Early Signals and Surveillance Challenges in Filovirus Outbreaks

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Aim: To characterize the early warning signs, surveillance, and initial reporting of filovirus outbreaks.

Methods:

- PRISMA-guided integrative review, 5 online databases, 46 filovirus outbreaks (1976-2025)
- 99 included reports
- Non-parametric analysis of extracted data and narrative synthesis of sources

Index Case(s) Snapshot:
Sex: 62% Male, 38% Female
Median age: 31.5 years
Haemorrhaging: 56%, late manifestation
Exposure known: 20/33 (61%)
Cluster vs Single: 17/46 (40%)

Spillover

"…villagers and nongovernmental wildlife organizations reported having found a large number of dead animals, particularly non-human primates (gorillas and chimpanzees) and forest duikers (Cephalophus sp.)…"

prior to 2003 EVD outbreak, Republic of the Congo — (Weekly Epidemiological Record 2003)

Potential for One Health Surveillance

- Target hunters with flyers and encourage wildlife carcass reporting
- Report to local/organizational authorities
- Testing carcasses for filoviruses, physicians put on alert

Community

"To develop a more "people-centered" early detection system, collaboration with the community must be at its core, and ideally the community should be seen as a resource instead of a barrier".

2012 EVD outbreak, Uganda — (de Vries D.H. et al. 2016)

Community health leads were nominated and trained in "detection and notification of suspected cases of VHF and other diseases of an epidemic nature…"

2000 SVD outbreak, Uganda — (Lamunu et al. 2004)

Recognition

"a nurse from the Nambwa health facility" who "participated in a local training program on the recognition of EVD cases in June 2016, which helped her rapidly identify an initial EVD case"

2017 EVD outbreak, DRC — (Nsio et al. 2020)

87% of first alerts came from physician/ hospital staff.

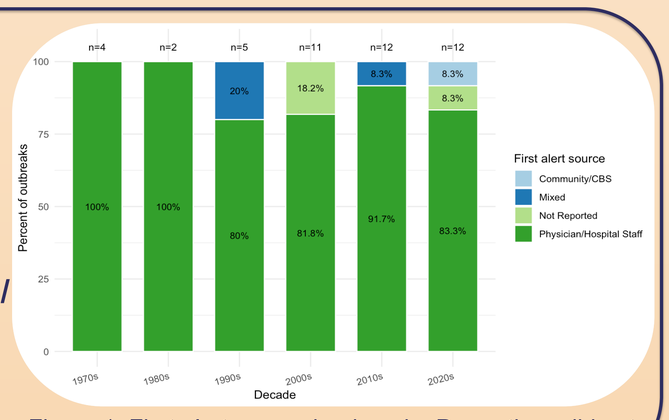

Figure 1. First alert source by decade. Proportions did not change across eras (Fisher's p > 0.5).

Hospitals & IPC

"The importance of nosocomial infection in this epidemic (13 health workers, 12 nurses, and 3 people who shared a room with an infected person) underlines the gaps in infection control in the healthcare structures in Isiro Health Zone and in the DRC in general".

2012 BVD, DRC — (Epelboin 2012)

Healthcare worker infections occurred in 76.7% of outbreaks.

There is weak evidence that these outbreaks had a longer time to declaration (Mann-Whitney [Wilcoxon rank-sum] p =0.07, 15 days (IQR 5-24) vs 6 days (IQR 2-12).

Laboratories

"…the rapid laboratory confirmation of EHF in-country likely contributed to limiting the size of this outbreak…"

2011 SVD outbreak, Uganda — (Shoemaker et al. 2012)

Delay Cascade:

Lack of laboratory infrastructure → Samples sent to far-away laboratories → Delay in diagnosis and proper IPC → Increased disease spread

Declaration

"enhanced VHF surveillance and laboratory detection…" post 2007 BVD outbreak underpinned the success of Uganda's 2017 MVD response — (Nyakarahuka et al. 2019)

Time to outbreak declaration decreased over time (Kruskal-Wallis p = 0.03).

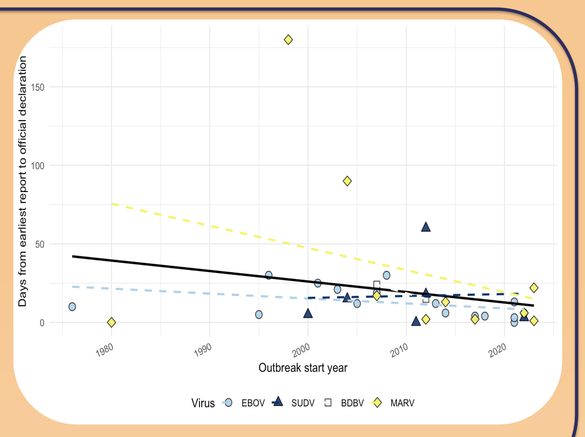

Figure 2. Solid line, global trend; dashed lines, virus-specific trends; shapes, virus species.

Recommendations

- **Prioritize clinician training**
- **Strengthen EBS: institutional and community**
- **Explore One Health surveillance**
- **Continue progress in lab capacity**
- **Better document outbreak beginnings**

Take-Away:

Across 46 filovirus outbreaks, first alerts overwhelmingly came from frontline clinicians. Strengthening clinician training, lab capacity, and integrating One Health principles may increase outbreak preparedness.

Access the full MSc project as well as code for analysis and plots on GitHub at: https://github.com/feeromerline/Early-Signals-and-Surveillance-Challenges-in-Filovirus-Outbreaks

or scan the QR code: