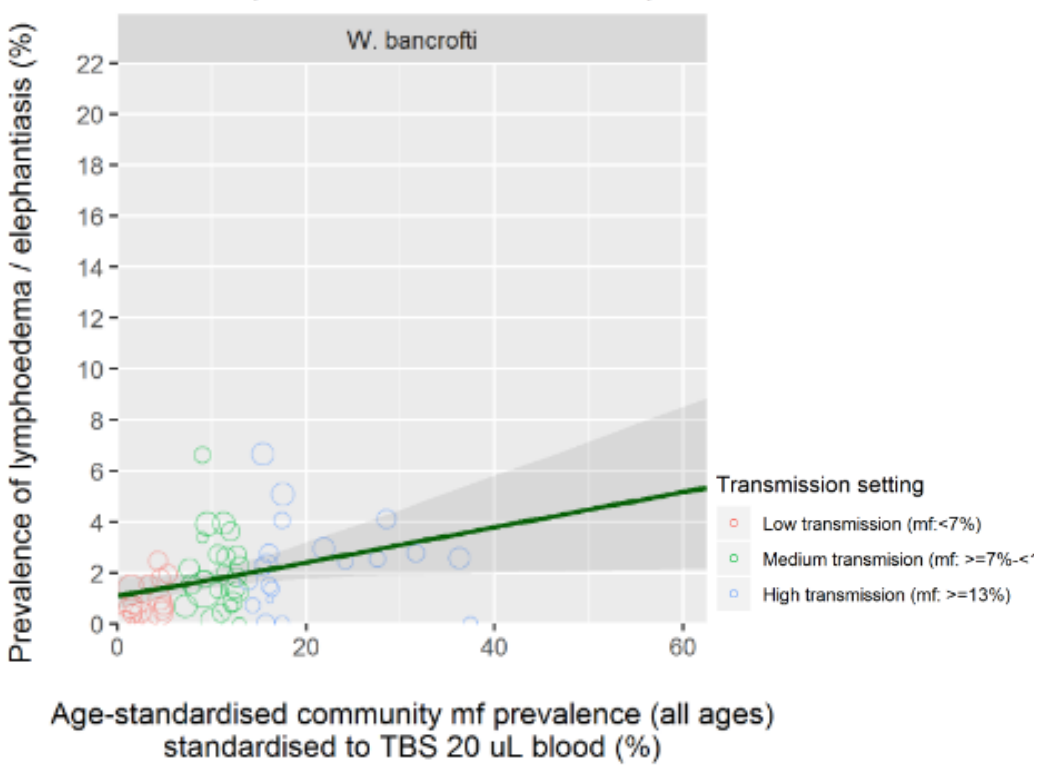
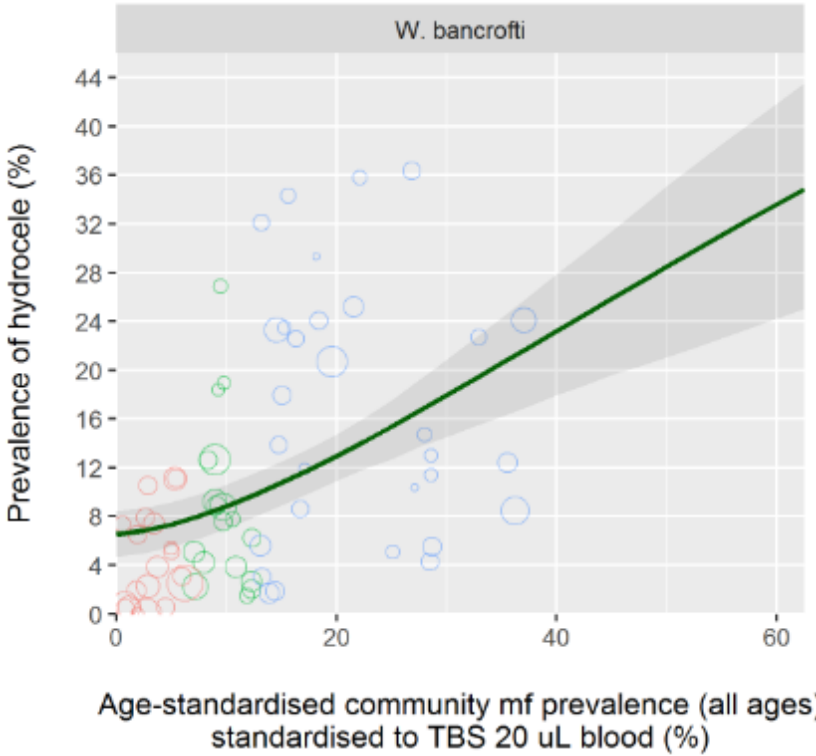
Step 2. Association: mf and morbidity in Africa

Lymphoedema

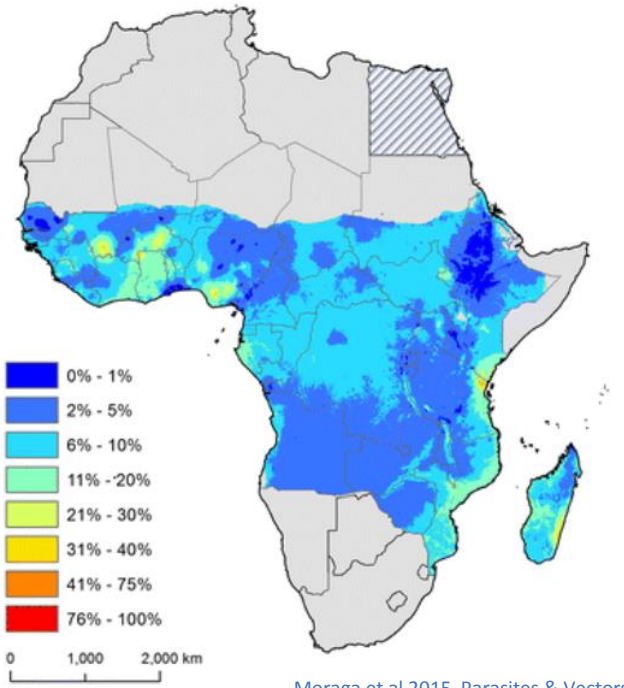


Hydrocele



Step 3. Estimate pre-control disease prevalence

Fig. Pixel-level map of mf infection



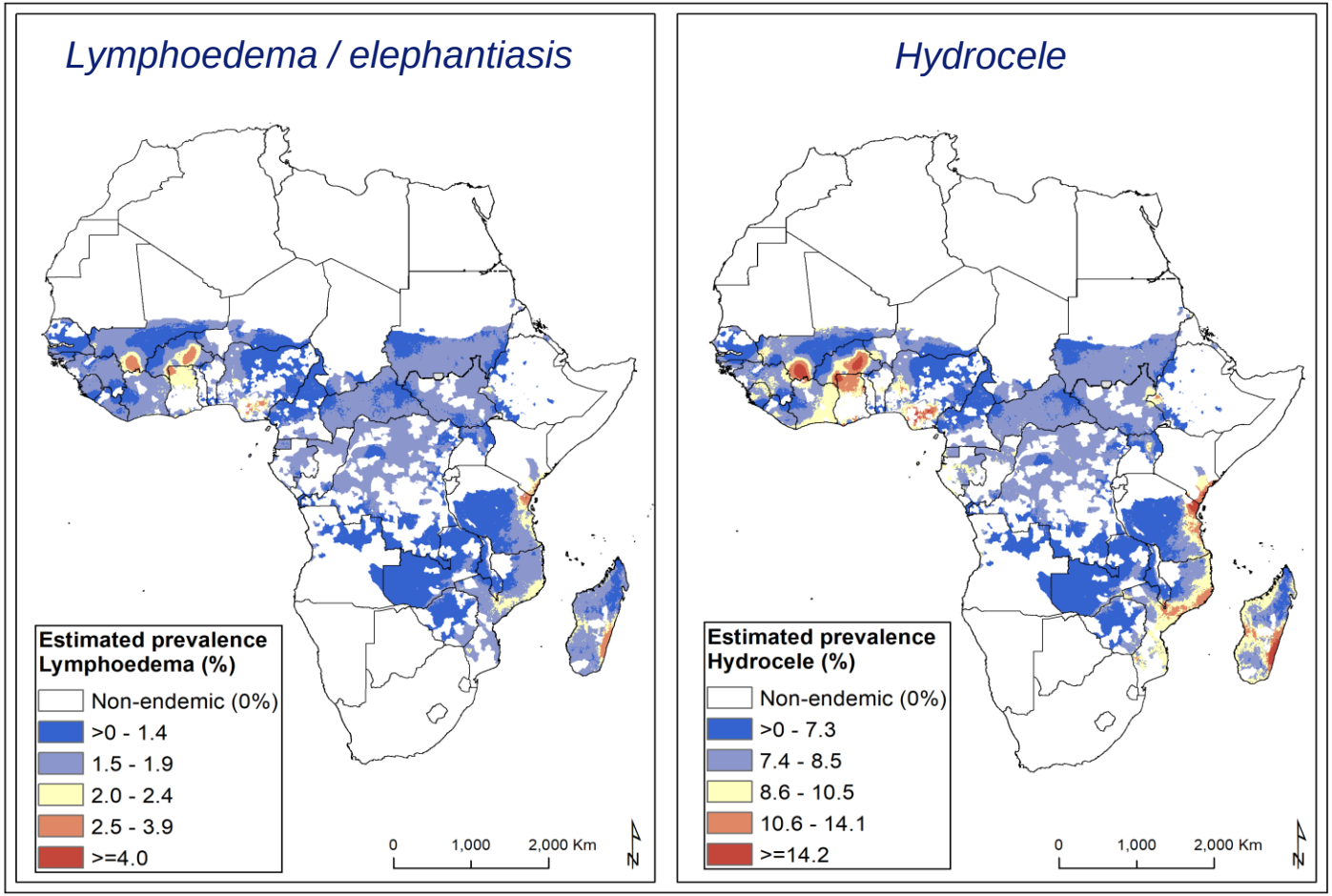
Moraga et al 2015, Parasites & Vectors

- Existing maps of infection prevalence (Moraga et al 2015, Parasites & Vectors, recently updated by Cano et al.)
- Apply association between infection and morbidity prevalence for Africa on pixel-level mf prevalence

➔ Estimate pre-control number of people with morbidity by pixel

- Population estimates by pixel

Step 3. Estimate pre-control disease prevalence



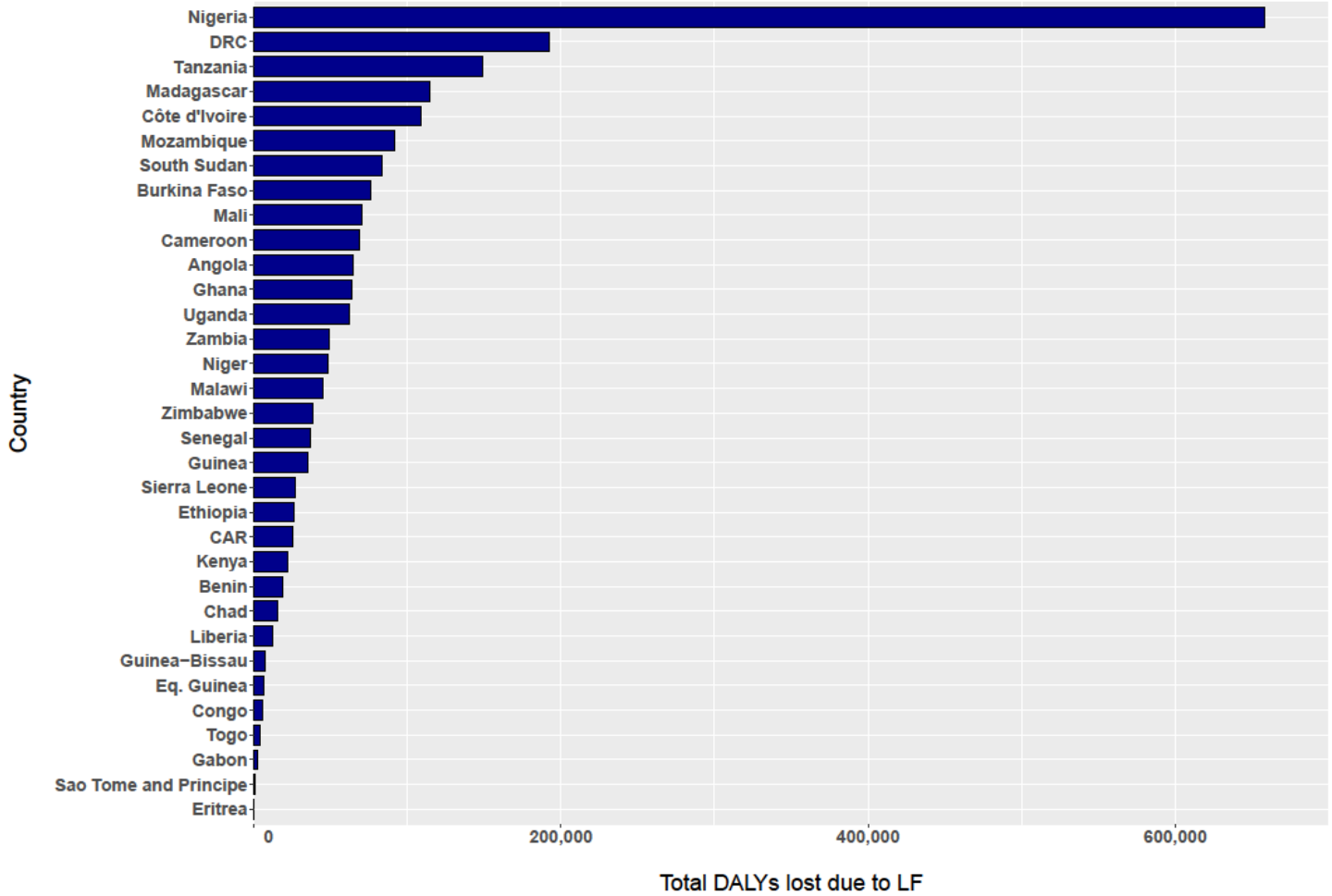
Step 4. Project trends in disease prevalence and burden

- Projected estimates of numbers of cases and disease prevalence based on:
  - Geostatistical map of pre-control mf prevalence (pixel-level estimates), overlaid with a raster for borders of MDA implementation units (IU)
  - Statistical model for the pre-control association between community-level mf prevalence and overall prevalence of morbidity
  - ESPEN data on history of MDA (<2019)
  - A cohort model for changes in morbidity prevalence by age and sex over time (*De Vlas et al. PLoS NTDs 10 (2) 2016*), based on the following assumptions :
    - Stable equilibrium before start MDA (<2000)
    - Morbidity incidence linearly declines to zero during the entire duration of a MDA campaign
    - Zero excess mortality due to symptoms

Number of diseased cases

	Number of individuals (x1000) (% of total population at risk)		
	2000	**2020**	**2025**
Total pop. at risk	303,033	527,897	602,205
Lymphoedema / elephantiasis	4,499 (1.5%) [3,499 – 5,621]	6,283 (1.2%) [4,816 – 7,830]	5,879 (1.0%) [4,532 – 7,371]
Hydrocele	12,207 (4.0%) [9,326 – 15,168]	17,268 (3.3%) [13,047 – 21,389]	16,337 (2.7%) [12,389 – 20,337]

Total DALYs lost per country for 2025



Conclusion and implications

Case estimate:

- Cases remaining with any clinical manifestation due to LF in Africa by 2025: >22 million cases
  - Hydrocele (74%)
  - Lymphoedema/elephantiasis (26%)

Burden estimate:

- Predicted total disease burden due to LF in Africa by 2025: 2.2 million DALYs lost
- Pre-control DALYs lost (1.7 million) are of same order of magnitude as GBD (1.6 million)

- Between 2000 – 2020 an increase in DALYs lost due to LF. Since 2020, a slight reduction (~6%) in total DALYs thanks to MDA alone.
- 16.3 million men with hydrocele requiring surgery (2025).
- 5.9 million people with any stage of lymphoedema / elephantiasis requiring morbidity management to prevent progression and episodes of adenolymphangitis (incl. antibiotics).
- Most cases in Nigeria (~29%), DRC (~9%), and Tanzania (~7%): all under MDA or surveillance

Acknowledgements

- **Erasmus MC**
  - Luc Coffeng
  - Wilma Stolk
  - Joost Vanhommerig
  - Sake de Vlas
- **Drugs for Neglected Diseases *Initiative***
  - Belén Pedrique
  - Sabine Specht
- **London School of Hygiene and Tropical Medicine**
  - Jorge Cano

This study is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of the Department of Public Health, Erasmus MC, University Medical Center Rotterdam (The Netherlands) and do not necessarily reflect the views of USAID or the United States Government.