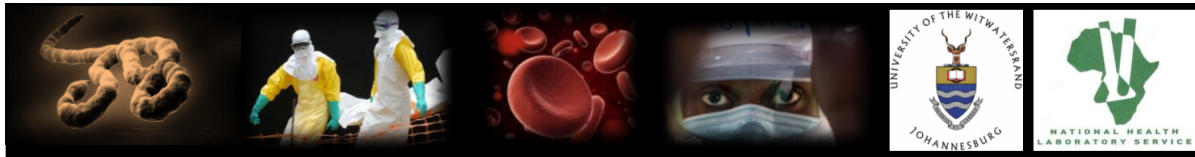


**'Superbugs': Filoviruses**  
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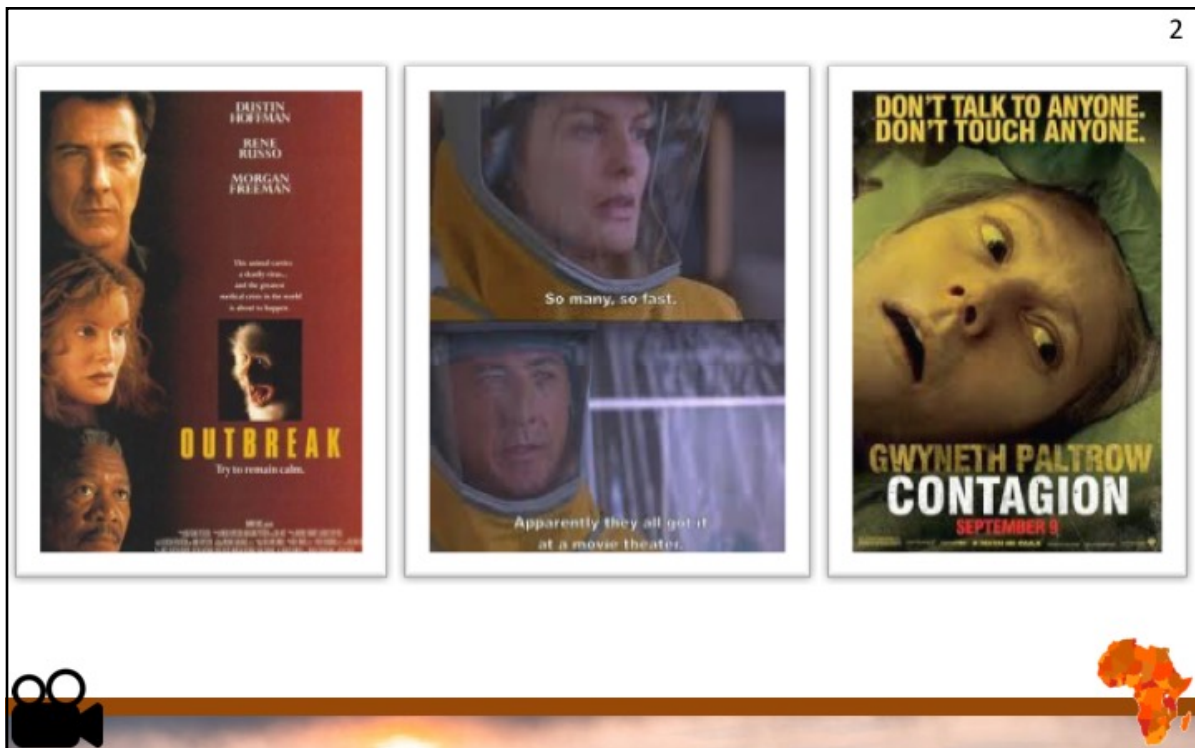
# 'Superbugs': Filoviruses

**Adriano G Duse**  
*Professor and Head: Division of Clinical Microbiology and Infectious Diseases  
School of Pathology of the NHLS and University of the Witwatersrand, Johannesburg, South Africa*

**Hosted by Prof. Sade Ogunsola**  
*President, Infection Control Africa Network, Nigeria*

Presentation design by Lindi Spezialetti – [lindi@topaz-inc.co.za](mailto:lindi@topaz-inc.co.za)  
[www.webbertraining.com](http://www.webbertraining.com) July 9, 2019

2



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## The Filoviruses

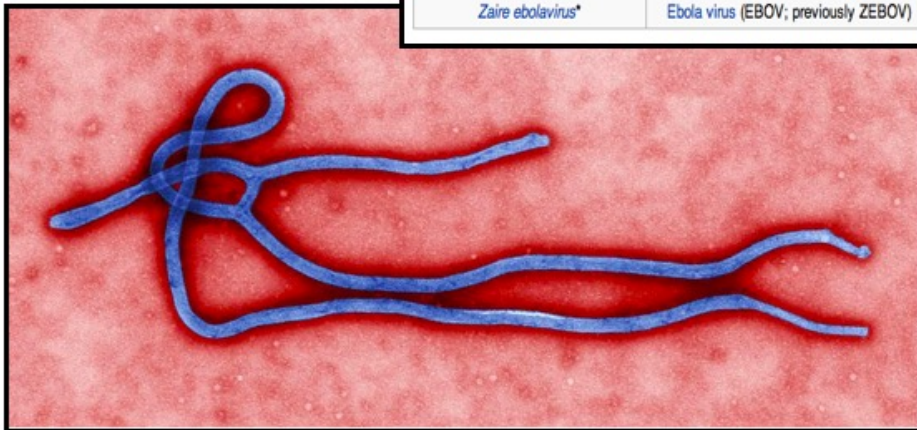
- Family: Filoviridae, at least 4 genera
  - Genus: Marburgvirus
    - Species: Marburg Marburgvirus;
    - 2 strains: Marburg (MARV) – ancestral location ? Uganda; RAVN (RAAV) [*Ravn* name of the Danish patient from whom first isolated]– ancestral location, ? Kenya
  - Genus: Dianlovirus
    - Species: Mengla virus ; Other species ?
    - Newly identified, China, phylogenetically between Ebola & Marburg viruses
    - Has potential to cause severe; actual disease-causing capability unknown
  - Genus: Cuevavirus
    - Species: Lloviu cuevavirus (LLOV) – Spain; also France & Portugal
    - Pathogenic to bats; no human infections described



**Family: *Filoviridae***  
 Single stranded RNA viruses  
 (filum – Latin – thread)

**Genus *Ebolavirus*: species and their EVD-causing viruses**

Species name	Virus name (Abbreviation)
<i>Bundibugyo ebolavirus</i> (accepted) <sup>[17]</sup>	Bundibugyo virus (BDBV; previously BEBOV)
<i>Sudan ebolavirus</i>	Sudan virus (SUDV; previously SEBOV)
<i>Tai Forest ebolavirus</i>	Tai Forest virus (TAFV; previously CIEBOV)
<i>Zaire ebolavirus</i> *	Ebola virus (EBOV; previously ZEBOV)



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**Isolation of genetically diverse Marburg virus in Egyptian fruit bats PLOS Aug 2009**

5



Kibuku Cave  
Uganda



Virus hunter, Watsa DRC

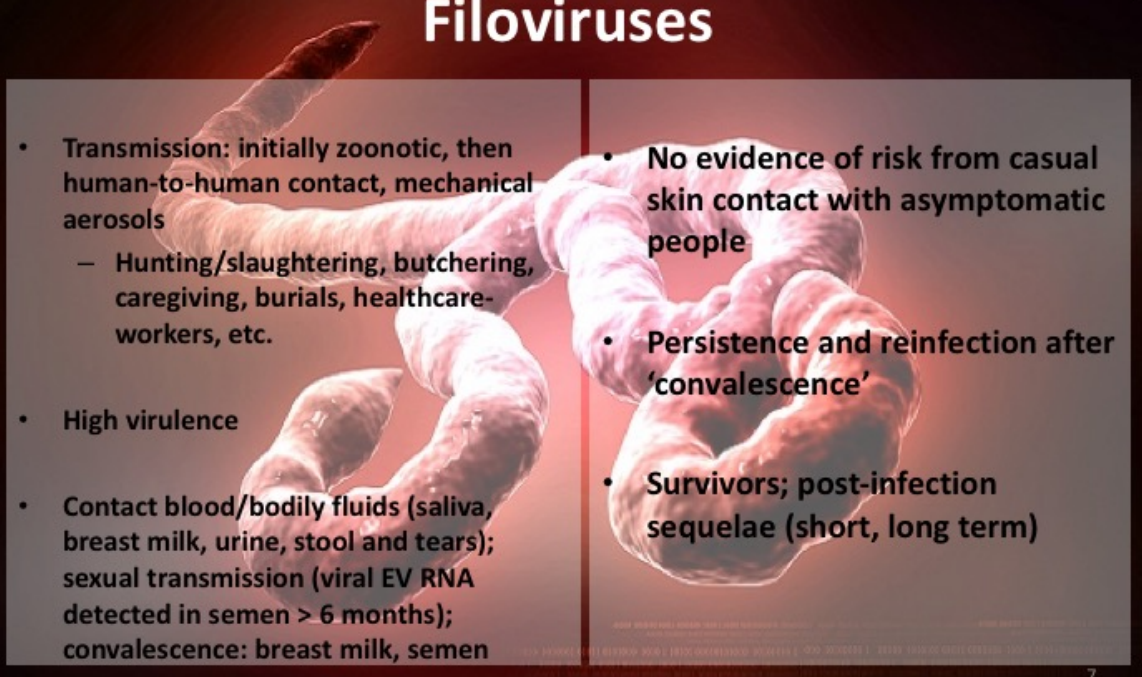


6

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7

## Filoviruses



- **Transmission: initially zoonotic, then human-to-human contact, mechanical aerosols**
  - Hunting/slaughtering, butchering, caregiving, burials, healthcare-workers, etc.
- **High virulence**
- **Contact blood/bodily fluids (saliva, breast milk, urine, stool and tears); sexual transmission (viral EV RNA detected in semen > 6 months); convalescence: breast milk, semen**
- **No evidence of risk from casual skin contact with asymptomatic people**
- **Persistence and reinfection after 'convalescence'**
- **Survivors; post-infection sequelae (short, long term)**

8

### Marburg virus activity over time (1967 – 2017)

Year	Virus	Geographic Location	Human Deaths	Cases	CFR
1967	MARV	Marburg and Frankfurt, GERMANY	7	29	24%
1967	MARV	Belgrade, YUGOSLAVIA	0	2	0%
1975	MARV	Johannesburg, SOUTH AFRICA	1	3	33%
1980	MARV	Nairobi, KENYA	1	2	50%
1987	RAVV	Nairobi, KENYA	1	1	100%
1988	MARV	Koltsovo, RUSSIA	1	1	100%
1990	MARV	Koltsovo, RUSSIA	0	1	0%
1998-2000	MARV & RAVV	Durba & Watsa, DEMOCRATIC REPUBLIC OF CONGO	128	154	83%
2004-2005	MARV	Uige, ANGOLA	227	252	90%
2007	MARV & RAVV	Kamwenge District, UGANDA	1	4	25%
2008	MARV	Colorado, USA	0	1	0%
2008	MARV	Lieden, NETHERLANDS	1	1	100%
2012	MARV	Kampala, Ibanda, Mbarara and Kabarole, UGANDA	9	18	50%
2014	MARV	Mpigi, UGANDA	1	1	100%
2017	MARV	Kween District, UGANDA	2	2	100%

Ref: wikipedia.org

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### Ebola virus activity over time (1976 – 2001)

Year	Virus	Geographic Location	Human Deaths	Cases	CFR
1976	SUDV /EBOV	Porton Down, UNITED KINGDOM (laboratory accident)	0	1	0%
1976	SUDV	Juba, Maridi, Nzara and Tembura, SUDAN	151	284	53%
1976	EBOV	Yambuku, ZAIRE	280	318	88%
1977	EBOV	Bonduni, ZAIRE	1	1	100%
1979	SUDV	Nzara, SUDAN	22	34	65%
1994	TAFV	Tai National Park, CÔTE D’IVOIRE	0	1	0%
1994-1995	EBOV	Woleu-Ntem and Ogooué-Ivindo Provinces, GABON	31	52	60%
1996	EBOV	Johannesburg, SOUTH AFRICA	1	2	50%
1995	EBOV	Kikwit, ZAIRE	254	315	81%
1996	EBOV	Mayibout, GABON	21	37	57%
1996	EBOV	Sergiyev Posad, RUSSIA (laboratory accident)	1	1	100%
1996-1997	EBOV	Ogooué-Ivindo Province, GABON; Cuvette-Ouest Department, REPUBLIC OF THE CONGO	45	60	75%
2000-2001	SUDV	Gulu, Mbarara and Masindi Districts, UGANDA	224	425	53%

10

### Ebola virus activity over time (2001 – current)

Year	Virus	Geographic Location	Human Deaths	Cases	CFR
2001-2002	EBOV	Ogooué-Ivindo Province, GABON; Cuvette-Ouest Department, REPUBLIC OF THE CONGO	107	135	79%
2002	EBOV	Ogooué-Ivindo Province, GABON; Cuvette-Ouest Department, REPUBLIC OF THE CONGO	10	11	91%
2002-2003	EBOV	Cuvette-Ouest Department, REPUBLIC OF THE CONGO; Ogooué-Ivindo Province, GABON	128	143	90%
2003	EBOV	Cuvette-Ouest Department, REPUBLIC OF THE CONGO	29	35	83%
2004	EBOV	Koitsovo, RUSSIA (laboratory accident)	1	1	100%
2004	SUDV	Yambio County, SUDAN	7	17	41%
2007	EBOV	Kasai Occidental Province, DEMOCRATIC REPUBLIC OF THE CONGO	186	264	71%
2007-2008	BDBV	Bundibugyo District, UGANDA	37	149	25%
2008-2009	EBOV	Kasai Occidental Province, DEMOCRATIC REPUBLIC OF THE CONGO	14	32	45%
2012	SUDV	Kibaale District, WESTERN UGANDA	36	77	47%
2012	BDBV	Orientale Province, DEMOCRATIC REPUBLIC OF THE CONGO	34	62	54%
2013-2016	EBOV	Liberia, Sierra Leone, Guinea, Limited and local: Nigeria, Mali, United States, Senegal, Spain, United Kingdom, Italy	11, 310	28, 616	70-71 / 57-59 %
2014	EBOV	DRC	49	66	74%
2018	EBOV	DRC	33	54	61
2018-present	EBOV	DRC	1277	2189	ongoing

## **Increasing frequency of recognized filovirus outbreaks in Africa since 1990**

11

Possible reasons:

- Better surveillance and capability to rapidly diagnose and characterize filovirus infections
- Spread among wild non-human primates and other animals > human epidemics d/t hunting, slaughtering, butchering and human consumption of infected dead animals (food chain)
- Epidemiology and ecology is more complex than previously understood
- Animal-human spillover infections because of human encroachment on natural ecosystems
- Increased human exposure driven by legal and illegal financial incentives, particularly mining activities; tourism (Marburg)
- Proximity of outbreaks to larger cities and human movement > spread to other areas outside of the outbreak epicenter




12

## **Ebola and Marburg viruses: Transmission**



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13



Sci Rep. 2012; 2: 811. PMCID: PMC3498927  
Published online Nov 15, 2012. doi: [10.1038/srep00811](https://doi.org/10.1038/srep00811)

### Transmission of Ebola virus from pigs to non-human primates


[Hana M. Weingartl](#)<sup>a,1,2</sup> [Carissa Embury-Hyatt](#)<sup>1</sup> [Charles Nfon](#)<sup>1</sup> [Anders Leung](#)<sup>3</sup> [Greg Smith](#)<sup>1</sup> and [Gary Kobinger](#)<sup>b,3,2</sup>

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This article has been [cited by](#) other articles in PMC.

**Abstract** Go to:

Ebola viruses (EBOV) cause often fatal hemorrhagic fever in several species of simian primates including human. While fruit bats are considered natural reservoir, involvement of other species in EBOV transmission is unclear. In 2009, Reston-EBOV was the first EBOV detected in swine with indicated transmission to humans. In-contact transmission of Zaire-EBOV (ZEBOV) between pigs was demonstrated experimentally. Here we show ZEBOV transmission from pigs to cynomolgus macaques without direct contact. Interestingly,




14


## Infection rates

- The number of people that one sick person will infect, on average and in the absence of an effective control intervention) is called  $R_0$ . For Ebola in 2 epidemics 1.3 – 1.8 (Chodwell, et al, J Theoretical Biology 2004;229:119-126)

<b>1 &gt; 2 infection rate</b> Hepatitis C Ebola	<b>1 &gt; 4 infection rate</b> HIV SARS	<b>1 &gt; 10 infection rate</b> Mumps	<b>1 &gt; 18 infection rate</b> Measles
--	---	--	--



$R_0$  → More contagious



## **Filovirus transmission: what is known and what is not ...**

- Limited data on how viral genomics affect phenotype/pathotype, patient VLs and epidemiological features of more recent filovirus strains
- Further study:
  - Role of aerosol (large droplets/small particles close to patients) transmission
  - Role on environmental contamination and fomite transmission
  - Degree to which minimally or mildly ill persons transmit infection
  - How long clinically relevant infection persists or persistence of Ebolavirus during convalescence
  - Role of 'super-spreading events' play in transmission dynamics
  - Whether strain differences or repeated serial passage in outbreak settings can impact virus transmission

Source: MBio 2015 Feb 19;6(2):e00137. doi:10.1128/mBio.00137-15



## **Ebola West Africa 20(13)14 – 2015(6)**





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**Public health impact far greater than case counts:**

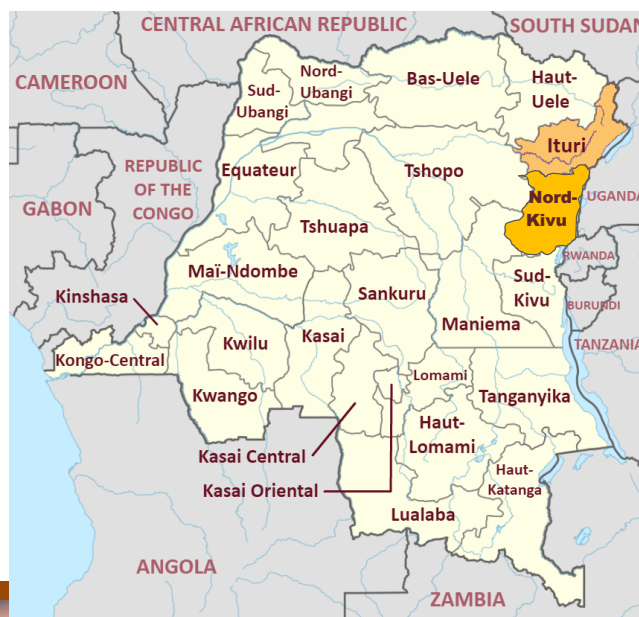
- Crippling of an already weakened health sector and HCW losses
- Significant impact on other endemic diseases (e.g. malaria) and associated mortality
- Substantial economic losses for entire sub-region
- Social disruption

**Total number of cases and deaths:**

- 8 May 2016: 28,616 cases; 11,310 deaths (overall case fatality: 40%) and > 10 000 survivors
- W African healthcare workers (HCW): 875 infections; 509 deaths, case fatality: 58% (in Sierra Leone: 72%)

**DRC – North Kivu and Ituri provinces**

20



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**Ebola DRC – as at 21 May 2019**



22

- Tenth EV outbreak in DRC; officially declared 1 August 2018
- 26 May 2019: 1920 cases; 1281 deaths (overall case fatality: 67%)
- Healthcare workers (HCW): 105 (6%); > 30 deaths

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**PPE for filovirus infections: a big challenge**



**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 and impaired mobility
- Scant evidence-based research regarding role of individual PPE items

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**Obstacles to filoviral outbreak responses: the centrality of human behavior**




26

**DRC Battles**

NATIONAL GEOGRAPHIC


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**The world's second-biggest Ebola outbreak is still raging. Here's why.**

Despite a coordinated response and a vaccine, the Democratic Republic of the Congo's struggle with the deadly virus seems to have no quick end in sight.



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Attacks on MSF facilities – DRC 2019

27



**FEAR!**

Media (social and conventional)

**PANIC!**

Rumors

**DENIAL!**

**CONFLICT!**

## Obstacles to the epidemic response

- Poor infection prevention and control practices, inadequate healthcare facility infrastructure, poor healthcare delivery
- Early outbreak population dynamics: initial mistrust and hostility towards multinational teams
- Filoviral infections attributed to witchcraft, zombification
- Denial of filovirus existence, a ploy of government to get international funds
- Anger; towards government and public health messages
- Behavioral, religious and cultural diversity
- Stigma of survivors, the infected or thought to be infected



## Stigma



### Burial and culture: dignity in burial



### 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 majeure) - serious economic consequences for the W African sub-region





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### Social media: the blame and misconceptions

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

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".

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

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

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

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.

Americans have vaccine and probably they invent this virus during cold war and use on who else than poor africans !! but they dont give vaccine to anyone except of this 2 or 3 persons from USA few weeks ago who are healed while others (africans especially)you will be died !!

34

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It comes to me as if the doctors dont even care about Ebola victims. Once their infected, they're 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 38 Comments

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.



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## The blame and misconceptions



Bleach is a strong disinfectant, but is totally harmless to us humans, and that's why we use it to clean our home. By either injecting a dose of bleach (20ml) into your bloodstream, or taking 200ml orally, you can clear yourself out of ALL ebola in your system, and prevent any more getting in! It's the one secret Big Pharma DOESN'T want you to know!



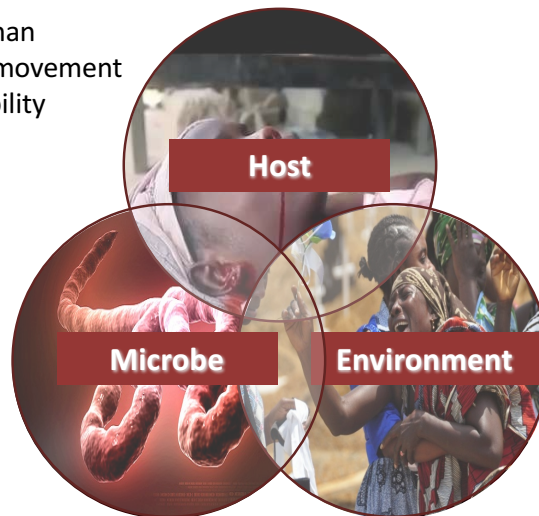
**Hostility and suspicion: stoning of healthcare teams and survivors**

37



- Individual human behavior and movement
- Host susceptibility

- Filovirus



- Geo-climatic, geographical and ecological
- Socio-cultural
  - Traditional beliefs, Traditional healers and Witchdoctors,
  - Religion,
  - Burial practices
- Suspicion and misconceptions
- Political
- Low-socioeconomic

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**SO... SUPERBUG: MAN OR MICROBE?**



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August 15, 2019	<i>(FREE Teleclass)</i> <a href="#">BED BUG PREVENTION IN THE HEALTHCARE SETTING</a> Speaker: <b>Dr. Marcia Anderson</b> , Environmental Protection Agency, United States
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