No Time to Lose

The return of Ebola Is the world better prepared than 40 years ago?

Peter Piot

European Tribute to Stanley Falkow

Institut Pasteur

29 September 2016







"....vino che rosso avanti il focolare brilla, al fischiare della tramontana, che giunge come un fragoroso mare e s'allontana simile a sogno: quando su le strade volano foglie cui persegue il cuore..." G. Pascoli

BRUNELLO DI MONTALCINO DENOMINAZIONE DI ORIGINE CONTROLLATA E GARANTITA

2011

ion formell

11.10.17



ISOLATION OF MARBURG-LIKE VIRUS FROM A CASE OF HÆMORRHAGIC FEVER IN ZAIRE

S. PATTYN W. JACOB G. VAN DER GROEN P. PIOT G. COURTEILLE

University of Antwerp and Institute of Tropical Medicine, Antwerp, Belgium, and Clinique Ngaliema, Kinshasa, Zaire

WE record here our findings in the investigation of the outbreak of severe hæmorrhagic fever in Zaire.

SOURCE AND EXAMINATION OF SPECIMEN

A 42-year-old woman (patient M.E.) fell ill on Sept. 23, 1976, in Yambuku, Equateur Province, Zaire. She was transported by air on Sept. 25 to Kinshasa, where a hæmorrhagic syndrome gradually developed. Clotted blood taken on the 5th day of illness was sent on ice to the Institute of Tropical Medicine, Antwerp. The sample arrived in the evening of Sept. 29 and was kept in the refrigerator.

The next morning serum was inoculated into 6 young adult



Preliminary Communications

ISOLATION AND PARTIAL CHARACTERISATION

A NEW VIRUS CAUSING ACUTE HEMORRHAGIC FEVER IN ZAIRE

OF

K. M. Johnson J. V. Lange P. A. WEBB F. A. Murphy

Virology Division, Center for Disease Control, Atlanta, Georgia 30333, U.S.A.

An outbreak of hæmorrhagic fever with an exceptionally high mortality-rate occurred in southern Sudan



peak case-rates in September, tional Commission operated in tober onward.^{1 2} Blood and tisons with hæmorrhagic disease in Belgium and England, and ratories appear in the accome these specimens were being wen (Microbiological Research Down) sent an aliquot of an m a patient in Zaire (no. 718, Center for Disease Control, idy.

l subsequent acute specimens, o (African green monkey) cells. inct cytopathic change (focal was evident, and an aliquot of emoved for negative contrast d 51 h 17 54

0

b



The Ebola River



Infection and transmission routes











Distribution of bats suspected to reservoir Ebola



Hypsignathus monstrosus

С



Epomops franqueti





Myonycteris torquata





Bombali virus & Ebola in bats (Goldstein et al

2018)

- Complete genome of a new ebolavirus, Bombali virus (BOMV) detected in free-tailed bats in Sierra Leone (little free-tailed (Chaerephon pumilus) and Angolan free-tailed (Mops condylurus)).
- The bats were found roosting inside houses, indicating the potential for human transmission.
- Goldstein et al show that the viral glycoprotein can mediate entry into human cells. However, further studies are required to investigate whether exposure has actually occurred or if BOMV is pathogenic in humans.

BRIEF COMMUNICATION https://doi.org/10.1038/s41564-018-0227-2

nature microbiology

Corrected: Author Correction

The discovery of Bombali virus adds further support for bats as hosts of ebolaviruses

Tracey Goldstein^{®114*}, Simon J. Anthony^{2,3,414*}, Aiah Gbakima⁵, Brian H. Bird¹, James Bangura⁵, Alexandre Tremeau-Bravard¹, Manjunatha N. Belaganahalli[®], Heather L. Wells^{®2}, Jasjeet K. Dhanota^{®1}, Eliza Liang^{2,4}, Michael Grodus², Rohit K. Jangra⁶, Veronica A. DeJesus⁶, Gorka Lasso⁷, Brett R. Smith¹, Amara Jambai⁸, Brima O. Kamara⁹, Sorie Kamara¹⁰, William Bangura¹¹, Corina Monagin¹¹², Sagi Shapira⁷¹³, Christine K. Johnson¹, Karen Saylors¹², Edward M. Rubin¹², Kartik Chandran⁶, W. Ian Lipkin^{2,3} and Jonna A. K. Mazet¹

- The government of Liberia, EcoHealth Alliance, Columbia University Mailman School identified
 Ebola virus in a bat in Liberia.
- genetic material from the virus and ebolavirus antibodies against it in a Greater Long-fingered bat (*Miniopterus inflatus*) in Liberia's northeastern Nimba District.
- Researchers are working to determine whether the strain found in the bat is exactly the same one associated with the 2013-2016 outbreak. The evidence so far, from about 20 percent of the virus' genome, suggests that it is closely related.
- No human cases of Ebola are linked to this discovery



Ebola & Marburg Outbreaks in Africa



Source: Public Health England (https://www.gov.uk/ebola-and-marburg-haemorrhagic-feversoutbreaks-and-case-locations#historic-map-of-outbreaks)

MEDICINE



West Africa Ebola outbreak



Community reactions





Ebola's perfect storm

he devastating Ebola epidemic in West Africa is the result of a perfect storm: dysfunctional health services as the result of decades of war, low public trust in government and Western medicine, traditional beliefs and even denials about the cause or existence of the virus, and burial practices that involve contact with contagious Ebola-infected corpses. There are now five affected West African countries: Guinea, Liberia, Nigeria, Sierra Leone, and most recently, Senegal. Ebola has killed around 2000 and infected more than 3500, with over 40% of cases occurring within the past few weeks.

The World Health Organization (WHO) predicts that 20,000 may become infected. This fast pace of Ebola's spread is a grim reminder that epidemics are a global threat and that the only way to get this virus under control is through a rapid response at a massive global scale—much stronger than the current efforts.

West African governments and the international community have been slow to act in a way commensurate to a major threat to health, economies, and societal stability. It took nearly 4 months after the first patient died in December 2013 before the outbreak was confirmed as being caused by the Ebola virus. Despite multiple calls by Médecins Sans Frontières (MSF), WHO and the governments concerned only declared the epidemic a public health emergency in August 2014 Finally national authoripopulations in quarantine. This must be done while dealing with other endemic health challenges: Uninfected people are dying from treatable diseases because of closed or abandoned health facilities, the cancellation of international flights to the infected countries is creating an obstacle to international support, and there are growing concerns about sending medical help without a plan of treatment for these workers (around 150 doctors and nurses have died of Ebola, and 240 medical staff are infected). A

Peter Piot is

director and

professor of Gl

Health at the

London School

of Hygiene &

London, UK.

lshtm.ac.uk

E-mail: directo

Tropical Medic

This is an opportune time to accelerate clinical evaluation of experimental therapies, vaccines, and

"Let us hope that this is the last Ebola outbreak where all we have to offer is isolation and quarantine, instead of a vaccine and treatment" diagnostics, while respecting ethical and scientific standards for such trials. Human trials of Ebola vaccines and therapies are about to start. WHO has announced that compassionate use of experimental therapies is ethically justified, even if they have not been tested in humans. An exceptional crisis requires an exceptional response. One of the lessons from the AIDS response is that prevention has little credibility if treatment for those infected is not available. Let us hope that this is the last Ebola outbreak where all we have to offer is isolation and guarantine, instead of a vaccine and treatment.

The impact of this epidemic will last long after its end. Health systems will need to be rebuilt, disease surveillance systems established, trust in health services and authorities rebuilt, orphans educated and protected and economic losses



Fig. 3. Molecular dating of the 2014 outbreak. (A) BEAST dating of the set GN, Guinea; DRC, Democratic Republic of Congo; time of most recent comme October 2002 to May 2006]. (B) BEAST dating of the tMRCA of the 2014 We tMRCA of the Sierra Leone lineages (23 April; 95% HPD, 2 April to 13 May). Posterior support for major nodes is shown.

Articles

Efficacy and effectiveness of an rVSV-vectored vaccine in preventing Ebola virus disease: final results from the Guinea ring vaccination, open-label, cluster-randomised trial (Ebola Ça Suffit!)

Dr Ana Maria Henao-Restrepo, MD Anton Camacho, PhD, Prof Ira M Longini, PhD, Conall H Watson, MFPH, Prof W John Edmunds, PhD, Prof Matthias Egger, PhD, Miles W Carroll, PhD, Natalie E Dean, PhD, Ibrahima Diatta, MSc, Moussa Doumbia, MD, Bertrand Draguez, MD, Sophie Duraffour, PhD, Godwin Enwere, FWACP, Rebecca Grais, PhD, Stephan Gunther, MD, Pierre-Stéphane Gsell, PhD, Stefanie Hossmann, MSc, Sara Viksmoen Watle, MD, Prof Mandy Kader Kondé, PhD, Sakoba Kéïta, MD, Souleymane Kone, MSc, Eewa Kuisma, PhD, Prof Myron M Levine, MD, Sema Mandal, MD, Thomas Mauget, MBA, Gunnstein Norheim, PhD, Ximena Riveros, MSc, Aboubacar Soumah, MD, Sven Trelle, MD, Andrea S Vicari, PhD, Prof John-Arne Røttingen, MD[†], Marie-Paule Kieny, PhD[†]

Ad26.ZEBOV/MVA-BN-Filo Ebola Vaccine ID Milligan et al, JAMA 2016;315:1610



The NEW ENGLAND JOURNAL of MEDICINE



The NEW ENGLAND JOURNAL of MEDICINE



ORIGINAL ARTICLE

Evaluation of Convalescent Plasma for Ebola Virus Disease in Guinea

Johan van Griensven, M.D., Ph.D., Tansy Edwards, M.Sc., Xavier de Lamballerie, M.D., Ph.D., Malcolm G. Semple, M.D., Ph.D., Pierre Gallian, Ph.D., Sylvain Baize, Ph.D., Peter W. Horby, M.D., Ph.D., Hervé Raoul, Ph.D., N'Faly Magassouba, Ph.D., Annick Antierens, M.D., Carolyn Lomas, M.D., Ousmane Faye, Ph.D., Amadou A. Sall, Ph.D., Katrien Fransen, M.Sc., Jozefien Buvze, Ph.D., Raffaella Ravinetto, Pharm.D., Pierre Tiberghien, M.D., Ph.D., Yves Claevs, M.Sc., Maaike De Crop.

ORIGINAL ARTICLE

A Randomized, Controlled Trial of ZMapp for Ebola Vin Infection

The PREVAIL II Writing Group, for the Multi-National PREVAIL II Study Team N Engl J Med 2016; 375:1448-1456 | October 13, 2016 | DOI: 10.1056/NEJMoa1604330

A time-scaled phylogenetic tree of 262 EBOV genomes from Guinea, Sierra Leone, Liberia and Mali.



MW Carroll et al. Nature 000, 1-5 (2015) doi:10.1038/nature14594



Geographic Dispersion of a Single Genetic Lineage in Sierra Leone



Source: Gire et al, Science 2014,345:6202





Early transmission and case fatality of Ebola virus at the index site of the 2013-16 west African Ebola outbreak: a cross-sectional seroprevalence survey

Joseph W S Timothy, Yper Hall, Joseph Akoi-Boré, Boubacar Diallo, Thomas R W Tipton, Hilary Bower, Thomas Strecker, Judith R Glynn*, Miles W Carroll*

237 participants from 27 households

- Ebola virus infection was more widespread in this spillover population than previously recognised (21 vs 11 ٠ cases) and that case fatality was lower than previously reported (55.6% vs 100% in adults)
- Their findings suggest minimally symptomatic infections were common in the West African Ebola epidemic and • that a substantial portion of cases might have been undetected during the outbreak

Asymptomatic infection and unrecognised Ebola virus disease 🕢 🦒 🖲 in Ebola-affected households in Sierra Leone: a cross-sectional study using a new non-invasive assay for antibodies to **Ebola virus**

Judith R Glynn, Hilary Bower, Sembia Johnson, Catherine F Houlihan, Carla Montesano, Janet T Scott, Malcolm G Semple, Mohammed S Banqura, Alie Joshua Kamara, Osman Kamara, Saidu H Mansaray, Daniel Sesay, Cecilia Turay, Steven Dicks, Raoul E Guetiya Wadoum, Vittorio Colizzi, Francesco Checchi, Dhan Samuel*, Richard S Tedder

Summary

Background The frequency of asymptomatic infection with Ebola virus is unclear: previous estimates vary and there is no standard test. Asymptomatic infection with Ebola virus could contribute to population immunity, reducing spread. If people with asymptomatic infection are infectious it could explain re-emergences of Ebola virus disease (EVD) without known contact.

Methods We validated a new oral fluid anti-glycoprotein IgG capture assay among survivors from Kerry Town Ebola Treatment Centre and controls from communities unaffected by EVD in Sierra Leone. We then assessed the seroprevalence

Lancet Infect Dis 2017; 17:645-53

Published Online February 27, 2017 http://dx.doi.org/10.1016/ S1473-3099(17)30111-1

Soo Commont page F70



OPEN ACCESS







ORIGINAL ARTICLE

Ebola Survivors

A Longitudinal Study of Ebola Sequelae in Liberia

The PREVAIL III Study Group★

- **PREVAIL** study of 966 survivors of EVD and close contacts (2,350),
- Survivors of EVD had a higher prevalence of health issues:
 - more survivors than controls had abnormal abdominal, chest, neurologic, and musculoskeletal findings and uveitis.
 - Other than uveitis (prevalence at enrolment, 26.4% vs. 12.1%; at year 1, 33.3% vs. 15.4%), the prevalence of these conditions declined during follow-up in both groups.
- EBOV RNA was detected in semen samples from 30% of the survivors tested, with a maximum time from illness to detection of 40 months.



Figure 2. Frequency of Semen Samples Testing Positive for Ebola Virus RNA since the Time of Acute Infection.

PREVAIL III (2019)

Health Policy

Will Ebola change the game? Ten essential reforms before the @ next pandemic. The report of the Harvard-LSHTM Independent Panel on the Global Response to Ebola

Suerie Moon, Devi Sridhar, Muhammad A Pate, Ashish K Jha, Chelsea Clinton, Sophie Delaunay, Valnora Edwin, Mosoka Fallah, David P Fidler, Laurie Garrett, Eric Goosby, Lawrence O Gostin, David L Heymann, Kelley Lee, Gabriel M Leung, J Stephen Morrison, Jorge Saavedra, Marcel Tanner, Jennifer A Leigh, Benjamin Hawkins, Liana R Woskie, Peter Piot

SECOND REPORT OF THE ADVISORY GROUP ON REFORM OF WHO'S WORK IN OUTBREAKS AND EMERGEN

ADVISORY GROUP ON REFORM OF WHO'S WORK IN OUTBREAKS AND EMERGENCIES

SECOND REPORT | JANUARY 18TH 2016



re Pub	cations C	ountries	Programmes	Governance	About WHO
dia	ontro				
lla	senue				
lO r	esponse	to the	Ebola Int	erim Asse	ssment
Panel r	enort				
anori	opon				
IO statem	ent				
uly 2015					
WHO welco	mes the repo	rt from the	e Ebola Interim A	Assessment Pan	el and thanks the
hard-workir	a members fo	or their rap	id review, analys	is and recomme	endations.

Englis

The Neglected Dimension of Global Security

A Framework to Counter Infectious Disease Crises



Distr.: General 9 February 2016 Original: English

Recommendations of post-Ebola panels

- Strengthening of epidemic preparedness and public health systems in countries
- Need for reform of WHO and global health governance, incl IHR
- More engagement with communities, NGOs and private sector
- Timely sharing of data and samples
- R&D systems where no market incentives



Coalition for Epidemic Preparedness Innovations

FINANCIAL TIMES

UK COMPANIES MARKETS OPINION WORK & CAREERS LIFE & ARTS

Davos + Add to myFT

Davos launch for coalition to prevent epidemics of emerging viruses

Billion-dollar programme aims to cut vaccine-development time from 12 years to one

DAVOS | Wed Jan 18, 2017 | 5:03pm EST

Global coalition aims to outpace epidemics [§]/_{ai} with new vaccines

business lifestyle fashion environment tech travel = browse all sections

scotland wales northern ireland education me

\$460m pledged for vaccine initiative aimed at preventing global epidemics

Lassa, Mers and Nipah will be first diseases targeted by programme announced at Davos by coalition of governments, philanthropists and business

Lassa Fever



MERS





Nipah





10th epidemic of Ebola Virus in DR Congo



Figure 2 : Distribution des cas confirmés/probables de la maladie à virus Ebola par zone de santé, du 1 mai 2018 au 24 mai 2019 et selon la date de confirmation.

Ebola virus disease cases by week of illness onset



UK Public Health Rapid Support Team

Destroyed Ebola Treatment Units in Katwa



Ebola Treatment Centers

- **rVSV (Merck)** : ring vaccination, exposed health care workers
- Ad26/MVA (Janssen): vaccination of people at risk of Ebola virus infection, HCW/FLW, support staff, military personnel, aid workers
- Vaccination of general population in "hot zones" ?





Yambuku Hospital Lab, DRC 2014







Peter Piot

Une course contre la montre

Mes combats contre les virus mortels, Sida et Ebola

