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DR Congo Ebola outbreak may intensify, despite vaccine

By - Johannes Adomako-Mensah, DaMina Global Health Research Analyst

Confirmed Cases of Ebola in DRC	35
Probable Cases	13
Suspected Cases	6
Total Cases	54
Number of Deaths	23
Mortality Rate	43%

Source: WHO

Despite high hopes for the experimental Ebola vaccine, the unlicensed recombinant Vesicular Stomatitis Virus-Zaire Ebola Virus (**rVSV-ZEBOV**) currently being deployed in DR Congo to stem the tide of the disease, the disease may yet intensify, before ultimately abating when more stringent quarantine measures are taken. The high transmissibility of the virus through body fluids, secretions and blood is exacerbated by improper burial practices, poor sanitation and consumption of fruit bat and monkey meat in the DRC.

Since the discovery of the deadly hemorrhagic fever-causing virus, eponymous with the eastern Ebola River in the Democratic Republic of Congo, in 1976, there have been nine recorded outbreaks in DRC where the disease endemic, with the last outbreak occurring less than a year ago. With so many previous Ebola outbreaks in DRC, many in the general population do not have the same sense of dread that was witnessed in West Africa during 2014.

In West Africa the outbreak constituted an unparalleled public health nightmare which pitted the unskilled and underprepared healthcare infrastructure of the region against a massive outbreak of a virus with no pre-exposure vaccine or approved treatment. Of the 28,600 cases catalogued across Guinea, Sierra Leone and Liberia, a case fatality rate of about 45% meant that in excess of 11,300 deaths were recorded between March 2014 and June 2016, with the brunt of the disease burden and fatalities (as much as 40%) borne by Liberia, a West-African state severely crippled by two devastating civil wars.

It is against this backdrop that the Health Division of Equateur Province in the Democratic Republic of Congo on 3rd May 2018 raised concerns about a cluster of twenty-one suspected cases of hemorrhagic fever resulting in seventeen fatalities in the market town of Bikoro in North Western DRC. The WHO officially declared a new outbreak of Ebola virus disease (EVD) on 8th May 2018 after two of five samples collected from suspected cases tested positive for Zaire Ebola virus.

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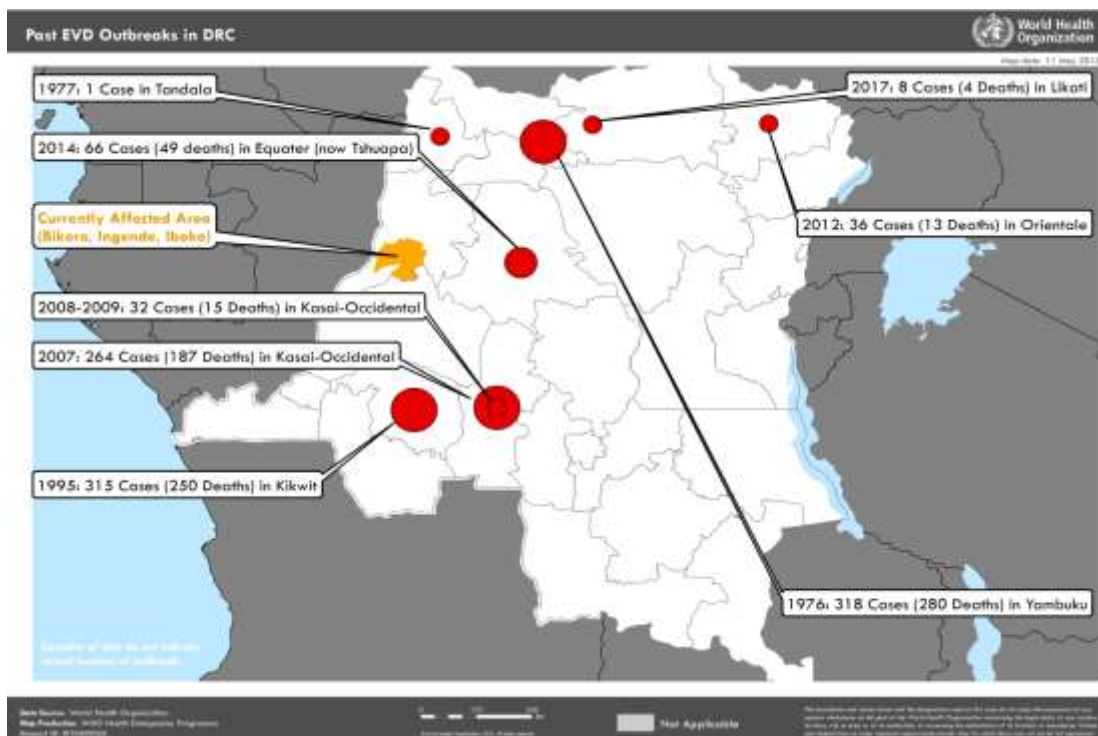
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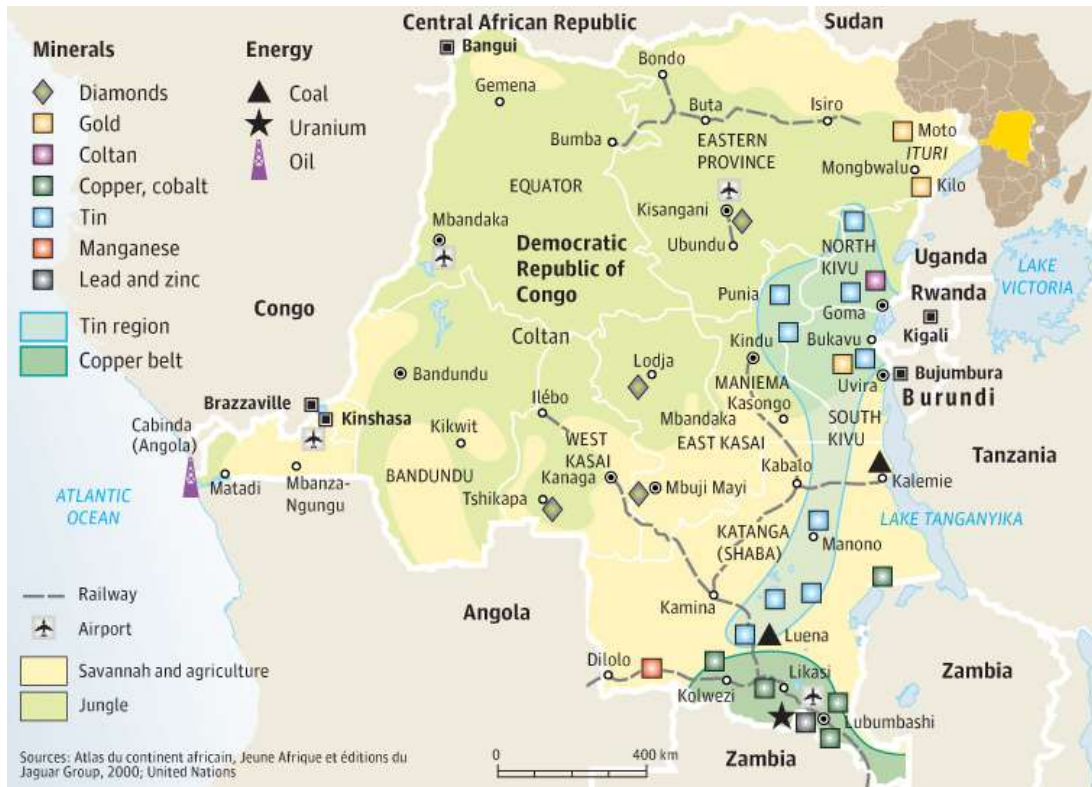
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DRC on epidemiological knife edge

Until this point, the heavily forested and relatively inaccessible geographical location of Bikoro, which lacks established road networks or a mobile network, portended for a “contained outbreak” akin to that which struck the Likati Health Zone of the Bas Uele Province in the northern part of DRC bordering the Central African Republic (CAR) barely a year prior (outbreak declared officially over in July 2017, 42 days - two consecutive 21 day incubation cycles of the virus - following a second negative test result for the last confirmed Ebola patient in that region), recording four deaths out of a total of eight confirmed cases. However, the troubling news of the appearance of three confirmed cases of Ebola in the inland port city of Mbandaka (80 miles north-west of Bikoro), the provincial capital of Equateur Province on the shoulder of the Congo river with a population of 1.2 million people, grossly heightened the stakes for unmitigated disease spread. With air and water access routes between Mbandaka and Kinshasa, the capital of DRC teeming with close to 10 million people, there is a veritable risk for urban contagion and international spread beyond the DRC which shares borders with a ring of nine other African countries, conditions which prompted Dr. Peter Salama of the WHO to characterize the situation as an “epidemiological knife edge.” Following this development, the WHO has, as of 18th May, 2018, raised the assessment of risk level to “Very High,” yet stopped short of declaring the situation a Public Health Emergency of International Concern, thereby placing no restrictions on regional/international travel or commerce.





The watershed moment of this current outbreak, beyond the coordinated efforts of local health authorities, the World Health Organization and Doctor's Without Borders (Médecins Sans Frontières), is the deployment of an experimental Ebola vaccine in advance of its approval by the relevant regulatory authorities. Developed in 2015 following successful trials in Guinea and Sierra Leone, the use of the unlicensed recombinant Vesicular Stomatitis Virus-Zaire Ebola Virus (rVSV-ZEBOV) vaccine is an unprecedented intervention in the fight against Ebola, made possible under the WHO's Expanded Access/Compassionate Use protocol, representing a landmark frameshift in the forty year history of this deadly virus. The vaccine, developed by Merck, is a live, attenuated and replication-competent chimeric virus, genetically engineered so that the surface glycoprotein (which permits adhesion and entry into host cells) native to the VSV (typically infects cattle and causes only relatively mild disease in humans) is replaced by the envelope glycoprotein expressed by Zaire-ebolavirus.

An Ebola outbreak in capital Kinshasa not impossible

By so doing, the hybrid virus glycoprotein elicits an immune response and seroconversion within the human host, with the antibodies generated conferring protection against real Ebola viremia. "Vaccination will be key to controlling this outbreak," said Dr. Tedros Adhanom Ghebreyesus, WHO Director-General, with more than 7,500 doses of rVSV-ZEBOV vaccines already being deployed to DRC, with 4,000 doses allotted to Kinshasa (no recorded cases as yet) to preempt virus spread. In a nod to the successful vaccination campaign of the 1960's and 1970's which

eradicated smallpox, the WHO has implemented a “ring vaccination” strategy in its deployment of the Ebola vaccine, focusing on confirmed cases of the disease and using contact tracing to identify contacts of these cases, and contacts of the aforementioned contacts, in an ever-widening scope of concentric rings centered around a confirmed index case. This approach also confers “herd immunity” amongst individuals who have not come into contact with the virus by preventing viral spread from would-be likely sources of contagion. The comprehensive vaccination campaign, which prioritizes healthcare workers operating in affected areas, is set to include Kinshasa, Mbandaka and Bikoro, the outbreak epicenter where 600 contacts and contacts of contacts have been identified.

In what might be termed as the only silver lining to the cloud that was the 2014-2016 Ebola pandemic, a collaborative effort by the WHO, Guinea’s Ministry of Health and other international partners yielded an experimental/candidate vaccine (rVSV-ZEBOV) at the end of a successful ring vaccination trial (Ebola Ça Suffit!) in 2015. In results published in the *Lancet*, Dr. Ana Maria Henao-Restrepo et al used an open-label, cluster-randomized ring vaccination trial design to demonstrate and quantify the efficacy of a chimeric, rVSV-vectored vaccine in preventing Ebola virus disease (EVD) using a study population in Conakry and the Basse-Guinée region of Guinea, and in Tomkolili and Bombali in Sierra Leone. Briefly, following the identification of a laboratory-confirmed case of EVD, rings of vaccination comprising the contacts of the index cases, and the contacts of these contacts were established, with the clusters eventually randomized into one of two groups: immediate vaccination (2119 vaccinated) and delayed vaccination (2041 vaccinated three weeks after identification of the index case) groups. There was an additional non-randomized cohort (permitting expanded access with vaccination of children aged 6-17yrs) of 1677 who also received immediate vaccination. Of the 5,837 people who received experimental vaccination with rVSV-ZEBOV, comprising a total of 117 rings of vaccination, there were zero recorded cases of Ebola occurring ten or more days after randomization for all immediately vaccinated participants, as compared to twenty three cases of viremia (EVD) among the delayed vaccination participants (in addition to those who did not receive the experimental vaccine at all). The findings of this trial suggest a vaccine efficacy of 100%. (Henao-Restrepo, Maria, et al, *The Lancet*, Volume 389, No. 10068, p505–518, 4 February 2017).

Vaccine has a questionable efficacy

The findings of this landmark trial and the successful testing of an effective Ebola vaccine have raised alarm in some quarters, with some groups raising concerns about the study-design and the methodology which may have contributed to the favorable results. At the most basic level, a veritable control group (an index case of Ebola and its associated rings) who would have received a placebo in lieu of the rVSV-ZEBOV vaccine did not exist for comparison for ethical reasons related to withholding a potentially life-saving intervention from an at-risk population.

As such, the delayed vaccination cluster doubled as the “control group” for those immediately vaccinated. In their paper, “Questionable efficacy of the rVSV-ZEBOV Ebola vaccine *The Lancet*, Volume 391, No. 10125, p1021, 17 March 2018),” Metzger, W.G., et al pointed out that post-randomization of volunteers into the “immediate vaccination” versus the “delayed vaccination” clusters, there was a significant difference in the level of medical surveillance and oversight between the two groups, given that the latter, delayed-vaccination cluster, were only seen on day 0 (when controls were identified) and day 21 (when vaccination occurred), with the intervening three weeks bereft of the medical oversight and behavioral intervention (such as strict maintenance of hygiene) that the “immediate vaccination” cluster enjoyed. By so doing, the author argues the feasibility of the stipulation that the reported outcomes of zero Ebola cases in the immediate cluster, versus 16 Ebola cases in the delayed cluster, could be due to variables other than vaccination with rVSV-ZEBOV, such as behavioral changes in the study subjects. “Given the possibility of a lower vaccine efficacy than reported, spreading the news of perfect vaccine efficacy for the rVSV-ZEBOV vaccine could have fatal consequences in a future outbreak if vaccinated individuals (eg, village health workers) neglect strict security measures (eg, wearing gloves and masks, safe funeral procedures) because they think they are fully protected.” (Metzger, Wolfram G., Vivas-Martinez, Sarai, *The Lancet*, Volume 391, No. 10125, p1021, 17 March 2018).

To be kept viable, the experimental vaccine has to be stored at temperatures between -60 to -80 OC, thereby requiring storage freezers with uninterrupted power supply in addition to containers capable of maintaining sub-zero temperatures for at least a week without access to electricity, so as to facilitate the delivery of the vaccine by motorbikes, helicopters and air bridge to the more remote and relatively inaccessible forested areas beset by active Ebola cases or contacts. It is within this context that any effort aimed at stemming the pandemic potential of this deadly virus must be multifactorial enough in its application so as to plug the fault-lines that exist across the medical, socio-cultural and geographical landscape of an Ebola crisis, with the WHO estimating that it would require in the region of \$26 million dollars over the next three months to effectively combat the virus. There are several key issues of note that will conspire to determine the potential for containment or risk for unmitigated spread.

Voluntary consent for non-licensed vaccine inhibits vaccination program

Given that rVSV-ZEBOV is a non-licensed, experimental vaccine that is supplied under a special provision of the WHO, voluntary informed consent would need to be acquired from individuals prior to vaccination, a process made further complex by the fact that it requires an intermediary to translate the rationale for and potential side effects of the said vaccine to those receiving it. This process will require a modicum of cultural sensitivity to allay the deep rooted distrust and prejudices that are typically held towards health workers, and this can only be achieved by a robust and syncretic public health campaign that does not neglect religious and traditional

beliefs, which tend to be the strongest driving force against compliant behavior with respect to quarantine protocols and vaccinations. "Our grandparents lived a long time here in Mbandaka and they never experienced this," said a merchant named Yvonne. "This is sorcery." Statements such as these point to the root of a deep seated mistrust for modern medicine which would only be amplified if government agencies attempted to mandate medical care, as has been suggested in some quarters. "Forced hospitalization is not the solution to this epidemic. Patient adherence is paramount. The quicker patients are admitted, the greater their chance of survival and of limiting the spread of Ebola," Médecins Sans Frontières said in a statement.

Worryingly, there have been reports of two patients in the Wangata district of Mbandaka breaching quarantine with the help of family members, with one patient being taken home and the other being taken to an evangelical church for prayers. Besides both patients passing away within twenty four hours, health officials were charged with the impossible task of contact tracing so as to administer vaccination to at-risk contacts. Regarding Ebola, the infected and the at-risk population are as much patients, as they are partners in the efforts to combat contagion, and this anecdote crystallizes the pragmatic futility of an efficacious and effective vaccine if contacts cannot be identified and vaccinated so as to stem viral spread.

Bush meat/monkey meat delicacy complicates Ebola control efforts

Even more entrenched are some of the cultural mores which may contribute to disease spread, such as the consumption of "bushmeat." It has long been argued that fruit bats and monkeys are both hosts of the virus, yet the persistence of monkey meat on the market in DRC notwithstanding an Ebola outbreak again lays bare the reality that the bulk of the effort probably rests on the educational and public health angle rather than a pure medical intervention. "Despite your Ebola stories, we eat monkey meat. We have eaten it forever. That is not going to change today. Ebola, that's in (market town) Bikoro," said one woman named Carine, a mother of eight children.

This presents a classic Aristotelian paradigm where the "whole" is indeed greater than the "sum of its parts," in that inasmuch as a viable vaccine, a robust public health outreach and an expansive educational campaign are important anchors of treatment, a successful coup de grâce against a looming Ebola pandemic will always have to necessarily be as interdisciplinary as it is macroscopic. It is indeed possible that the "epidemiological knife edge" that Dr. Peter Salama of the WHO referred to could very well be favorably "blunted" and "broadened" by a successful ring-vaccination campaign with the experimental rVSV-ZEBOV.

However because there is no way of guaranteeing this a priori, things may get worse before they get better, and the forty two days (two 21-day viral life cycles) since the beginning of the ring

vaccination campaign (from mid May through the last week of June) will be the most critical window during which time we would advise clients and other interested parties to avoid or reduce cross border travels into or out of that region so as not to introduce new variables into an already erratic paradigm. The exercise of extreme vigilance by International and local health officials via vaccinations and the provision of infra-red thermometers at river and airports of entry, plus a participatory public doing their quota by observing proper hygiene, practicing proper burial rituals that minimize direct contact with a suspected case of hemorrhagic fever case, and acceding to vaccination requests in the event of contact with an index case of Ebola, or a contact of a contact, might just be enough to negotiate a safe-landing.

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To schedule in-depth Q&A on the Ebola outbreak with Johannes

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