10th December 2012

CRED Technical Brief: Outbreaks in Fragile States. Yellow Fever in Darfur September – December 2012

Contact details:
Dr Mandana Mehta
(MBBS, DTMIH)
mandana.mehta@uclouvain.be

This technical brief consists of 2 sections:

1. An Overview of Yellow Fever

1.1 What is Yellow Fever?

Yellow fever (YF) is caused by a **mosquito born** virus that is endemic in tropical regions of Africa and South America. It is classed as a **Viral Haemorrhagic Fever**. In its most severe form it causes **jaundice** with **liver and kidney failure** together with **systemic bleeding**. The importance of yellow fever lies mainly in its tendency to occur in **epidemic proportions** and in **the high mortality** of the disease. Despite the availability of a safe and effective vaccine, YF continues to pose a significant public health problem. Table 1 summarises the clinical features of YF. No diseases specific treatment exists; only supportive care can be given. This includes intravenous fluids, blood products for severe bleeding and dialysis for renal failure.

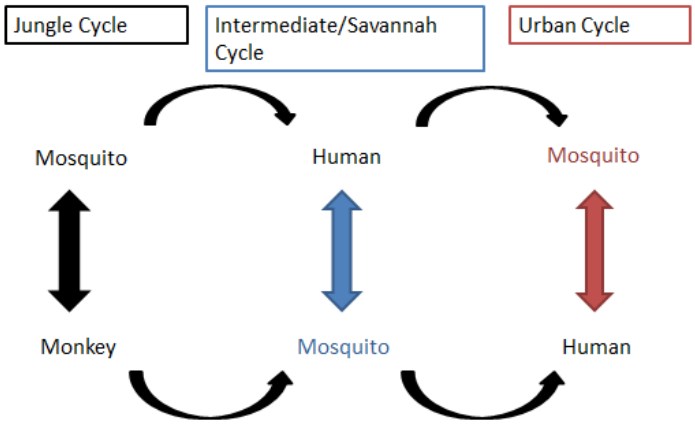
Table 1. General Features of Yellow Fever
• Incubation period 3-6 days • A patient is infectious for the first 3 days • Classical picture only seen in 10-20% of cases • Patients from endemic areas tend to have a milder form • Death tends to occur between days 7-10 • Case Fatality Rate (CFR) ranges from 20-50% • If a patient survives till day 12 one can expect full recovery • Following infection there is lifelong immunity • Surveillance definition = fever and jaundice • The extremes of age are vulnerable to increased mortality and morbidity • If a case is confirmed the WHO must be notified.
Course of the illness:
• **Red phase**: Flu-like symptoms, vomiting common with congestion of the face and neck. • **Remission**: For 1 day the patient feels better • **Yellow phase**: Second febrile episode with mild jaundice. Liver and kidney failure may also occur • Thereafter a **general deterioration** of the patient occurs with hypotension; shock; haemorrhaging (from all mucous membranes); convulsions and delirium.
Clinical diagnosis:
• Flu-like syndrome with fever + jaundice + haemorrhaging + albuminuria + leukopenia + thrombocytopenia + massive liver failure (transaminases 15,000-40,000). • Clear cerebrospinal fluid. • Any case of fulminating hepatitis in an endemic area could well be yellow fever, particularly if

there is haemorrhaging and kidney involvement.
- Laboratory diagnosis involves testing of serum to detect virus-specific IgM and neutralizing antibodies.

1.2 Epidemiology of Yellow Fever

Yellow fever is a zoonosis – this means that the mosquitoes can transmit the virus to monkeys in the wild. This creates an additional reservoir of the virus in endemic areas. In fact there are three different transmission cycles for the virus, with each cycle involving a different species of the Aedes mosquito. A simplified diagram depicting these is shown in Figure 1. However the epidemiology of YF varies in different ecological zones. The transmission capability of the mosquito in South America is for example much lower than in Africa. West Africa is characterised by small, frequent urban outbreaks. Meanwhile East Africa is particularly vulnerable to large-scale outbreaks as evidenced by the largest epidemic of YF reported worldwide (Ethiopia 1960–1962) and more recent outbreaks of YF (Kenya 1992–1993, Sudan 2003, Sudan 2005). Unlike West Africa there is not a wealth of information on the epidemiology of YF in East Africa.

Figure 1. Yellow fever transmission cycles



Epidemics of YF depend on several factors: geographical location; the duration of the virus maturation cycle, the characteristics of the mosquito population, the size of the monkey population in the endemicity area, and the immunisation status of the human population.

Therefore by conducting a few entomological surveys, epidemiologists and entomologists should be able to predict and characterise epidemics so that appropriate preventative and containment measures can be taken. In recent African outbreaks children have been affected more than other age groups.

1.3 Prevention of Yellow Fever Outbreaks.

Traditionally prevention is based on three pillars:

I. Vaccination
II. Vector (mosquito) control
III. Isolation of patients in mosquito free rooms

More recently there is also a movement towards establishing surveillance and case reporting in endemic countries. Information regarding any suspected or confirmed cases is referred to the WHO. In this brief we will focus only on the first pillar.

1.3.1 The vaccine and vaccine strategies:

There is a **highly efficient** vaccine, which shows a seroconversion rate of above 95% in adults and children alike. Although immunity is likely to be for life, the international health regulations recommend a booster every 10 years for those persons living in an endemic region.

Two vaccination strategies:

A). **Routine immunisation**. At least 23 of 30 at risk African nations have included the routine vaccination as part of the Extended Programme of Immunisation (EPI); of these, half have managed to reach the recommended coverage of 80%. Reassuringly in endemic areas with high vaccination coverage, the occurrence of yellow fever outbreaks has decreased substantially.

B). **Post-outbreak immunisation**. In the event of an epidemic, a mass vaccination campaign must be started and measures taken to combat the mosquito population. Nursing staff must be vaccinated.

For yellow fever to cease being a public health problem, Africa must maintain at least an annual 80% yellow fever vaccine coverage of children under the age of 1 year

2. Synopsis of the Darfur Epidemic Sep – Nov 2012.

The current outbreak of YF in Darfur started at the beginning of September 2012. As of the latest WHO situation report from November 30th 2012:

- 32 out of 64 localities in Darfur are affected
- Total number of suspected cases is 677 including 164 deaths (CFR of 24.2%)
- The majority of cases are located in Central Darfur (58%) (17.2%, 14.6% and 9.3% are located in West, North and South Darfur respectively).
- Persons aged between 15 and 30 years are the most affected (52.6%)
- The most frequently cited symptoms are fever (97.9% of cases), bleeding 50.2% and jaundice (41.4%).

Between the 20th and 25th of November a 12 day mass vaccination campaign was started, which as of 30th of November, had reached 79% of the population in West Darfur, 56% in Central Darfur, 65.3% in North Darfur and 64.5% in South Darfur.
The importance of swift expansion of the vaccination efforts to cover remote areas is emphasised by reports of persons travelling from West to Central Darfur in order to be vaccinated. This is cause for concern regarding the spread of the epidemic. In addition, recent reports of renewed displacements of persons into Zam Zam camp signify an important source of infection to a vulnerable population. The mass vaccination of camps for internally displaced persons is of high priority.

> Priority Action 1:
> Given the vulnerable immune status of the population, swift expansion of vaccination services is vital to prevent individuals travelling to vaccination centres and thereby exposing themselves or others to the virus.

From WHO reports of YF outbreaks in Africa in the past decade only one other outbreak of similar epidemic proportions took place – in South Kordofan in 2005. This epidemic spanned 4 months from September- December, with 607 suspected cases and 163 deaths (CFR of 26.9%). A mass vaccination campaign was carried out at that time. However optimal coverage may not have been achieved. No accurate figures on the coverage of yellow fever vaccination in Sudan have been obtainable since the conflict began in 2003. What we know from data regarding the coverage of routine infant immunisations (such as Measles and BCG) is that coverage of these was impeded by the conflict (see Figure 2 and Table 2 below). Given that the YF booster vaccine is recommended every 10 years in this region it is evident that this outbreak was an unfortunately predictable event that could have potentially been prevented if only the conflict had not interrupted healthcare delivery and overwhelmed an understaffed, under resourced health system. As previously mentioned the three pillars of YF prevention are vaccination, vector control and the isolation of patients in mosquito-free rooms. However in conflict affected and post-conflict settings the situation is further complicated by mass population movements which allow the infection to spread. Therefore in these cases we recommend adding a fourth pillar – that of the monitoring and surveillance of the population. In particular any suspected or confirmed case should be asked for an accurate history of their most recent movements for active case finding.

> Priority Action 2 :
> In fragile states it is important to monitor the movement of the population during a YF outbreak. This includes an accurate history of a case's recent movements and active case finding.

Table 2. Vaccination Coverage in Darfur of 0-59 month olds[1].

	2003			2004			2005			2006		
	Coverage	Vaccines covered		Coverage	Vaccines covered		Coverage	Vaccines covered		Coverage	Vaccines covered	
North Darfur	85%	MCV		67%	MCV		76%	MCV;BCG		75%	MCV	
South Darfur	0%	na		37%	MCV;BCG; DTP;Pol		68%	MCV		80%	MCV	
West Darfur	0%	na		79%	MCV		57%	MCV;BCG		63%	MCV;BCG	

Figure 2. Vaccination Coverage of 0-59 month olds 2004-2006. Data from CE-DAT (CRED)

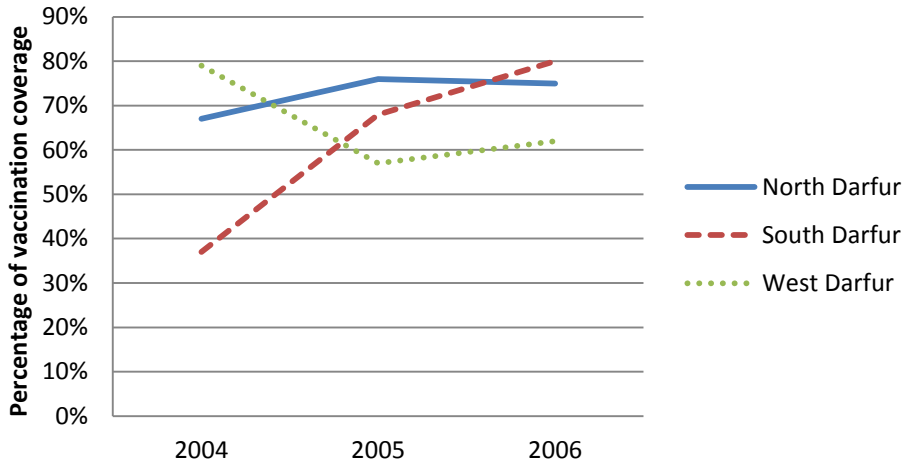
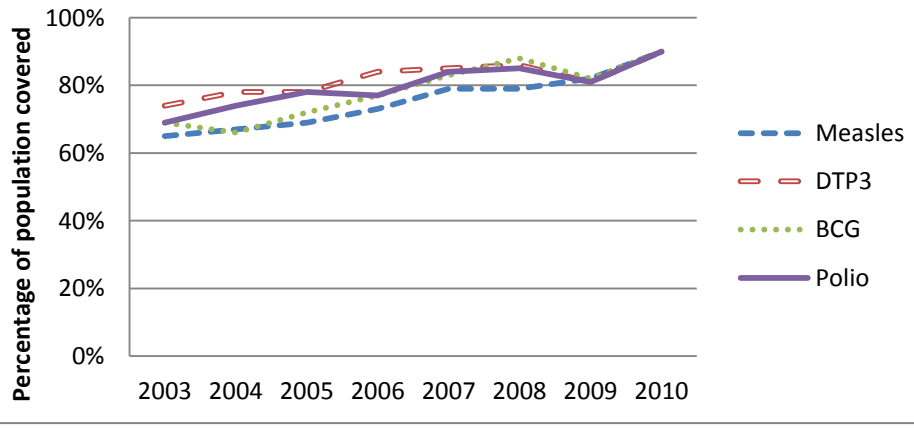


Figure 3. Vaccination coverage of 1 year olds data adapted from WHO (http://apps.who.int/gho/data/?vid=80100#)



[1] Data collected from available CE-DAT surveys http://www.cedat.be/

Suggested Reading

- Ellis BR and Barrett ADT. *"The enigma of yellow fever in east Africa"* Rev. Med. Virol. **18:**331-346 (2008).
- Jentes ES et al., *"The revised global yellow fever risk map and recommendations for vaccination, 2010. Consensus of the informal WHO working group on geographic risk of yellow fever"* Lancet Inf Dis **11**(8): 622-632 (2011)
- Van den Enden E. *"Illustrated Lecture Notes on Tropical Medicine"* Institute of Tropical Medicine, Antwerp. 2011.
- Barnett E. "*Yellow Fever: Epidemiology and Prevention"* Clinical Infectious Diseases **44**(6) 850-856. (2007)
  "*Yellow Fever Outbreak in Darfur, Sudan. Situation Report No 11, 1 December 2012"* Federal Ministry of Health and WHO. http://www.who.int/csr/don/archive/disease/yellow_fever/en/