Dear Editor-In-Chief,

We are submitting an original research article manuscript for review and potential publication in PLOS ONE, should it be accepted. This is our first submission to PLOS, and it has not been submitted elsewhere.

As has been clearly seen this year during the COVID-19 pandemic, the vast majority of countries are not sufficiently prepared for epidemic and pandemic outbreaks of infectious diseases. Policy-makers are faced with large levels of uncertainty and public scrutiny, and often lack an objective framework with which to make decisions – particularly in developing nations. When epidemic interventions involve vaccinations, constrained vaccine availability compounds this difficulty, and makes the decision of which locations to prioritize for prompt response and vaccinations near-impossible to quantify. As a result, many decision makers resort to a pro-rata allocation of resources.

There is existing research into the allocation of resources during an epidemic – and these articles, along with ours, indicate that this pro-rata allocation is sub-optimal and propose alternatives. Here, we propose two novel resource allocation strategies; for the allocation of vaccination teams, and vaccine deliveries by drone. These two strategies allocate resources on each day of an epidemic simulation according to the highest total expected prevented exposures resulting from the allocation for the following day, allowing the allocation to remain effective over time as the epidemic progresses. The epidemic simulation is modeled by an SEIRVD compartmental model, which accounts for migration between interconnected subpopulations within a geographical network. This allows these strategies to be compared with alternative intuitive strategies (of which some are derived from those presented in literature), on a variety of multiple generic population distribution structures – ensuring that the comparisons and other results are generalized enough for application on actual geographical networks. When these simulations are repeated, the presented strategies were found to be consistently superior to the alternatives.

A notable difference between the delivery allocation strategy and other vaccine allocation strategies in literature is that the actual deliveries are allocated, instead of vaccines only. It is well known that intervention delay has a large impact on an epidemic’s progression (which is confirmed in various results in this article also) and so, scheduling deliveries in a sensible manner and taking time into account ensures that the valuable and little time available at the inception of an epidemic intervention is best used. This aspect of urgency, along with their potential use for deliveries to hard-to-reach locations, is why drones are the chosen delivery method in this article. Along with the strategy comparisons and other results, the feasibility of their use for vaccine deliveries was evaluated, and we discovered that they can be successfully used if a sufficient number are available.

We hope you find this manuscript satisfactory in terms of literary and technical excellence, in order to meet the high standards of PLOS ONE. We intend to reach decision-makers with this research, to improve the effectiveness of epidemic response – perhaps even in the coming months, should a COVID-19 vaccine be released.

We suggest Joshua Yukich, Jeremy Goldhaber-Fiebert, Ceyhun Eksin and Bernadette Abela-Ridder as potential Academic Editors, with Professor Erwin Hans from the University of Twente, and Lotty E. Duijzer from Erasmus University Rotterdam, as potential reviewers if possible.

Kind regards,

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