

# Overview of Sudan's Experience with Ebola Haemorrhagic Fever (1976)

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### Abstract

*A large outbreak of haemorrhagic fever (subsequently named Ebola Haemorrhagic Fever) occurred in the Southern Sudan between June and November 1976. There were a total of 284 cases with 151 deaths; the overall case fatality rate was 53%. The outbreak appears to have originated in the workers of a cotton manufacturing factory in Nzara. Although the link was not well established, it appears that Nzara could have been the source of infection for a similar outbreak in the Bumba zone of Zaire or vice versa.*

*This paper presents information on the history of Ebola haemorrhagic fever outbreak in Sudan and the experience learned from it as well as the future expectations based on the personal experience of one of the authors of this paper who was the Director of Epidemiology Department in the Central Ministry of Health-Sudan (1976) and the head of the team from the Central Ministry of Health to investigate the outbreak. Literature review of documents published was also made and assisted in writing this paper.*

*There are so many challenges to answer the question that still remains as to the nature and origin of the responsible virus. With local and international collaboration a coordinated response will lead to successful containment of the disease.*

**Key words:** Sudan, Ebola, Haemorrhagic Fever

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### Introduction

The Ebola virus was first identified in September 1976 in a western equatorial province of Sudan and in a nearby region of Zaire (now Democratic Republic of the Congo) in 1976 after significant epidemics in Yambuku, northern Zaire, and Nzara, southern Sudan [1] that was first thought to be typhoid fever. Between June and November 1976, the Ebola virus infected 284 people in Sudan, causing 151 deaths [2].

The disease was severe, with fever, diarrhoeal and haemorrhagic symptoms; the case fatality rate was high and a large number of cases were among the staff of Maridi hospital. The first hypothesis was that it could have been Yellow fever, Lassa fever, Marburg disease or Congo Crimean haemorrhagic fever, all of which were known to be present in Africa.

Material collected by Sudanese epidemiologists was sent to high-security laboratory in the United Kingdom and another in the United States of

America. Less than two weeks later the virus was found to resemble Marburg virus under electron microscope but the Center for Disease Control in Atlanta, USA, soon found that the new virus, called Ebola, was antigenically different [3].

The Ebola virus, Filoviridae family, comprises of four distinct subtypes: Zaire, Sudan, Côte d'Ivoire and Reston [2]. The natural reservoir of the Ebola virus is unknown but seems to reside in the rain forests of the African continent and in areas of the Western Pacific. The virus is probably transmitted from animal to man by a vector and later by direct contact with the blood, secretions, organs or other body fluids of infected persons or during burial ceremonies where mourners have direct contact with the body of the deceased person. The infection of human cases with Ebola virus has been documented through the handling of infected chimpanzees, gorillas, and forest antelopes both dead and alive. Health care workers have frequently been infected while treating Ebola patients [2].

Ebola Haemorrhagic Fever (EHF) is a febrile haemorrhagic illness and one of the most virulent viral diseases known to humankind with an Incubation period of 2 to 21 days, causing death in 50-90% of all clinically ill cases [1].

Ebola is often characterized by the sudden onset of fever, intense weakness, muscle pain, headache and sore throat. This is often followed by vomiting, diarrhoea, rash, red and itchy eyes, impaired kidney and liver function, and in some cases, both internal and external bleeding [2]. Specialized laboratory tests on blood specimens detect specific antigens and/or genes of the virus. Antibodies to the virus can be detected, and the virus can be isolated in cell culture. Tests on samples present an extreme biohazard risk and are only conducted under maximum biological containment conditions [2].

There is no specific treatment or vaccine as yet available for Ebola haemorrhagic fever and isolation with strict barrier nursing techniques should be implemented. Severe cases require intensive supportive care. People who have died from Ebola should be promptly and safely buried [2]

#### **Sudan's 1976 experience**

Late in 1976 an outbreak of an unknown disease occurred in three districts - Nzara, Maridi and Tambura - of Western Equatoria Province of Southern Sudan [4 &5]. It was described as a highly infectious disease characterized by a high case fatality rate especially among hospital staff in Maridi Hospital [5].

The official news of the outbreak reached the Regional Ministry of Health and Social Welfare in Juba the capital of Western Equatoria Province on 15<sup>th</sup> September 1976 through a telegram sent by the Medical Officer of Maridi Hospital [4, 6] and assistance was required from the Central Ministry of Health and WHO on 26<sup>th</sup> September 1976 [5, 6]. The first Author, who is an epidemiologist and the then Director General of Epidemiology Department

at the Central Ministry of Health, was requested to head a team and proceed to the outbreak area to: Investigate the outbreak, establish diagnosis of the disease, implement control measures, and to report. The epidemiologist from the Central Ministry of Health formed a combat team consisting of (physicians, public health officers, laboratory specialist, laboratory technicians, nurses and a statistical clerk). He also prepared logistics such as medicaments, infusions, gloves, masks, gowns and syringes) to be airlifted with the team. He left Khartoum, along with his team, for Juba on the 3<sup>rd</sup> of October and was in Maridi the same day [5, 6].

#### **The situation in Juba**

Only few scattered information was received in the regional Ministry of Health and Social Welfare in Juba about signs and symptoms of the disease (fever with haemorrhages and death) but no epidemiological information was available with regards to date and place of the start of the outbreak, number of cases and deaths [5]. Except for spraying with DDT in Maridi, Yambio and Nzara and limited vaccination against yellow fever, none of the recommended control and preventive measures was carried out [4].

#### **The situation in Maridi**

On the same day the combat team was airlifted by Helicopter to Maridi and before landing in Maridi the epidemiologist from the Central Ministry of Health instructed the team members to take very strict precautionary measures to protect themselves (wear gloves, gowns, and double layer mouth and nose masks). These precautionary measures proved to be very essential in later epidemics [5].

In Maridi the situation was really very grave. There were few people in the town, the town was almost deserted and the surroundings were gloomy and sad. There were over 30 cases in three hospital wards, most of them seriously ill, a few in coma,

some were recovering. A few patients were left neglected; a large number of nursing staff was in panic and did not show up for work. A doctor, a nurse and a teacher already died and a nurse, a hospital cleaner, a messenger were admitted [5, 7]. On examining the 30 cases in hospitals almost all of them gave the same history of sudden onset of high fever, severe headache, myalgia, gastrointestinal upset (vomiting or diarrhea or both), chest pain with cough, dryness of mouth and throat. There were haemorrhagic manifestations. (epistaxis, haemolysis, haemoptysis, melena) as well as cachexia. Nervous symptoms involvement including convulsions and coma [5]. All patients were given antimalarial treatment without improvement and then anti-typhoid drugs during the second week [7]. Supportive treatment was given to patient mainly on symptomatic bases, fluid and electrolyte balance and regulation of the blood pressure [5]. The information collected in Maridi Hospital is summarized in table (1) which shows a case fatality rate of 54% [7].

Table (1): The epidemiological information collected in Maridi Hospital

Position	Number	Infected	% Infected	Deaths
Doctor	2	1	50%	1
Office personnel	11	5	45%	1
Medical Assistant	6	6	100%	5
Nurses	53	14	26%	5
Students Nurse	95	39	41%	22
Cleaners	39	6	15%	2
Natives	24	5	21%	5
<b>Total</b>	<b>230</b>	<b>76</b>	<b>33%</b>	<b>41</b>

### Methods used to investigate the epidemic

Investigation of the outbreak in Sudan involved finding of the cases and recording pertinent information. Several sources were used to find as many cases as possible: Hospital records, visiting homes of patients and ferreting out other cases or their contacts, searching house-to-house in the

infected areas for additional cases, and contacting local chiefs for information.

A case was defined as: anyone having the symptoms of fever and headache lasting for at least two days with the addition of gastrointestinal symptoms (diarrhea or vomiting) or chest pain; or diagnosed by a physician in a hospital [8].

Teams were formed mainly of students and headed by sanitary overseers or public health officers. These were asked to search the area, house by house, and detect cases in order to organize their prompt removal to the quarantine [6]

### Specimen collection

Blood, urine, throat swab, CSF, stools and excreta specimens were collected transported by air to Khartoum and then to Porton-Down, England for virological diagnosis and isolation of the etiologic agent [5,7].

### Control measures

The following steps were taken in Juba as provisional control measures and were implemented [5, 6]:

1. Complete closure of Equatoria province.
2. Strict and rigid closure of Maridi district.
3. Restriction of movement within Equatoria province.
4. Restriction of movement from south to north Sudan.
5. Application of vigorous surveillance along the international border of Equatoria.

The control measures implemented in Maridi were as follows [5]:

1. Very strict quarantine measures and isolation of suspected cases.
2. The application of strict aseptic techniques in handling specimens for investigation.
3. Minimize the unnecessary handling of patients by either the hospital staff or their relatives.

4. The wearing of gowns, masks, gloves by all hospital staff attending these wards (barrier nursing).
5. Disinfect reusable supplies and equipment.
6. Dispose of waste safely.
7. Use safe burial practices.
8. Compulsory and prompt notification
9. Detection of cases, contact tracing and follow-up
10. Health education

#### **The origin of the outbreak**

The origin of the outbreak was Nzara, a small township in Yambio District of some 20,000 people clustered around an extensive agricultural organization and Cotton Manufacturing Factory employing a total of 2,000 staff. The town is partly composed of brick built houses in labour lines and surrounded by densely inhabited areas with mud and thatched tukols, housing the majority of the town's population.

Ecologically, the area lies close to the central African rain forest zone. It is a rich agricultural country with extensive teak plantations and fruit orchards. Much of the area is dense woodland with areas of secondary forest. The civil disturbances of the last two decades had caused many people to leave the area, but since the early 70's the area has become rapidly repopulated with subsequent reclamation of forested areas for subsistence farming as population pressure increases.

On 6<sup>th</sup> August 1976 a student from Nzara arrived in Maridi en-route to Juba. He was suffering from severe febrile illness and became increasingly ill and was admitted to Maridi Hospital. He died a week later. His brother and nephew after burring him in Maridi returned to Nzara. The brother became ill and died in Nzara. The nephew fell ill, went to Juba for treatment, flew to Khartoum and died in Omdurman on 30<sup>th</sup> August 1976 [7]. This was the first epidemiological information from

Maridi Town and was communicated to Regional Health Ministry and Social Welfare in Juba and to Central Health Ministry in Khartoum in order to investigate any secondary cases and to take necessary actions. Later on it was learned that no secondary cases occurred in Juba or Khartoum and Omdurman [5].

#### **Tracing the epidemic**

A plan was prepared by the epidemiologist from the Central Ministry of Health to trace the epidemic forward i.e. north and west of Maridi, and backward i.e. south and east of Maridi. Investigation forms were designed and prepared to be completed during the epidemiological investigation [5].

The investigation showed that the outbreak did not spread forward. Maridi Town was therefore the end point of the spread of the epidemic and that it was most likely that the area down to Nzara, from where the student came to Maridi, has been exposed to the disease. The search for cases and deaths in villages all along the road from Maridi and Nzara was made. The villages were rapidly surveyed by the epidemiologists [5]. On reaching Yambyo and based on the available information from Maridi Town, en-route information and the epidemiologist's experience, the epidemiologist from the Central Ministry of Health finally confirmed the diagnosis as Viral Haemorrhagic fever similar to Lassa and Marburg fevers but not identical. He also reported that the hospital acted as an amplifier of the disease leading to one of the most tragic hospital outbreak that ever occurred in the recent of history of medicine [5].

This information was telexed to the regional Ministry of Health and Social Welfare, Central Ministry of Health and WHO. The epidemiologist then proceeded investigating the epidemic down to Nzara.

### **The chronology of occurrence of cases in Nzara**

The original cases of haemorrhagic fever occurred amongst employees of the Nzara Cotton Manufacturing Factory; the Factory has excellent records of employee absenteeism which facilitated the epidemic investigation. The review of the factory records revealed that one or two factory workers per week started dying of haemorrhagic disease and subsequently their families or friends who cared for them would manifest the same symptoms [8].

On 27<sup>th</sup> June YuG fell ill and died on 6<sup>th</sup> July and on this same day the student fell ill and left for Maridi, later Bz fell ill and died on 14<sup>th</sup> July followed by his wife, the only surviving relative. On 18<sup>th</sup> July PG fell ill and died on 27<sup>th</sup> July, 69% of the cases were traced to PG. Late in August several people developed the disease including two nurses and died [5].

Detailed investigation at Nzara showed that around mid June a family of 4 members suffered from a similar disease and all died. The head of the family who returned from Congo and died 3 days later prior to the death of his family was a smuggler between Sudan and Congo which raised the question as to whether the disease could have originated in the Congo [5].

With the help of a WHO team later in Nzara, every possible insect, small rodents and animals were collected and examined. Despite tremendous efforts of experienced and dedicated researcher Ebola natural reservoir was never identified.

### **Constraints**

- Transport was a major constraint. The lack of cars and the acute shortage of fuel in the area were real obstacles in the way of carrying out many activities [5, 6].
- Radio communications were deficient and postal services were almost nonexistent especially after closure of the area. Use was

made of the available radio communication sets belonging to some voluntary organizations [5, 6].

- The running away of the nursing and auxiliary staff of the hospitals and the similar attempts by the patients and their relatives and contacts constituted one of the main problems (6). It took quite an effort to persuade these people to return to the hospital [5, 6].
- The shortage of medical and public health personnel in the area was yet another big constraint [4].
- Local circumstances and logistics in the Sudan did not allow elaborate routine nor scientific tests. Thus, only limited material was to be investigated leaving many questions unanswered [9].

### **Conclusions**

There were three outbreaks of Ebola haemorrhagic fever in Sudan [2]. The first one started in the year 1976 with a total of 284 cases and 151 deaths with a case fatality rate of 53% as mentioned earlier. Secondly in 1979 a total of 34 cases and 33 deaths with a case fatality rate of 65% was reported, and finally in 2004 the health authorities of Yambio, Western Equatoria, South Sudan have reported a total of 17 cases, including 7 deaths from Ebola with a case fatality rate of 41%. The last person identified as infected with Ebola haemorrhagic fever died on 26<sup>th</sup> June 2004 in Yambio Hospital.

During the 2004 outbreak, Ebola virus was confirmed by laboratory tests at Kenya Medical Research Institute and the Centers for Disease Control and Prevention in the United States. On 7<sup>th</sup> August 2004 WHO declared that the outbreak in southern Sudan is over [10].

The control efforts included, for example, an isolation ward at Yambio Hospital with a low fence so that patients were effectively isolated, yet still able to see and talk to their family and friends over

the fence at a safe distance [10]. The Yambio experience has proven the value of rapid outbreak detection, local response capacities, active community involvement, and the coordination of specialized international assistance to the outbreak's containment. The intensive social mobilization for Ebola was essentially the reason for the rapid containment of this outbreak [10].

The three Ebola haemorrhagic fevers in Sudan burned themselves out; the first epidemic lasted the longest time and affected the largest area. The 1979 epidemic was focal and the 2004 epidemic was localized.

There are so many challenges that remain, among these are developing additional diagnostic tools to assist in early diagnosis, ecological investigations of Ebola virus and monitoring suspect areas to determine the incidence of the disease.

The communities affected by Ebola should make efforts to ensure that the population as well as the health personnel are well informed, both about the nature of the disease itself and about necessary outbreak containment measures including contact tracing and follow-up of people who may have been exposed to Ebola. Community resources should be mobilized to conduct health education. And finally, compulsory and prompt notification of the disease should be implemented.

The World Health Organisation recommended guidelines for epidemic preparedness and response: Ebola Haemorrhagic Fever (EHF) and Hospital-based guidelines titled Infection Control for Viral Haemorrhagic Fever in the Africa Health Care Setting based on the experience from Sudan and Congo were developed and provide an overview on viral haemorrhagic fevers and Ebola Haemorrhagic Fever.

#### **The future:**

With more frequent Ebola outbreaks detected in recent years the big question still remains as to the

nature and origin of the responsible virus and no one can predict where or when the next Ebola outbreak will happen but with local and international collaboration a coordinated response will lead to successful containment of the disease.

#### **Laboratory accidents**

It is worse mentioning the accidents that occurred in laboratories (Box 1) in the battle to discover the mystery of Ebola haemorrhagic fever [2].

##### **Box 1: laboratory accidents**

**November 1976:** Microbiological Research Establishment, Porton, UK Needle stick injury, recovered.

**February 2004:** Fort Detrick, Maryland (USA) Needle stick injury, recovered.

**May 2004:** State Research Center of Virology and Biotechnology (Vector), Koltsovo, Russian Federation Needle stick injury, died on 19<sup>th</sup> May 2004.

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