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Values and hopes of ebola vaccines mass immunization programs and treatments adoption and implementation benefits in africa

Abstract

The potential benefits of safe, effective and cost effective Ebola vaccines and massive population-based immunization and treatment can be easily demonstrated by the unprecedented Ebola outbreak consequences that raged West Africa and intimidation the international public health security. Effective community-based health programming and contextual understanding have shown to be of tremendous benefits of global poliomyelitis immunization initiative. Africa fertility rate is among the highest in the world and projected growth over next 40years, from 1.1billion to 2.4billion by 2050. It has become clear that the lack of effective Ebola immunization programs and management logistics in both vulnerable populations and international travellers was complicated by weak health planning and epidemics preparedness. Moreover, poor prognosis and late local, regional and international response led to preventable toll of over 27,609 cases and 11,261 deaths been recorded in West Africa recently. As Ebola still represents a common threat in Africa and threatening the global community; this article reports a cumulative survival rate varying between 37-66% in West Africa with the highest in Sierra Leone of 67% in contrast to 26% in DR Congo with the highest cumulative frequencies of seven of Ebola resurgence episodes from 1977-2014, and Uganda five episodes from 2000-2012. But what exactly triggers to those Ebola patients fortunate enough to survive is still to be elucidated. West Africa has recorded a cumulative fatality rate ranging from 34-63 %. Understanding the benefits of Ebola immunization should be of importance and could provide inklings into Ebola's weakness in such dearth of local medical and healthcare delivery, intense global travel and food insecurity systems. Hence, development and effective deployment of massive population-based Ebola immunization program and travel medicine policy on prevention and control measures should be a major priority post-Ebola emergency response directed to curb and to eradicate the threatening Ebola outbreaks. In addition, development of evidence-based innovative community-based primary healthcare services, functioning delivery mechanisms, other public health interventions surveillance and recovery packages. Hence, support in improving safety and healthy living in achieving the national / regional growth, sustainable development goals and global health security.

Keywords: ebola, outbreak, travel, transmission, immunization, programmes, benefits, horizon

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Ernest Tambo,[1,2,8] Chidiebere EU,[3] Olowasogo AO,[4] Isatta W,[5] Jeannetta KJ,[6] Jeane YN[7,8]

[1]Sydney Brenner Institute for Molecular Bioscience, South Africa
[2]Africa Diseases Intelligence Surveillance and Interventions Foundation (ADISIF), Yaoundé, République du Cameroun
[3]Faculty of Basic Medical Sciences, Department of Human Biochemistry, Nnamdi Azikiwe University Awka, Nnewi Campus, Nigeria
[4]Department of Public Health, School of Allied & Environmental Health, Kwara State University, Malete, Federal Republic of Nigeria
[5]Health and Education Quality Systems Strengthening (HQESS), Freetown, Sierra Leone
[6]Public Health Development Initiative (PHDI), Monrovia, Liberia
[7]Service de Biochimie, Université de Yaoundé I, Yaoundé, République du Cameroun
[8]Faculté des Sciences Biomédicales et Pharmaceutiques, Université des Montagnes, Bagangté, République du Cameroun

Correspondence: Ernest Tambo, Sydney Brenner Institute for Molecular Bioscience, Wits 21st Century Institute, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa. & Africa Diseases Intelligence Surveillance and Interventions Foundation (ADISIF), YaoundÃ©, RÃ©publique du Cameroun, Email tambo0711@gmail.com

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Introduction

The Ebola epidemic's death toll has climbed to at least 4,922 out of 10,141 known cases in eight countries reported by the World Health Organization (WHO) as an international public health concern in West Africa. Unprecedented Ebola outbreaks in West African countries mainly Guinea, Liberia and Sierra Leone has been accounted for 27,609 cases and 11,261 deaths as of July 5th 2015, a figure that health experts fear may be significantly underreported.[1] The WHO estimated the true toll may be 1.5times higher in Guinea, 2.5times higher in Liberia and twice the reported rate in Sierra Leone.[2] Demographic explosion and health transition in the last two decades in Sub-Sahara Africa (SSA) has been of public health concern. The world's human population is estimated to cross 2.2billion people by 2050 and the trajectory of the population of SSA is set to double significant within next generation according to World Bank data.[2,3] In these countries, the worrisome scenarios have been keeping cases in the highly infectious end stages or suspected relatives at home rather than getting treated in Ebola health centres already overcrowded and perceived as death sentence due to lack or limited coherent care. Also some cases burying their dead in accordance with Africa traditional beliefs and cultural practices, with neither official death clearance nor respect or adherence to safety precautions. Notably, Senegal, Mali, Nigeria and Liberia have successfully contained outbreaks and been declared Ebola free by the WHO certification expert committee.[1,4]

The rapid Ebola transmission dynamics is of the essence of effective vaccines and drugs to counter the constraints of timely financial mobilization and provision of humanitarian emergency relief supplies. In addition, active surveillance systems including effective community engagement and empowerment, prompt detection case investigation, tracing and mandatory quarantine/isolation measures for at least for 21-42days of high-risk suspected or probable individuals that had contact with Ebola-infected patients at home or in Ebola Treatment Centres.[1,4,5] These are necessary steps in improving and guiding evidence-based decision making policies, humanitarian response, priority in quality care interventions and efficient service delivery. The innovative supportive measures and recommendations should be applied in improving and fostering significant change in vulnerable countries health systems programming, policies and economic enhancements, which may contribute to compliance to international health regulations and global health initiatives in diseases prevention and control.[4,6] Nevertheless, robust and sustainable innovative approaches should be developed and implemented for

effective Ebola community-based immunization programs and treatments in prevention and control of regional and global outbreak threat and public health burden.[4,5] The need to understand the potential benefits of intensive surveillance and screening programs of vulnerable population and travellers in an integrated approach require more research and development (R&D) investments efforts of all stakeholders.

Significant science and technological advancements have increasingly been applied in improving health care and agricultural productivity. Although, the slow population growth in recent years in many African countries has been associated with HIV/AIDS pandemic, high rates of malaria, TB, maternal and infant mortality, and emerging outbreaks (e.g. Ebola, influenza, meningitis, cholera, polio, etc.). Africa is expected to record the world's largest population growth from 1.1billion to 2.4billion between now and 2050 (Figure 1).

Figure 1 Rising population demography in Africa.

People crowd a street in a market in Lagos, which is expected to overtake Cairo soon as Africa's largest city.

This paper provides insights into Ebola immunization programs adoption and implementation based on innovative health systems planning and redesigning and United Nations (UN) Africa population trend and dynamics forecasting. But also in pioneering African government population health and policy on fertility rate control including improving family planning services, more efficient maternal and child care packages. Hence, it further advocates in galvanising the strengthening public-private partnerships and collaborations in Ebola vaccines R & D and clinical trials investments, promoting community participation and capacity empowerment in achieving the UN Sustainable Development Goals (SDGs) and global health security agenda.

Chronology and progress in ebola vaccines and treatments

The deadly Ebola epidemic in Africa can only be conquered by mass deployment of safe, effective and deliverable Ebola vaccines to boost and protect human immune system response. However the long unprecedented epidemics underscore the need for more quicker and accelerated actions in vaccines R&D investment by all actors. At this time, there are no vaccines to protect against EVD licensed for use in humans. Clinical trials for several candidate vaccines are in various phases and a safe and effective vaccine is hoped for by the end of 2015 and there are no proven Ebola vaccines to prevent individuals becoming infected[4–9] (Table 1).

Currently, into human experimental clinical trials of multivalent DNA vaccine against EVD is ongoing in West Africa and in regions neighbouring EVD-endemic areas including vaccine candidates cAd3-EBOV (cAd3), from GlaxoSmithKline (GSK) and the U.S. National Institute of Allergy and Infectious Diseases and rVSVΔG-EBOV-GP (rVSV), from New Link Genetics and the Public Health Agency of Canada, Ad26-EBOV and MVA-EBOV by Johnson & Johnson and Bavarian Nordic and Recombinant protein Ebola vaccine candidate by Novavax as well as Convalescent plasma are ongoing. Results from Phase I clinical trials for two vaccine candidates - ChAd3-ZEBOV and VSV-EBOV have been shown to be safe and well tolerated in humans.[10–13] Both cAd3 and rVSV vaccine candidates at two different doses (1×1010 vp, 2.5×1010 vp, and 5×1010 vp). and 2x1010PU and 2x1011PU) respectively have demonstrated 100% efficacy in studies in nonhuman primates, but how that will translate to human subjects remains unknown as the minimum antibody titre needed to confer protection and common adverse events in humans is unknown. These studies will assess safety, side effects, and immunogenicity, including antibody responses as measured by enzyme-linked immunosorbent assay (ELISA) and neutralization assays and T-cell immune responses as measured by intracellular cytokine.[5,12,14] Other potential therapies under identification, verification, safety and efficacy exploration include Favipiravir Brincidofovir, Interferons, ZMapp, Amodiaquine, Atorvostatin plus Irbesartan / Clomiphene and amiodarone.[1] Few data on long term efficacy and safety in human is available. Yet Phase III of vaccine trial of VSV-EBOV efficacy has shown highly effective against Ebola, but more conclusive evidence is needed on its capacity to protect populations through the herd immunity.[15,16]

A shared and flexibility Ebola international partnerships and health plans that reflects strategic priorities is needed to support preparedness for and response strategies in EVD epidemics, including pre-positioning and capacity building, developing health programme plan, and vaccines products accessibility and availability in most vulnerable remotes communities. Also effective and integrated coordination and community participation of both vulnerable and non as well as travellers in the context of Ebola epidemic response and vaccination is required. A number Ebola candidate vaccines are at preclinical and clinical stages in the development pipeline.[10,11,13,14] There is a need for careful multicenter clinical trials documentation and long term pharmacovigilance to ensuring that mass immunization safety and efficacy outcomes. Also, reliable and sustainable surveillance and monitoring systems including vaccines procurement and supply chains management as well as other medical equipment are important at national and global level. Effective integrated nationwide and regional Ebola mass immunization approach, well defined planning with standard operating procedures and guidance are much needed in Ebola immunization policy formulation and monitoring their effectiveness post marketing Ebola immunization strategy.

It is also important to nurture long term design, planning, implementation and evaluation of vaccination interventions in emergencies, including detailed adequate safety and immunogenicity assessment and communication towards campaigns and routine vaccination vital in setting up national or regional disease surveillance systems.

Population dynamics, globalisation and EVD outbreak burden in africa

As African population growth and patterns varied from country to country and future trend projections depend on assumptions about vital rates. The world population is projected to grow from 6.1billion in 2000 to 8.9billion (47 % increase) in 2050 according

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to UN and World Bank projections. Hence, Africa population growth will be much faster and will add 1.0billion and rise from 13-20% of world population.[2,3] The future impact of national and global Ebola immunization and prompt treatments on population growth and quest for quality health and well-being, social justice, productivity and health equity in achieving the SDGs is underscored.

Maximizing Ebola immunization business investment requires building effective strategic plans, forecasting across all levels to gain fundamental information and knowledge to create an effective and profitable Ebola vaccine ventures network and mechanisms.[16,17] Global air traffic has grown in volumes in the last decades providing thousands of unduplicated international country pairs, number of passengers, and tonnes of freight across different region with direct implications on airlines projections with increasing risk of international dissemination especially with major commercial airports affected in West Africa air traffic and imports.[2,3] Recent temporal and spatial epidemics events around the world have taught us that Ebola outbreaks and public health concerns is increasingly risky with the intensification of globalization of travel and trade, environmental and climate changes and growing inequalities. Also migration into mega-cities has led to new possibilities of cross-transmission of diseases and outbreaks associated consequences and problems, including higher rates of poverty and unemployment, and environmental degradation.[2,5]

Table 1 Chronology ofEbola outbreak prevalence and mortalityin African sub-regions

Sub Region	Country	Population 2013 (million)	Ebola Outbreak Year and Species	Cases (n)	Deaths (n)	Fatality Rate (%)	Survivor Rate (%)
Western Africa	Guinea	1,611	Zaire ebolavirus, 2014	1037	658	63.45	36.55
	Liberia	3,955	Zaire ebolavirus, 2014	3289	1702	51.74	48.25
	Sierra Leone	5,696	Zaire ebolavirus, 2014	1890	649	34.33	65.66
	Nigeria	173.6	Zaire ebolavirus,2014	32	13	40.65	59.37
	Senegal	14.13	Zaire ebolavirus, 2014	1	0	0	100
	Mali	15.3	Zaire ebolavirus, 2014	1	1	100	0
	Ivory Coast	21,075	Taï Forest ebolavirus, 1994	1	0	0	100
Central Africa	Gabon	1,475	Zaire ebolavirus,1994, 1996 and 2001/02.	208	145	69.71	30.29
	Congo	3,683	Zaire ebolavirus, 2001/02. 2003 and 2005	249	207	83.13	16.87
	DR Congo	66,020	Zaire ebolavirus, 1977 ;1995 ;2005 ; 2007 ; 2008, 2012 and 2014				
Eastern Africa	South Sudan	8.26	Sudan ebolavirus 1976, 1979, 2004	335	180	53.73	46.27
	Uganda	32,710	Zaire ebolavirus, 2000 ;B. ebolavirus, 2007 ;Zaire ebolavirus, 2011 ; Sudan ebolavirus,2012 ;Zaire ebolavirus, 2013	606	284	46.86	53.14
	Angola	21,47	Ebola like Marburg virus,2005				
				101	93	92	8
Southern Africa	South Africa	50,110	Zaire ebolavirus,1996	1	1	100	0

Sharing the potential benefits of national ebola immunization programs and treatments

Our findings provide evidence that can allow and assist policymakers and stakeholders to develop and implement evidence-based health programs for post 2015 MDGs by looking beyond the global picture to those specific to African continent.[18,19] More detail and attention on the trends on disease and outbreaks burden rather than have a one-size-fits-all health plan and understanding you have of context and need the better able the system is to respond appropriately. Ebola immunology (the development of new Ebola vaccines) could play a major contributor in boosting human immunity and protection against Ebola infection or transmission and eventually eradication of the EVD. Lessons learnt from national polio immunization challenges and issues impact can serve as guide pending promising preliminary results from ongoing preclinical trials, clinical trials in West Africa and healthy volunteers. Yet, uncertainty remains regarding long term safety and efficacy of most Ebola experimental vaccines and success of spurious immunization programs and treatments, its cost effectiveness and gains require more research in Sub-Sahara Africa and elsewhere including travel medicine.[20,21]

The hopes of Ebola mass immunization benefits in averting the huge tool of deaths, disability and socio-economic consequences is one of the most cost-effective ways in supporting an ambitious achievement of SDGs and global health initiatives.[10,21] Also in nurturing community and population productivity, effective health programming including community-based activities such as health education, capacity building and training, upgrading of complex logistical and cold chain systems and improving human development in Africa and worldwide, but also fostering new partnerships, new country commitments in new global health programs and ambition is required. Aware of the persistent conflicts and wars events, mining, deforestation and ecosystem degradation, weak health systems and poor sanitation, and climate changes have a huge impact on outbreaks and emerging infectious diseases, Ebola infection is likely to shift from epidemic to endemicity and far from over across Africa and

globally.[21,22] However, with a depth of commitment from all levels of government and civil society and dedication of significant resources to scaling up community acceptance and resilience immunization, in boosting effective Ebola Research and Development(R & D) innovative solutions and interventions across world pharmaceutical industries. As Ebola outbreak dynamics spread persists, the implications on globalization of travel such as decreased commercial airlines activities in affected areas with potential of expansion of epidemics around the globe. The recent past unforgiveable West Africa Ebola scenario showed the urgent need to increase the development and speeding implementation of Ebola immunization programmes in most endemic countries especially in Africa, South East Asia and South America including Ebola immunization and information traveller's medicine. Globally, the importance of winning the fight against Ebola and other emerging infectious diseases is imperative in the 21st century and beyond.[12,13] There is a need for national commitment and public-private investment in strengthening health systems and Ebola robust population-wide immunization with efficient immunization delivery systems and health advice and other health interventions.[11] This is vital in strengthening the expectations of Ebola vaccines financing and in shaping vaccine markets sustainability over time. The effectiveness is further supported by the Africa Union emergency response funds and WHO-UN emergency fund on immunization programmes. For example the vaccine Zmapp development is one of the most advanced of the experimental treatments and has be proven effective in preclinical and currently used as compassionate drug in Ebola crisis in West Africa, but limited stocks.[5,23]

Public private partnerships (PPPs) including communities in developing medium to long-term relationships in Ebola immunization investment and to deliver vaccine health asset and service should be underpinned in public health programmes those improving health and life expectancy, community productivity and quality health or interventions outcomes. There is a need to leverage on private sector expertise and shared responsibility towards well maintained vaccines storage and delivery services, capacity development and training, continuous vaccination awareness and education, cost-effective public infrastructure, and facilities are paramount in the maintenance and operation, quality of and to share benefits with the governments, municipalities and community at large. The importance of public-private partnership (PPP) in providing empowerment-based approaches, diligent planning and transparent focus on dual strengths in supporting enablement and skill-building those promote survivors to create stability and supports. Also provide information and understanding on its roles on acquired immunity and responsibilities in the community, respect to human dignity, connectedness, and hopes.[1,22,24,25]

Importantly, public health professional and stakeholders should set up primary health care early warning and surveillance-response systems for rapid disease risk assessment approaches and tools to detect, identify, analyze within the first week of the threat in order as well as basic public health medical supply needs and provide an evidence-based and timely comprehensive response.[22,26] Appropriately, Ebola vaccine development venture might be different from documented vaccine platforms and provide novel financial and economic model in R&D strategic investment, pricing and patent policies to successfully safe and effective products in improving appropriate preventive measures in safeguarding the health and wellbeing of vulnerablelow-income and developing countriespopulations.

Conclusion

Effective deployment of Ebola immunization programs requires a robust health programming and preparedness including Ebola vaccines procurement and cold chain management with long term pharmacovigilance. As well other community-based interventions to foster and improve adequate local community resilience and empowerment should be imperative. Support from government, private organizations and the international community partnerships and collaborations are crucial in strengthening national and regional Ebola Immunization policy formulation and successful goals and immunization metrics outcomes. Translation of evidence-based cost effective national health schemes, diseases and epidemics prevention, early warning and surveillance systems and emergency response policies, strategies and plans in ensuring the attainment of the SDGs, Universal Health Coverage under the global health initiatives and actions. While vulnerable Africans and travellers await patiently for effective and safe Ebola vaccine, the future promising mass population Ebola immunization programmes, as we advocate the urgency in adoption and implementation, in reinforcing travel medicine, national and global health security.

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Conflicts of interest

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