• EV activity ‘silent’ from 1979-1994, after which EV outbreaks reemerged with vigor
  – Intervals between recorded outbreaks shorter; recurring on 1-2 yearly basis; sometimes 2-3 times within one

• Ebola West Africa (2013-16) largest EVD outbreak in history

• West Africa: history of civil conflict
  – Poverty
  – Poor healthcare delivery and health facilities
  – Low levels of education
  – Large population movement & displacement
Population explosion:
- Increased pressure on food production, including access to bush meat (in Liberia, a critical source of protein exceeding 75% of country's meat use)

High human mobility
- W African region migration rates exceed movement in the rest of the world by >7-fold
- To capitals/other large towns/cities
- Across borders
Deaths:
- 8 May 2016: 28,616 cases; 11,310 deaths (overall case fatality: 40%) & > 10,000 survivors
- West African healthcare workers (HCW): 875 infections; 509 deaths, case fatality: 58% (In Sierra Leone: 72%)

Public health impact far greater than case counts:
- Crippling of an already weakened health sector & HCW losses
- Significant impact on other endemic diseases (e.g. malaria) & associated mortality
- Substantial economic losses for entire sub-region
- Social disruption
• Exposures: hunting, food-handling, butchering, community activities; burials
• Host susceptibility
• Poor hygiene
• Poor education
• Overcrowding
• Belief systems
• Mobility
Microbe: Zaire Ebolavirus

- ssRNA
- Reservoir: evidence for bats; other?
- Transmission: initially zoonotic, then human-to-human contact, mechanical aerosols
- Low infectious dose
- High virulence

- Contact blood/bodily fluids (saliva, breast milk, urine, stool and tears); convalescence: breast milk, semen
- No evidence of risk from casual skin contact with asymptomatic people
- Persistence & reinfection after ‘convalescence’
- Survivors; post-infection sequelae (short, long term)
# Epidemiological characteristics of the 2013-2016 West African Ebola outbreak

## Summary of Ebola outbreak characteristics in West Africa

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
<th>Current estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reproductive number ($R_0$):</td>
<td>Number of healthy people one sick individual infects over the course of his/her illness.</td>
<td>Guinea: 1.71</td>
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<tr>
<td></td>
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<td>Liberia: 1.83</td>
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<td></td>
<td></td>
<td>Sierra Leone: 2.02</td>
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<tr>
<td>Serial interval:</td>
<td>Time between consecutive people falling ill in a chain of transmission.</td>
<td>15.3 days</td>
</tr>
<tr>
<td>Incubation period:</td>
<td>Amount of time passed between a person becoming exposed to Ebola and when they start to show symptoms of the disease.</td>
<td>11.4 days</td>
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<tr>
<td>Doubling time:</td>
<td>Time taken for the number of sick individuals to double.</td>
<td>Guinea: 15.7 days</td>
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<tr>
<td></td>
<td></td>
<td>Liberia: 23.6 days</td>
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<tr>
<td></td>
<td></td>
<td>Sierra Leone: 30.2 days</td>
</tr>
<tr>
<td>Confirmed case fatality rate:</td>
<td>Number of people who die of confirmed Ebola infection.</td>
<td>Guinea: 70.7%</td>
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<td></td>
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<td>Liberia: 72.3%</td>
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<td></td>
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<td>Sierra Leone: 69.0%</td>
</tr>
<tr>
<td>Unconfirmed case fatality rate:</td>
<td>Number of people who die of suspected but not confirmed Ebola infection.</td>
<td>Guinea: 13%</td>
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<td>Liberia: 58%</td>
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<td></td>
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<td>Sierra Leone: 35%</td>
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</tbody>
</table>

*Source: Doi:10.1371/journal.pntd.0003652.t002*
Complexity of PPE
[2017: WHO Task Force on IPC, 1 Task Group looked at evidence for PPE]

- Differences in PPE items contained in packaged kits
- Discordant donning/doffing protocols; multiple steps (complexity)
- Regular training required
- Thermal discomfort & impaired mobility
- Scant evidence-based research regarding role of individual PPE items
Environment

Physical:

- Geographical & geophysical
- Location of epicentre
- Encroachment on tropical forest ecosystems (animal –human interface)
  - Guinean forest surrounding outbreak area: major biodiversity spot contains one quarter of all African mammalian fauna
  - Human encroachment; cumulative forest loss estimated to be between 83%-86%
- Porosity of borders

Cultural, religious, belief systems, political
Obstacles to the epidemic response

Poor infection prevention and control practices, inadequate healthcare facility infrastructure, poor healthcare delivery

Early outbreak population dynamics:
- Initial mistrust & hostility towards multinational Teams
- EVD attributed to witchcraft, zombification
- Denial of EVD existence, a ploy of government to get international funds
- Anger; towards government and public health messages
- Behavioral, religious & cultural diversity
- Stigma of survivors, the infected or thought to be infected
Fear!  Panic!!  Denial!

Media (social and conventional)

Rumors
Challenges inc. controversial public health messages

• ‘Do not eat bush game’
• Social distancing; no handshaking
• Closure of markets (economic implications) and recreational areas e.g. bars and discotheques
• Inequity regarding who gets vaccination / treatment
• Stopping of flights; border closures; travel bans
• Closure of mining operations (force majeur) - serious economic consequences for the W African sub-region
Cultural insensitivities ...

A healthcare worker checks a Liberian girl’s temperature ...
• Burial rituals and culture: dignity in burial

• Understanding Muslim burials
  – Engagement with Imams, Muftis and other influential community leaders
  – understanding how last rites are performed on the deceased (washing and preparation of the body);
  – identifying infection risks and looking at ways to overcome these
  – In Islam, 3 conditions exist where body preparation processes are curtailed: (i) death by water, persons who have died in a lake or water, (ii) death by burns/accidents, (iii) ‘other’ – permission of the highest ranking authority in a region
Bull*** our government is spreading it to reduce the population. Remember satan has control over governments. Also our own government worships satan.

Wow look at all this Bible prophecy coming true this tell me that it's time for all of us to give our lives to JESUS right now and be covered by his blood we all need to repent of all our sins and ask JESUS to forgive us.

This virus has the same symptoms with ZOMBIFICATION which was a voodoo practices; Zombie is defined as corpse said to be revived by witchcraft.

Americans have vaccine and probably they invent this virus during cold war and use on who else than poor Africans!! but they don't give vaccine to anyone except the 2 or 3 persons from USA few weeks ago who are healed while others (Africans especially) you will be died!!

Ebola is the lifeline for the American economy that has already tumbled over the edge. The virus can be more powerful than any bomb; especially if America holds the "cure".

America is going to release ebola in America and blame it on ISIS. New 9/11 and population control.

Our elites are particularly into genocide in Africa. You must not think that all white men wish to kill all black people. Its really all about oligarchs and elite Jew pigs.

I say drop a bomb on them they are a third world country destroy their kings a boom we get Africa and we can sell it.

It comes to me as if the doctors don't even care about Ebola victims. Once their infected, they are no longer human treat them like scum and leave them for dead as they slowly rot on the inside and die alone never to see their family again.

Social media: the blame and misconceptions

Catholic Archbishop: Ebola is punishment from God for homosexuality

October 24, 2014 by Michael Stone

Gays are under attack in Liberia after many Christian leaders, including Catholic Archbishop Lewis Zeigler of Monrovia, declared Ebola to be a punishment from God for the act of homosexuality.
Individual human behavior and movement
Host susceptibility

EBOV

Geo-climatic, geographical and ecological

Socio-cultural
  Traditional beliefs,
  Traditional healers and Witchdoctors,
  Religion,
  Burial practices

Suspicion and misconceptions

Political
Low-socioeconomic
Conclusions

• Inter-epidemic regular training & preparedness
• Geographic origin, population mobility and social circumstances favored the largest Ebola outbreak described to date
• Early social mobilization is crucial
• Effective use of social media
• National, traditional and community leaders must be involved; ownership crucial for sustainability
• Multi-scaled early warning and surveillance efforts needed locally, nationally, regionally and globally
• Further research needed: ecology, transmission, prevention & cure; design of, PPE & donning/doffing protocols