Optimal allocation of resources to healthcare workers or the general populace: a modelling study

MyVan Vo, Joshua A. Glasser and Zhilan Feng

Article citation details
R. Soc. open sci. 8: 210823.
http://dx.doi.org/10.1098/rsos.210823

Review timeline
Original submission: 8 May 2021
Revised submission: 30 October 2021
Final acceptance: 1 November 2021

Note: Reports are unedited and appear as submitted by the referee. The review history appears in chronological order.

Review History
RSOS-210823.R0 (Original submission)

Review form: Reviewer 1 (Sanyi Tang)

Is the manuscript scientifically sound in its present form?
Yes

Are the interpretations and conclusions justified by the results?
Yes

Is the language acceptable?
Yes

Do you have any ethical concerns with this paper?
No

Have you any concerns about statistical analyses in this paper?
No

Recommendation?
Accept as is
Comments to the Author(s)
The submitted paper was well written and some interesting results concerning the COVID-19 control have been provided, I do suggest that this paper could be accepted for publication RSOS.

Review form: Reviewer 2

Is the manuscript scientifically sound in its present form?  
Yes

Are the interpretations and conclusions justified by the results?  
Yes

Is the language acceptable?  
Yes

Do you have any ethical concerns with this paper?  
No

Have you any concerns about statistical analyses in this paper?  
No

Recommendation?
Accept with minor revision (please list in comments)

Comments to the Author(s)
Comment on Manuscript_RSOS-210823
In this manuscript, the authors developed an ODEs system consisting of two groups (HCW and members of the community) and investigated the optimal allocation of potentially scarce medical resources between these two groups to control the pandemic. The manuscript overall is well-written, and the methods and findings are illustrated with clear details. However, some concerns can be addressed to increase clarification:

1. My main concern is about the model setting. Many studies have studied the transmission of diseases in a hospital setting (e.g., https://doi.org/10.1098/rsos.201895; https://doi.org/10.1371/journal.pone.0030170; doi:10.3934/mbe.2019181; doi: 10.3934/mbe.2015.12.761https://doi.org/10.1016/j.mbs.2019.01.013) that the three main causes for HCW infections are due to 1. HCW-to-HCW contacts; 2 HCW-to-Patient contacts; 3, environmental contamination. For the specialty of COVID-19, I am ok to consider HCW-to-friends/family/neighbors/other members of the community contact. But please clarify why you ignore patients (as another important group) if you try to control the infections for HCWs, since in my view if you ignore patients, you will greatly decrease the risk of HCWs. Is it a better idea to consider HCWs, patients, and other communities? Please clarify.

2. The authors used both the reproduction number and final size as measurements for control of the disease for different allocation strategies. As we know, the population of HCWs is relatively small compared to the general community). The final size \( F = F_1 + F_2 = \frac{Z_1}{N} \) (the fraction of HCWs) + \( \frac{Z_2}{N} \) (the fraction of community) is not fair to use since even though all HCWs are infected, \( F \) value can’t be reflected dramatically. I would suggest using both \( F_1 \) and \( F_2 \) respectively to indicate the control of the disease since it is a big deal if the hospital’s system is ruined by pandemics (e.g., most HCWs get infections). So it goes back to my #1 concern, please clarify the model set.
For table 1, it is best to have another column to indicate the source/reference of your parameter values even though in the text you mentioned some reference there.

For figure 3, I think you showed the result for Optimal strategies B and C. Please change your figure legend (A with % HCW; B with % HCW) to B and C.

Decision letter (RSOS-210823.R0)

We hope you are keeping well at this difficult and unusual time. We continue to value your support of the journal in these challenging circumstances. If Royal Society Open Science can assist you at all, please don’t hesitate to let us know at the email address below.

Dear Dr Feng

On behalf of the Editors, we are pleased to inform you that your Manuscript RSOS-210823 “Optimal allocation of resources to health care workers or the general populace: a modeling study” has been accepted for publication in Royal Society Open Science subject to minor revision in accordance with the referees’ reports. Please find the referees’ comments along with any feedback from the Editors below my signature.

We invite you to respond to the comments and revise your manuscript. Below the referees’ and Editors’ comments (where applicable) we provide additional requirements. Final acceptance of your manuscript is dependent on these requirements being met. We provide guidance below to help you prepare your revision.

Please submit your revised manuscript and required files (see below) no later than 7 days from today’s (ie 25-Oct-2021) date. Note: the ScholarOne system will ‘lock’ if submission of the revision is attempted 7 or more days after the deadline. If you do not think you will be able to meet this deadline please contact the editorial office immediately.

Please note article processing charges apply to papers accepted for publication in Royal Society Open Science (https://royalsocietypublishing.org/rsos/charges). Charges will also apply to papers transferred to the journal from other Royal Society Publishing journals, as well as papers submitted as part of our collaboration with the Royal Society of Chemistry (https://royalsocietypublishing.org/rsos/chemistry). Fee waivers are available but must be requested when you submit your revision (https://royalsocietypublishing.org/rsos/waivers).

Thank you for submitting your manuscript to Royal Society Open Science and we look forward to receiving your revision. If you have any questions at all, please do not hesitate to get in touch.

Kind regards,
Royal Society Open Science Editorial Office
Royal Society Open Science
openscience@royalsociety.org

on behalf of Dr Shigui Ruan (Associate Editor) and Glenn Webb (Subject Editor)
openscience@royalsociety.org
Associate Editor Comments to Author (Dr Shigui Ruan):
Comments to the Author:
Please revise your manuscript by addressing the comments made by the second reviewer.

Reviewer comments to Author:
Reviewer: 1
Comments to the Author(s)
The submitted paper was well written and some interesting results concerning the COVID-19 control have been provided, I do suggest that this paper could be accepted for publication RSOS.

Reviewer: 2
Comments to the Author(s)
Comment on Manuscript_RSOS-210823
In this manuscript, the authors developed an ODEs system consisting of two groups (HCW and members of the community) and investigated the optimal allocation of potentially scarce medical resources between these two groups to control the pandemic. The manuscript overall is well-written, and the methods and findings are illustrated with clear details. However, some concerns can be addressed to increase clarification:
1. My main concern is about the model setting. Many studies have studied the transmission of diseases in a hospital setting (e.g., https://doi.org/10.1098/rsos.201895; https://doi.org/10.1371/journal.pone.0030170; doi:10.3934/mbe.2019181; doi:10.3934/mbe.2015.12.761https://doi.org/10.1016/j.mbs.2019.01.013) that the three main causes for HCW infections are due to 1. HCW-to-HCW contacts; 2 HCW-to-Patient contacts; 3, environmental contamination. For the specialty of COVID-19, I am ok to consider HCW-to-friends/family/neighbors/other members of the community contact. But please clarify why you ignore patients (as another important group) if you try to control the infections for HCWs, since in my view if you ignore patients, you will greatly decrease the risk of HCWs. Is it a better idea to consider HCWs, patients, and other communities? Please clarify.
2. The authors used both the reproduction number and final size as measurements for control of the disease for different allocation strategies. As we know, the population of HCWs is relatively small compared to the general community). The final size F=F1+F2=Z1/N (the fraction of HCWs) +Z2/N(the fraction of community) is not fair to use since even though all HCWs are infected, F value can’t be reflected dramatically. I would suggest using both F1 and F2 respectively to indicate the control of the disease since it is a big deal if the hospital’s system is ruined by pandemics (e.g., most HCWs get infections). So it goes back to my #1 concern, please clarify the model set.
3. For table 1, it is best to have another column to indicate the source/reference of your parameter values even though in the text you mentioned some reference there.
4. For figure 3, I think you showed the result for Optimal strategies B and C. Please change your figure legend (A with % HCW; B with % HCW) to B and C.

===PREPARING YOUR MANUSCRIPT===
Your revised paper should include the changes requested by the referees and Editors of your manuscript.
You should provide two versions of this manuscript and both versions must be provided in an editable format:
one version should clearly identify all the changes that have been made (for instance, in coloured highlight, in bold text, or tracked changes); a 'clean' version of the new manuscript that incorporates the changes made, but does not highlight them. This version will be used for typesetting.

Please ensure that any equations included in the paper are editable text and not embedded images.

Please ensure that you include an acknowledgements' section before your reference list/bibliography. This should acknowledge anyone who assisted with your work, but does not qualify as an author per the guidelines at https://royalsociety.org/journals/ethics-policies/openness/.

While not essential, it will speed up the preparation of your manuscript proof if you format your references/bibliography in Vancouver style (please see https://royalsociety.org/journals/authors/author-guidelines/#formatting). You should include DOIs for as many of the references as possible.

If you have been asked to revise the written English in your submission as a condition of publication, you must do so, and you are expected to provide evidence that you have received language editing support. The journal would prefer that you use a professional language editing service and provide a certificate of editing, but a signed letter from a colleague who is a proficient user of English is acceptable. Note the journal has arranged a number of discounts for authors using professional language editing services (https://royalsociety.org/journals/authors/benefits/language-editing/).

====PREPARING YOUR REVISION IN SCHOLARONE====

To revise your manuscript, log into https://mc.manuscriptcentral.com/rsos and enter your Author Centre - this may be accessed by clicking on "Author" in the dark toolbar at the top of the page (just below the journal name). You will find your manuscript listed under "Manuscripts with Decisions". Under "Actions", click on "Create a Revision".

Attach your point-by-point response to referees and Editors at the 'View and respond to decision letter' step. This document should be uploaded in an editable file type (.doc or .docx are preferred). This is essential, and your manuscript will be returned to you if you do not provide it.

Please ensure that you include a summary of your paper at the 'Type, Title, & Abstract' step. This should be no more than 100 words to explain to a non-scientific audience the key findings of your research. This will be included in a weekly highlights email circulated by the Royal Society press office to national UK, international, and scientific news outlets to promote your work. An effective summary can substantially increase the readership of your paper.

At the 'File upload' step you should include the following files:
-- Your revised manuscript in editable file format (.doc, .docx, or .tex preferred). You should upload two versions:
  1) One version identifying all the changes that have been made (for instance, in coloured highlight, in bold text, or tracked changes);
  2) A 'clean' version of the new manuscript that incorporates the changes made, but does not highlight them.
-- An individual file of each figure (EPS or print-quality PDF preferred [either format should be produced directly from original creation package], or original software format). 
-- An editable file of each table (.doc, .docx, .xls, .xlsx, or .csv).
A copy of your point-by-point response to referees and Editors. This will expedite the preparation of your proof.

At the 'Details & comments' step, you should review and respond to the queries on the electronic submission form. In particular, we would ask that you do the following:

- Ensure that your data access statement meets the requirements at [https://royalsociety.org/journals/authors/author-guidelines/#data](https://royalsociety.org/journals/authors/author-guidelines/#data). You should ensure that you cite the dataset in your reference list. If you have deposited data etc in the Dryad repository, please only include the 'For publication' link at this stage. You should remove the 'For review' link.
- If you are requesting an article processing charge waiver, you must select the relevant waiver option (if requesting a discretionary waiver, the form should have been uploaded, see 'File upload' above).
- If you have uploaded any electronic supplementary (ESM) files, please ensure you follow the guidance at [https://royalsociety.org/journals/authors/author-guidelines/#supplementary-material](https://royalsociety.org/journals/authors/author-guidelines/#supplementary-material) to include a suitable title and informative caption. An example of appropriate titling and captioning may be found at [https://figshare.com/articles/Table_S2_from_Is_there_a_trade-off_between_peak_performance_and_performance_breadth_across_temperatures_for_aerobic_scope_in_teleost_fishes_/3843624](https://figshare.com/articles/Table_S2_from_Is_there_a_trade-off_between_peak_performance_and_performance_breadth_across_temperatures_for_aerobic_scope_in_teleost_fishes_/3843624).

At the 'Review & submit' step, you must view the PDF proof of the manuscript before you will be able to submit the revision. Note: if any parts of the electronic submission form have not been completed, these will be noted by red message boxes - you will need to resolve these errors before you can submit the revision.

**Author's Response to Decision Letter for (RSOS-210823.R0)**

See Appendix A.

**Decision letter (RSOS-210823.R1)**

We hope you are keeping well at this difficult and unusual time. We continue to value your support of the journal in these challenging circumstances. If Royal Society Open Science can assist you at all, please don't hesitate to let us know at the email address below.

Dear Dr Feng,

I am pleased to inform you that your manuscript entitled "Optimal allocation of resources to health care workers or the general populace: a modeling study" is now accepted for publication in Royal Society Open Science.
If you have not already done so, please ensure that you send to the editorial office an editable version of your accepted manuscript, and individual files for each figure and table included in your manuscript. You can send these in a zip folder if more convenient. Failure to provide these files may delay the processing of your proof.

Please remember to make any data sets or code libraries 'live' prior to publication, and update any links as needed when you receive a proof to check - for instance, from a private 'for review' URL to a publicly accessible 'for publication' URL. It is good practice to also add data sets, code and other digital materials to your reference list.

COVID-19 rapid publication process:
We are taking steps to expedite the publication of research relevant to the pandemic. If you wish, you can opt to have your paper published as soon as it is ready, rather than waiting for it to be published the scheduled Wednesday.

This means your paper will not be included in the weekly media round-up which the Society sends to journalists ahead of publication. However, it will still appear in the COVID-19 Publishing Collection which journalists will be directed to each week (https://royalsocietypublishing.org/topic/special-collections/novel-coronavirus-outbreak).

If you wish to have your paper considered for immediate publication, or to discuss further, please notify openscience_proofs@royalsociety.org and press@royalsociety.org when you respond to this email.

Our payments team will be in touch shortly if you are required to pay a fee for the publication of the paper (if you have any queries regarding fees, please see https://royalsocietypublishing.org/rsos/charges or contact authorfees@royalsociety.org).

The proof of your paper will be available for review using the Royal Society online proofing system and you will receive details of how to access this in the near future from our production office (openscience_proofs@royalsociety.org). We aim to maintain rapid times to publication after acceptance of your manuscript and we would ask you to please contact both the production office and editorial office if you are likely to be away from e-mail contact to minimise delays to publication. If you are going to be away, please nominate a co-author (if available) to manage the proofing process, and ensure they are copied into your email to the journal.

Please see the Royal Society Publishing guidance on how you may share your accepted author manuscript at https://royalsociety.org/journals/ethics-policies/media-embargo/. After publication, some additional ways to effectively promote your article can also be found here https://royalsociety.org/blog/2020/07/promoting-your-latest-paper-and-tracking-your-results/.

On behalf of the Editors of Royal Society Open Science, thank you for your support of the journal and we look forward to your continued contributions to Royal Society Open Science.

Kind regards,
Royal Society Open Science Editorial Office
Royal Society Open Science
openscience@royalsociety.org

on behalf of Glenn Webb (Subject Editor)
openscience@royalsociety.org
Appendix A

Responses to Reviewer 2

We thank the reviewers for their comments and suggestions that helped us to improve the presentation of our work. Reviewer’s comments are italicized.

Comments:

1. My main concern is about the model setting. Many studies have studied the transmission of diseases in a hospital setting (e.g., https://doi.org/10.1098/rsos.201895; https://doi.org/10.1371/journal.pone.0030170; doi:10.3934/mbe.2019181; doi:10.3934/mbe.2015.12.761; https://doi.org/10.1016/j.mbs.2019.01.013) that the three main causes for HCW infections are due to 1. HCW-to-HCW contacts; 2. HCW-to-Patient contacts; 3. environmental contamination. For the specialty of COVID-19, I am ok to consider HCW-to-friends/family/neighbors/other members of the community contact. But please clarify why you ignore patients (as another important group) if you try to control the infections for HCWs, since in my view if you ignore patients, you will greatly decrease the risk of HCWs. Is it a better idea to consider HCWs, patients, and other communities? Please clarify.

Response: We added references to other modeling studies concerning HCWs. Our focus is on identifying the optimal allocation under limited supply of masks between HCWs and the general community. But our model includes four infectious states, one of which is symptomatic people who are hospitalized (i.e., patients), so there are contacts between HCWs and patients.

2. The authors used both the reproduction number and final size as measurements for control of the disease for different allocation strategies. As we know, the population of HCWs is relatively small compared to the general community. The final size $F=F_1+F_2=Z_1/N$ (the fraction of HCWs) + $Z_2/N$ (the fraction of community) is not fair to use since even though all HCWs are infected, $F$ value can’t be reflected dramatically. I would suggest using both $F_1$ and $F_2$ respectively to indicate the control of the disease since it is a big deal if the hospital’s system is ruined by pandemics (e.g., most HCWs get infections). So it goes back to my #1 concern, please clarify the model set.

Response: In this study, we considered the proportions of infected people as a measure to compare various strategies. But the reviewer’s point is well taken. In future studies, we might also consider HCWs as a potentially scarce resource. We discuss our choice and possible future work in the last paragraph.

3. For table 1, it is best to have another column to indicate the source/reference of your parameter values even though in the text you mentioned some reference there.

Response: Done.

4. For figure 3, I think you showed the result for Optimal strategies B and C. Please change your figure legend (A with % HCW; B with % HCW) to B and C.

Response: The legend now reads: Strategy C is compared with Strategies A and B. The figure is correct.