ABSTRACT

Ebola Virus Disease (previously was recognized as Ebola Haemorrhagic Fever) is a Severe, often fatal illness, with a death of up to 90%. The illness affects humans and nonhuman primates (monkeys, gorillas and chimpanzees).\textsuperscript{1} Today, West Africa is facing the biggest outbreak of Ebola virus disease (EVD) in history. Of all the viral haemorrhagic fevers, EVD is amongst the most virulent pathogens and case fatality rates up to 90% have been reported for it. Its high pathogenicity and transmissibility and potential to be misused as a bioterrorism agent has threatened the entire world. This review aims to provide an overview for diagnosis and treatment options available currently and those that are under process but have shown promising results for the future. The test available currently for diagnosis includes ELISA, RT-PCR (Real Time-Polymerase Chain Reaction), combination of nucleic acid purification and nested multiplex RT-PCR Film Array (FA) system, nucleic acid sequencing technologies, serum neutralization test, NAT (nucleic acid test) molecular detection, Ebola virus isolation, antigen detection, IgM or IgG antibody detection. While the treatment options currently under clinical trials are DNA vaccines, Ebola VLPs, Vaccinia virus-based vaccine, Venezuelan equine encephalitis virus (VEEV)-like replicon particles, recombinant Zaire Ebolavirus ΔVP30, Kunjin virus-based vaccine, recombinant cytomegalovirus (CMV)-vaccines, recombinant paramyxovirus-vaccines, adenovirus-based vaccines and vesicular stomatitis virus-based vaccines, recombinant rabies virus (RABV)-based vaccines.
monoclonal antibodies, nucleoside analogues, Phosphorodiamidate morpholino oligomer, ribavirin, interferons, recombinant human activated protein C (rhAPC).

**KEYWORDS:** Ebola virus, RT-PCR, ELISA, Ebola vaccines.

**INTRODUCTION**

There are four species of Ebola virus with different apparent pathogenicity zaire ebolavirus (zebov) has the maximum upto 90% case fatality rate followed by sudan ebolavirus (sebov) with upto 50% case fatality rate, while fatality in humans have not been reported yet for Tai Forest (côte d’ivoire) (ciebov) and reston ebolavirus (rebov) as they seem to be associated with nonhuman primates. The newly discovered bundibugyo ebolavirus (bebov) with 40% case fatality rate has been proposed as the fifth species.\(^2-3\) Fruit bats in Africa are thought to be the natural hosts of Ebola virus. The virus is transmitted to humans by coming in contact with body fluids of animals that have been infected like chimpanzees monkeys, fruit bats etc. While human to human transmission results from contact with the body fluids of an infected person or though exposure to objects that have been contaminated with infected persons secretions like clothing, house hold things etc. EVD has an Incubation period of 2-21 days.\(^4\) The disease can cause multi organ-dysfunction, organ failure and death in advanced infection and it affects organs like kidney, pancreas, liver however of these renal dysfunction and acute kidney injury can be reversed with adequate fluid resuscitation in the initial stages.\(^5\)

(Source: Ebola virus transmission from fruit bats to humans. The virus is transmitted by contact with contaminated body fluids. Source: Centre for Disease Control, USA).

**Fig1. Life cycle of Ebola virus & route of transmission in human body.**
Table 1. Life cycle & human transmission phases of Ebola Virus.

<table>
<thead>
<tr>
<th>Enzootic cycle</th>
<th>Epizootic cycle</th>
<th>Human Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>New evidence strongly implicates bats as the reservoir host for ebolaviruses, though the means of local enzootic maintenance and transmission of the virus within bat population remains unknown.</td>
<td>Epizootic caused by Ebola viruses appear sporadically, producing high mortality among non-human primates and duikers and may precede human outbreaks. Epidemics caused by Ebola viruses produce acute disease among Humans, with exception of Reston virus which does not produce detectable disease in humans little is known about how the virus first passes to human, triggering waves of human to human transmission, and an epidemic.</td>
<td>Following initial human infection through contact with an infected bat or other wild animal, human-to-human transmission often occurs. Human to human transmission is a predominant feature of epidemics.</td>
</tr>
</tbody>
</table>

Ebolaviruses: Zaire virus, Sudan virus, Tai Forest virus, Bundibugyo virus, Reston Virus (non-human).

Worldwide, there have been 28,637 cases of Ebola virus disease and 11,314 deaths reported till 22nd November 2015. Survival rate in of Ebola virus is very low as compared to any other epidemics.

Table 2. Number of Ebola cases diagnosed and death & its survival death ratio reported.

<table>
<thead>
<tr>
<th>Status</th>
<th>Guinea</th>
<th>Liberia</th>
<th>Seria Leon</th>
<th>Italy</th>
<th>Mali</th>
<th>Nigeria</th>
<th>Senegal</th>
<th>Spain</th>
<th>UK</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>3803</td>
<td>10672</td>
<td>3955</td>
<td>1</td>
<td>8</td>
<td>20</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Death</td>
<td>2535</td>
<td>4808</td>
<td>1401</td>
<td>0</td>
<td>6</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Death Ratio</td>
<td>1: 0.666</td>
<td>1: 0.45</td>
<td>1: 0.354</td>
<td>0</td>
<td>1: 0.75</td>
<td>1: 0.4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1: 0.2</td>
</tr>
</tbody>
</table>

(Source: http://apps.who.int/ebola/ebola-situation-reports)

Confirmed, probable and suspected EVD cases worldwide (October 2015).

Fig 2. Number of Ebola cases diagnosed and death.

(Source: Centres for Disease Control and Prevention).

Fig4. Morphology of Ebola virus.

Observing the Seasonal and cyclical patterns of Ebola virus infections suggest that factors such as climate may be useful predictors of EVD outbreaks.\(^7\)\(^-\)\(^8\) It was further seen that lower temperature and higher absolute humidity have been associated with EVD outbreak from 1976 to 2014.\(^9\)
METHODS OF EBOLA DIAGNOSIS

One of the important reasons for a positive response to this outbreak has been the availability of laboratory facilities that allow rapid testing of suspected cases.\textsuperscript{[10-11]} For testing the samples should be collected according to strict protocols.

i. The most general assays used for antibody detection are direct IgG (Immunoglobulin G) and IgM (immunoglobulin M) ELISAs and IgM capture ELISA (Enzyme Linked Immunosorbent Assay). IgM antibodies can appear as fast as two days following the onset of clinical signs & symptoms and disappear between 30 to 168 days after infection while IgG-specific antibodies develop between 6 to 18 days after illness onset and remain for a long time. An IgM or rising IgG titer (four-fold) contributes to strong diagnosis.\textsuperscript{[12]}

The introduction of real-time RT-PCR was a great achievement in the area of field diagnosis as it is not only a highly sensitive test, but it also permits to identify filoviruses with minimal manipulation and equipment. The results of RT-PCR can be received within 24-48 hours before those of enzyme linked immunosorbent assay (ELISA) test.\textsuperscript{[13]} This method helps in diagnosis of acute EVD by viral genome detection via RT-PCR and is the considered main confirmatory test for Ebola virus infection.\textsuperscript{[14]} The virus is generally detectable 48 hours after infection in both lethal and non-lethal cases. In epidemic settings and some European countries, category 4 laboratories are set up locally, and RT-PCR is available four hours after the sample has arrived.\textsuperscript{[15]} A positive test shows that the patient is potentially infectious, especially if it is associated with diarrhoea, vomiting, or bleeding, a higher viral load correlates with adverse outcome.\textsuperscript{[16]} Whereas a negative test result within the first 48 hours after exposure does not rule out EBOV(Ebola Virus) infection, because viral load can be low and undetectable early in illness.\textsuperscript{[17]} The antibody profile of the sera from patients with fatal disease in comparison to those who survive is significantly different. This difference can be taken as a prognostic marker for the treatment of the patient as antibody responses strongly differ between lethal and survivor cases and it has been seen that patients after death show a much lower or even absent antibody response in comparison to the ones who survive.\textsuperscript{[18-19]} While RT-PCR assays have become the first choice diagnostic technique for detection of filoviruses, they require the use of high-precision thermal cycler or real-time PCR machine in contrast, RT loop-mediated isothermal amplification (LAMP) is a simple and fast technique that allows for reverse transcription and DNA amplification in one step under isothermal conditions(60–65°C), thereby avoiding the need for a thermal cycler.\textsuperscript{[20]}
**Table 3. Oligonucleotide primers used in RT-PCR and nested PCR of EBO virus sequences in the glycoprotein gene with predicted sizes of amplicons.**

<table>
<thead>
<tr>
<th>Primer</th>
<th>Gene target</th>
<th>Primer sequence (sense)</th>
<th>T° Hybridization</th>
<th>Target gene (product size)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBO-1</td>
<td>GP</td>
<td>5’-TGGGTAATYATCCTYTTCCA (+)</td>
<td>38°C</td>
<td>479 bp</td>
</tr>
<tr>
<td>EBO-2</td>
<td>GP</td>
<td>5’-ACGACACCTTCAGCRAAAGT (-)</td>
<td>43°C</td>
<td>308 bp</td>
</tr>
<tr>
<td>EBO-3</td>
<td>GP</td>
<td>5’-GTTTTGTCGKGAACAACTGTC (+)</td>
<td>38°C</td>
<td>419 bp</td>
</tr>
<tr>
<td>EBO-4</td>
<td>GP</td>
<td>5’-TGGGAAAGCWAAGTCWCCCGG (-)</td>
<td>37°C</td>
<td>353 bp</td>
</tr>
<tr>
<td>FILO-A</td>
<td>POL</td>
<td>5’-ATCGGAATTTTCTTCTCATT (+)</td>
<td>55°C</td>
<td>353 bp</td>
</tr>
<tr>
<td>FILO-B</td>
<td>POL</td>
<td>5’-ATGTGGGTGGGTATAATAATCAGCAG (-)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAB-1</td>
<td>POL</td>
<td>5’-GAATGTAGGTTAGAACCTTCGG (+)</td>
<td>55°C</td>
<td>353 bp</td>
</tr>
</tbody>
</table>

A polymerase (POL) or Glycoprotein (GP) genes aimed by the primers. EBO-1, EBO-2, EBO-3 and EBO-4 oligonucleotide sequences was generously provided by H. Feldmann while FILO-A and FILO-B oligonucleotide sequences were from Sanchez et al.[21] The reactivity of the oligonucleotides was tested by RT-PCR and nested PCR on Gabon 1994 EBO virus RNA.

i. RT-LAMP assays hold great promise for filovirus field diagnostics, but they have been shown to be slightly less sensitive compared to equivalent Taq Man RT-PCR assays.[22] Recent advances in nucleic acid sequencing technologies (referred as ‘next-generation’sequencing [NGS]) have revolutionized the field of viral diagnostics. These technologies give high speeds and number that can produce large volume of DNA sequence data.[23]

ii. Other investigation include serum neutralization test, NAT (nucleic acid test)molecular detection, Ebola virus virus isolation, antigen detection, IgM or IgG antibody detection (acute phase, convalescent phase) (LSPQ, 2014). EVD antigens and nucleic acids can be identified from Day 3 to Days 7–16 post the onset of disease.

iii. Film Array® panels are effective tests for evaluating patients with EVD.[24-25] Laboratory findings in EVD also include Leukopenia, thrombocytopenia & elevated liver enzyme. Quick and well-regulated inflammatory response with elevated IL-6 concentration and IL-1beta presence in a patient who is symptomatic is indicative of a good outcome, while a defective innate immune reaction with excess macrophage activation with release of interleukin-10, absent antibody response and increased concentration of interleukin-1RA, and neopterin after some days of start of disease is related with a fatal outcome.[26]
Table 4. Use of laboratory technique for diagnosis at different stages of disease.

<table>
<thead>
<tr>
<th>SN</th>
<th>Time line of infection</th>
<th>Diagnostic test</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Few days post clinical signs and Symptoms start</td>
<td>1. Antigen-capture enzyme-linked immunosorbent assay (ELISA) testing IgM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Polymerase chain reaction (PCR),</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Virus isolation (viral culture in Vero cells)</td>
</tr>
<tr>
<td>B</td>
<td>Later phase or post recovery</td>
<td>IgM and IgG antibodies</td>
</tr>
<tr>
<td>C</td>
<td>Retrospectively in dead patients (serum and tissues)</td>
<td>Immunohistochemistry testing, PCR, Virus isolation</td>
</tr>
</tbody>
</table>

In early stages of the disease symptoms only IgM antibodies are seen in plasma in acute stage. IgG are usually identified in chronic infections (post recovery). Polymerase Chain Reaction (PCR) is a DNA test to match the DNA (RNA) from the sample to known Ebola DNA. Retrospective testing after death-virus can be isolated from serum or tissues can be used to identify the presence of the virus.

The current Ebola outbreak has highlighted the need for efficient diagnostic tools. Diagnosis of Ebola Virus Disease (EVD) has relied on RT-PCR techniques on blood specimens. Non-invasive diagnosis would make the management of patients easier, faster and safer for healthcare workers. To achieve this the Film Array (FA) system has been developed which is an automated and qualitative in vitro diagnostic platform that combines nucleic acid purification and nested multiplex RT-PCR (BioThreat-E) test designed to detect Ebola virus, Zaïre strain from whole blood and urine. The system is a very precise, rapid and easy-to-use. PCR molecular diagnostic instrument which delivers test results in approximately one hour using a closed, sample-to-answer system. Based on in vitro technical performance procured on urine and whole blood samples, an Emergency Use Authorization was obtained on October 25, 2014 and the Bio Threat-E test was listed for WHO procurement on August 19, 2015.[27] In the past, only a malaria screen and RT-PCR were recommended because of the risk to laboratory workers.

However, it is now recognised that other diagnostic tests can be done securely according to documented guidelines, as long as the laboratory is informed about the sample in advance and the samples are correctly packaged and retained at the end in case the results are positive.[28] Malaria is still the most common cause of fever in people who live, work or have returned from, an endemic area therefore it should be ruled out.[29] A patient with a positive test for malaria should be treated keeping in mind the possibility of a dual infection. Ebola
virus infection should be considered in a patient who does not respond to anti-malarial therapy. It is recommended that confirmatory tests for Ebola virus infection are performed before, or along with, differentiating tests for other conditions if Ebola virus infection is suspected.

**EBOLA Prophylaxis**

Currently the available treatment for Ebola is mainly supportive and includes minimizing invasive procedures, maintaining electrolytes, blood pressure and as patients are frequently dehydrated they benefit most from managing the hemodynamic and haemostasis, when started in the early phase of the disease, fluid replacement therapy significantly increases the chance of survival, further maintaining oxygen, blood levels, and treatment of any associated infections is essential.  

The very first step in management of EVD starts with detecting the patients with clinical signs and symptoms that is consistent with the case definition as provided by WHO and the centres for Disease Control and Prevention (CDC).

This is very essential for patients living in geographical areas where Ebola virus infections have previously been reported and patients in other countries having similar signs and symptoms who have been to these countries in the past twenty one days. These patients need to be rapidly isolated and the patient contacts should be detected and necessary containment and preventive measures should be established. Blood samples need to be collected at the earliest and handed over to the nearest clinical lab certified to conduct diagnostic evaluation for Ebolavirus. In previous outbreaks attention was paid to possible treatment of EVD patients with blood transfusion from EVD survivors for e.g. in the outbreak of Ebola Virus in Kikwit in the year 1995, patients receiving convalescent serum from EVD survivors showed a much lower CFR(case fatality rate) however these results were obtained from a small number of patients with a possible treatment prejudice furthermore, this passive immunotherapy did not appear to play an effective role in a non-human primate model. Currently Numerous drugs with a possible result in Ebola virus disease are in the experimental phase and have displayed favourable effects against Ebola viruses in animal models and also have been used in small numbers in the treatment of EVD patients. The WHO has declared that, considering the severity of the current outbreak, it is ethical to use experimental drugs for treatment and prevention of EVD.
Below mentioned are the most likely drugs showing promising results, available information from preclinical and clinical trials issued in peer-reviewed journals.

i. The nucleoside analogue Favipiravir has been widely tested in humans the drug has reported action against Ebola viruses and numerous other variety of RNA viruses. Favipiravir prevented death in mice infected with EBOV when treatment was started 6 days post infection. This drug also acquired acceptance in Japan for treatment in humans infected with new influenza viruses.[34-35]

ii. Drugs TKM-ebola and AVI-6002 are in process of development for the treatment of EVD and exert their action via gene silencing. These two drugs have shown to be fruitful in mouse and primate models and some safety and pharmacokinetic data in humans are available for AVI-6002.[36-38]

iii. Drug BCX-4430 is also a nucleoside analogue with broad spectrum action against RNA viruses and has shown to be successful against the Ebola virus in a mouse model.[39]

iv. ZMapp is a cocktail of monoclonal antibodies and is being used to treat few patients of EBOV. A fine evidence that ZMapp is beneficial in EVD can be seen from experiments in non-human primates in which ZMapp was able to regress advanced EVD when given up to 5 days after infection[40] however its part in treatment of EVD still requires to be confirmed as its effective data in humans have not been published yet, also there is a short reserve of ZMapp at this time. One more set of promising Ebola therapeutic in addition to the ones mentioned above is in the form of a new class of positively charged phosphorodiamidate morpholino oligomer (PMO)s which are called PMOplus. This stable PMO molecules is similar to single-stranded DNA and affect viral RNA transcription and translation. These PMOplus therapeutics have been under developed and tested in phase1 clinical trials explaining their safety in healthy human subjects between ages 18–50 years.[41] There are few drugs which are being probed as preventive medications for EVD, e.g. amiodarone, chloroquine and clomiphene.[42]

Other treatment options such as interferons, ribavirin, recombinant human activated protein C (rhAPC) and recombinant nematode anticoagulant protein c2 (rNAPc2) have presented fluctuating levels of effect against EBOV infections in animal models.[43]
Progress in enhanced Morpholino antisense drug conjugate with cell penetrating peptides is currently advancing.\[44]\ One problem is that Ebola virus more commonly infects low-income countries, which might not have enough facility to develop a vaccine but as EVD is considered a weapon of bioterrorism, this might be a driving force for the developed world to formulate a reliable and safe vaccine soon enough. Until then, countries should concentrate on early detection, isolation, prompt treatment, contact tracing, and proper burials but there are many potential anti-filovirus vaccine platforms that are under investigations such as a

1) DNA vaccines which is a Four GP DNA vaccine was shown to completely protect mice from lethal EVD, evaluation of DNA vaccine in rodents have shown promise for their use in humans. The DNA vaccines were verified to be safe, well accepted and immunogenic in the phase 1 and subsequent phase 1b study.\[45-46]\n
2) Ebola VLPs (virus-like particles) protected guinea pigs and NHPs against EBOV they are promising as prophylactic vaccine and greater effort should be made to increase their production.\[47-49]\ Further (VLPs) can provide post-exposure protection by amplifying Type 1 interferon signalling in macrophages and dendritic cells, that are believed to be the initial Ebola virus infection sites.\[50]\ Multiple viruses have been used as vaccine vectors, which can be replication competent or defective.

A) Vaccinia virus-based vaccine in 2014 MVA-BN filo vaccine was designed for EBOV. The United States National Institute of Health demonstrate that a regimen consisting of MVA-BN filo and Janssen’s Ad26 vaccine resulted in complete safety from EBOV. The MVA-BN filo vaccine quickly entered into phase 1 trial and in primary results presented good safety and immunogenicity furthermore, the phase 3 study using the Ad26 EBOV vaccine combined with MVA-BN filo vaccine is currently going on.\[51]\n
B) Venezuelan equine encephalitis virus (VEEV)- GP-VRP was evaluated in cynomolgus macaques in 2013 and it was observed that a single dose is capable of providing complete protection against intramuscular challenge.\[52]\n
C) Kunjin virus-based vaccines Reynard et al. developed a kunjin virus-based vaccine expressing ebolavirus GP, membrane anchor-truncated GP and D637L- mutated GP.\[53]\n
The surviving animals showed complete clearance of the virus. Thus KUN replicons have the potential to be vaccine candidates but further studies are needed.
D) Recombinant rEBOVΔVP30 in April 2015, it was reported that EBOVΔVP30, protects NHP against lethal infection with EBOV when given either one or two doses. The rEBOVΔVP30 vaccine presents all viral proteins and viral RNA to the host which is expected to facilitate a protective immune response but future clinical trials are needed to validate efficacy.[54]

E) Recombinant cytomegalovirus (CMV)-based vaccines: CMV-based vectors can achieve high vaccine coverage in inaccessible wildlife populations such as great apes due to its exclusive potential to re-infect and circulate through target populations regardless of prior CMV immunity. A high level of long lasting (>8months) CD + T cells against EBOV NP was seen in mice while a low level of anti EBOV antibodies detected. Thus a protective efficacy of CMV-based vaccines should be evaluated in larger animal models such as NHPs.[55]

F) Recombinant rabies virus (RABV)-based vaccines: An RABV causes more than 24,000 fatalities every year in Africa therefore an effective bivalent RABV/Ebola virus vaccine would be valuable.[56] Detailed investigation of immune responses showed that the successful Ebola virus could induce strong virus specific antibodies.

G) Recombinant paramyxovirus-based vaccines has been explored as a vector for vaccination via the respiratory route. Results suggested that successful vaccination with HPVI3/EBoGP could be achieved by increasing the number of doses in HPIV3-immune population. In order to bypass the main obstacle of already present immunity in humans, a Newcastle disease virus (NDV) vaccine candidate (NDV/GP) was developed. Evaluation of NDV/GP in rhesus monkey suggested that it would be effective for immunization against ebolavirus.[57]

H) Adenovirus-based vaccines: Recombinant adenovirus (5Rad5) vaccines primed with DNA vaccines showed high protection against Ebola further rRad5 was found to be safe in phase 1 clinical trial.[58-59] A phase 2 clinical trial of a replication-defective recombinant chimpanzee Ad3-vectored (ChAD3-EBOV) has been conducted, but results are not yet available and recently it was placed in a phase 3 clinical study.[60]

I) Vesicular stomatitis virus (VSV)-based vaccines. The VSV(tVSV) was found to be highly potent and safe also protection by mucosal route was as effective as systemic route.[61] It also displayed potential of cross protection between Ebola virus specie.[62] Due to its robust nature it may serve not only in prophylactic setting but also confer post exposure protection.[63] It is
of interest to note that (rVSV) was once administered to a researcher exposed to EBOV following which he stayed healthy. (rVSV) was a success in phase 3 clinical trials therefore can be considered as highly safe and effective vaccine for preventing EVD.\textsuperscript{[64]}

**Prevention of Ebola Infection**

Patient Isolation is a must before any investigation in order to minimize the contact with the health care staff and other patients it should be continued until the patient is tested negative. An individual travelling to an area affected by Ebola should follow these basic hygiene practices such as washing hands with soap and water, hand sanitizer (alcohol based), avoid contact with body fluids or the things that have come in contact with a patient suffering from Ebola as the virus is present in almost all kinds of body fluid like urine, saliva, blood, vomit, nasal and gastrointestinal secretion. Attention should also be given to avoid burial rituals where there are chances of an individual to come in contact with the body of the patient who died from Ebola therefore relatives should be counselled properly regarding the mode of transmission of EVD and to adapt safe practice for the disposal of dead bodies for e.g dead body should be packed with leaky proof body bags for safe disposal. One should also avoid coming in contact with bats and nonhuman primates and consumption of raw meat prepared from these animals.\textsuperscript{[65]}

Monitoring of health and being alert for clinical signs and symptoms for 21 days is essential after returning from the Ebola affected area. Further awareness about disease to healthcare workers on the safe specimen handling for routine laboratory diagnostics is necessary. Health care workers need to wear appropriate personal protective equipment (PPE) including disposable face mask, gloves, goggles and a gown at all times, powered air purifying respirator (PAPR) or N95 respirator along with surgical hood, full face shield, boot or shoe covers.

However Ebola in early stages may not be highly contagious in fact coming in contact with a person in early stages one may not acquire the disease. One major reason of Ebola affecting the poor nation is lack of basic hygiene practices, improper lab facilities and well educated medical staff.\textsuperscript{[66]}

**CONCLUSION**

Diagnostics for Ebola virus (EVD) must be sensitive and reliable as misdiagnosis could be dangerous. Therefore, the confirmation of Ebola virus fevers (EVF) need kind attention.
Basic research & vaccine trails to find filovirus treatment have been ongoing since past 20 years. Outcome of all efforts was slow due to incomplete understanding of the virus and the lack of commercial interest for vaccine development. However with the current knowledge of Ebola viruses and use of vaccine for Ebola fever treatment. However successful vaccine trails is great challenge to molecular biologist & perhaps it could be devine gift to Ebola infected individual.

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