# Rapid Recoveries of Hemorrhagic Fever (Ebola) in Sierra Leone with Ozone Therapy

Robert Rowen, MD  Howard Robins, DPM  Kojo Carew, MD  Michael Morlai Kamara, MD

**Abstract**:

Importance: Ebola Virus Disease is a highly communicable and highly lethal disease which story has gripped the world. To date, there is no known reliably effective treatment. We report a very inexpensive and safe therapy with fast recovery in all patients treated.

Background: Ebola Virus Disease (EVD) has ravaged three countries in West Africa. The mortality rate is extremely high, and it is perceived not only as threat to all of Africa but to the entire world. There is no known treatment to date other than passive immunity administration, which often fails. Ozone therapy has been in clinical use for decades and has been found to have physiological effects which should directly inactivate the virus itself, as well as modulate its damaging effects.

Methods: Ozone therapy administration by a combination of direct intravenous gas administration, rectal gas administration and ozonized water was administered to patients with known EVD or apparent acute Ebola infection, and one case of extremely high risk. Treatment was carried out for up to ten days despite total remission of symptoms.

Findings: All four patients with positive EVD and the single patient not tested remitted all symptoms within 2-3 days and fully recovered. The single case treated for prophylaxis did not develop any symptoms. We present the scientific background of the possibility of ozone therapy as a cure for Ebola virus disease and three consecutive cases of known disease, one case of contaminated needle penetration exposure developing classic symptoms within 3 days, and one case of extremely high risk treated preventively with ozone therapy. All ill cases had an immediate recovery course upon initiation of therapy and were nearly or totally symptom free within 3 days. The single case of non-symptomatic high risk exposure did not develop symptoms.

Interpretation: Ozone therapy may be a useful modality in EVD and other viral diseases and should be immediately studied to save lives that might otherwise be lost.

Funding: Funding for supplies and equipment only came from private donors (see acknowledgments). No funding was provided for any of the authors. Rowen and Robins made the trip to Sierra Leone at their own personal expense.

Key words: Ebola, Hemorrhagic Fever, ozone therapy, oxidation, virus, antiviral therapy

**Background**:
Hemorrhagic fever is caused by a Filovirus of several strains commonly known as Ebola (Ebola Virus Disease or EVD). Its incubation period ranges from 2-21 or more days. The virus first suppresses the immune system while it explodes in numbers within the body. Unlike many viruses, multiple viral particles enter cells to replicate. Cell death occurs quickly. By the time the immune system catches up with EVD, the immune inflammatory response itself leads to severe circulatory carnage, damage to endothelial cells and outright hemorrhaging. The death rate is extremely high. West Africa is currently afflicted by the Zaire species, which carries a higher mortality rate than previous outbreaks which had an approximately 60% death rate. By 25 February 2015, total cases reported reached 23,825. Total deaths: 9,675 in 6 countries: Liberia, Guinea, Sierra Leone, Nigeria, the US and Mali.

The current outbreak in West Africa has been described by the WHO In a 26 September 2014 statement, the WHO said, "The Ebola epidemic ravaging parts of West Africa is the most severe acute public health emergency seen in modern times." Ebola is a class 4 pathogen, extremely easy to contract by contact with any contaminated body fluid, inclusive of semen. The risk greatly escalates as the disease progresses - the viral load exponentially increases. To date, there it no known proven effective treatment[i]. A recent editorial in JAMA has issued a call for fast track of promising vaccines, and it is of "utmost urgency". Clearly there is a great need for prophylaxis and treatment for those exposed to Ebola.[ii]

Ebola operates differently than many viruses. It enters dendritic cells and shuts down their immune system alerting alarms. This action permits the virus to replicate wildly and, while unchecked, infect and damage critical organs, inclusive of liver and kidneys. The cells explode releasing new viruses and cellular material into the bloodstream. This can result in a cytokine storm[iii], characterized by massive capillary leakage and tissue destruction, at which point the immune system may do more harm than good.[iv]

Ozone is an allotrope of oxygen, existing in nature as O3, created by solar UV radiation and lightning. It is the strongest naturally occurring oxidant. Unknown to most, Scripps Institute reported that ozone is actually generated by our own immune systems as part of its armamentarium of oxidants, which can be hurled against pathogens[v]. Other immune system generated anti-infection oxidants include hydrogen peroxide, singlet oxygen, nitric oxide, and sodium hypochlorite.

Ozone was discovered years ago to kill bacteria virtually instantly. Modern research has confirmed that ozone kills bacteria in easily reachable concentrations nearly instantly [vi] and up to 100 times faster than chlorine containing disinfectants[vii] (now the standard in disinfecting from Ebola contamination).

Nikola Tesla patented the first commercial medical ozone generator. In World War I, German physicians used medical ozone therapy to disinfect wounds. German medical researchers soon discovered that ozone application to various body fluids or cavities would result in additional beneficial effects such as enhanced circulation, oxygen delivery, and faster healing.

Ozone therapy has been in continuous medical use for nearly the full last century, especially in Europe for a variety of infectious, immunological and circulatory conditions. Velio Bocci, MD of Italy and his team investigated the immune effects of ozone therapy. He published his results first in a series of studies (over 175) in peer reviewed medical journals, and now found succinctly in his book "Ozone, A New Medical Drug"[viii]. Bocci details many mechanisms of ozone's ability to assist in the treatment of many medical conditions. Amongst these mechanisms include: 1) modulation of the immune system and its inflammatory/anti-inflammatory cytokines, 2) increase in production of red cell 2,3 DGP[ix] which encourages more oxygen delivery, and improved rheology properties of blood (increased RBC flexibility) 3) increased levels of key anti-oxidant enzymes such as SOD, and increased levels of glutathione. Cuban medical ozone researchers, led by Silvia Menendez, PhD, have independently verified these findings.[x]

Medical ozone therapy induces production of key vasoprotective hormone prostacyclin[xi]. Ozone therapy has been shown to increase muscle[xii] and tumor[xiii] oxygenation in humans by direct measurement using polarographic electrodes. In addition ozone protected against hepatic ischemia free radical reperfusion injury in several studies[xiv].

Cuban researchers found that ozone oxidative preconditioning exerts inhibitory effects on TNF-alpha production during endotoxic shock. In addition it exerts influence on the antioxidant-prooxidant balance for preservation of cell redox state by the increase of endogenous antioxidant systems[xv].

Most important, Ebola virus, similar to other viruses appears to have an absolute need for reduced sulfhydryl groups on its lipid envelope glycoproteins. Mirazimi, speculated on the richness of disulfide bonds in many viral glycoproteins as a factor for infectivity. They studied CMV and found the virus must have reduced sulfhydryl groups to infect cells[xvi]. If the thiol groups were oxidized, CMV lost infectivity. If the thiols were chemically reduced via the disulfide reducing agent dithiothreitol, the virus regained 65% of its infectivity. Reflecting on the reduction of "critical" disulfide bonds for vaccinia virus cellular entry, Markova, et. al, found that protein disulfide isomerase inhibitors limited the entry of HIV-1 into T cells.[xvii]. Vaccinia virus is likewise dependent on the reduction of "critical" disulfide bonds, which allow delivery of the viral core into the cytoplasm.

Ozone gas has been found to inactivate a myriad of viruses inclusive of polio, Norwalk, coliophage MS2, hepatitis A and others.[xviii xix xx xxi]

Regarding Ebola, David Sanders, PhD stated on his website:
"Our studies have also allowed us to determine the disulfide-bond map of the Ebola glycoprotein and to propose that reduction of the disulfide bond between the two subunits of the Ebola glycoprotein complex, GP1 and GP2, ***is a critical step in the entry of Ebola virus into cells***."[xxii]

Reduced sulfhydryl bonds are exceptionally easily and instantly[xxiii] oxidized by ozone. The reaction products are disulfide and water in a basic chemistry reaction: SH + SH + O3 → S-S + H2O + O2. While ozone itself lasts only microseconds in blood, the reaction of ozone and lipids in blood leads to the production of more stable but still highly reactive oxygen species (such as peroxides, anion superoxide, nitrogen monoxide, peroxynitrite, hypochlorous acid), which would have a similar oxidizing effect. Peroxides would react as follows; ROOH + SH + SH → S-S + ROH + H2O. As immune cells generate and release these species during invasion, these oxidation reactions may be a significant mechanism of defense.

While viruses might be inactivated by this mechanism, one would speculate that human enzymes be likewise inactivated. Human cells are aerobic and are designed for redox shuttling. Viruses are totally dependent on cellular entry to accomplish anything. Shut out of the cell, they are essentially neutered while antigenically intact for immune response. However, aerobic mammalian cells can and do quickly repair oxidation stresses to their membranes. One effect of which is enhancement of the hexose monophosphate shunt, which, incidentally is the mechanism for creation of higher levels of 2,3 DGP.

Finally, intravenous oxygen gas has been administered in equivalent volumes for decades in Europe. Numerous papers have reported significant beneficial effects on several physiological parameters. Regelsberger stated, "Apart from the general improvement in oxygen availability, i.v. oxygen therapy causes eosinophilia, which can be valued as an increase in undetermined cellular immunological resistance. Furthermore, rheological qualities of the blood as well as diuresis are improved, the release of oxygen into the tissue is increased, and the blood pH is normalized."[xxiv] Intravenous oxygen gas in human volunteers was found to induce eosinophil generated 15-LOX-1, as a powerful anti-inflammatory enzyme, believed to be a key factor in the inflammatory modulating effects of IV oxygen gas.[xxv]

These considerations caused lead author Rowen to speculate that that ozone therapy might be an ideal candidate to actually cure EVD (as well as other viruses). Rowen has been using ozone therapy to treat virus and bacterial infections in an outpatient setting since 1986. He recruited Dr. Howard Robins, who pioneered a very inexpensive and relatively medical waste free technique of ozone administration- direct intravenous gas administration (DIV). Their hypothesis was that this method would be an ideal and inexpensive method of treating EBV in West Africa. DIV ozone administers an oxygen/ozone gas mixture intravenously using a 27g winged infusion set.. The clinician sets an ozone concentration up to 55 mcg/cc

(gamma) (Approximately 98% O2 and 2% O3). Great care is taken to see that no air, which is 79% nitrogen gas, which can cause an embolus, enters the body. There are no reports in the worldwide literature, even after decades of use, that intravenous oxygen gas results in embolism. Desaturated venous blood is "thirsty" for it.

In October 2014, Rowen and Robins traveled to Sierra Leone at the invitation of President Ernest Bai Koroma, and taught a large number of health professionals assembled by Kojo Carew, MD on ozone therapies, particularly the DIV technique. (Dr. Carew had, in July 2014, met with President Koroma and introduced him to ozone therapy as a possibility for Ebola treatment. Carew's American friend, Mr. McNamara, co-incidentally introduced Rowen and Robins to Dr. Carew in September. Mr. McNamara is an ozone decontamination specialist who developed an ozone "fogging" device for decontamination of contaminated areas). We had the honor of meeting President Koroma personally, twice, who told us that "protecting the front line providers" was his greatest priority in the Ebola war.

A protocol (Rowen-Robins Method) for ozone treatment was developed inclusive of oral vitamin C, and a supplement supporting recycling of glutathione (Thiodox, Allergy Research Group).

Robins demonstrating DIV technique on Rowen before gathering of SL professionals. Sixty cc of gas is administered in this treatment.

Drs. Rowen and Carew visited and taught the method at the Hastings Ebola treatment facility outside of Freetown on October 24, 2014. The staff informed them that the facility had a 60% mortality rate from EVD at the time, which was then considered among the best results in Sierra Leone. For unknown reasons the Ministry of Health suddenly forbade the administration of ozone therapy on patients at the center while the educational session was in progress. Since all confirmed cases of Ebola suffered mandatory quarantine, it became extremely difficult to locate and treat cases outside this mandate. However, four cases did arise from within the facility amongst health care providers, who were President Koroma's first priority. These did manage to receive ozone therapy and we now report the results in these four consecutive cases and one case of ozone therapy prophylaxis. All patients received and executed an informed consent document.

**Materials and Methods**: In the following cases "DIV" ozone indicates direct intravenous ozone gas at 55 mcg/cc at a volume between 20-40 cc. "Rectal ozone" indicates administration of ozone gas rectally at a concentration of 36 mcg/cc at a volume between 150-350 cc. "Ozone water" was made by bubbling ozone gas at approximately 70 mcg/cc into water for 15 minutes. Administration volume was 300-500 cc. All cases were provided Thiodox® and Buffered Vitamin C® (donated by Allergy Research Group). Dose of Thiodox was one twice daily and for vitamin C – four to eight grams daily.

**Case Reports:**

Case 1 – Physician SK, 28, male, at the Hastings Ebola Center in Freetown stuck himself with a contaminated needle. He was fearful to get an Ebola test, knowing if positive he would have been forcibly picked up and placed in quarantine and denied ozone therapy, which he feared would cost him his life. He was one of the physicians Rowen and Carew trained in ozone therapy at Hastings and had received 20 cc of DIV on October 23, 2014 as part of the training. The following is his verbatim and signed report edited only to remove names. What appears in brackets is editing by Dr. Carew for accuracy.

*14th November: Needle prick in the red zone while trying to cannulate an EVD positive patient. Even though the patient was in the recovery ward with no complaint and symptoms. She had done the blood (test) but it came positive and was waiting for the second specimen to be taken.*

*The needle went through the PPE and pricked me a finger length anteriorly above the wrist. I was wearing Tybek (the thinnest PPE). The prick happened just above the margin of the gloves, making me more exposed. Had it gone through the gloves, as in the case of another doctor, it wouldn't have the skin.*

*15th November: No symptoms, but planning to start ozone therapy.*

*16th November: No symptoms- feeling fine. Called Dr. Carew and went to see him. DIV [30 cc] done. [He also received 500 cc ozone water]. Was given Vit. C, Thiodox, colloidal silver. I was also given the ozone machine, couldn't use it - gas leak.*

*17th November: Fever at night, loss of appetite, bowel movements (unusual) and urge*

*to empty my bowel. The urge was very strong. I tried to suppress it. I took ciprofloxacin, paracetamol, doxycycline, drank ORS. Couldn't sleep because of fever and the urge. I went after midnight passed stools and I felt some comfort. The stool was not watery but not too hard (it was very soft). I came and slept.*
*18th November: Loss of appetite in the morning and weakness. Slightly febrile, muscular pain and joint (suppressible). Went directly to Blue Shield and finally Dr. Carew came with Jeff [McNamara]. Before their arrival I was really weak and couldn't stand. For too long had to sit down. But after drinking the ozone water Jeff prepared I regained my strength and felt much better. I also tried the [ozone] fog. Started rectal ozone.*
*19th November: Slight weakness. Appetite is much better. DIV done, started working again. Did rectal ozone.*
*20th November: For the first time I did rectal ozone 3x times a day. One DIV. Slight weakness. Slept well at night. My temperature was 37.1 degrees Celsius.*
*21st November: My appetite is improving. DIV and rectal.*
*22nd November: DIV and rectal. No complaints. Prepared ozone water.*
*23rd November: No complaints. Ozone water but no DIV and rectal.*
*24th November: No DIV and rectal. Just ozone water.*
*25th November: No complaint. Ozone water.*
*26th November: No complaints. Ozone water.*
*27th November: Just ozone water.*
*28th November: No DIV, just ozone water.*
*29th November: No DIV, just ozone water.*

Physician SK fully recovered and resumed his duties within just days of commencement of therapy.

Case 2 - Physician MB, 35, male, had close personal contact (a hug) with another physician after the latter tested negative for Ebola. However, within 2 days a repeat test (PCR) came positive. MB developed typical Ebola symptoms within 3 days. He was placed in quarantine, but was offered and accepted ozone therapy administered by the recovered physician SK.
When symptoms began, he received 30 ml of ozone gas at 55 mcg/cc. When his test returned positive, he was given an additional 2 intravenous gas administrations, 40 cc each 12-16 hours apart. He also drank 300-500 cc ozonated water after the intravenous treatments. Within 72 hours, all symptoms had cleared. A subsequent test for Ebola was negative. The government announced this case as a complete recovery of Ebola in a physician national, but did not report that he had received ozone therapy.

Case 3- SS, 25, male nursing student on the Ebola front line, who was present for the ozone training from Drs. Rowen and Robins in October 2014. He documented exposure to Ebola via damaged protective gloves enabling blood of an Ebola patient to come in contact with his skin. He also, without protective gear, cared for a friend, who later was confirmed to have EVD. On December 2, 2014, he developed fever, malaise and headache. He received 2 DIV ozone gas injections of 20 and 30 cc

respectively at 55 mcg/cc. Upon testing positive for EVD, (PCR) he was taken to the Hastings Ebola treatment center where he was not permitted further ozone therapy. However, ozone water (as described in case 2) was clandestinely taken to him, 100 cc per treatment for 3 consecutive days. He had a complete and non-complicated recovery.

Case 4 -IB, 24, male aid. Working in "red zone". While bathing an Ebola patient, on or about November 24, 2014, he accidentally splashed body fluid contaminated water that went through his facemask and entered his eyes and mouth. Within 5-7 days, he developed progressive symptoms of extreme fatigue, body pains and vomiting. He started on anti-malarials. The next day, he informed facility physician who immediately administered IV ozone gas, 40 mcg/cc, 40 ccs. Within a few hours of the gas injection, almost all symptoms subsided. He also received two rounds of ozonated water (as in case 2). However, by then, he was about symptom free. His Ebola test proved positive (PCR) and he was placed in the treatment unit and prohibited from further DIV ozone. He did receive their usual treatment protocol consisting of D5W, Ceftriaxon (IV), Metronidazole (oral), Immunoboost (oral vitamin). He had an uneventful stay within the Ebola containment unit and was discharged in the first week of December.

Case 5 - GB was the female companion of a 67-year-old Sierra Leone senior physician who died of EVD. She had intimate contact with him at the time of his falling ill. Authorities placed her essentially under house arrest with armed military guards at her home to prevent entry and exit of all persons, inclusive of anyone who might bring her ozone therapy. She was in great fear for her life. She was very much aware of ozone therapy having urged her partner to accept it before he died. She could not receive it in her home, nor could she leave to get it. In the middle of the night she scaled a razor wire fence shredding her skin and evaded the guards. She arrived at Dr. Carew's "Blue Shield" facility where she received: one DIV ozone treatment, and daily rectal ozone and ozone water for ten days. She also received vitamin C and Thiodox twice daily. She did not develop symptoms.

Mr. McNamara had developed and deployed an ozone-fogging device, which was employed at the health facility of Dr. Carew for decontamination and protection of Dr. Carew and all exposed to patients treated there.

**Discussion**: EVD has a progressively explosive downhill course from the time of symptom appearance. Typically, death will occur within a week or less in the majority of cases. In all the ozone treated cases, symptoms did not progress from the start of ozone therapy, and symptomatic patients were totally free of all symptoms, inclusive of fever, generally by day 3 of treatment.

Through December 2014, Sierra Leone suffered 11 of its national physicians doctors infected with Ebola and confirmed with tests. All but one died. The latter (case 2) received ozone therapy. Case 1 was also a physician. Hence, of the two of 12 total Sierra Leone physicians with confirmed or high probability of EBV, both quickly

recovered with ozone therapy. (Dr. Martin Salia was offered and refused ozone therapy. He received convalescent serum and was transferred to the USA and died only 2 days after refusing ozone therapy. Dr. Victor Willoughby, a senior Sierra Leone physician likewise refused ozone therapy opting for ZMapp, which was rushed to Sierra Leone. He died while the ZMapp was thawing for administration. Source: public news wires).

Both senior authors had expected rapid recovery with ozone therapy, but admittedly not to this extent (within a few days and with limited treatments). Rapid recovery was expected because of the violent nature of EVD, and the known direct countering biological benefits/effects of ozone therapy. This merits further discussion.

When considering the mechanisms of Ebola induced pathology, we see rapid cellular entry, an explosion of viral particles into the blood stream, and rapid cellular re-entry perpetuating the cycle viciously. Then the repressed immune system "awakens" and pulls out all its weapons to do battle. But unfortunately, that battle results in a cytokine storm, wherein the immune system does more damage to the vascular system and tissues than the virus. Death occurs due to capillary leaks, hemorrhage and organ failure.

Circulatory compromise – The final common denominator in any vascular insult is oxygen deprivation and resultant cellular injury and death. Ozone therapy is known to improve rheological properties of blood, increase 2,3 DGP, shifting the oxyhemoglobin curve to the right and releasing more oxygen in tissues. Ozone itself is oxygen. Clearly, in advanced EVD with blood vessel damage, tissues are starved of oxygen and energy production. Any enhancement of oxygen delivery to tissues could be potentially salvaging. Bocci, Menendez, and others have well demonstrated that ozone therapy enhances oxygen delivery and utilization. Any additional available oxygen might salvage cells that might otherwise die.

Viral entry - The fact that Ebola and many, if not most other viruses, require reduced sulfhydryl groups to enter cells, may be the Achilles heel and provide the means to undo the lethality of this virus. Sulfhydryl groups are key to activity of many cellular enzymes; and their state of oxidation/reduction provides a means of the aerobic cell to activate or inactivate these enzymes. It appears from the cases at hand that EBV has a very narrow window of redox activity/infectivity, and its envelope glycoproteins must be reduced as suggested in the literature. The symptomatic patients began a recovery essentially with the first oxidation (ozone) treatment. The senior authors did expect recovery, but within 5-7 days, considering the progressively downhill course of virtually all symptomatic untreated patients and massive cellular injury. These symptomatic cases responded positively with the very first treatment. It appears that an oxidant stress to the blood stream carrying newly emerging viruses may be capable of oxidizing and inactivating sulfhydryl entry mechanisms. Inactivated viruses will be incapable of entering the cell for further replication, while able to encourage healthy immune response.

Gonzales, et al, reported on a case of another vicious virus now likely endemic in the USA. A man (54) developed a high fever and severe arthralgia among other symptoms. He was positive for Chikungunya virus. He received two intravenous infusions of vitamin C, 100 grams each. He immediately began recovery and was clear of symptoms in two days. This is very similar to our observations with ozone.

Most interesting is that vitamin C (ascorbic acid) in these doses has been found to undergo a newly discovered metabolism. "Pharmacologic ascorbate can act as a pro-drug for hydrogen peroxide ($H_2O_2$) formation, which can lead to extracellular fluid..." While doing cancer research and investigating a heretofore unknown metabolism of ascorbic acid at high concentrations (only achieved by IV administration), NCI researcher Mark Levine and his group, found that in its "antioxidant" capacity, it donates an electron to ferric +3 ion reducing it to Fe+2. This ion in turns reduces O2 to superoxide. Catalase further reduces the superoxide to hydrogen peroxide.[xxvi] Effectively, this research suggests that the widely reported anticancer and anti-infective properties of ascorbic acid may be mediated through its capacity as a prodrug for a powerful naturally leukocyte produced oxidant – hydrogen peroxide. (Our immune cells also produce ozone, and Bocci has theorized that the key mediator in ozone's beneficial effects is hydrogen peroxide). This case mirrors our own Ebola cases.

Oxidation therapy was reported as far back as 1920 to dramatically cut the mortality rate of influenzal pneumonia in the great epidemic of that time. British physician Oliver, in India, took only hopeless cases and nearly halved the death rate with intravenous hydrogen peroxide therapy, costing, even in today's world, pennies for materials.[xxvii] We have nothing, even in today's modern world, that compares.

Cytokine storm - Ebola induces a cytokine storm.[xxviii] Ozone therapy has been shown to significantly modulate TNF-alpha and inflammatory cytokines. Bocci has investigated and reported ozone as a cytokine inducer.[xxix] Bocci called ozone the "ideal cytokine inducer", inclusive of anti-inflammatory cytokines.[xxx] EVD instigates pathologically high levels of NO. Ozone modulates NO.

The actual extraordinary rapid recovery of the treated patients suggests that all three mechanisms may be at play, and particularly viral inactivation. Ozone easily oxidizes SH groups to S-S groups, which, according to literature, is expected to inactivate viral entry. Ozonides, reactive oxygen species generated by ozone therapy such as peroxide species, would also easily oxidize reduced sulfhydryl groups based on simple chemistry.

It appears from this pilot report, that Ebola virus has an extremely narrow redox window of infectivity. Even ozone exposures (rectal and water) far less powerful than DIV appears to have assisted in dispatching symptoms and aiding recovery. We

believe that the temporary oxidant stress to EVD patients oxidizes viral surface glycoproteins. The virus particles are unable to recover since they have no means themselves of repairing damage to their glycoprotein "spikes".

Additional damage to viral infectivity could be inflicted on the lipid envelope. The virus hijacks and steals lipids from our own cell membranes. Virus infectivity is dependent upon a functional lipid membrane. Agents that attack the lipid envelope may be useful as antiviral drugs [xxxi]. Ozone directly attacks unsaturated fatty acids, which would be expected to be part of the Ebola lipid envelope. Our cells can repair the alteration. The virus cannot. Lorizate lamented that compounds which could attack viral lipids lack specificity and are "thus unacceptably toxic." Ozone therapy, in use for decades, has no reported toxicity and may serve as an ideal lipid altering anti-viral agent.

Statistical probability: With the Hastings center's survival rate of only 40%, the statistical probability of these results (100% survival) arising from mere chance is 0.4 to the fifth power, or exactly 1%. Furthermore, the statistical significance of our findings is significantly magnified in that there was no progression of the disease in any patient after ozone therapy commenced.

Ethics: International agencies, inclusive of the WHO, called for the use of any reasonable treatment in the fight against Ebola. ("*In the particular circumstances of this outbreak, and provided certain conditions are met, the panel reached consensus that it is ethical to offer unproven interventions with as yet unknown efficacy and adverse effects, as potential treatment or prevention.*"[xxxii]) Considering the known and widely accepted mortality of EVD, we then consider it to be unethical to withhold a known, nearly 100 year old, safe therapy from a disease, which has a 60% probability of death to do a double blind study, or to deny ozone therapy as a prophylaxis.

Cost: The ozone cost of treatment per patient was less than 10 USD excluding the cost of ozone generator. Medical waste was limited to one 27 gauge "butterfly" needle per treatment (0.75 USD) and one syringe (reusable as ozone sterilizes the syringe as it fills each time) for each patient. Beyond the modest cost of a reliable generator, the cost of the DIV form of ozone will largely rest in the labor cost of the administrator.

Safety: The world literature is devoid of any reports of toxicity when ozone has been administered within the guidelines of the Robins method of DIV or the more common method of major autohemotherapy. In the latter, between 50-200 cc of blood is removed, treated with ozone, and returned to the patient. During training, we treated several score African health professionals and lay people with DIV ozone without any toxicity except rare vein irritation. Both senior authors have performed thousands of ozone treatments with negligible untoward effects, and both have

observed what would be considered hard to believe resolutions of common viral and even bacterial infections in hours to days.

Availability: Ozone therapy is not patentable; therefore it will fail to generate a profit for any developer or promoter. Hence, it is obvious why ozone therapy, though widely practiced, is not industry or mainstream promoted and remains relatively unknown. This was a major reason Rowen and Robins chose to complete this mission at their own risk and cost. Expecting and achieving success for the most dread virus on the planet, ozone therapy might attain its rightful place in healing and saving lives, regardless of lack of profit potential and industry glamour.

Weaknesses of this report: We acknowledge that these cases were treated early in the course of the disease (soon after symptoms developed). None were critically ill. The effects of ozone therapy on late stage disease remain unknown.

Conclusion: Ozone therapy, a modality not well known, accepted, or understood by conventional Western medicine, has shown to be a safe and ideal treatment for EVD in all patients who received it. Symptoms of EVD ceased within 3 days in 3 cases of confirmed Ebola and in one highly suspect case in front line health workers. Two were physicians. All patients treated recovered. A fourth person at extremely high risk did not develop any signs or symptoms after receiving ozone therapy. In contrast, 2 leading Sierra Leone physicians who were offered ozone therapy after developing symptoms (in the weeks following our mission) and who tested positive for Ebola both died. Ozone therapy also appears to be an effective treatment for prophylaxis of overt Ebola exposure.

Direct intravenous ozone therapy is extremely inexpensive, safe and leaves virtually no contamination. International organizations and local governments would do well to immediately conduct a formal trial of this inexpensive, novel, efficient, and safe therapy for EVD. The therapy could afford significant security for front line workers, whose lives are in constant danger.

Disclosures:

The authors wish to express gratitude to Longevity Resources, Inc of Vancouver B.C. for generously donating 10 ozone generators for use in Sierra Leone, and to Allergy Research Group of California for its generous donation of oral Buffered Vitamin C and Thiodox to complement the ozone therapy. ACS 200 silver was supplied courtesy of Results RNA Company. Additional thanks goes to the many selfless contributors and supporters of ozone therapy who spontaneously and generously donated unsolicited funds for the purchase of medical supplies and transport of supplies. Rowen and Robins received no financial support and personally paid all travel expenses out of their own funds. None of the authors have any financial disclosures to make.

Special thanks to ozone technician Jeff McNamara of Colorado, USA for introducing and bringing the parties together at this critical time and providing “ozone fogging” technology for front line protection.

Author contributions:

Dr. Rowen sourced the scientific references, drafted the manuscript, and compiled the transmitted information from Sierra Leone.

Dr. Robins provided training, education and expertise in his method of ozone delivery and traveled together with Dr. Rowen to Sierra Leone.

Dr. Carew initiated the contacts with the President of Sierra Leone and coordinated all training, both didactic and practical brining in scores of health care professionals.

Dr. Karama coordinated difficult retrieval of information and results back from Sierra Leone. Additionally, he visited each of the named patients and deceased physicians at his own peril to offer the therapy and obtain informed consent.

Dr. Jalloh was the supervisory physician to the treatment of case 2 and assisted with training at the Sierra Leone Ebola center.

[i] Choi JH, Croyle MA (December 2013). "Emerging targets and novel approaches to Ebola virus prophylaxis and treatment". *BioDrugs* 27 (6): 565–83. doi:10.1007/s40259-013-0046-1. PMC 3833964. PMID 23813435.
[ii] Giesbert, T., Editorial | March 05, 2015 Emergency Treatment for Exposure to Ebola Virus, The Need to Fast-Track Promising Vaccines JAMA March 5, 2015
[iii] Tisoncik, et. al. Microbiol. Into the Eye of the Cytokine storm Mol. Biol. Rev. March 2012 vol. 76 no. 1 16-32
[iv] Gaya Amarasinghe (virologist) , of Washington University in St. Louis, on NPR 8-26-2014
[v] PNAS | March 18, 2003 | vol. 100 | no. 6 | 3031-3034 From the Cover Chemistry / Biochemistry Babior, et. al Investigating antibody-catalyzed ozone generation by human neutrophils
[vi] Antimicrobial Effects of Ozonated Water Against Generic E.coli on Swine IntestinesVarying Ozone Concentrations and Exposure Times
[vii] Disinfection Using Chlorine Bleach December, 2011 / OSU Biological Safety / Environmental Health & Safety / 541-737-4557
[viii] Bocci, Velio, *Ozone, A New Medical Drug 2nd ed* 2011
[ix] Viebahn-Hänsler R. The use of ozone in medicine: Mechanisms of action. Munich. 2003. May 23-25,
[x] Menéndez S, González R, Ledea OE, Hernández F, León OS, Díaz M. Ozono. Aspectos básicos y aplicaciones clínicas. La Habana, Cuba: Editorial CENIC; 2008
[xi] Schulz S, Nike S, Watzer B, Nüsing RM. Ozone induces synthesis of systemic prostacyclin by cyclooxygenase-2 dependent mechanism in vivo. Biochem Pharmacol. 2012;83(4):506-13.
[xii] Clavo, et. al. J Altern Complement Med. 2003 Apr;9(2):251-6
[xiii] Clavo B, et. al. Ozone therapy for tumor oxygenation: a pilot study. Evid Based Complement Alternat Med. 2004;1:93–8.
[xiv] Peralta C, et.al., Protective effect of ozone treatment on the injury associated with hepatic ischemia reperfusion: antioxidant–pro-oxidant balance. Free Rad Res. 1999;31:191–6.
[xv] Zamora, et al. Mediators Inflamm. 2005 Feb 24;2005(1):16-22
[xvi] Mirazimi, A et.al, *Journal of General Virology* (1999), 80, 2861–2865. Printed in Great Britain
Free thiol groups are essential for infectivity of human cytomegalovirus
[xvii] Thiol/disulfide exchange is a prerequisite for CXCR4-tropic HIV-1 envelope-mediated T-cell fusion during viral entry March 1, 2004; Blood: 103 (5)
[xviii] Kekez MM1, Sattar SA., Phys Med Biol. 1997 Nov;42(11):2027-39. A new ozone-based method for virus inactivation: preliminary study.
[xix] AShin GA, Sobsey MD., Appl Environ Microbiol. 2003 Jul;69(7):3975-8.
Reduction of Norwalk virus, poliovirus 1, and bacteriophage MS2 by ozone disinfection of water.
[xx] Herbold K, et. al., Appl Environ Microbiol. 1989 Nov;55(11):2949-53.
Comparison of ozone inactivation, in flowing water, of hepatitis A virus, poliovirus 1, and indicator organisms.
[xxi] Emerson MA, et. al., Appl Environ Microbiol. 1982 Mar;43(3):603-8.
Ozone inactivation of cell-associated viruses.
[xxii] http://bilbo.bio.purdue.edu/~viruswww/Sanders_home/research.html
[xxiii] Bocci, Ozone, *A New Medical Drug,* page 20, Springer, 2005
[xxiv] Forsch Komplementarmed Klass Naturheilkd, 2002 Feb;9(1):7-18.
[xxv] Chaitidis, P,, Prostaglandins, Leukotrienes and Essential Fatty Acids Volume 71, Issue 5 , November 2004, Pages 271-276, Impact of intravenous oxygen therapy on the expression of reticulocyte-type 15-lipoxygenase in human volunteers
[xxvi] Gonzalez, MJ, et al, J Orthomol Med. 2014;29(4):154-156.
High Dose Intraveneous Vitamin C and Chikungunya Fever: A Case Report.
[xxvii] Oliver, L, Lancet, Feb.21, 1920
[xxviii] Tisoncik, et.a. Microbiol. Mol. Biol. Rev. March 2012 vol. 76 no. 1 16-32, 1 March 2012, Into the Eye of the Cytokine Storm
[xxix] Bocci V, et. al., *J Biol Regul Homeost Agents* 1993, 7(4):133-138., Studies on the biological effects of ozone: 4. Cytokine production and glutathione levels in human erythrocytes.
[xxx] Bocci V, personal communication to Rowen
[xxxi] Lorizate, M Cold Spring Harb Perspect Biol. 2011 Oct 1;3(10):a004820. doi: 10.1101/cshperspect.a004820
Role of lipids in virus replication
[xxxii] http://www.who.int/mediacentre/news/statements/2014/ebola-ethical-review-summary/en/