In Memory of

National Professor N Islam

Infectious Diseases:

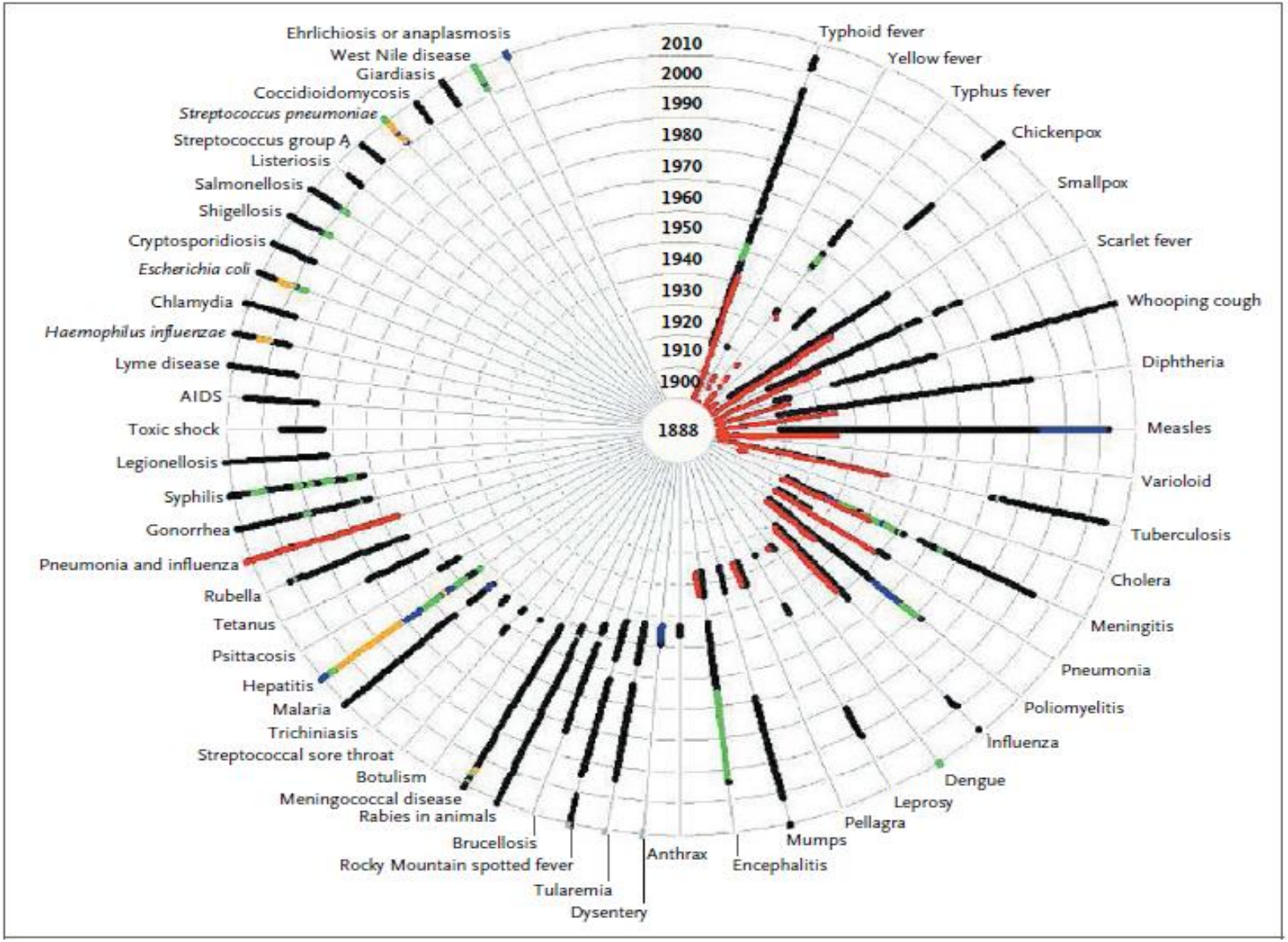
Old and New Global Threat

M Abul Faiz

BSM: 1- 2 March 2014

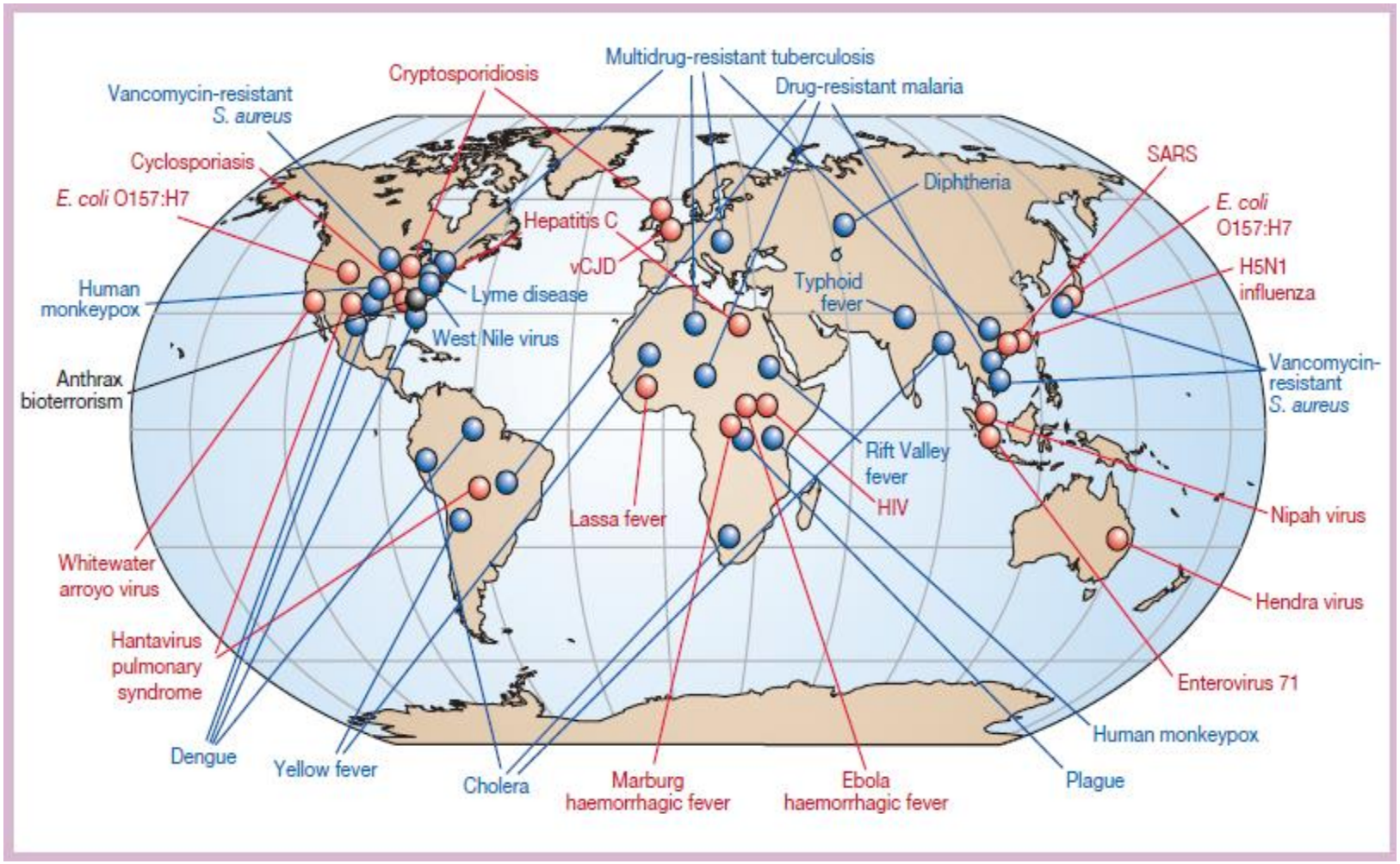
- **Double burden of communicable Diseases and Non-communicable diseases along with unfinished agenda of maternal and children (& newborn) health.**

Availability of Weekly Counts of Reported Diseases from Any U.S. Location, 1888–2011



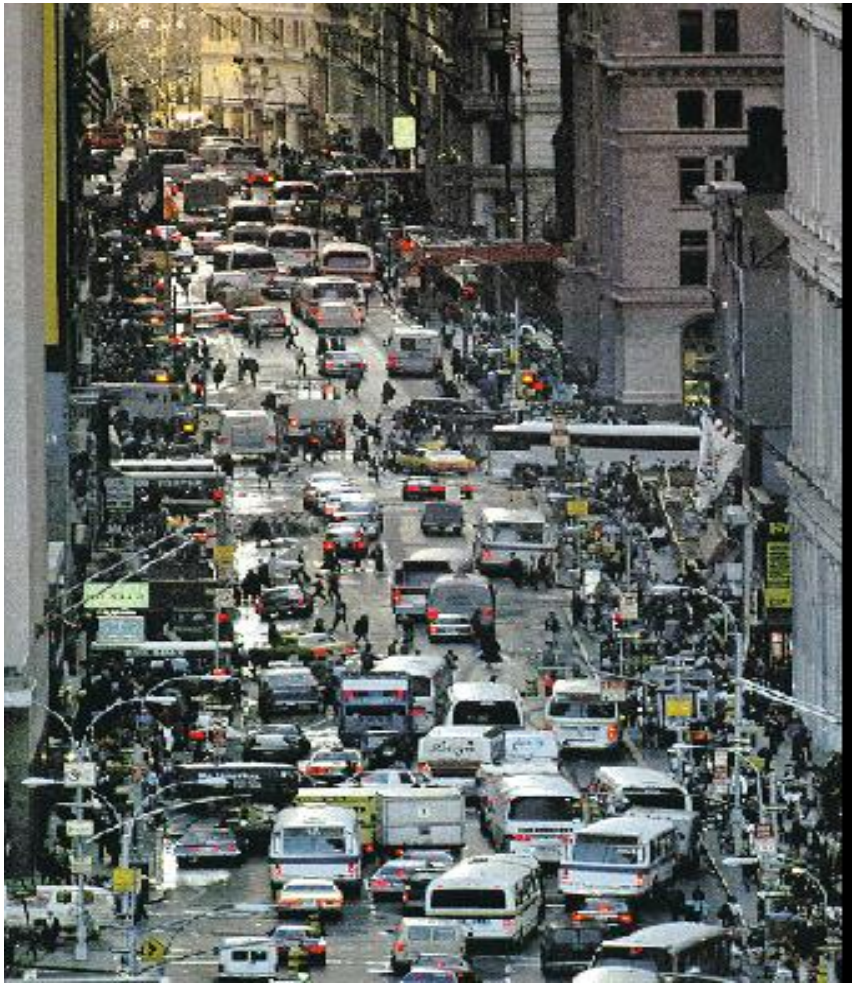
NEJM; 2013: 369;22

Global examples of emerging and re-emerging infectious diseases



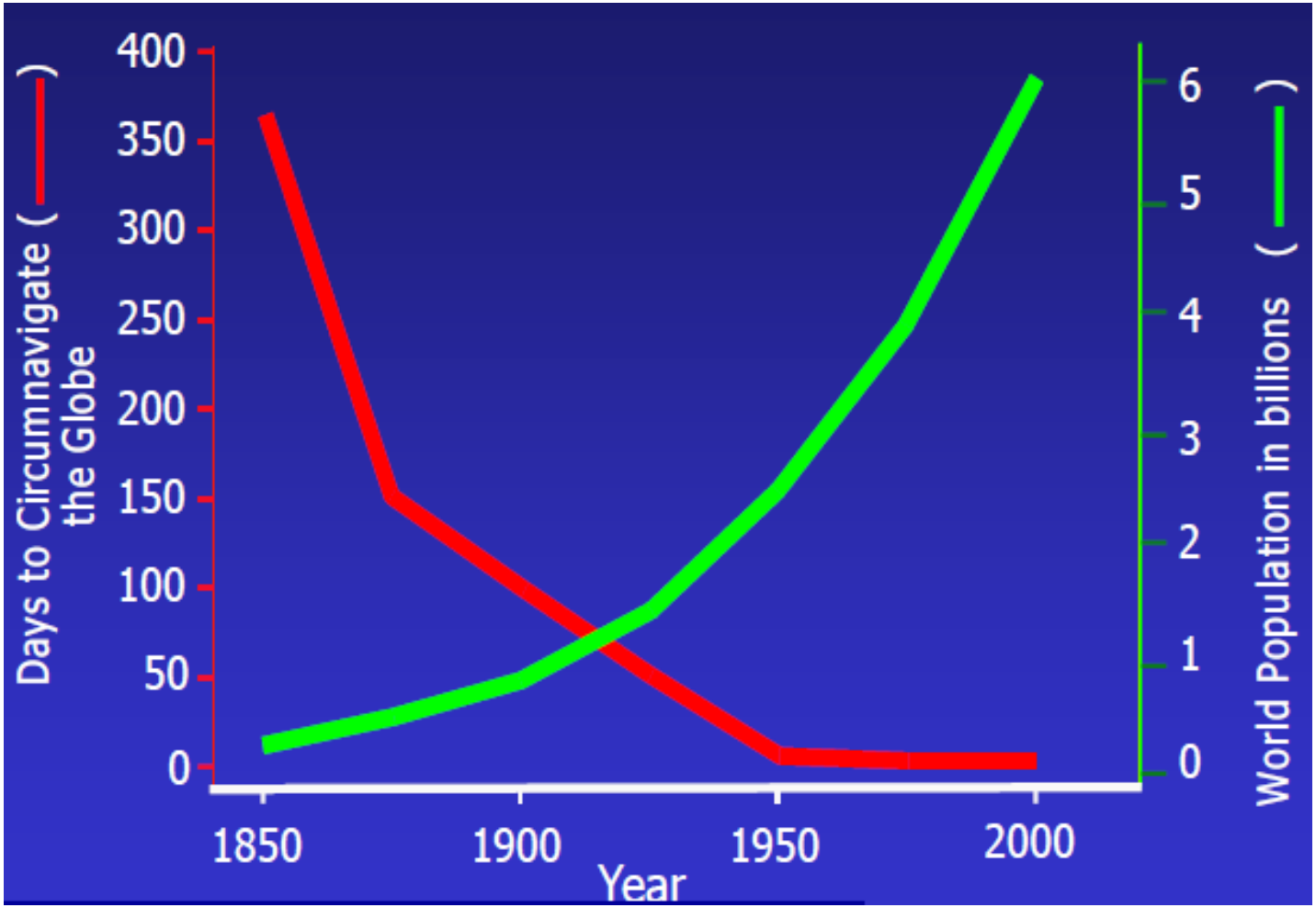
Emerging Infectious Diseases

- **Major Factors Contributing to the Emerging Infectious Diseases.**
  - **Human demographics and behavior**
  - **Technology and industry**
  - **Economic Development and land use**
  - **International travel and commerce**
  - **Microbial adaptation and change**
  - **Breakdown of public health measures**
  - **Bioterrorism**



Source: Lancet 2006; 367: 1008–15

Speed of Global Travel in Relation to World Population Growth



Murphy and Nathanson Semin Virol. 5.87. 1994.

Existing Diseases

- **Drug resistant TB- GeneXpert, XDR TB.**
- **MDR typhoid.**
- **Malaria- ACT based treatment, Artemisnin injection, Rectal, Artemisininn resistance- monitoring- TRAC, Resistance gene identified- elimination of malaria.**

- **Neglected Tropical diseases**
  - **Elimination of filariasis 2018- global**

Patients queuing at a filariasis clinic in India

KA Elimination

- **Progress- single dose Lip AM B**
- **Challenges- Dx and Rx of PKDL, point of cure, new diagnostics**
- **Good vector control**
- **Cutaneous leishmaniasis- imported from the Middle east**

Vaccine preventable diseases- New ones

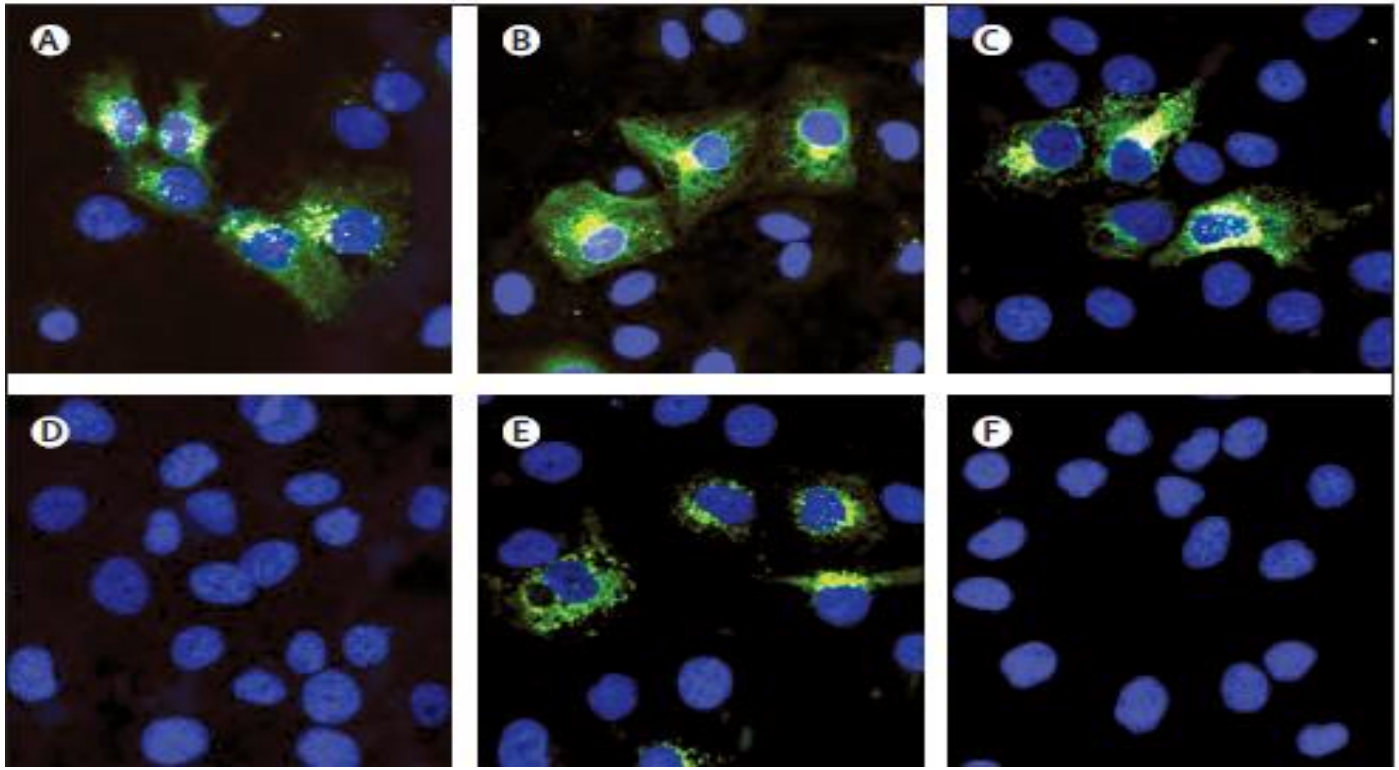
- **Hepatitis B**
- **HiB**
- **Rubella**
- **Human Papillomavirus (HPV)**
- **Rotavirus**
- **Japanese encephalitis (JE)**

New illness emerged from animals

- **SARS**
- **H1N1**
- **H5N1**
- **H7N9**
- **MERS-CoV**

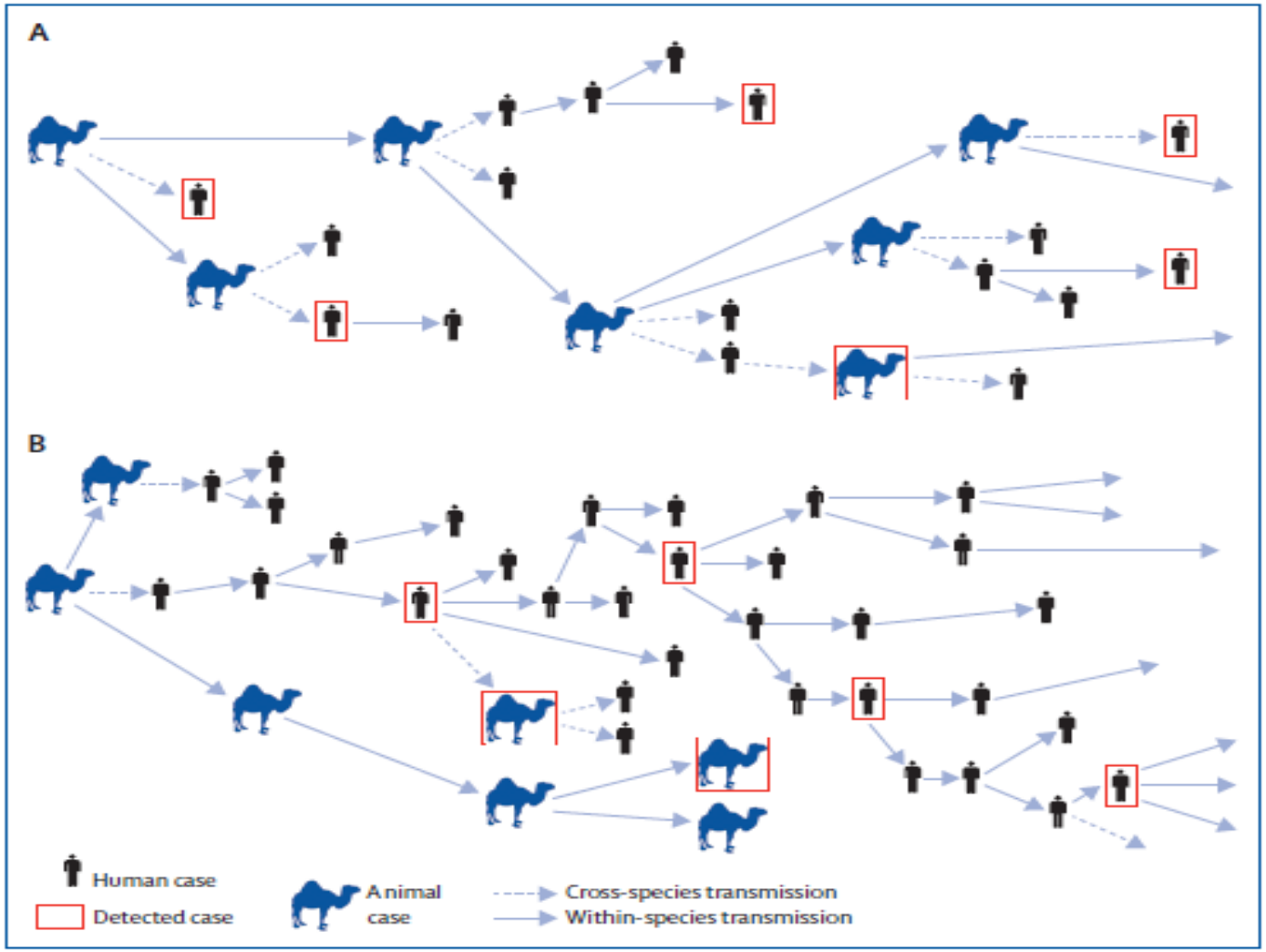
Causing worldwide concern due to potential of pandemic.

Middle East respiratory syndrome coronavirus (MERS-CoV) serological response in camels from Qatar



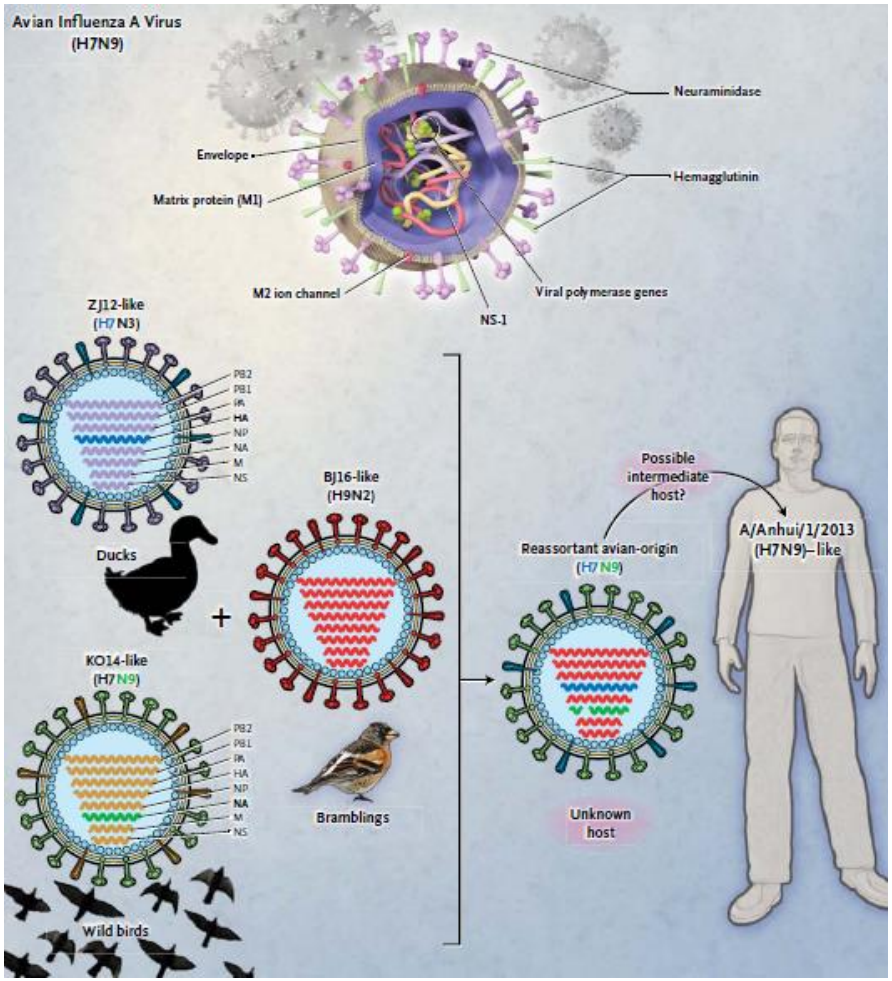
Immunofluorescence staining (green) of MERS-CoV infected and formalin fixed Huh7 cells (nuclei shown in blue) with serum samples from camel 5 (A), camel 7 (B), and camel 11 (C), negative camel control serum sample (D), a serum sample from a human case of MERS-CoV (E), and a serum sample from a healthy person (F). Fluorescent intensities (G) in relative fluorescence units (RFU) for MERS-CoV S1 antigen are shown for the 14 dromedary camels when tested at serum dilution 1/2560 versus virus neutralisation titres.

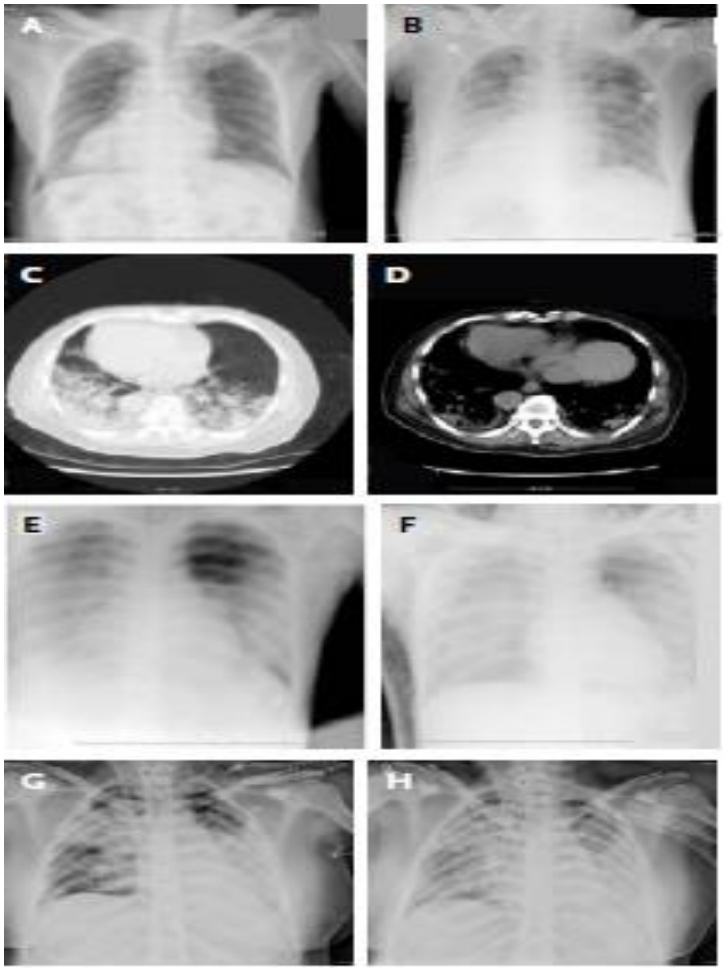
Possible MERS-CoV transmission scenarios



www.thelancet.com/infection Vol 14 Feb. 2014

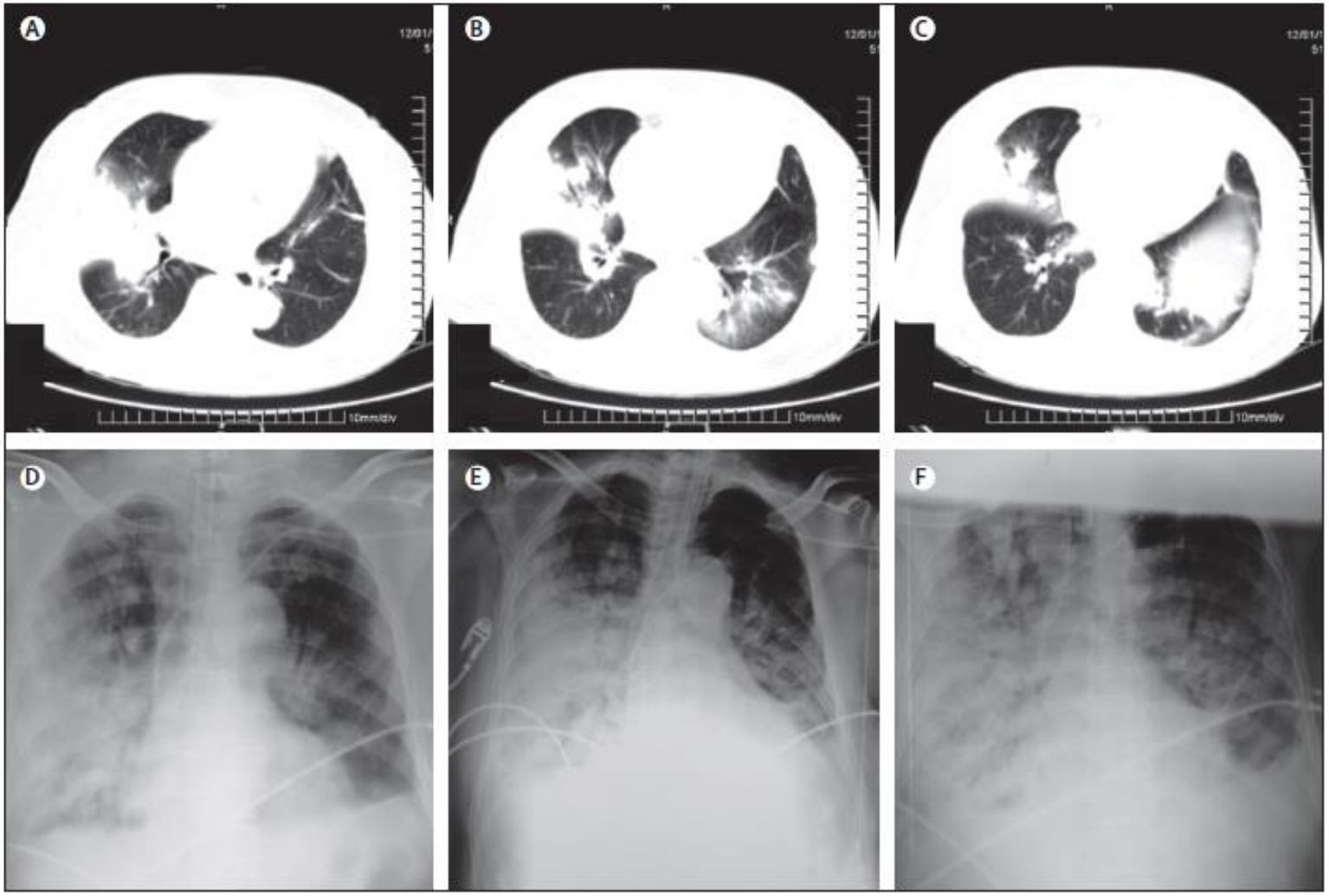
Human Infection with a Novel Avian-Origin Influenza A (H7N9) Virus





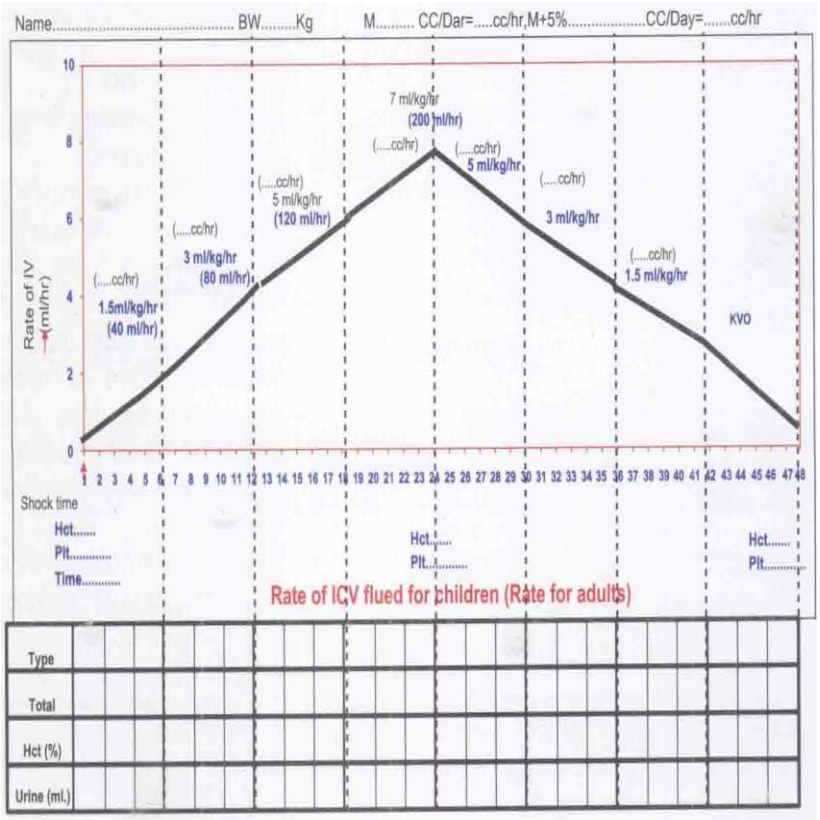
NEJM 2013: 368;20

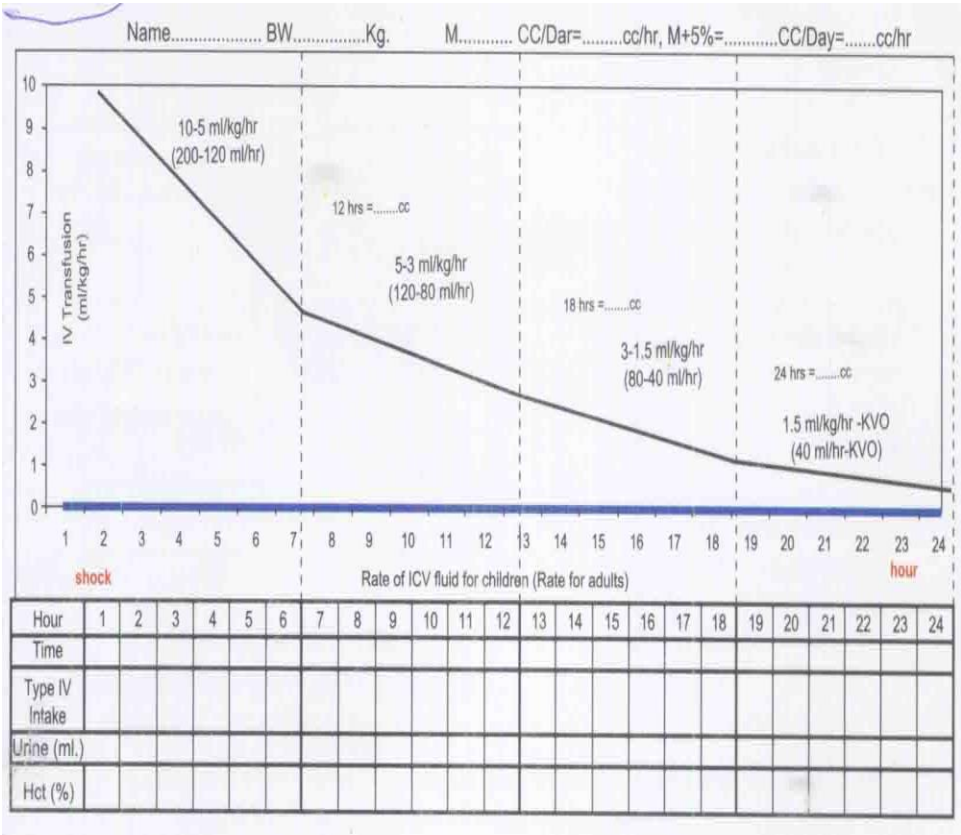
Clinical and epidemiological characteristics of a fatal case of avian influenza A H10N8 virus infection



Lancet 2014; 383: 714–21

- **Dengue: Probable dengue, Dengue with warning signs, Severe dengue**
- **No vaccine yet, no specific drug**





IV Adjusts non-shock grade I, II

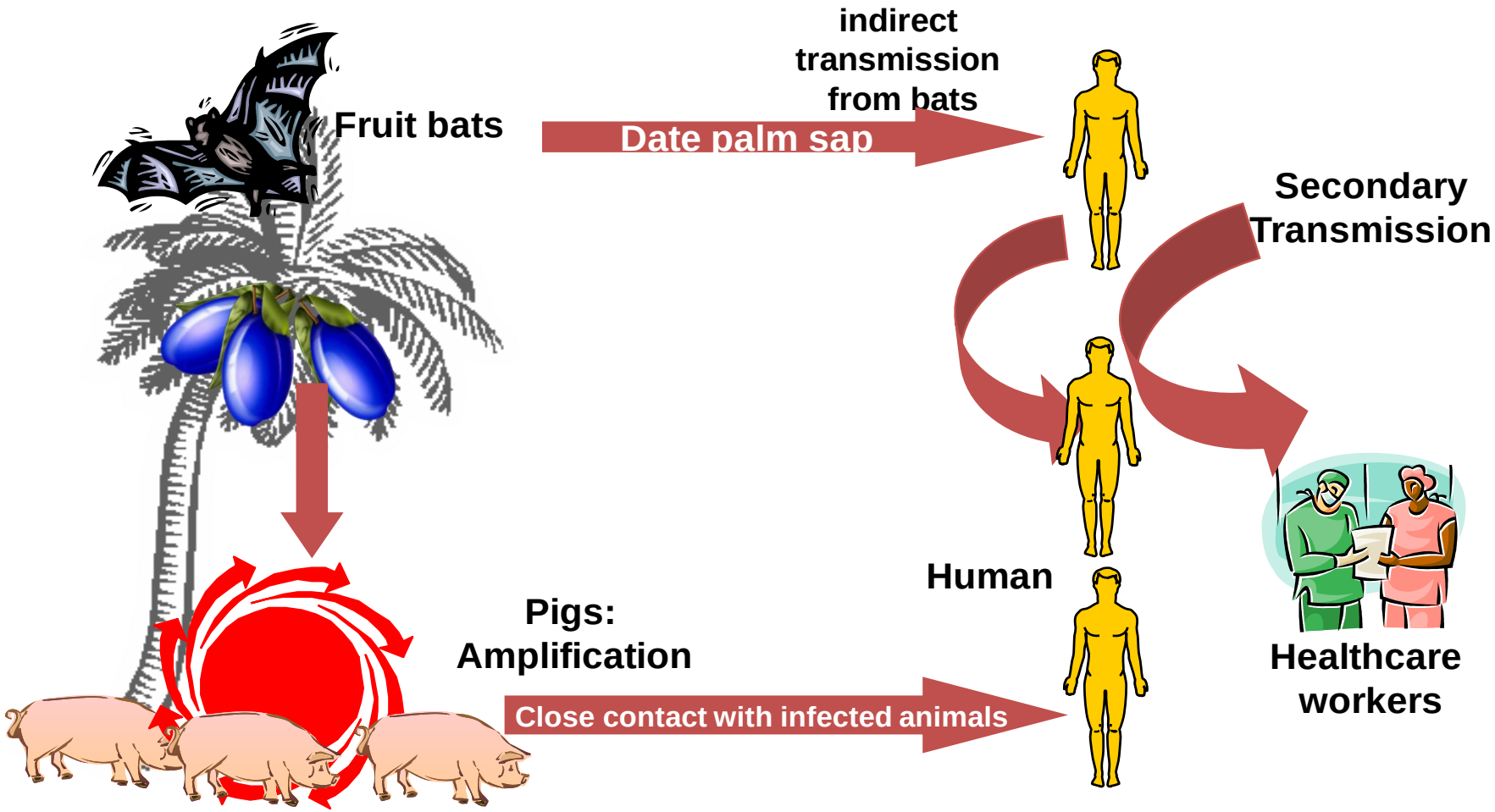
IV Adjusts non-shock grade III, IV

Some Emerging Diseases

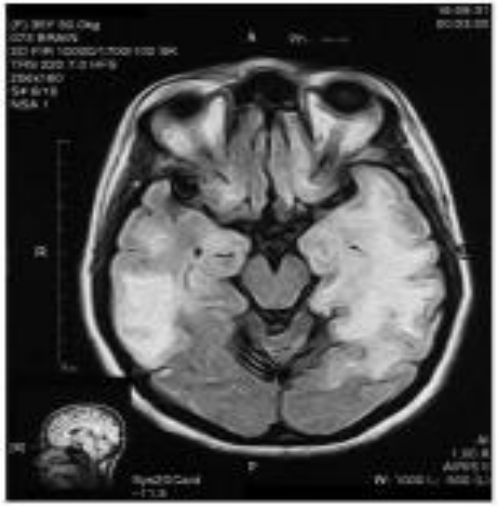
- **Nipah infection**
  - **High mortality**
  - **Major sequelae (MRI)**
  - **Food born-animal related (zoonosis)**
  - **Human-human transmission potential**
  - **No definitive treatment.**

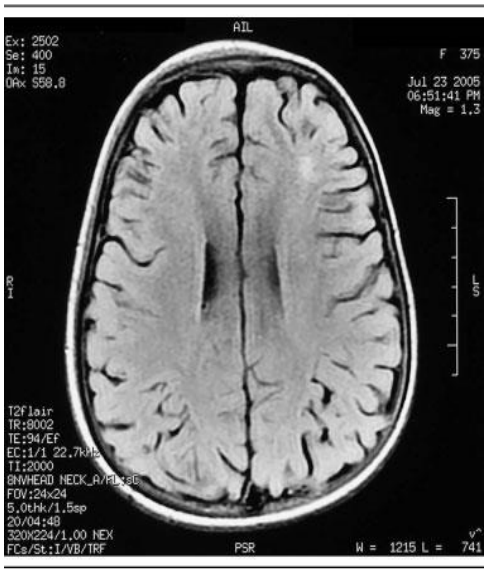
Year	case	Death	CFR (%)
2001	13	9	**69**
2003	12	8	**67**
2004	56	45	**80**
2005	12	10	**83**
2007	15	8	**53**
2008	10	9	**90**
2010	8	7	**87**
2011	35	31	**89**
2012	13	11	**85**
2013	24	21	**88**
Total	198	**157**	**79**

Nipah virus transmission



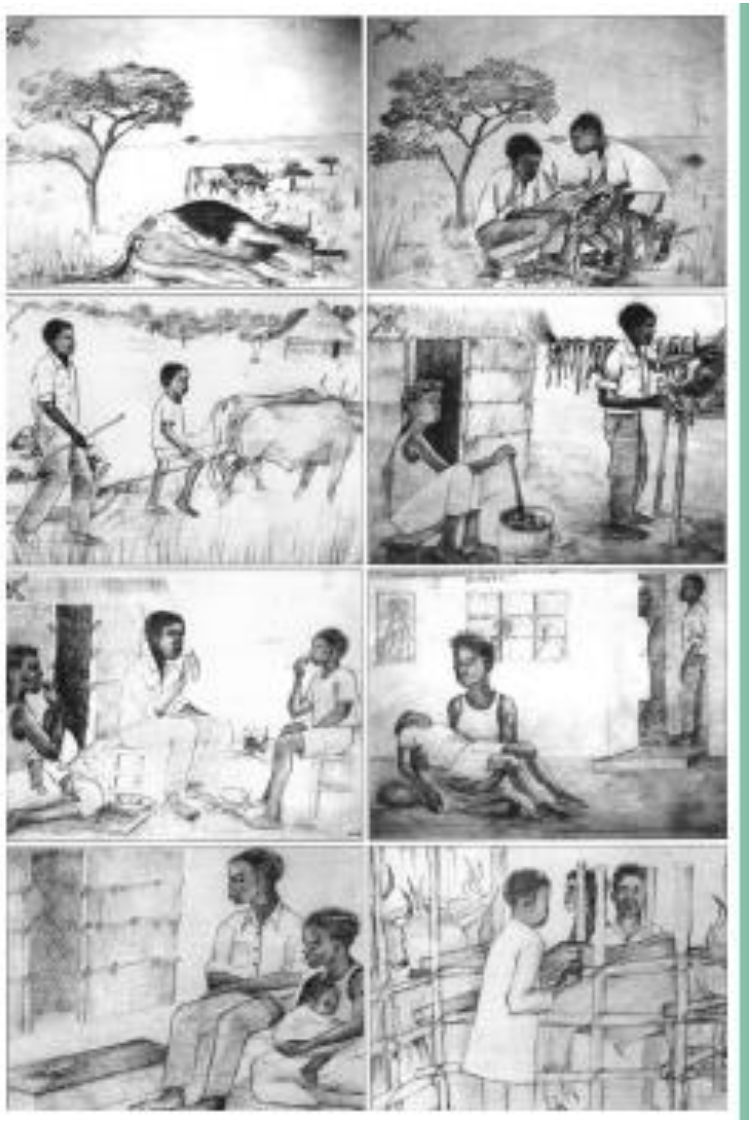
Confluent region of hyperintensity in left frontal lobe on FLAIR MRI sequence 8 months following acute Nipah virus encephalitis in a 6-year old female with focal right arm and leg weakness, cervical dystonia, and ataxia.

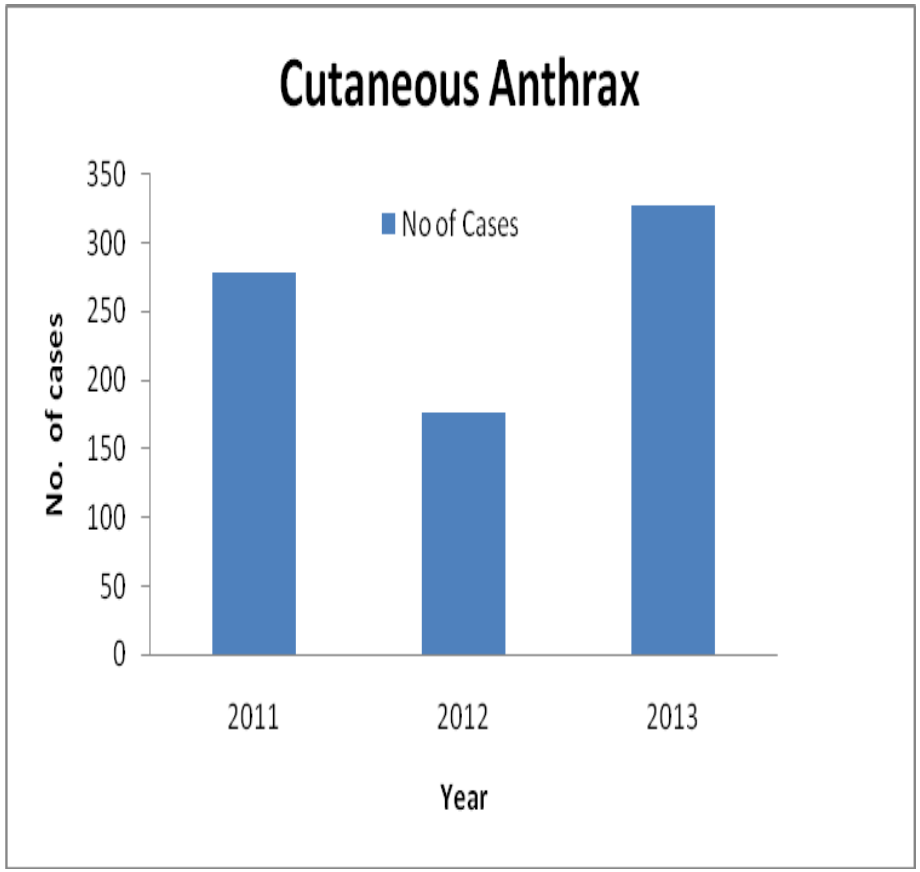




Ann Neurol 2007;62:235–242

Anthrax in humans and animals

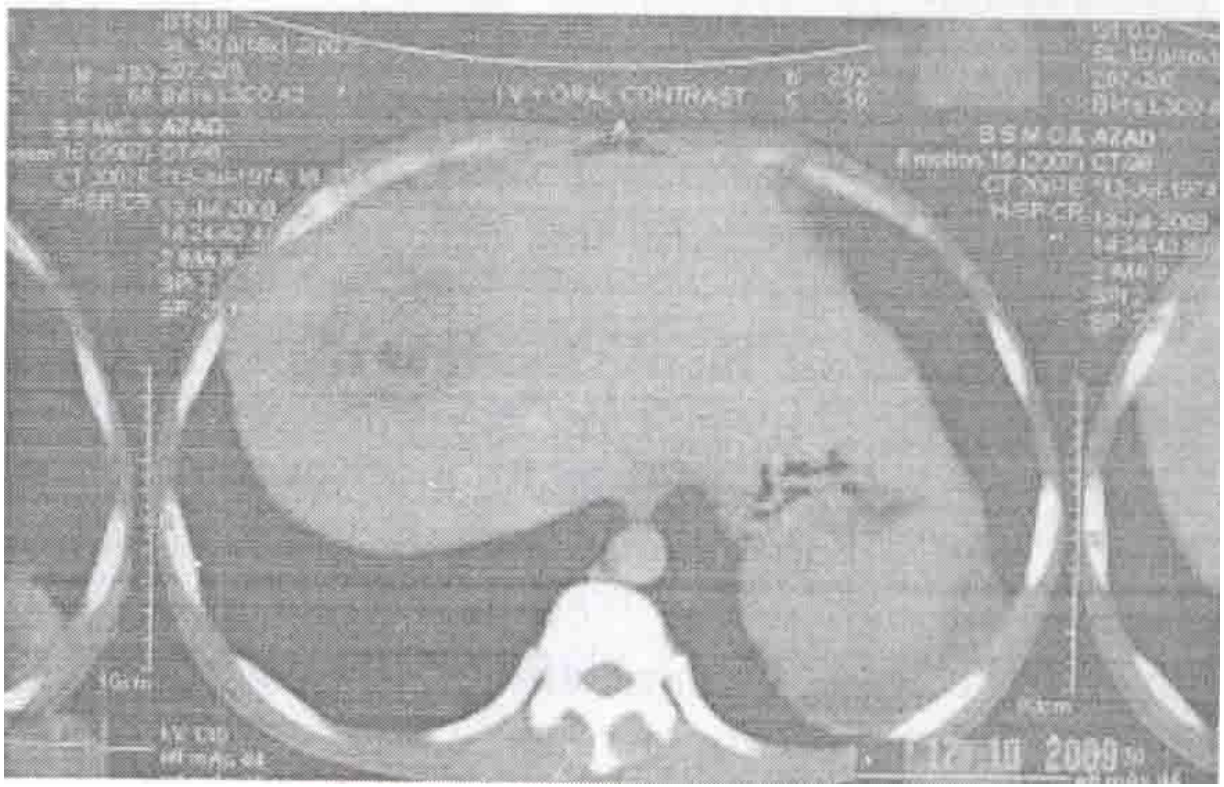




- **Anthrax- cases from diff parts of BDs (No from IEDCR).**

Meliodioisis

- **Serosurvey, Cases, Relation with DM-farming**



CT of abdomen showing multiple low density areas in the liver and spleen consistent with hepatoplenic abscesses

Antibiotic Resistance

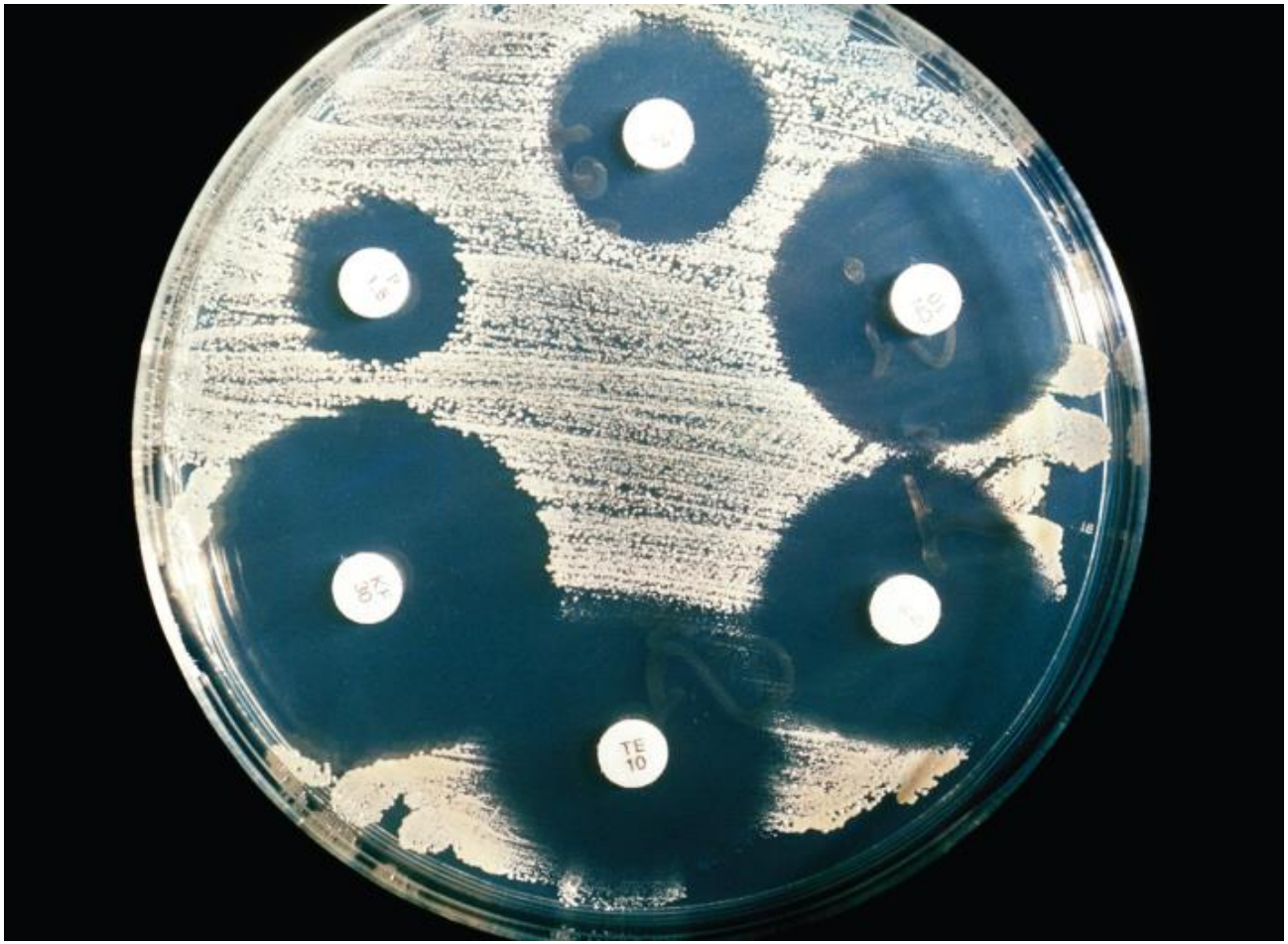
- **In the resource limited settings antibiotic use is heavy and infection control is weak, also diagnostic and prognostic uncertainties drives irrational use of antimicrobials.**
- **The pipelines of development of new antimicrobials is not very promising and seems to be dry.**
- **Scientists apprehend that 'in the very near future, the wonder-drug of the 20th Century antibiotics may cease useful'.**

Antibiotic Resistance

- No monitoring mechanism
- Poor microbiology facility
- ICU set up infancy
- MRSA
- Poultry and veterinary sector use of antibiotic.

- Antibiotic resistance in priority pathogens
  - Neonatal sepsis
  - Pneumonia
  - Meningitis
  - Diarrhoeal pathogens

Culture-based methods remain the cornerstone of diagnosis and resistance testing



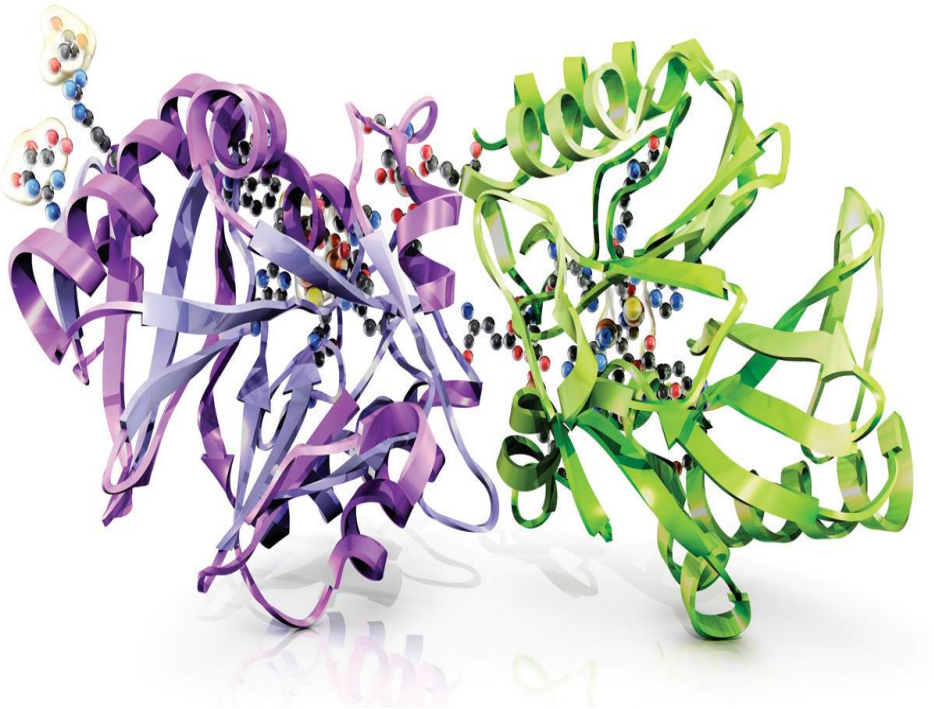
Source: Lancet Infect Dis 2013; 13: 1057–98

High standards of food processing can prevent contamination of food with bacteria

Source: Lancet Infect Dis 2013; 13: 1057–98

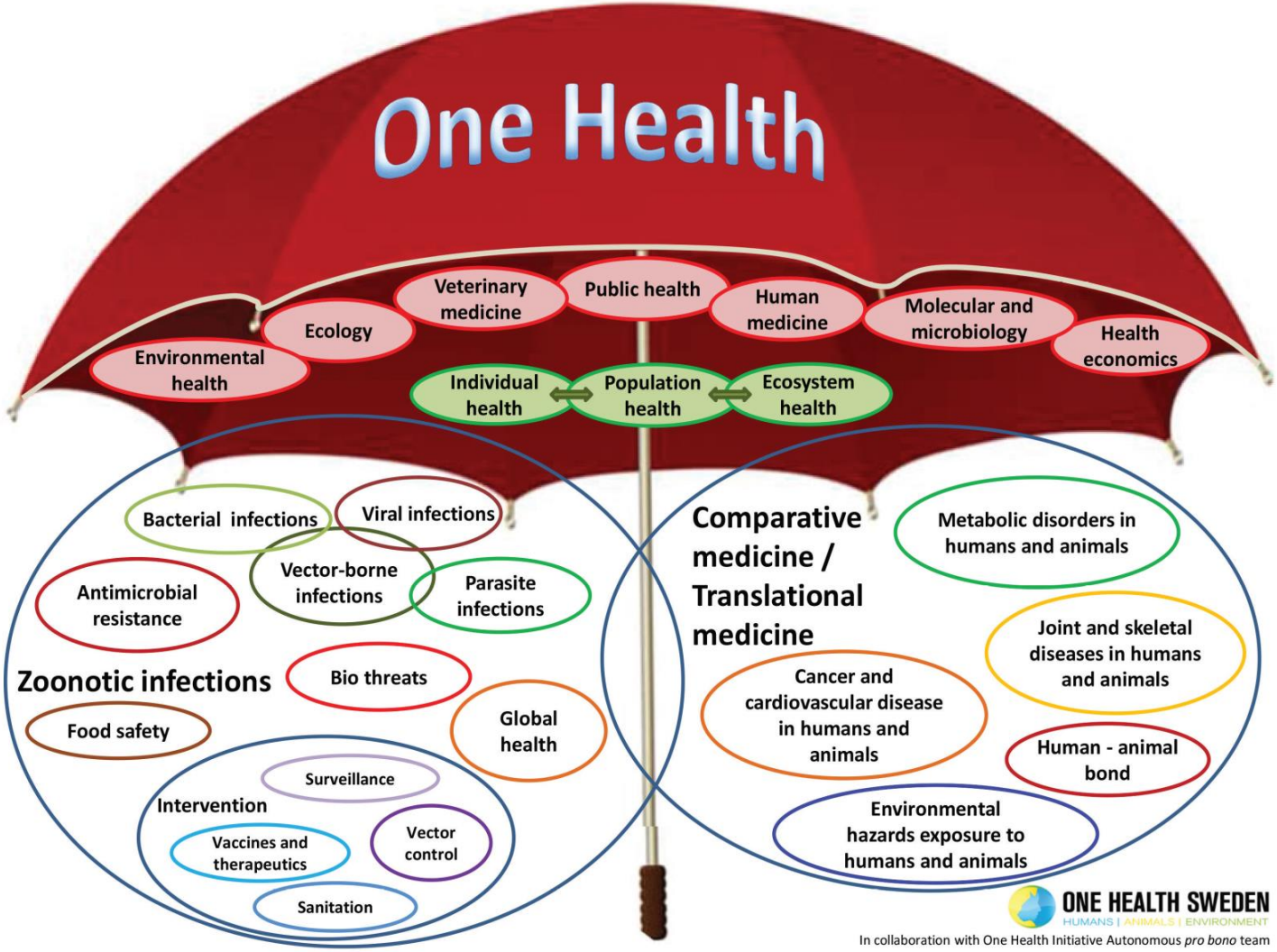
New Hope

- **New antibiotics**
- **Adjuvants**
- **Antivirulent strategies**
- **Biological therapeutics**



Potential targets of new drugs include resistance enzymes such as ESBLs

Scope of One Health according to the One Health Initiative



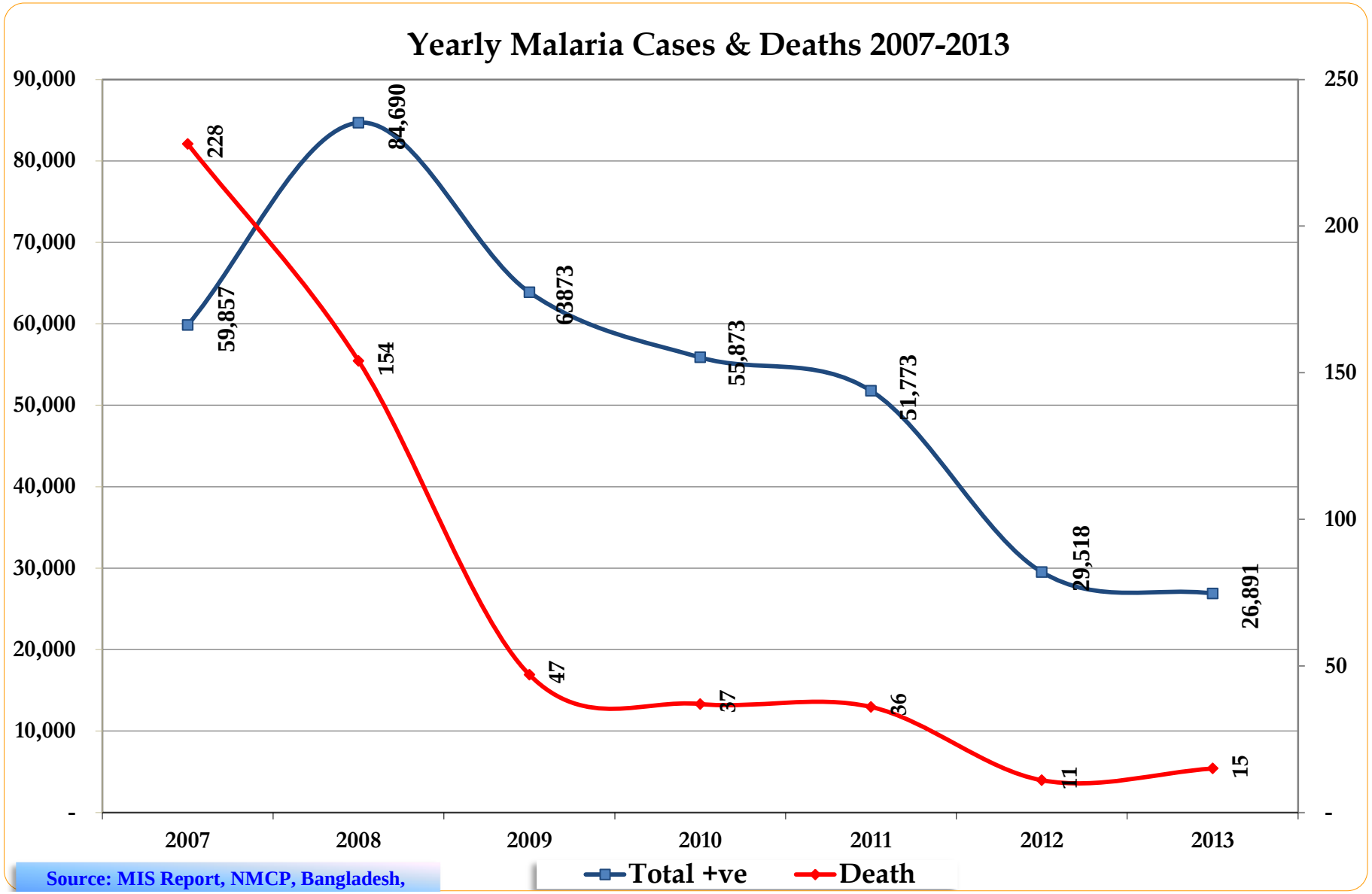
(www.onehealthinitiative.com)

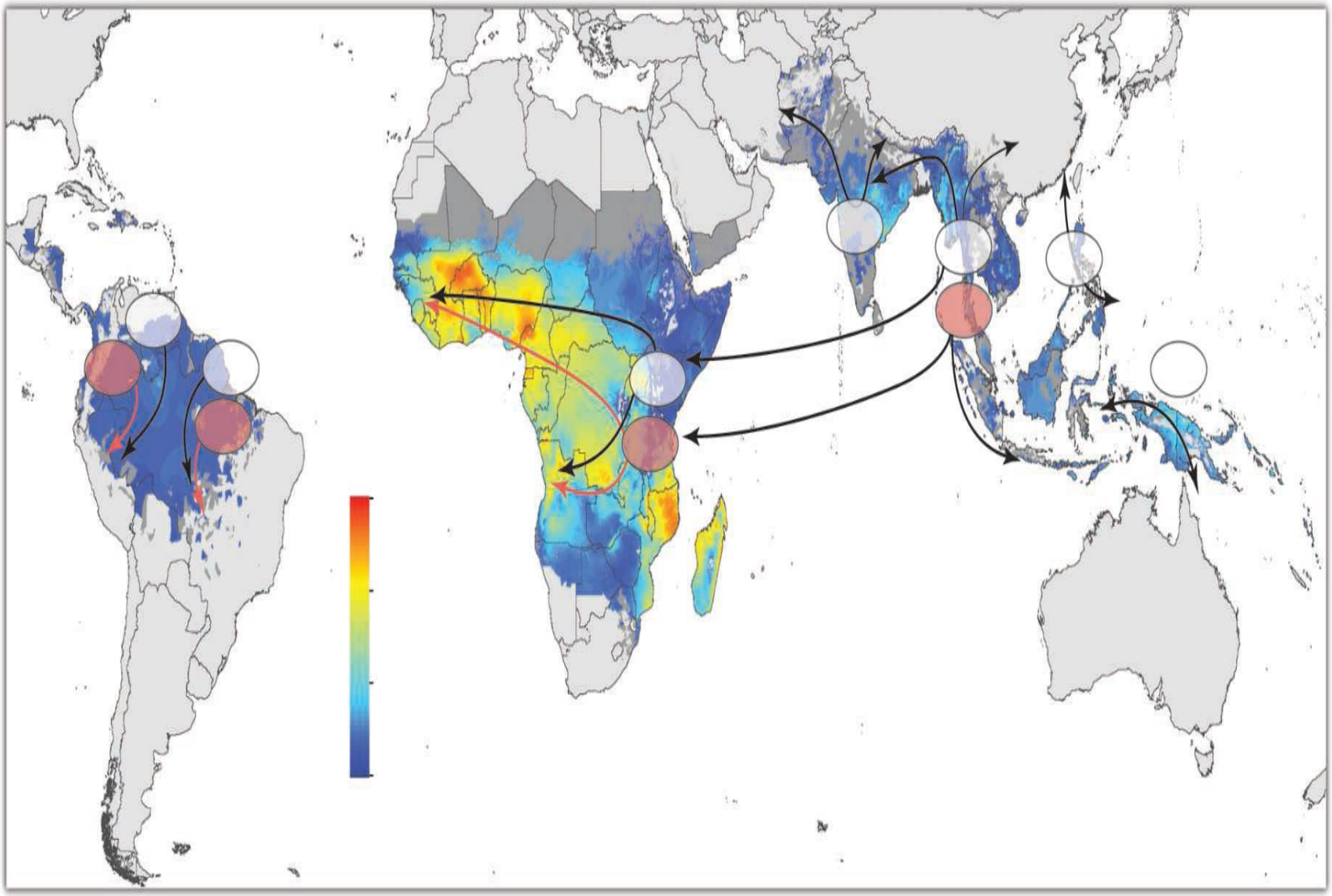
Satellite transmitter placement to duck to track migratory patterns

A cancer detection dog trained by the charity Medical Detection Dogs.

Source: Veterinary Record | 85, January 25, 2014

Malaria

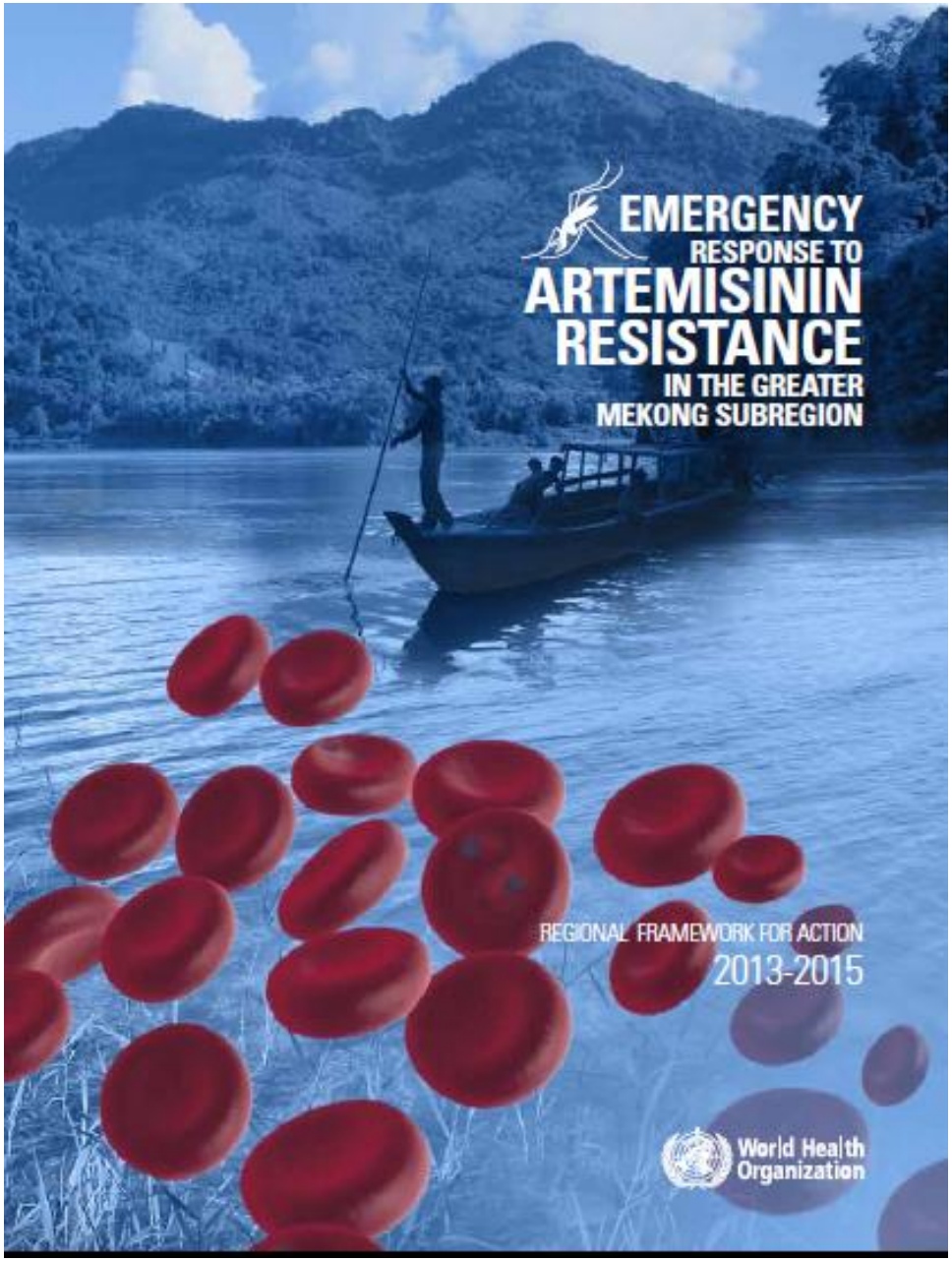

Yearly Malaria Cases & Deaths 2007-2013
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
-
250
200
150
100
50
-
2007
2008
2009
2010
2011
2012
2013
59,857
84,690
63873
55,873
51,773
29,518
26,891
228
154
47
37
36
11
15
Total +ve
Death
Source: MIS Report, NMCP, Bangladesh,

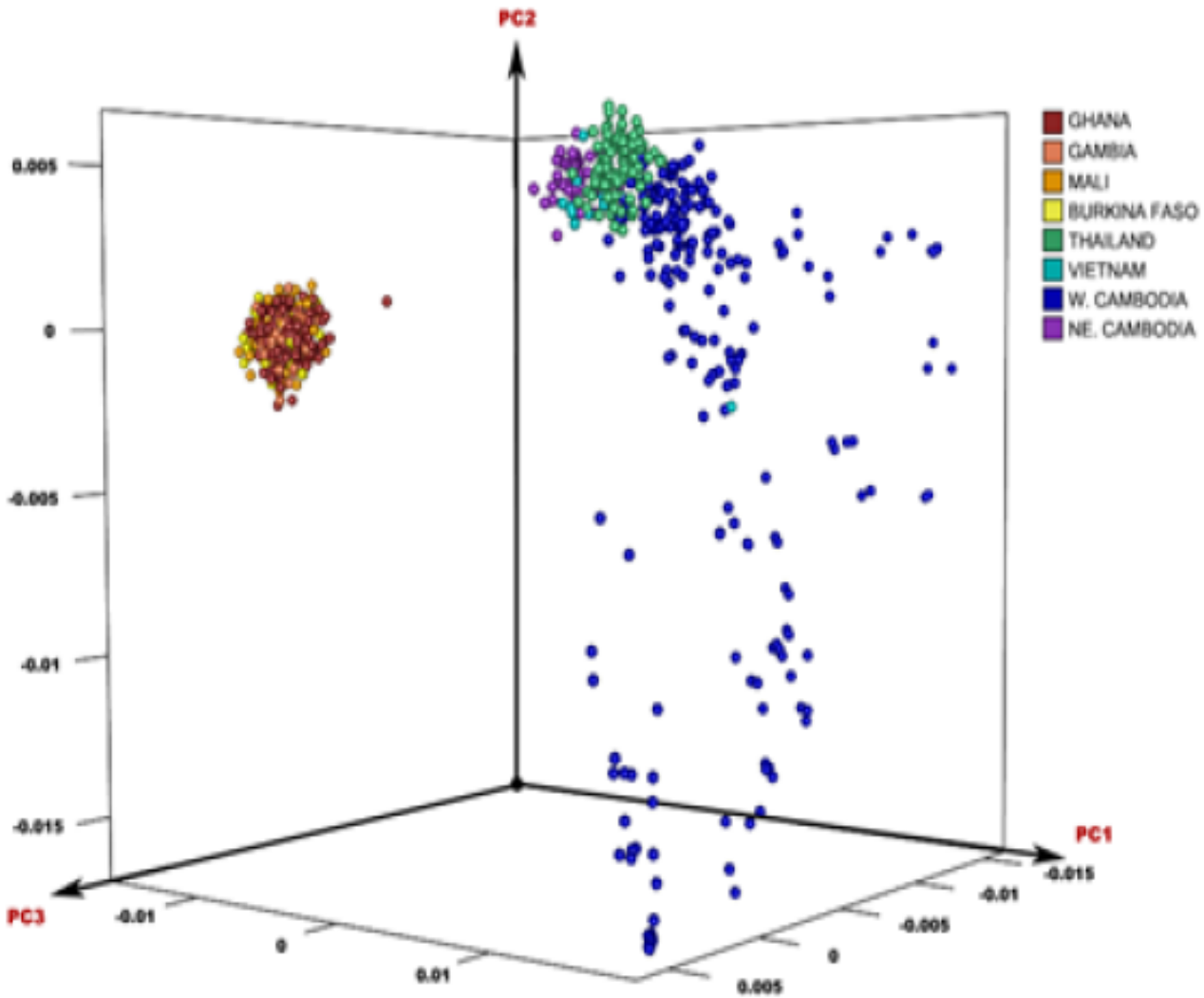


Source: SCIENCE; VOL 340 28 JUNE 2013

Source: Nature News: 18 Dec 13

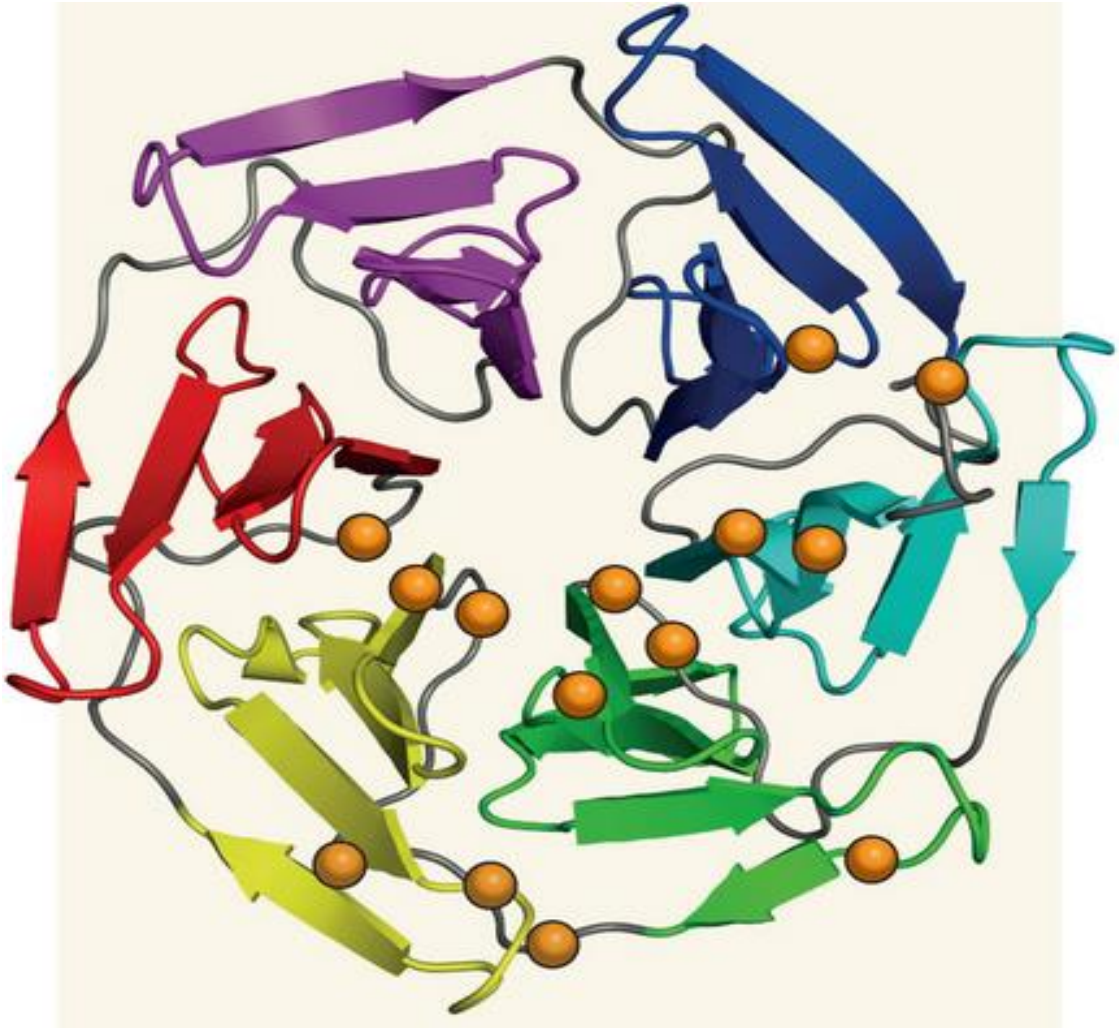
In parts of southeast Asia, artemisinin-based malaria drugs are taking longer to clear the parasite out of the body, so that patients still test positive after several days of treatment, instead of testing negative after the usual two days.


EMERGENCY
RESPONSE TO
ARTEMISININ
RESISTANCE
IN THE GREATER
MEKONG SUBREGION
REGIONAL FRAMEWORK FOR ACTION
2013-2015
World Health
Organization



Principal Component Analysis of Pf genomes from SE Asia and West Africa (first three components shown). While parasites from most countries show a high degree of similarity, and cluster closely, parasites from Western Cambodia (dark blue) are exceptionally differentiated.

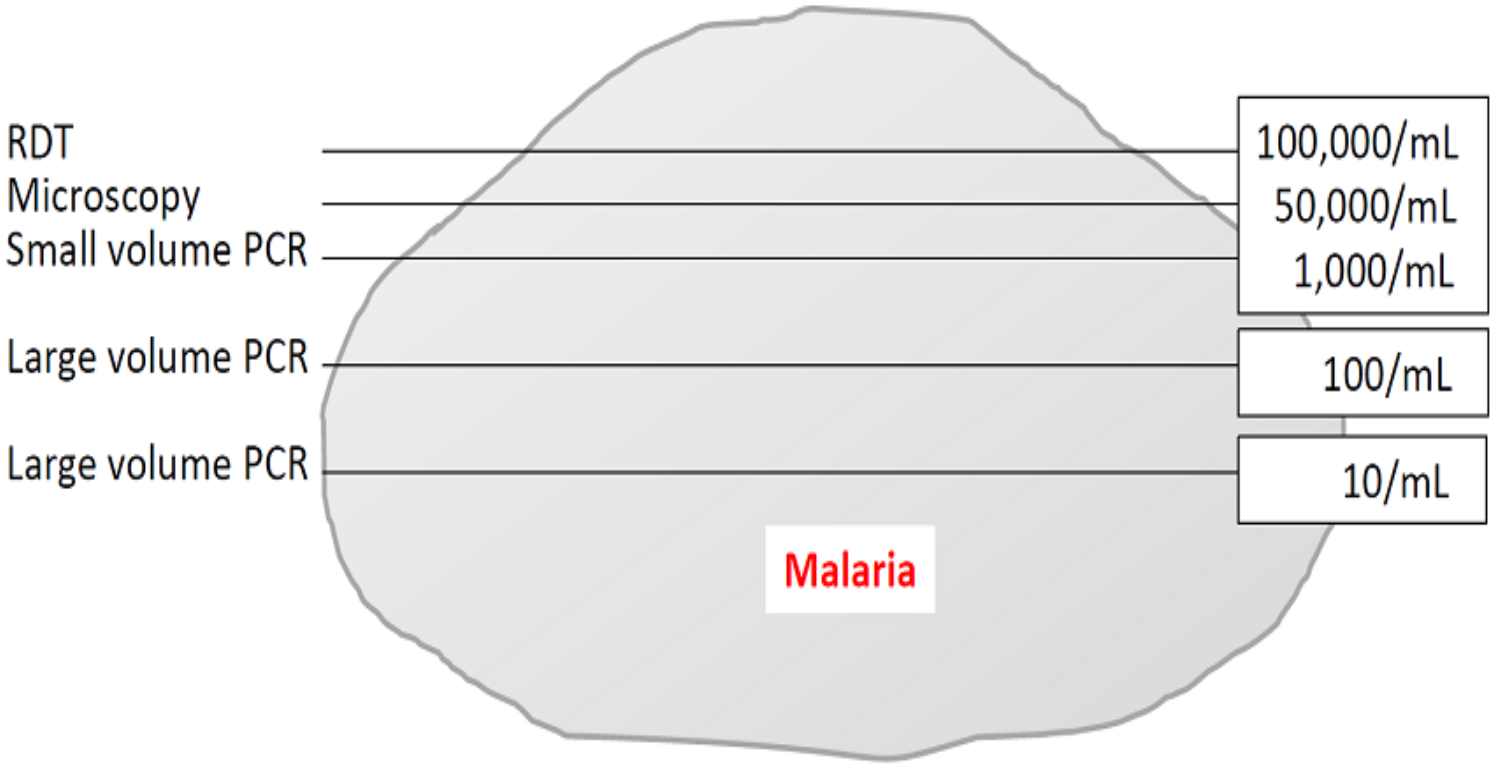
Propeller Mutations



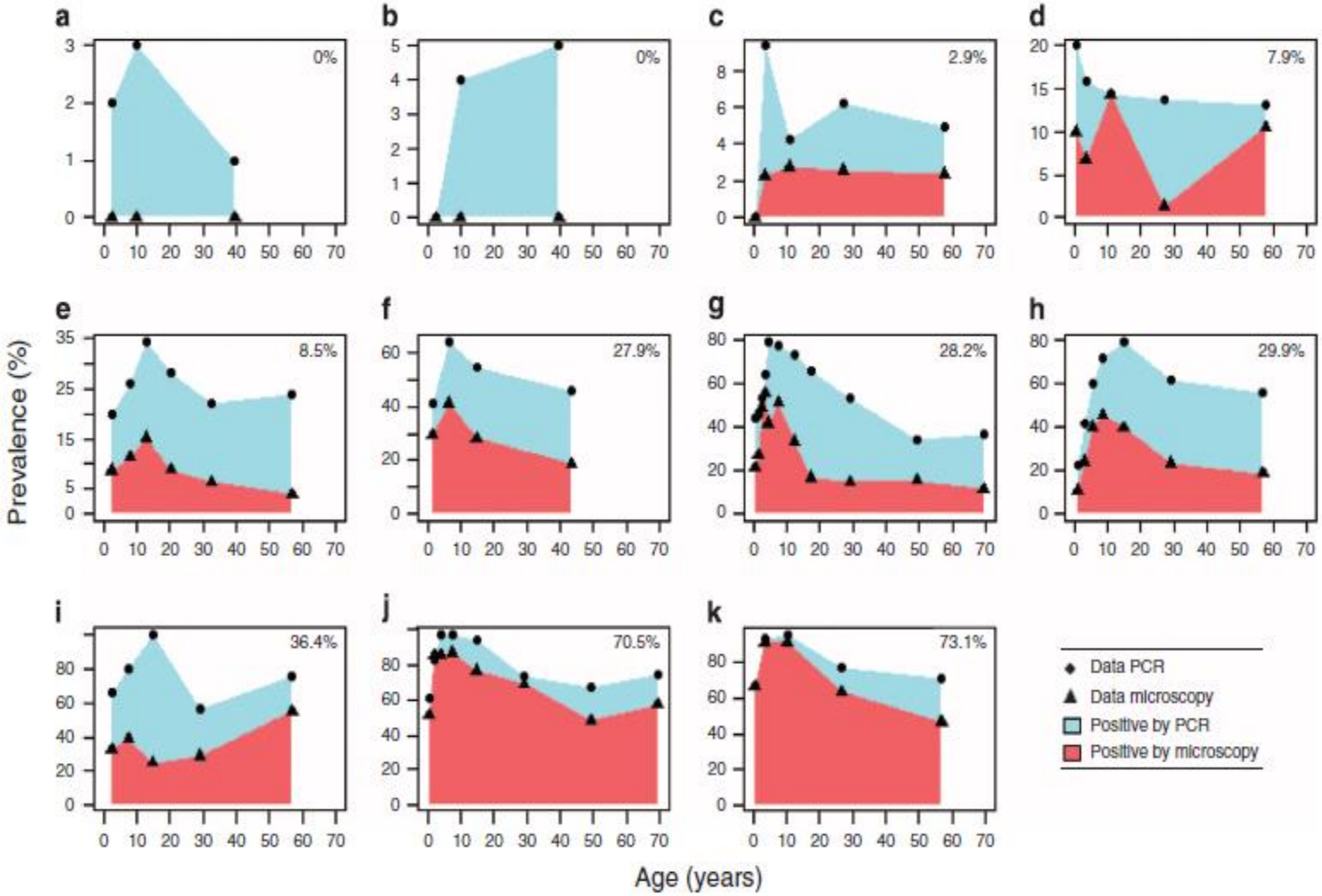
Nature 2014: 505, 30–31

How much malaria can we detect?

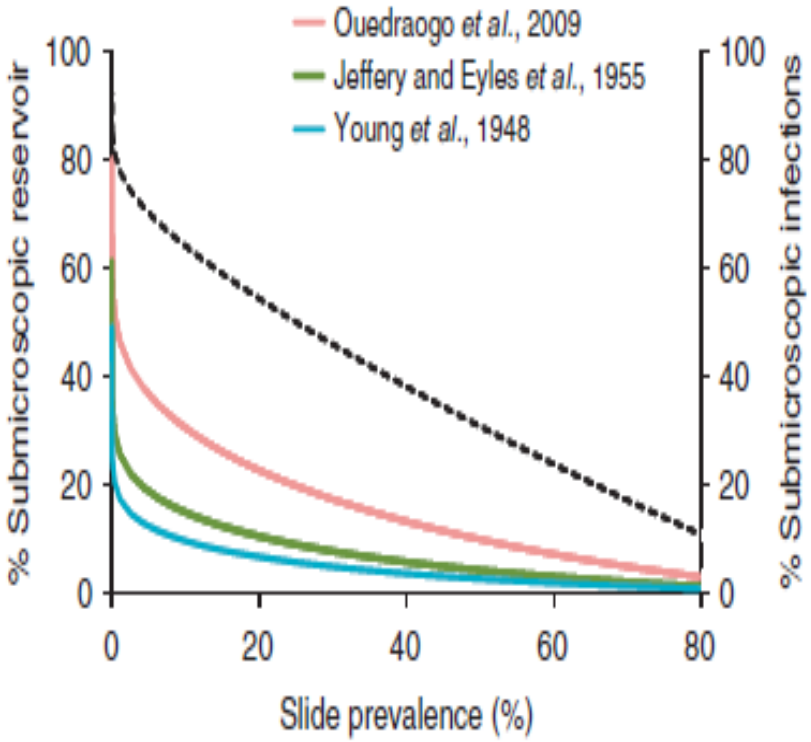
Effects of different sensitivities of detection on estimated prevalence of malaria



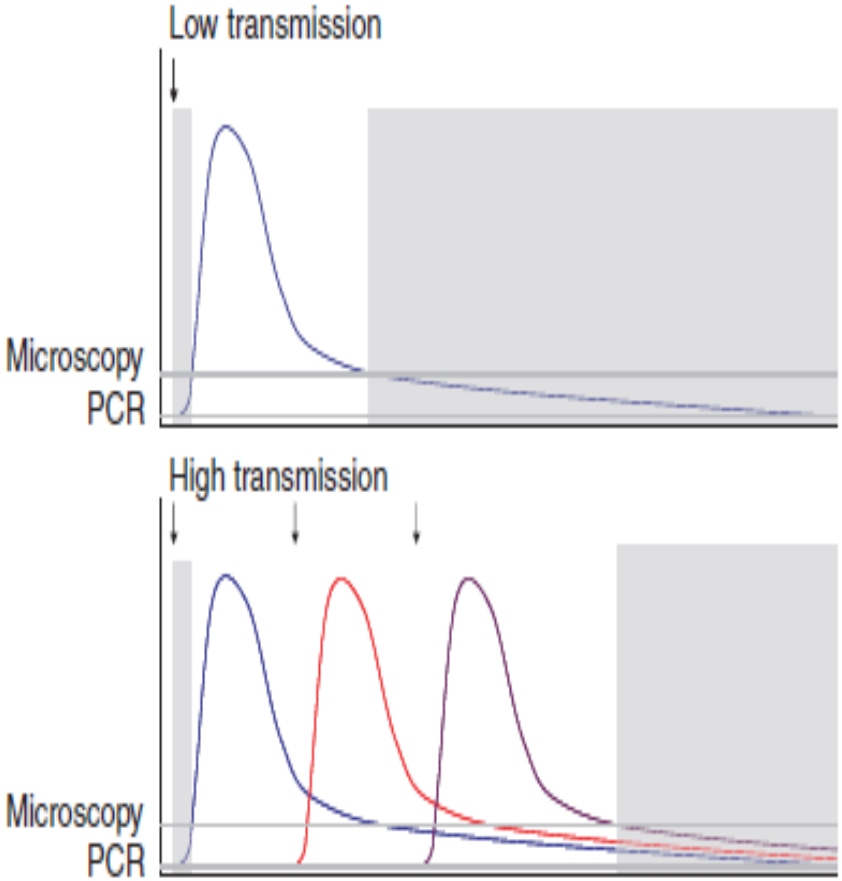
Age-specific microscopy and PCR prevalence



Source: NATURE COMMUNICATIONS | DOI: 10.1038/ncomms2241



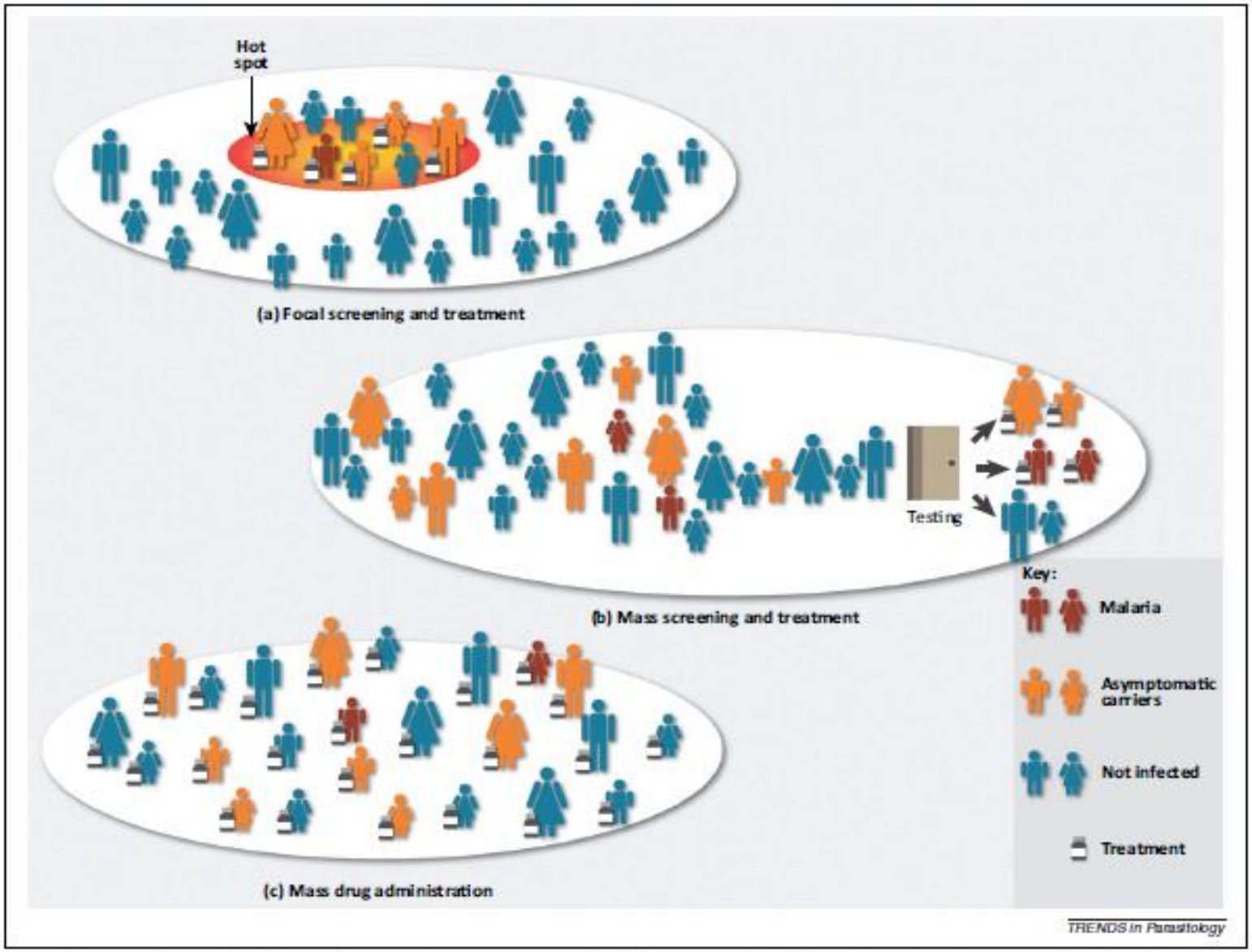
Estimated contribution of submicroscopic infections to the infectious reservoir



Hypothesized within-host dynamics of parasitaemia.

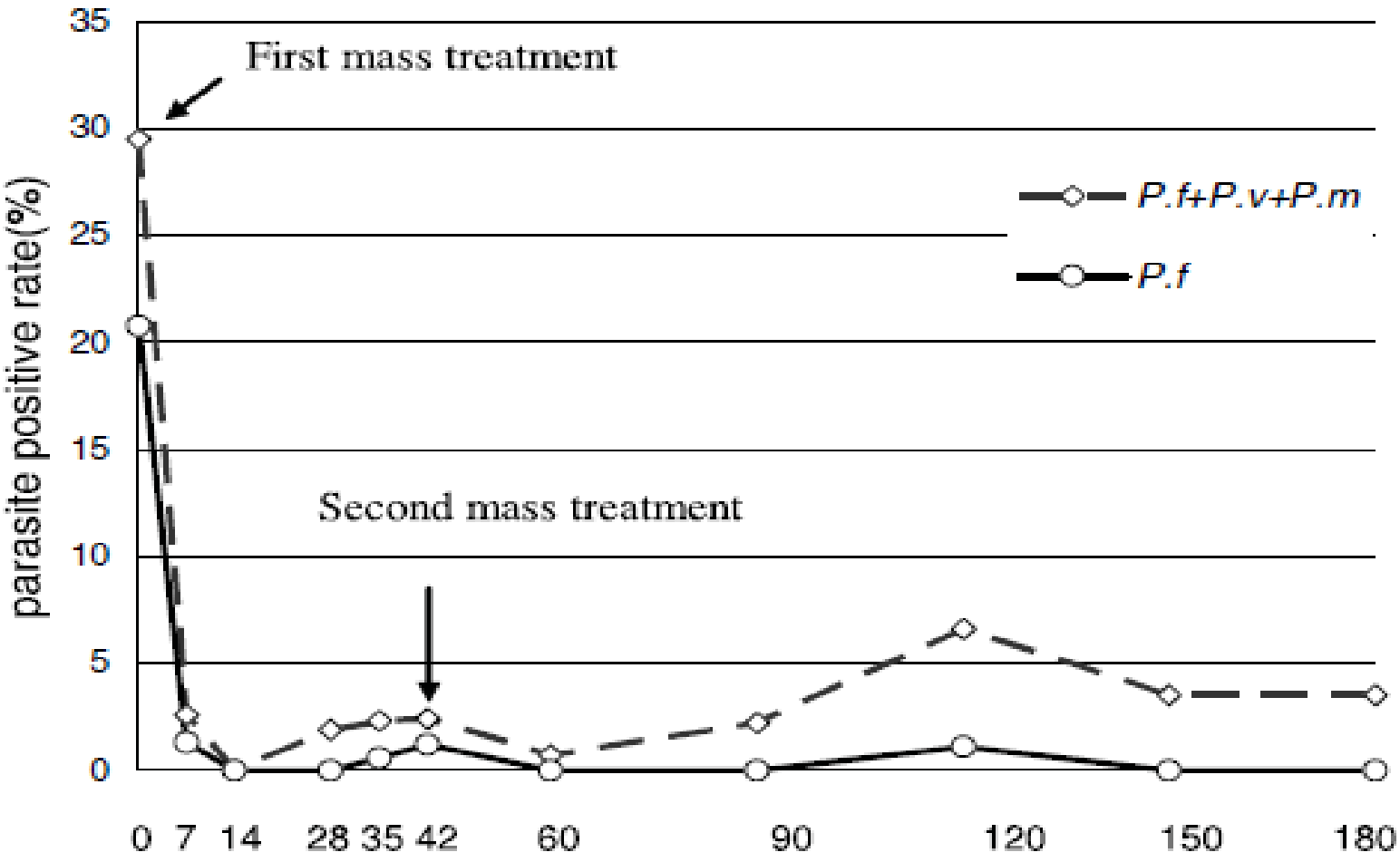
Source: NATURE COMMUNICATIONS | DOI: 10.1038/ncomms2241

Various Treatment Approaches



Source: Trends in Parasitology ; 2013: 29(2): 60-64

Changes in parasite rates in children in the 3 villages with Mass Drug Administrations (MDA)



Song et al. Malaria Journal 2010, 9:57

Comment

- **Challenges:**
  - **Appropriate diagnosis of existing infectious diseases,**
  - **Addressing emerging diseases of serious concern,**
  - **New zoonotic diseases,**
  - **Antimicrobial resistance,**

- **Opportunity:**
  - **Molecular basis of understanding microbial diseases and resistance.**

- **Action:**
  - **Human resource development and appropriate care of infectious and tropical diseases.**

Thank You