Review of: "An Optimal Control for Ebola Virus Disease with a Convex Incidence Rate: Imputing from the Outbreak in Uganda"

Semu Mitiku Kassa[1]

1 Botswana International University of Science & Technology

Potential competing interests: No potential competing interests to declare.

This paper considers SEIR-type model for the transmission dynamics of the Ebola Virus Disease (EVD) and used optimal control analysis to propose an intervention strategy. The model considers a convex incidence rate to take double exposure of individuals in to account. The problem is well formulated and the mathematical analyses of the model is presented with the required level of rigour. Numerical simulations are also presented to support the theoretical analysis of the controlled model. Moreover, the cost-effectiveness analysis of some targeted control interventions are also investigated numerically.

The paper is well written and the result of which may give important information to policymakers. However, authors may need to clarify or address the following issues:

1. In modelling the incidence rate of the disease, authors used a convex incidence rate. However, this kind of incidence rate assumes that the risk of contracting the disease grows as prevalence of the disease increases. This assumption may work for some special class of the population, where their social or work responsibility requires them to be involved in the process. On the other hand there is an argument which states that individuals change their behaviour as disease progresses, and this can result in a concave-like incidence rate. Authors may need to comment on this and clarify the validity of their assumptions.
2. In their Optimal Control model (Expanded Equation) on page 10, authors indicated that the individuals who are traced for their contact history are removed from the exposed **E** class and moved to the infectious **I** class. This looks a bit strange to me as these individuals were expected to be quarantined/isolated so that they can not pass the disease in case they were infected. Unless I missed something, the model looks to assume that the purpose of contact tracing is just to reduce the incubation period of the
   infected individuals. This requires a clarification or an adjustment from the authors so that the corresponding control strategy could be reasonable.
3. The design of the control c_1 assumes that the lock-down measure can effectively eradicate the disease. However, in African social and family settings, this may not seem to be achievable. Therefore, this also requires some adjustment. For example, considering some multiplier ($\rho \in (0, 1)$) of c_1 that represents the effectiveness of the lock-down measure may solve this problem.
4. In defining the cost function, the cost of treatment c_3 is considered to be quadratic. Unless some additional costs (like,

for instance, development and production costs) are included, treatment cost is usually assumed to be directly proportional to the count of individuals treated. That means, in reality, the cost of treating individuals should be calculated as the price of applying a unit dose plus maintenance cost times the total number of treated individuals. Unless one is assuming that manufacturing of the doses is based on the actual demand, the price can not be taken to change quadratically. I do understand the benefit of the quadratic cost assumption in mathematical simplifications of the optimal control analysis. However, if the mathematical analysis of the singularity conditions is considered with due care, I believe that it is more logical to take the cost of treatment as a linear relation rather than quadratic. Otherwise, authors need to come up with an additional assumption to justify this. For example, in the case when the process of treating requires persuading infected individuals or their families for them to be treated, this may lead to a nonlinear cost.

5. In the calculation of the cost-effectiveness analysis, the values of the coefficients in the marginal cost play important role. However, in this study, these values seem to be taken without any additional explanation. It would be more convincing if authors analyse also the sensitivity of their results with respect to the variation in the cost coefficients.