**Welcome to our website!**

We are a group of second year medical students at the University of Edinburgh. As part of our curriculum, we had to choose a project for our “student selected component” (SSC), that we were interested in and produce a website over a period of 10 weeks. The project we chose asks the question: “Ebola: what makes it so dangerous?”

In order to answer this question, we had four key aims to address:

* **How did Ebola come about?**
* **How does it spread?**
* **How does it affect its victims?**
* **Is there a cure?**

Our website contains several sections that reflect our aims, comprising of:

1. **Epidemiology** – overview of all outbreaks of Ebola, both past and present.
2. **Pathophysiology**  – what Ebola is, how it affects its host and how it is transmitted.
3. **Treatment** - vaccines, drugs and therapies that may cure Ebola.
4. **Ebola in the west** – how far will Ebola spread, what global measures are being taken to halt its spread, when might it disappear?

We hope that this website can shed some light on a grave and dangerous disease, that continues to reap thousands of lives in West Africa. Claiming more than 4,800 lives it is apparent that its spread and severity has been underestimated. It will take a global effort to stop this disease in its tracks, and we believe that our project shows hope in this. Please use the links at the top of the page to navigate yourself through our sections.

**Epidemiology**

Ebola has been around for a long time, with the first known outbreaks taking place as far back as 1976, occurring almost simultaneously in Sudan and in the Democratic Republic of Congo (formerly Zaire).  As documented in the *Lancet* in 19771, it was differentiated from Marburg virus (a similar virus that also causes acute haemorrhagic fever) by indirect immunofluorescence. It was given the name Ebola in reference to a river in the Democratic Republic of Congo, near to where the first examined sample of Ebola virus was collected.

The Sudanese outbreak is well documented in a report by the WHO2. The paper states that 284 cases of the virus were recorded in this outbreak, with a mortality rate of 53%. It describes the initial objectives of the WHO team that were brought in to help control the virus, which included finding out the means of transmission within humans and the collection of blood from infected individuals for testing and potential treatment of further cases. The *Zaire* strain of Ebola appeared towards the end of 1976, affecting 318 and killing 2803. At that time it was assumed that the *Zaire* and *Sudan* strains were the same, but it was recognised that the illness caused by the *Zaire ebolavirus* had “fewer respiratory symptoms, a shorter clinical course, and a higher fatality rate.3” A study documented in *The Journal of Infectious Diseases*details some of the first tests carried out to prove the existence of two strains. The *Zaire* strain was much easier to isolate in cell culture, and it had a much greater infectivity and potency amongst suckling mice, thus providing substantial proof of difference in strains4.

Following these initial outbreaks, Ebola haemorrhagic fever in humans remained virtually non-existent for approximately 15 years. Another strain was however identified in a group of imported monkeys in Reston, Virginia in 1989, providing scientists with evidence that monkeys were a potential reservoir of the infection5. Ebola re-emerged from its perceived dormant period between 1994 and 1997, resulting in a total of 5 outbreaks; three in Gabon, one in the Democratic Republic of Congo, and one in the Ivory Coast.  The latter was where the *Côte d’Ivoire*subtype was first encountered. The experiences of the first individual to be infected are well documented in a Case Report by *The Journal of Infectious Diseases*, which includes the clinical course of the disease and treatment/interventions provided6.  The paper raises the point that it is difficult to identify and successfully diagnose a new tropical disease such as this strain of *ebolavirus*, due to the similarity of its symptoms with malaria and other such diseases. It also highlighted the need for improved national surveillance and laboratory testing around the world to aid with early identification of new disease outbreaks/epidemics6.

The Kikwit epidemic of 1995 provided scientists with the first real chance to study an outbreak of *ebolavirus* as it progressed7. International teams recognised the important role of close contact in the passing on of infection, citing exchange of bodily fluids by various means and the touching of cadavers as two important risk areas for transmission7.  Investigations at this time failed to reveal the ‘true reservoir’ for*ebolavirus*, but there was encouraging work done with regard to the production of experimental filovirus vaccines7, which will be covered in more detail in the treatment section. Perhaps most intriguingly of all, this paper comments on the challenges faced by local health systems during the epidemic. Despite the massive aid effort and training of sufficient healthcare staff during the epidemic, much of the aid had dried up within 3 months of its conclusion, along with a reversion to old techniques by healthcare workers. Perhaps later outbreaks, which there were a number of, were made worse by a lack of training and resources. Outbreaks of significance post 1995 include the discovery of the *Bundibugyo ebolavirus* strain in Uganda in 20078, and the current outbreak, which was declared a Public Health Emergency of International Concern in August 2014 by the World Health Organisation.9

Knowledge gained from previous outbreaks may prove useful in influencing the management of the current outbreak.  Previous outbreaks have been stopped by minimising the ability of the virus to be transmitted, along with the early identification and isolation of patients that present with symptoms of the disease.10 What is most discerning about the current one is that, whilst this knowledge exists on how to stop Ebola, the outbreak has surpassed all previous outbreaks in terms of distribution and mortality, and this is set to continue. 11 It has been estimated that the reproductive rate of the current Ebola outbreak lies between 1.34 and 3.65, which is consistent with values calculated for past outbreaks.12Values above 1 suggest that the virus has the ability to infect significant proportions of the population if sufficient interventions are not in place.12 The results of such calculations need to be interpreted with caution, as the transmission rate of Ebola decreases exponentially when control measures are implemented.13 However, bearing this in mind, why is the prevalence of the current outbreak so much higher than previous outbreaks?  It has been noted that there was an underestimation of severity, with countries at the source perpetuating the outbreak through ineffective health-infrastructures.10There is also an apparent weakness in the ability of the international community to counteract such a fast spreading disease.

The improvement of health infrastructure in the worst affected countries is one way in which the tide of the current outbreak can be stemmed, and future outbreaks prevented.  It is argued that the costs of doing this would garner considerable benefit in terms of initiating an effective response, which would far outweigh the social and economic impact Ebola is currently having.11 However, many questions remain unanswered with regards to Ebola, such as its reservoir, pathology and the three dimensional structure of the virus. Nonetheless, with an average of 1.49 years between outbreaks, it appears Ebola is here to stay.12

**References**: <http://studentblogs.med.ed.ac.uk/2014-ssc2a-c3/?p=14>

**Pathophysiology**

**Background**As previously discussed  in the 'Epidemiology' section, the Ebola virus (EBOV), formerly the ‘Zaire’ ebolavirus after where it was first discovered in 1976, is the most deadly of the five named virus species that fall into the genus *Ebolavirus*1*.*The five species of the *Ebolavirus*are*: Zaire ebolavirus, Sudan ebolavirus, Reston ebolavirus, Côte d’Ivoire ebolavirus,*and *Bundibugyo ebolavirus*2*.*These belong to the family *Filoviridae,*and order *Mononegavirales3.*

EBOV is the single member of the species *Zaire ebolavirus*. It is the most understood and researched virus of the five, due to its large outbreaks throughout Sub-Saharan Africa. With a case fatality rate of 78%4, there has been much study of its pathological effect on humans, with particular interest on ‘ebola haemorrhagic fever’ (EHF), which usually leads to the death of those infected.

**Clinical Manifestations**The Ebola virus has an incubation period of 2-21 days (mean of 4-10)5, with an average time of death at 10.2 days after onset of symptoms6. Early symptoms of EHF include: fever, myalgia, vomiting, diarrhea, and abdominal pain. These symptoms are often accompanied by mild hypotension, postural hypotension, vasodilatation of the conjuctivae, and flushing of the skin7.

As the fever progresses, vascular damage and capillary leakage gives rise to nondependent oedema and large effusions into body cavities, such as the pleural and peritoneal cavities8. In the terminal state, the patient appears obtunded and begins to enter shock. Late symptoms of shock include tachypnea, aneuria, and normal/subnormal body temperature.9In 41% of patients in terminal state EHF, there are haemorrhagic manifestations10. Haemorrhagic observations include conjunctiva bleeding, petechial rash (bleeding into the skin); epistaxis (nose bleed), haematemesis (vomiting of blood) and melena (dark/black faeces)11.

Overall, general manifestations of EHF include rapid and abrupt onset of symptoms, shock, fluid redistribution, disseminated intravascular coagulation (DIC) and absence of an antibody response to the virus12.

**Transmission, Target and Pathogenesis**At symptom onset, the measured titre of Ebola virus RNA in the blood increases logarithmically13. This RNA is present in bodily fluids and varies by fluid type. Across a variety of studies Ebola virus RNA has been detected up to 101 days after symptom onset in semen, 33 days from vaginal swabs, 29 days from rectal, 23 days from urine, 22 days from conjunctival swabs, 21 days in blood, 15 days in breast milk, 8 days in saliva, and 6 days on skin14. However, these studies were conducted with a minimal number of subjects so it is possible that Ebola RNA could be present in these fluids for longer than the times specified above.

Ebola RNA is spread through direct contact with infected individuals. This can be with that individual themselves, their bodily fluids or their dead body. Once contact has been established the Ebola virus RNA enters the body via mucosal surfaces or injured skin, then by haematogenous (blood) and lymphatic spread it infects macrophages/monocytes and dendritic cells (immune cells) in nearly every organ of the body15.

Infection of monocytes triggers a secretion of pro-inflammatory cytokines (IL-1B, TNF-a, IL-6) and chemokines (IL-8, GRO-a), chemical mediators involved in co-ordinating an immune response.  Particularly important are the inflammatory mediators TNF-a, IL-6, and GRO-a, that cause endothelial reorganization when released by virally-infected macrophages. This restructuring creates inter-endothelial gaps, increasing endothelial permeability and causing oedema16. Other inflammatory mediators trigger coagulation cascades in the blood that lead to various problems, including DIC.

**Survival**Survival of Ebola virus infection is associated with three factors: a) an antibody response against the virus; b) cell-mediated immunity to the viral GP (glycoprotein) antigen; and c) clearance by CD8 T cells17.

Fatal outcomes often involve rapid infection and apoptosis of macrophages and dendritic cells, releasing toxically high concentrations of pro-inflammatory cytokines and chemokines. This loss of key immune cells, essential in controlling and guiding the immune response, lead to impaired T cell priming and proliferation. T cells are vital for both eliciting an antibody response from B-cells (helper CD4 T cells), and targeting and killing infected cells (cytotoxic CD8 T cells)18.

Overall, without adequate priming and production of T cells and rapid eradication of the virus, no immunity ensuring survival can be produced.

**References**: <http://studentblogs.med.ed.ac.uk/2014-ssc2a-c3/?p=14>

**Treatment**

There are two main approaches to the management of Ebola - medical treatments and prevention. At present there are a limited number of options, but several have shown promise in the early stages.

**Medical Treatments**One potential avenue for treatment of Ebola patients is ZMapp. ZMapp is a mixture of three distinct monoclonal antibodies which recognise the Ebolavirus antigen1, thus helping to kill the virus. The drug has been used during the recent outbreak in a number of cases, showing promise where it has been used, and has potentially helped save the lives of 2 American aid workers and one British nurse who all contracted Ebola and survived after using ZMapp2-4. However, an African doctor who was treated with the same drug later died2, as did a Spanish priest5. No trials have actually been conducted to see whether ZMapp is an effective treatment in humans1 and it is still classed as an experimental treatment.

Although no human trials have been undertaken using ZMapp, there have been several studies conducted on animals to test its use for treating Ebola. One such trial by Olinger et al. showed that using ZMapp could provide protection for Rhesus Macaques infected with Ebolavirus, even when administered 48 hours after infection.6It showed that 10 out of 13 infected animals survived when given treatment, compared with only 1 in 5 controls. However, the study had a very small sample size and the data was collected over three separate experiments over different time periods, meaning they may not have all had the same conditions. The paper is also not clear on how the animals for the study were selected, indicating a potential source of bias.

Following on from this trial, Qiu et al. showed that ZMapp can be used to cure Rhesus Macaques of Ebola, even when given up to 5 days post infection.7 18 macaques who were injected with the Ebola virus survived after being given doses of ZMapp 3 days apart, with some not receiving it until 5 days post infection.7 The sample size for this study is larger than that of the first study, and this trial follows and builds on this work, showing that ZMapp can be successful when administered up to 5 days after catching Ebola in macaques, further to the 48 hours determined by Olinger et al. However, the small number of controls means that the untreated animals are not representative of the full picture - had more controls been used it is likely some would have survived naturally, leading to a different mortality rate than that found in the trial.

The existing literature on ZMapp is scarce, and as no research has been done on humans, we cannot say for certain that it will be a good drug to treat Ebola in humans. The studies discussed show very promising signs and certainly indicate it could be an effective treatment. However, the fact that the studies were conducted on macaques, coupled with the small sample sizes, mean that no cast iron conclusions about human use of Zmapp can be drawn, and further research will be needed to fully prove its effectiveness.

Another treatment area which has been explored is the possibility of giving blood transfusions from patients who have had Ebola and survived, thus transferring the antibodies they produced in fighting it8. During the 1995 Ebola outbreak in the Democratic Republic of Congo, a study was conducted in which 8 Ebola sufferers were treated using transfusions from recovering patients9. They found that it was an effective treatment, with the mortality rate for those treated being 12.5%, much lower than the mortality rate for the whole outbreak, which was around 80%9. However, each patient was also given lots of other treatment (antibiotics and supportive care for example) as well as ZMapp, so it is impossible to tell what really made the difference. This, along with the very small sample size and potential for biased selection of patients (it was not made clear how this was decided) mean that this may not be an accurate reflection of the effectiveness of the treatment.

Blood transfusions have been utilised during the current outbreak, with some success10,11, having been named by the WHO as the best potential method for treatment currently12. Whether it will prove effective on the large scale remains to be seen – the current research shows promising signs but is not enough to say for definite that it will be. Large scale clinical trials will be needed to show beyond doubt that it is a good technique to use, and we will no doubt come to learn over the coming months of its clinical effectiveness.

**Prevention**A slightly different approach to treating Ebola is to prevent it through the production and distribution of a vaccine. At present, there is no approved vaccine for Ebola, however there has been substantial activity regarding the development of one. A study showed that giving a recombinant vaccination containing a respiratory pathogen and the Zaire strain Ebola virus (EBOV) to rhesus monkeys protected 88% of the animals against severe hemorrhagic fever and death caused by EBOV13. However, the HPIV3 vector is too common a human pathogen, and the widespread seroprevalence to this virus in adults would decrease its effect. DNA vaccines expressing the envelope glycoprotein (GP) or nucleocapsid protein (NP) genes of Ebola virus were also evaluated in adult immunocompetent mice - 78% survival of subjects was achieved after four vaccinations14. The GP and NP vaccines when compared showed that approximately the same level of protection could be achieved with either vaccine14. However a major limitation of the study was that only female mice were used, as the safety and immunogenicity must be confirmed in males too.

There is evidence of vaccines that have a safe and immunogenic effect on humans, but the sample sizes in these clinical trials have been small15,16.  More testing is required to remove the element of chance, but the results are helpful in the vaccine’s development as randomisation and double-blinding removed a lot of possible bias. Martin, J.E. et al.’s clinical trial in 2006 stated that more work must be done on replication-defective adenoviral vector vaccines15. This was studied and proved to be safe and immunogenic by Ledgerwood, J.E. et al. in 2010, but additional non-human primate and human studies must be conducted in order to find a vaccine suitable for broader populations16, as the population sample in this study was mainly healthy caucasian adults.

Trials are now underway in Oxford with 60 volunteers being injected with a vaccine containing a small portion of genetic material from the virus - it will not trigger disease but will prompt the production of anti-EBOV antibodies17. The vaccine is being developed by GlaxoSmithKline and the US National Institutes of Health, and is being fast tracked so that it could hopefully be used to immunise health workers in affected areas by the end of 2014.17

There are several reasons as to why treating Ebola virus is so difficult. These barriers to treatment must be overcome in order for successful prevention and treatment to take place. One such barrier is lack of capacity in treatment facilities, containment methods and diagnostic tools18. The recent surge in cases has stretched resources and hospital beds are filling up. There have been facilities in West Africa where one physician was responsible for 30 to 50 moderately to severely ill Ebola patients19. With no vaccine currently available, and resources of curative drug ZMapp running low, it seems vital for prevention methods to be more effective.

The transmission of the Ebola virus also makes its treatment difficult, as it is highly contagious (although not airborne). Close contact with the bodily fluids of an infected person causes transmission, such as during health-care procedures, home care or traditional burial practices. In Guinea, approximately 60% of cases have been related to these burial practices, with women being most affected (as they are the principal care-givers there)18. There is also a high level of population mobility in West Africa, with people travelling between different villages, increasing the potential for spread20.

Fear may be another reason for treatment to be difficult. People may often refuse to accept their symptoms or diagnosis, as they do not want to deal with the consequences of being diagnosed with Ebola - this is similar to cancer patients in many Western societies20. Therefore, they do not consult a doctor and remain undetected until their condition becomes severe enough to spread to others. Superstitions may also play a role in this, especially in small villages in West Africa, with many said to believe that Ebola appears if you say the word aloud. Traditions can also cause people to seek herbal/homemade remedies rather than specialist help, causing the virus to spread.

**References**: <http://studentblogs.med.ed.ac.uk/2014-ssc2a-c3/?p=14>

**Ebola in the West**

**Disease Spread**  
So far, it has been difficult to predict what threat the current Ebola virus (EBOV) poses to global health and security. Since its identification in 1976, EBOV outbreaks have been confined to areas in West Africa, with minimal exposure in the Western world. Papers written on Ebola before the current outbreak seem sceptical of its worldwide threat, naming it a “minor threat to global health”, and stating the disease to be “self-limiting”1, with the prevention of transmission being “in principle, straightforward.”2 However, this attitude is being questioned in the light of recent events, where EBOV has managed to spread further than expected, overcoming supposedly fool-proof prevention methods.

**UK Prevention**Since the outbreak of EBOV in March 2014, high income countries (HIC) such as the UK and the USA have been bombarded with dramatic news stories such as ‘Ebola WILL reach Britain’3 and ‘SHOCKING: CDC Admits 100-150 People a Day Entering US from Ebola Infected Countries’4- but is there any truth to this? Since the outbreak was declared a public health emergency on August 8th,5 the UK has been implementing a series of action plans and preventative measures to stop Ebola entering the country. How fool-proof these interventions are, however, is questionable when looking at the recent transmission in the USA despite precautionary measures.

One of the most recent UK measures is screening at airports and Eurostar stations for those from affected countries, costing around £9 million to implement.6 Although reassuring the public, this has been highly criticised by experts, goes against WHO advice and potentially creates a false sense of security.7 Flaws are also evident when looking at the recent USA cases: the questionnaires could be falsely filled in, as was the case with Thomas Duncan when he denied being exposed to EBOV on screening forms. Furthermore, the second nurse diagnosed with EBOV after treating Duncan was allowed to board a flight with a 37.5°C temperature due to it not reaching the 38°C guideline of the Centre for Disease and Control (CDC), further emphasising the screening test’s futility.8Airport screening can also be very ineffective - in the 2003 SARS outbreak, airport screening failed to detect the only positive case, potentially because they screened before boarding the plane, which may be less effective than screening on arrival.9

Protocols are also being put in place by British hospitals to meet the state of “national preparedness” required by International Health Regulations5, with four main hospitals in the UK being “put on standby” in case of EBOV spread.10 London’s Royal Free Hospital has the most sophisticated isolation ward, successfully treating the repatriated British nurse who became infected in Sierra Leone. Workers throughout NHS hospitals are being sent guidance handouts  for suspected cases, emphasising the need for a travel history of presenting patients and the need for every member of staff to familiarise themselves with the hospitals’ specific guidance.

As mentioned, the effectiveness of these measures in stopping the virus is questionable when looking into the recent spread of disease in the US, who seemingly followed similar protocol. On closer inspection of the treatment of Thomas Duncan and how the two nurses subsequently contracted the disease, it becomes clearer rigorous protocol may not have been followed, with medical records suggesting health workers had exposed skin and were not required to wear full body suits during initial treatment.8 This information needs to be interpreted with caution due to contrasting reports, and certain parties having reason to exaggerate mistakes made. Furthermore, there has been suggestion that the NHS would be more efficient at responding to EBOV than the USA’s private health care system; Britain’s preparation was recently described as “superb”, with the government’s access to all health workers through the NHS making communication much easier.7 In addition, there have been suggestions that the initial discharge of Thomas Duncan was due to his inability to pay - not a factor in the NHS – although again this does not come from official sources and needs to be treated with caution.11

**Worldwide action**  
In the USA, compulsory 21-day quarantine periods have been declared for any health worker or traveller who may have been exposed to the disease, following the positive diagnosis of Dr Craig Spencer after working in Guinea.12Legal action is also being taken against those not adhering to quarantine periods; one nurse who defied her quarantine after returning home from a Sierra Leone MSF mission is now under questioning by the state government.13

Mauritania has recently closed its borders with Mali after a 2-year old recently succumbed to the disease in Mali.14 Countries identified to be high risk, including the two mentioned, have been told to make preparations in case they are subject to any cases.15-16

Joanne Liu, head of MSF, and Peter Piot, the identifier of Ebola, have both called for “quasi-military intervention”, believing it crucial in keeping the epidemic under control. Many troops have been provided from the US, UK and Germany.17 ,  with army medics being flown out to set up high-standard treatment centres for infected health workers. 18

**Why  HICs are helping combat EBOV?**There may be alternate motivations for HICs to fund Ebola research and patient care other than purely humanitarian reasons. Perhaps due to morality - the resources required are relatively small, and all HICs are able to help “curb the epidemic”.19 Another reason is research – originally much of the research on Ebola in the USA was due to a mixture of fear of spread and bioterrorism.19 The current outbreak requires new specifically targeted research, and HICs cannot carry out this research without also providing aid, as this could be seen as exploitation. There have also been some statements made suggesting that vaccines and treatments would probably already exist if Ebola affected many people in HICs, as it would make “research financially attractive to drug companies”, with one man describing this as “the moral bankruptcy of capitalism”.20

More recently, HICs have increased incentive for trying to combat Ebola, with many healthcare workers from these countries becoming infected on top of the already high numbers.21

**Earlier Prevention?**An underestimation of the effects of Ebola may have damaged the initial response - the WHO did not launch their current ‘joint response plan’ until the end of July 2014, despite MSF and other organizations naming the outbreak “out of control” in June.20

As well as this, conditions in the affected countries are considerable factors as to why EBOV has achieved such devastation. Healthcare workers have had to deal with “numerous issues” including “weak health systems... few staff... little equipment” making surveillance and care almost impossible without outside help.20 Furthermore, the affected countries, among the poorest in the world, are having to steer their budget towards the Ebola epidemic, leading to treatment of other diseases being put aside. Recent estimates have shown that a good facility treating 70 patients requires a minimum of 250 health workers,21 an impossible feat in countries such as Sierra Leone whose have around 3 doctors to every 100,000 people.22 Traditional burial practices and constant movement between affected countries have also contributed, with Guinea having over 60% of cases attributed to burial practice.21 Moreover, decades of conflict have left residents distrustful of authority and restrictive guidelines,23 causing people to “escape surveillance systems, hide symptomatic family members and flee treatment centres.”21 Fear has made Ebola all the more dangerous.

**References**: <http://studentblogs.med.ed.ac.uk/2014-ssc2a-c3/?p=14>

**Conclusion**

Over the past ten weeks, our group tried to answer the question “Ebola: what makes it so dangerous?” In order to do this we guided our research towards addressing the following questions:

* **How did Ebola come about?**
* **How does it spread?**
* **How does it affect its victims?**
* **Is there a cure?**

To show how we answered these questions we have summarised each of our sections, addressing their key findings.

**Epidemiology**This section covered the history of Ebola and its previous outbreaks, and how the responses seen may exacerbate Ebola’s lethality. As far back as the mid 90s it was recognised that improvement in national surveillance and laboratory testing around the world was needed to identify new outbreaks and epidemics, but this did not happen. Also, challenges faced by local health systems included a lack of training and resources – massive aid efforts and training during epidemics (particularly Kikwit 1995) were ineffectual afterwards, as money dried up soon after the epidemic and healthcare staff reverted to old techniques. This raises questions about whether the current crisis could have been avoided if the money and specialist training remained. With the benefit of hindsight it is clear there is weakness within the international community in combating disease, with a need for more cooperation between countries. More research is required to fully understand this pathogen - only then can we begin to gain control over it.

**Pathophysiology**This section described the scientific basis of Ebola. Overall it was apparent that loss of key immune cells and impairment to T cell priming and proliferation were the main causes of death in those infected by the Ebola virus. Several aspects of its pathophysiology explain its lethality. Firstly, the short time from onset of symptoms until death gives little time to identify, assess and successfully treat people with the disease. Secondly, the early symptoms that people present with are not indicative of Ebola infection, leading to late diagnosis of the disease. This allows infected individuals to continue to travel and interact with others. This illustrates why a vaccine is paramount – without prior immunity, prognosis is poor.

**Management**This section discussed the different treatment options that are currently being explored to tackle Ebola. ZMapp was discussed, with trials having been carried out on rhesus macaques (small sample sizes) with relatively high levels of success. Despite this, the literature available on ZMapp is scarce. With no human trials, we cannot conclude whether it would be an effective treatment method.  
Next, blood transfusions were explored. They have been touted as the best potential method of treatment by the WHO, however despite its success, only small scale trials have been performed. Large scale clinical trials are required to show its true potential, as with other treatment methods. Thus, we are not yet able to conclude whether it will be useful in the long run.  
Vaccines have had lots of promising results in preliminary tests. Animal trials have shown potential in this area, and a number of human clinical trials have already taken place. However, they were carried out on small sample sizes not representative of the broader population. On the other hand, vaccines containing a small amount of genetic material show a lot of promise, prompting the development of one such vaccine by GSK and the US National Institutes of Health, with the hope of rolling it out to health workers in affected areas by the end of 2014.

It is clear that prevention is better than cure. Ebola is highly infectious, but preventing its spread can be easy. It is clear that avoiding exposure to bodily fluids of those infected is the best method of prevention. Risk of exposure increases during healthcare procedures, home care, travel between villages (West Africa has high levels of population mobility) and burial practices. Interestingly, 60% of cases in Gabon have been related to burial practice alone. These aspects need to be targets for improving prevention, however ending these habits; particularly burial practices will prove difficult.

**Ebola in the West**Our research into whether Ebola could become a threat in more developed Western countries showed many countering arguments, from newspaper articles pronouncing international spread of the disease to research papers dismissing even the possibility of it arriving. We concluded that because high-income countries have fewer risk factors for the spread of Ebola, i.e. weak health systems and unsafe burial practices, the disease would not become an epidemic to the same extent as in West Africa. Despite this, our protocol and prevention guidelines are not foolproof. One off cases, perhaps leading to small outbreaks, are a possibility.

**Overall Conclusions**So – what makes Ebola so dangerous? It is, in reality, a combination of several factors, all of which have been discussed in this website. A major component is the disease itself: its severity, easy mode of transmission and lack of treatment, so that that once caught, it is one of the most feared viruses present in the world today. But perhaps the main reason EBOV has become so widespread is the environment in which it has multiplied in – the poor health infrastructure, distrust of health systems and government and lack of trained staff and funding. It has been suggested that Ebola will soon become part of daily life in West Africa, and we can only hope that the efforts of the WHO, MSF and the international community will be enough to curb this epidemic, otherwise it could be that Ebola is here to stay.

**Reflections on the Project**Before we began the project, we set out clear objectives that we wanted to achieve. These were:

* To learn about the recent outbreaks of Ebola
* To learn how to carry out and present a critical appraisal
* To improve team working skills
* To improve our researching ability
* To learn how to put together a comprehensive website
* To get an idea of what Ebola might be like in the western world
* To improve knowledge and understanding of statistical tests
* To improve confidence of working in a group setting

In order to fulfill our first objective, we divided our research into focused areas (i.e. pathophysiology and transmission), allowing us to explore all aspects of the disease in detail. This exposes not just a single reason why Ebola is such a threat, but many. Additionally, when we shared our findings together, we gained a more holistic understanding of the topics we researched.

Furthermore, the experience of having to present our own critical appraisal was daunting, but it gave us valuable experience in being sceptical of our research later in the project. It taught us a range of skills: using a critical eye on research papers’ claims and findings; adopting a careful and methodic research approach to finding papers; understanding statistical tests; extracting strengths and weaknesses from papers; and ultimately weighing up whether a paper was valid and useful. As a result, we feel that we have fulfilled the second, fourth, seventh and eighth objectives.

Moreover, from working in sub-teams in our research, to intertwining all the sections together for the website, teamwork was vital. Knowledge of each section was shared among the group, giving a common understanding for discussions and decision-making. Therefore as the project progressed we achieved our third objective.

Before SSC2a, the majority of our group had had no experience with designing, creating or using their own website. However those who had experience of this shared their expertise with the rest of us, and we now feel confident that we have gained this invaluable skill, fulfilling the fifth objective.

Finally, although it was not one of our specified aims, the group was intrigued by what effect the Ebola outbreak could have outside of West Africa. This was critically relevant for the current crisis, particularly with regard to international aid. Consequently we made one of our research sections encompass this topic (‘Ebola in the West’), thus fulfilling our sixth objective.

**Final Word**Thank you for taking the time to read over our website, we hope it has been an informative experience for you. Please find below a list of links directing you additional areas of our website.

**Group Critical Appraisal**:  
<http://studentblogs.med.ed.ac.uk/2014-ssc2a-c3/?p=10>

**Contributions**:  
<http://studentblogs.med.ed.ac.uk/2014-ssc2a-c3/?p=8>

**Information Search Report**: <http://studentblogs.med.ed.ac.uk/2014-ssc2a-c3/?p=12>

**Word Version**:  
<http://studentblogs.med.ed.ac.uk/2014-ssc2a-c3/?p=6>