International Journal of
Health Systems and Medical Science

ISSN: 2833-7433
Volume 1 | No 1 | Jul-2022

Yellow Fever Surveillance System and their Effectiveness

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Abstract: Yellow Fever is a viral hemorrhagic fever which strikes an estimated 200,000 persons worldwide each year and causes an estimated 30,000 deaths 1. Yellow fever virus is the prototype of the family Flaviviridae, which currently contains over 70 viruses, of which most are arthropod-borne, including dengue viruses 2-3.there are three different epidemiological patterns of yellow fever virus transmission. The sylvatic or forest pattern, the Aedes aegypti- borne urban cycle 4.and an intermediate cycle that bridges these two patterns. The different epidemiological patterns of transmission lead to the same clinical disease 5

The main vector of yellow fever within village and urban settlements is female Aedes. (stegomyia) aegypti (only females feed on blood to obtain protein for egg production) The virus is transmitted when a mosquito bites an infected human and then, after an extrinsic (in the mosquito) incubation period of 12-21 days bites a susceptible human. Ae, aegypti breeds readily in all types of domestic and Peridomestic collection of fresh water, including flower vases, water drums, tin cans, broken coconut shells, old tyres and gutters 6.In the forest pattern of yellow fever monkeys are the primary host, and man is an accidental host (In South America yellow fever is an occupational disease of people cutting down the forest)7.Humans become infected with yellow fever virus when bitten by the primary mosquito vector, Ae, Africans, Ae, bromeliad or one of the several other mosquito species. Most of these mosquito breed and live in holes and cracks in the upper party of three in the forest. Intermediate epidemics are a mixture of man - to -man transmission, and are often characterized by focal outbreaks separated by areas without human cases.8.In some surveys ,it has been possible to estimate an annual incidence of infection of susceptible humans of at least 1%,so that ,by adulthood, immunity rates of 50% or more are not unusual.9. An attack of yellow fever is followed by a solid long - lasting immunity against reinfection 10. The incubation period in human is generally an infected mosquito. The Patient is only infectious to mosquito for the first three to four days after onset of symptoms. The disease of fever, headache, backache, general muscles pain, nausea, and vomiting11. Milder Cases of yellow fever may not present with jaundice. There is a characteristics bradycardia in relation to the temperature 12.About 15% of those infected develop a serious illness with several phases, an acute phase of about three days with sudden onset of fever headache, myalgia, nausea, and vomiting remission for up to 24 hours(characteristics saddle -back fever) and a toxic phase with jaundice and vomiting (black vomitus) in which haemorrhagic signs (bleeding of gums, nose and haematuria), albuminuria, and oliguria (reduction of urine production) may occur. The patient may suffer from hiccups, diarrhea, progressive tachycardia, and shock. Examination of the abdomen reveals intense epigastric tenderness 13. At least half of the individuals who reach the toxic phase do not survive. Death usually occurs between the seventh and tenth day after onset.14. The possibility of yellow fever should not be dismissed in the absence of jaundice or of albuminuria. Malaria and yellow fever may coexist in a region,15 and malaria usually shows clinical symptoms almost identical with those of the early stages of yellow fever, sudden onset, headache, generalised aches, and vomiting, Even with the finding of malaria parasite in the blood smear, the possibility of yellow fever is not ruled out.16 .In the beginning of an infection, there is a little to distinguish the illness from a number of other febrile conditions. Typhoid fever, rickettsial infection, influenza, leptospirosis, viral hepatitis, infectious mononucleosis, and other arboviral

fever, like dengue, Lassa fever and chikungunya may all resemble anicteric yellow fever. The definitive diagnosis of yellow fever is made by serology or virus isolation, which requires special reagents and techniques as well as expertise in the interpretation of the test results. The histopathological diagnosis is based on eosinophilic degeneration of the hepatocytes leading to the formation of councilman bodies in 1930s a viscerotome program was instituted in South America. All individuals who died after a short- term febrile illness had a liver punch specimen taken by health officials and sent to specially trained pathologist 17. Liver biopsies are not done in living patients because of the risk of severe haemorrhage. A viscerotome service has not been instituted in Africa.

Yellow fever is endemic in 34 countries of Africa with a combined population of 468 million. Yellow fever vaccine, one of the earliest viral vaccines to be developed, has proved safe and efficacious. The vaccine is transported and stored frozen. The development of new protective additives have increased the thermostability of the vaccine. The shelf life at - 20 or 40 o C is now up to two years, and the estimated half-life at a room temperature is 10 months, However once a vial is opened, the vial must be kept cold and used within one immunization session and it must be discarded after then. One dose of yellow fever vaccine provides protection for at least 10 years and possibly life long.18. A single dose will confer immunity in 95% of persons vaccinated. Four strategies have the potential to bring yellow fever fully under control in Africa epidemic control, mass immunization and surveillance.19.In Africa, epidemic control often suffers from delays of the two months or their between the onset of epidemics and their recognition, partly due to the occurrence of the first cases in remote areas with few medical services and the unfamiliarity of medical personnel with the disease .Responses to a possible outbreak include collection and testing of specimens. epidemic investigation emergency vaccination takes place as soon as an outbreak has been confirmed, In an attempt to limit the spread of infection by immunizing all person in the focus regardless of their former immune status. Good Surveillance is essential in all at - risk countries for the early detection of cases which will allow fast action to control an outbreak. It has often proved difficult to identify early, isolated cases before they trigger an epidemic because of the difficulties of distinguishing yellow fever from disease with similar symptoms (e.g malaria) Other potential problem with emergency campaigns include difficulty in obtaining the large supply of vaccine, syringes and needles, and sudden deployment at short notice of large numbers of health workers. Another disadvantage is that immunity does not appear until seven days after immunization.

Keywords: Yellow fever virus,Mosquito- borne Transmission, vaccine Emerging Disease.

INTRODUCTION

In 1988, the EPI Global Advisory Group reviewed the situation on Yellow fever and noted a relatively high incidence in children. It recommended that countries at risk for yellow fever should in corporate yellow fever vaccine into the routine activities of the national immunization programme, and this was endorsed by a joint WHO and United Nation Children's fund (UNICEF) Technical Group on immunization in Africa. Due to small risk of adverse reactions, yellow fever vaccine should not be administered to children less than six months of age, so it is usually administered at the time of the measles vaccination at nine months of age older children should also be vaccinated routinely in areas at high risk for yellow fever epidemics 20.

Since the late 1980s, there has been a dramatic resurgence of yellow fever vaccination activities in many of the countries at risk, which Include the poorest in the world, are generally weak. only 5 to 34 African countries at risk reported yellow fever vaccine coverage data in 1996.Outbreaks were reported in several countries in west Africa in 1994-1995 and in 1995,Peru experienced the largest yellow fever Outbreak reported from any country in the Americas, Since 1950 The WHO therefore commissioned a literature review of yellow fever to provide background materials for assessment of the current strategies focusing of the following.

The epidemiology of yellow fever particularly in Africa

A review of yellow fever surveillance system and their effectiveness

A review of studies examining the cost effectiveness of preventive yellow fever vaccination programmes

I. Pre Vaccination epidemiology 1700 - 1930 the first account of a sickness that can definitely be recognised as yellow fever occurred in Guadeloupe and in Yukatan in 1648. 21-22

Slave trade in seventeenth century formed an intimate bond between west Africa and Spanish-Portuguese America." Yellow Jack" was one of the most dreaded of the diseases of the Atlantic trade routes, the legend of the " Flying Dutchman", a vessel doomed to haunt the seas around the cape of Good Hope because yellow fever broke out and no port would give her harbourage and all the crew perished, as described by Sir Walter Scott, was inspired by stories of this disease. Linds account 1792 of fever abroad; the vessel off the coast of Senegal in 1768 is usually accepted as the first in which we can definitely recognise yellow fever in Africa. No clinical description of the fever was given, but the evidence for its being yellow fever was its occurrence first in men who had been ashore, and its apparent propagation aboard ship. The first clinical report on yellow fever was published by Schotte in 1782 and on the " Synochus Atriabiliosa" in Senegal in 1778," the vomiting continued it became green, brown, and at last black.and was coagulated in smell lumps- A continual diarrhoea, with gripings, now took place, by which a great quantity of black and putrid faeces were evacuated. The SK in became now fully of Petchiae" 25. In 1848 Josiah Clark Nott (1804- 1973) was spread by mosquitos " we can well understand how insect wafted by the winds(as Happens with mosquito, flying ants, many of the Aphides etc) should haul up on the first tree, house aga soremonotion, entangled or not with aqueous Vapor, while weeping along on the wings of the wind, could be caught in this way 26.But it was Cuban Physician C J Findlay (1833- 1915) who published in 1881 the first really serious theory of the mosquito transmission of yellow fever.

1. The existence of a yellow fever patient into whose capillaries the mosquito is able to drive its sting and to impregnate it with the virulent particles, at an appropriate stage of the diseases.
2. That the life of the mosquito be spared after its bite upon the patient until it has a chance of biting the person in whom the disease is to be reproduced.
3. The coincidence that some of the persons whom the same mosquito happens to bite thereafter shall be susceptible of contracting the disease.27

Because of the considerable difficulties caused by yellow fever for the American War, the American authorities appointed a yellow fever commission with Walter Reed(1851- 1902) an army Surgeon, as its head. In Sept 1900 the work of the Reed commission proved conclusively that

a. the mosquito was the vector of yellow fever
b. There was an interval of about 12 days between the time that the mosquito took an infectious blood meal and the time it could convey the infections to another human being
c. yellow fever could be produced experimentally by the subcutaneous injection of blood taken from the general circulation of a yellow fever patient during the Ist and 2nd day of his illness, and
d. yellow fever was not conveyed by fomites 28

Laboratory work on yellow fever was very much handicapped by the lack of an experimental animal.1927 Dr A F Maheffy and Baver of the commission 's laboratory staff managed to transmit yellow fever to an animal other than man using blood from a yellow fever patient (a 28 years old west African man named Asibi) into a rhesus monkey, propagation of the new famous Asibi strain of yellow fever virus also begun with this experiment 29 the same workers confirmed that 30

a. causative agent of yellow fever was afilterable virus.
b. the infection was easily transmitted from monkey to monkey, or from man to monkey by injection of citrated blood taken from easily in the disease.
c. that it was transmitted from monkey to monkey by Aedes aegypti mosquitoes

d. that once infected, mosquitos remained infective for the entire period of their lives, which in some instances exceeded three months, and

e. that the bite of a single infected mosquito was sufficient to produce a fatal infection In a monkey.

II. Pre vaccination epidemiology in Africa from 1906- 1922 cases of yellow fever were apparently rare in former French Africa from 1922 to 1927 very numerous small outbreaks without apparent interconnection were reported in west Africa. In all these small outbreaks the infected area was extremely localised 31 .

From 1927 to 1931, disease incidence decreased markedly and seemed to disappear from one colony after another. In 1931, however, yellow fever reappeared .The almost simultaneous reappearance of cases of yellow fever, with no connection between them, in a large number of places scattered over west Africa and in countries where the disease had not been reported at all for several years. was explained by the persistence of latent yellow fever foci in these countries .In the epidemic periods, it was the European in particular who ever affected as they had not gained protection through a previous attack 32. The number of serological studies increased considerably after Theiler's discovery enabled mice to be used ,instead of monkey Macacus rhesus, for protection test 33.the result of these test were often positive in sierra Leone and southern Nigeria, The prospecting mission of stefanopoulou in 1931-32 in former French West Africa discovered a good number of positive sera in the west and south of Senegal. and along the upper course of the Senegal River, in the Macina area(former French Sudan) and the former upper Volta Territory Test also gave positive results in the parts of former Togo land under French Mandate, on the other hands, the test gave negative results in almost all the places studied in Guinea and the Ivory Coast. In places where the disease was endemic, the proportion of positive immunity test increased fairly regularly with age, whilst in places where the disease appeared Sporadically the immunity curve according to age was irregular Negative results for test among children indicated the absence of yellow fever during recent years from the area. In the same way, the ages of children giving a positive reaction to the test fixed the epidemic years 34

III. Development of Vaccines

Two live attenuated YF vaccines were developed in the 1930s,the French neurotropic vaccine from human virus passaged in mouse brain and the 17D vaccine from human virus passaged in Embryonated chicken eggs.

Milestone in the development and use of French neurotropic vaccine between 1939 and 1952 over 38 millions doses were administered (mostly by Scarification along with smallpox vaccine) and incidence declined dramatically. However a high incidence of encephalitic reaction in children led its use in children under 10 years being stopped in 1961 and manufacture of the vaccine was discontinued in 1980.

Milestone in the use of French vaccine 35

1927 - one of the first strains of yellow fever virus was isolated at the Institute Pasted at Dakar.

1928 - The virulent organs from an 8infected monkey were transported to Europe and America. Where they were placed at the disposal of various laboratories under the name of " French Slain)

1931- The first trials on human simultaneous injection of a suspension of the French strain and a certain of vanity of human Immune serum.

1932- A method involving the subcutaneous inoculation of the modified French strain alone. without immune serum was introduced

1941- A departmental order made yellow fever vaccination by Scarification compulsory for the whole civilian and military population of French West Africa, Yellow fever virtually disappeared from colonial French west and Equatorial Africa by virtue of a programme of compulsory immunization initiated in 1942.The same period was marked by major epidemics in the British colonies of Gold Coast and Nigeria which had not implemented a policy of preventive immunization.

1951-1952 During the epidemic in Panama Honduras, and Costa Rica and again in Eastern Nigeria, when the French neurotropic vaccine was used, cases of Post vaccinal Encephalitis were seen Encephalitis was reported to occur in Nigeria at a rate of 3- 4 / 1000 vaccination mainly in children,with a case fatality rate of 38%

1961- The French neurotropic vaccine stopped being recommended for children under 10 years, because of the noted association with a high incidence of encephalitis reaction in children.

1980- The manufacture of the French neurotropic vaccine was discontinued Today 17D Is the only type of YF vaccine produced

1936- The Asibi strain of yellow fever was successfully established in culture medium containing embryonic mouse tissue and 10% normal monkey serum in Tyrade's solution. After cultivation through 18 subculture in this medium, cultivation of minced whole chick Embryo-After 58 subcultures in the latter medium, was modified by removing the brain and spinal cord from chick embryo before mincing, The virus was later maintained continuously in this medium for over 160 subcultures. The resultant strain was designated as 17D.

IV. Early Post Vaccination epidemiology 1940-1980

The first experiments in large scale vaccination against yellow fever were conducted in French Africa .South of the sahara .During 1934 and 1935,5699 persons were given three successive subcutaneous inoculations with the French neurotropic vaccine .

Before mass immunization campaigns were started in Africa, typical urban outbreaks occurred in Lagos, Nigeria, in 1925- 1926 In Accra, Ghana in 1926-1927 and again in 1937, and in Banjul, The Gambia, in 1934-1935.In 1940 mass immunization was initiated in French - speaking countries in west and Equatorial Africa where 25 million people were immunized about every four years. As a consequence, yellow fever disappeared gradually in these countries, while epidemic and endemic activity continued in counties without immunization programme.

Surveillance

Surveillance and rapid response to identified disease threats are at the core of preventive medicine. A well designed and well .Implemented infectious disease Surveillance programme can provide a means to detect unusual clusters of disease, document the geographic and demographic spread of an outbreak, estimate the magnitude of the problem describe the natural history of the disease, identify factors responsible for epidemiological research and assess the success of specific intervention efforts. The effectiveness of surveillance depends on the speed of reporting and analysing the results. Monitoring of factors such as population growth and migration, vector abundance and natural environmental factors is an essential component of surveillance. These factor can influence both the spread of yellow fever and the effectiveness of efforts to control them. Surveillance can take many forms, each having advantages and disadvantages Although most infections with YF do not cause jaundice, This sign is the easiest on which to base case reporting. Most countries have a system for reporting cases of hepatitis, or jaundice, which can be adopted to provide information about the occurrence of suspected yellow fever. An unusually high case - fatality rate among cases of jaundice might indicate the possibility of an outbreak of yellow fever.

For effective YF surveillance, the following measures are essential, identification of suspected patient, prompt investigation of each suspected case with collection of appropriate clinical specimens, transport of specimen from the field to the laboratory in cold boxes, reliable completion of laboratory test, forwarding specimens, as appropriate to higher level laboratories should additional test be indicated, and rapid feedback to the district and national level so that disease control measures, including mass immunization campaigns, can be instituted. Some of the practical difficulties faced in implementing these measures are described in the review of the Kenyan Sentinel Surveillance System. To improve surveillance, WHO AFRO has developed a training workshop and field guide for district level staff on EPI target disease Surveillance, which focuses on Poliomyelitis, measles, neonates tetanus, and yellow fever A series of laboratory workshop on YF diagnosis have been held in the African region in the 1990s for Anglophone and Francophone countries action to

strengthen the laboratory network for YF have followed on from the success of the WHO polio laboratory network programme. WHO is currently revising its references material for Surveillance, and has developed suggested case definitions types of surveillance, minimum data elements and data analysis and case investigation forms WHO has not emphasied histopathological Surveillance in Africa because patients are more likely to die at home,and families are reluctant to provide consent for an autopsy. The present yellow fever surveillance system can be improved by reducing the number of sentinel sites, training more staff locally and organising regular and reliable communication between the sentinel sites and KEMRI.The yellow fever surveillance should be 8integrated gradually with the MOH activities. Any other arboviral research could be carried out in a few well chosen sentinels for scientific interest and "Virological trends" only.

CONCLUSION:

Yellow fever has caused devastating epidemics in Africa, South Central and North America and Europe. Yellow fever has not spread to Asia for unknown reasons. Recently there have been some reported cases of imported yellow fever both in Europe and in the USA.it is of great importance to inform all the international vaccination centers about the dangers on yellow fever.

Yellow fever resurged in the 1990s,1989- 1991 was an especially active periods in Africa ,where 34 countries are at risk for yellow fever,17 have a policy to include yellow fever vaccine in the EPI, but 14 have poor immunization program me performance and 14 out of 34 belong to countries in greatest economical need. It is very difficult to try to prioritise the 34vAfrican at - risk countries in order of highest to lowest risk, because the resurgence of yellow fever is unpredictable, but certain criteria could be used, the reported epidemics during the past years catagorised under the different topolpe reported cases over the past 15 years Immunization coverage and performance including the reported measles immunization coverage.

1 Recent epidemics: Nigeria has reported for more cases than any other country during the past 15 years. Seem to have been a center for epidemics and need a lot support for controlling yellow fever,as does Mali and Liberia .Other countries in west Africa(including Bukina Faso, Ivory Coast, Ghana, Togo, Benin, Nigeria, Niger, and camroon) also need extensive vaccination coverage in the country (especially in East and central Africa)

2 The reported cases during the past 15 years arefrom Angola, Benin, Bukina Faso, Cameron, Gabon, Ghana, Guinea, Kenya, Liberia, Mali, Mauritania, Nigeria, Senegal, Sierra leone and Togo. Out of them Angola, Bukina Faso, Gabon, Ghana, Mauritania, Nigeria and Senegal already have a policy to include yellow fever vaccination to EPI,Of these countries the immunization programme performance is poor (-50%) in Angola) Bukina Faso, Mali and Mauritania are also included in the countries of the greatest economical need. only part of some countries is exposed to the risk of severe outbreaks, e.g In Angola Mali and Kenya only some district need to be included in yellow fever vaccination programme, By now because of the extensive epidemics from 1984- 1994.much of the population of Nigeria has been vaccinated through mass vaccination programme .or has gained natural immunity- it is important now to susceptible population- infants. The importance of surveillance should not be forgotten, especially taking the experience of the surveillance in Kenya into consideration e.g Gambia has had a successful immunization programme with combined strategy. The last Gambian epidemic was reported in 1979,but a sensitive surveillance system is still needed to improve the detection diagnosis and prevention of yellow fever outbreaks and monitor yellow fever coverage including details of vaccination by age group given in response to outbreaks. Immunization given through the EPI are one of the most cost effective child survival intervention, The mass immunization campaigns are also effective and reasonably cost effective and they secure the additional funding needed. there are no studies about the cost effectiveness of combined preventive vaccination through EPI and surveillance verses mass vaccination campaigns, such studies should be encouraged .However, in countries that have recently experienced widespread epidemics, most ' preventive' campaigns are probably not indicated. The cost of using YF vaccine could be administered in the same syringe as measles vaccine, laboratory test to determine the stability of YF and measles vaccine mixed after dilution and kept for ups to four hours would be easy perform and should be done using measles vaccines from the range of manufacturers, as the effect of

mixing could vary depending on vaccine source, should laboratory experiment be encouraging, a field study of serroresponse to such. Vaccine mixed prior to vaccination could be done relatively quickly and inexpensively concurrently the potential interest of vaccine manufacturers in producing a combined vaccine should be explored, but the practical implication of distributing this vaccine to only certain countries,or regions with in a country, should be assessed. All Asian countries should make an efforts to check that all persons arriving from yellow fever endemic countries have a valid yellow fever vaccination certificate. In South America yellow fever is a disease of forest workers but there is danger that Aedes aegypti mosquito which has reinfested all over south and central America, could transmit yellow fever in an urban cycle. The urban epidemics were prevented in the early 1900,just by depriving the mosquito of their breeding places this could be also enough today to prevent urban yellow fever in South America towns, combined with yellow fever vaccination as part of "occupational" health care for forest workers. The combined strategy of surveillance,out break response and prevention is still needed to combat yellow fever. The group" highest priority" needs yellow fever vaccine to be included in the EPI urgently but also efforts to improve the immunization performance in general, followed by mproved surveillance system practical problem will be caused by political instability and weak infrastructure in some of these countries. The group " high priority" needs yellow fever vaccine to be included in the EPI, but need support to improve the immunization performance in general together with an improved surveillance system. Most of the countries in group " medium Priority" have already included yellow fever vaccine in the EPI and relatively low YF activity. However many of these countries are politically unstable and or in great economic need and their immunization programme and surveillance system for all .The EPI disease need to be strengthened. Reason for difference between coverage of YF and measles vaccine should be investigated locally some of these countries have had little YF activity for decades. but surveillance needs to be continued and strengthened as resurgence has been documented after long intervals in other countries. The priority to give to introducing YF vaccine into the countries in this group which have no YF vaccination, Congo, Eq Guinea, Ethiopia, Sierra Leone, Sudan, Agenda and Zaire.

The " lowest Priority" countries excluding Gambia have not reported yellow fever cases surveillance and possible outbreak response is enough at this stage ,Gambia has already a good existing immunization programme. which naturally needs support to continue. Large countries like Mali, Mauritania, Niger,, Chad, and Sudan could make a decision to immunize Below perhaps 15 degree N based on ecological consideration and similarly Angola could prioritize the region above ,perhaps 12 degree However it need to be reiterated that such priority Scheme are problematic when Ae, egypti exist outside the zone of 'emergence ‘creating a 'receptive ' area within national boundaries Moreover, The problem of migration and movement of non immune persons into the endemic region both in normal commerce and during political unrest is substantial. These are precisely the issue now in South America and there is a risk of recreating then in Africa.

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