Title: Contact Tracing during the West African Ebola Outbreak

Activities: Perform contact tracing activities; Train epidemiologists in contact tracing; Train community on surveillance and/or contact tracing; Manage contact tracing data; Provide clean water; Provide food aid

Stakeholders: National and subnational health authorities; World Health Organization

Phases: Surveillance and preparedness; Detection; Early response; Intervention

Years: 2014-2016

Countries: Guinea; Liberia; Sierra Leone

Agent: Ebola

Case study prepared by: Emily Sherman, July 29, 2019

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Contact tracing, the identification and follow-up of persons who may have been in contact with an infected person, was one of the most important response activities during the 2014-2016 West African Ebola virus disease (EVD) outbreak.[1] Contact tracing began with the identification of every person with which an Ebola patient had come into contact. These contacts were notified of their status and followed-up with daily for the duration of the maximum incubation period of 21 days since their last date of contact. During follow-up visits, temperatures were monitored, and symptomatic contacts were evacuated to a treatment center or hospital. By removing suspected cases from environments in which they could easily infect others, it was hoped that transmission would be stopped and the outbreak would eventually be contained.[2] Unfortunately, a combination of many factors complicated contact tracing efforts and decreased their efficacy in containing the outbreak.[3]

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[1] Vincent Wong, Daniel Cooney, Yaneer Bar-Yam. *Beyond Contact Tracing: Community-Based Early Detection for Ebola Response.* 26 May 2015, revised 8 March 2016. arXIv: 1505.07020v2

[2] Olu Olushayo Oluseun, Lamunu Margaret, Nanyunja Miriam, et al. *Contact Tracing during an Outbreak of Ebola Virus Disease in the Western Area Districts of Sierra Leone: Lessons for Future Ebola Outbreak Response*. Frontiers in Public Health. 2016;4:130. DOI=10.3389/fpubh.2016.00130

[3] World Health Organization, Regional Office for Africa (WHO AFRO). *Contact tracing during an outbreak of Ebola virus disease*. Brazzaville (Republic of Congo): WHO AFRO; 2014. Available from:http://www.who.int/csr/resources/publications/ebola/contact-tracing-during-outbreak-of-ebola.pdf

Barriers to effective contact tracing during the West Africa outbreak included the inability to establish a comprehensive list of contacts,[4] difficulty in acquiring the trust of affected communities, inadequate selection and training of contact tracers,[5] an exponential increase in EVD cases over time that required an insurmountable number of contact tracers,[6] and insufficient public health infrastructure.[7] Unlike previous EVD outbreaks that were able to be effectively contained using contact tracing as the primary method, the majority of affected areas in West Africa were very densely populated,[8] impeding on the ability to identify everybody who an EVD patient came into contact or interacted with.[9] Even contacts that could be named were likely to distrust and resist communication with contact tracers due to the fear of being stigmatized within their communities.[10]

In the Kenema district of Sierra Leone, contact tracing was hampered by insufficient financial and human resources. While 89% of contacts were monitored for the full 21-day period, some contact tracers' lack of basic education was evident in spelling errors and illegible handwriting that made it difficult or impossible to interpret data. Moreover, it became clear that the majority of EVD cases and their contacts had not been listed in the national database.[11] In the Western Area (WA) district, communities were quarantined in an attempt to simplify the process of contact tracing and contain the spread of EVD. However, a lack of provisions for basic needs such as food and water fostered resistance that contributed to an incomplete contact tracing database, where as many as 75% of confirmed EVD cases had not been listed as contacts prior to the onset of their symptoms. This resistance prompted Sierra Leone's government to pass a law in August 2014 that made it illegal to hide Ebola patients.[12] Furthermore, the average number of contacts per case in WA was significantly lower than comparable outbreak locations. While the average in Lagos, Nigeria was 22.6 contacts per EVD patient and the average in Port Harcourt, Nigeria was 133, WA's average was merely 8.5. This reflected a need for contact tracers chosen

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[4] Shrivastava SR, Shrivastava PS, Ramasamy J. Utility of contact tracing in reducing the magnitude of Ebola disease. *Germs* (2014) 4(4):97–9. doi:10.11599/germs.2014.1063

[5] Olu Olushayo Oluseun, et al. *Contact Tracing during an Outbreak of Ebola Virus Disease in the Western Area Districts of Sierra Leone: Lessons for Future Ebola Outbreak Response*.

[6] Shrivastava SR, et al. Utility of contact tracing in reducing the magnitude of Ebola disease.

[7] Chowell G, Nishiura H. Transmission dynamics and control of Ebola virus disease (EVD): a review. BMC Medicine. 2014;12:196

[8] Coltart, Cordelia E M; et al. "The Ebola outbreak, 2013-2016: old lessons for new epidemics." *Philosophical transactions of the Royal Society of London. Series B, Biological sciences* vol. 372,1721 (2017): 20160297. doi:10.1098/rstb.2016.0297

[9] Vincent Wong, et al. *Beyond Contact Tracing: Community-Based Early Detection for Ebola Response.*

[10] Sacks JA, Zehe E, Redick C, Bah A, Cowger K, Camara M, et al. *Introduction of mobile health tools to support Ebola surveillance and contact tracing in Guinea*. Glob Health Sci Pract. 2015;3(4):646-659.

[11] Senga, Mikiko, et al. "Contact tracing performance during the Ebola virus disease outbreak in Kenema district, Sierra Leone." *Philosophical transactions of the Royal Society of London. Series B, Biological sciences* vol. 372,1721 (2017): 20160300. doi:10.1098/rstb.2016.0300

[12] Roy-Macauley C. *Sierra Leone makes hiding Ebola patients illegal*. Associated Press. http://www.aol.com/article/2014/08/23/sierra-leone-makes-hiding-ebola-patients-illegal/20951542/ Aug 23, 2014. Accessed 29 July 2019.

directly from the community; better training and supervision; and adequate delivery of food, water, and other basic needs to quarantined communities.[13]

Recognizing that ambiguously defined procedures for contact tracing led to variation in quality of implementation, the WHO released a detailed guide to *Contact Tracing During an Outbreak of Ebola Virus Disease* in September 2014. It established the definition of contact as physical contact, identified West African-specific challenges to contact tracing (widespread geographically, lack of resources, and inaccessibility), and standardized procedures. It also included paper-based forms for data collection, including those necessary for proper contact identification and follow-up visits.[14]

In many instances, however, paper contact tracing forms proved to be inefficient. Paper forms allowed for a lack of accountability on the side of the contact tracers and a declining ability to process and respond to trends in data in a timely manner on the side of the government. It took at least two to three days to process paper-based contact tracing data and even longer in some isolated areas. Paper-based contact tracing also increased the length of time needed for data entry and the risk of entering it incorrectly. In Guinea, an experimental program for mobile contact tracing was implemented in an attempt to solve these issues. Contact data was recorded in a smartphone application designed in alignment with protocols from the World Health Organization (WHO) and the Centers for Disease Control and Prevention, as well as consultations with the United Nations and Guinean government. The application enabled contact tracers to input data that were updated to dashboards for analysis every hour as opposed to every several days. Officials could also see daily tracing activity (or lack thereof) and respond accordingly, enforcing accountability. In addition, trends in data such as noncompliance were able to be addressed quickly. Drawbacks of the mobile system included difficulty in training, contact tracers' lack of familiarity with smartphones leading to misuse, and contacts' suspicion of technology leading to resistance. Still, mobile contact tracing's potential for rapid data sharing in isolated locations may make it valuable for faster outbreak response.[15]

Other efforts to modify traditional contact tracing to increase its efficacy included a transition from monitoring specific contacts to community-based monitoring. Community-based monitoring's approach of non-specific observation of all residents and isolation of those who were symptomatic eradicated the need to identify individuals while maintaining a high level of effectiveness. Moreover, travel restrictions imposed on affected communities until there was no risk of infection allowed attention and resources to be focused on the communities that needed

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[13] Olu Olushayo Oluseun, et al. *Contact Tracing during an Outbreak of Ebola Virus Disease in the Western Area Districts of Sierra Leone: Lessons for Future Ebola Outbreak Response*.

[14] World Health Organization, Regional Office for Africa (WHO AFRO). *Contact tracing during an outbreak of Ebola virus disease*.

[15] Sacks JA, et al. *Introduction of mobile health tools to support Ebola surveillance and contact tracing in Guinea*.

them the most. Resources were also conserved with community-based monitoring as the number of required responders correlated to the number of infected communities rather than the number of infected individuals. Community-based monitoring was implemented in Liberia in mid-September 2014.

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During the 2014-2016 West African Ebola virus disease (EVD) outbreak, contact tracing was implemented as a method to contain the spread of disease by identifying and isolating potential EVD cases. However, contact tracing efforts were complicated by factors such as West Africa's high population density, community resistance, deficient public health infrastructure, and a lack of essential resources.