

Controlling Ebola with Vaccines: Dynamic Modeling and the Ring Vaccination Trial in Guinea, West Africa

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Abstract

The 2014-16 Ebola epidemic in West Africa was unprecedented in its size and destruction. A total of 28,616 Ebola cases were reported in Guinea, Liberia and Sierra Leone, with 11,310 deaths. The actual numbers were probably even higher. Furthermore, Ebola and other hemorrhagic viruses still threaten much of Africa and other parts of the world.

We worked with WHO and host of other organizations to design, analyze and interpret a phase III, randomized ring vaccination in trial in Guinea with the rVSV-vectored Ebola vaccine. Rings were randomized to immediate or delayed vaccination. At the interim analysis, the vaccine efficacy was found to be 100%. The trial was stopped and all further rings were given immediate vaccination. Ring vaccination was shown to be effective in containing Ebola transmission.

In this talk, we describe the mathematical and statistical models that were used to design, analyze and interpret the trial, and to predict the future effectiveness of ring vaccination, both for Ebola and other emerging pathogens. This includes both large-scale stochastic simulation models and dynamic statistical analytic models used for estimation and inference. We will describe the major statistical challenges of the trial and how they were overcome.