PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (**http://bmjopen.bmj.com/site/about/resources/checklist.pdf**) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

ARTICLE DETAILS

TITLE (PROVISIONAL)	How do different navigation systems affect emergency response time? A prospective simulation study
AUTHORS	van Mark, Anke; Hallstein, Tim; Holzgreve, Fabian; Groneberg, David; Ohlendorf, Daniela

VERSION 1 – REVIEW

REVIEWER	Swan, David Université Gustave Eiffel, TS2 / Laboratoire mécanismes d'accidents (LMA)
REVIEW RETURNED	11-Sep-2023

GENERAL COMMENTS	Dear Authors, Thank you for the possibilty to review your article. Your work covers an important topic that largely justifies your study. However, the limits of your study approach are too great for me to give a positive verdict for publication. I can't help but feel that a revised version of your work would be more suitably published in a different journal with a greater focus on pre-hospital care. With this in mind, here are some of my thoughts on the paper : My number one issue with your approach is the fact your results are based uniquely on simulations and so the time gains demonstrated can only be deemed theoretical. There really needs to be a discussion on the reality of these findings, my primary remark being that emergency ambulance drivers may already use such "short-cuts" on a day to day basis. Such experience of traffic conditions and the ability of ambulance drivers to adapt to them would perhaps render your results irrelevant from a public policy perspective. I understand that there can be difficulty using real-data but am not convinced it is insurmountable as you seem to suggest with regards to data protection. You should perhaps also consider the safety implications with regards to such GPS tools. Is there not a greater risk being taken when using such "forbidden" routes? In many ways, I think your paper would be of much greater value if you were able to survey ambulance drivers in order to give greater insight of how such a gps tool may influence their driving. More generally : - The two main hypotheses are clear but lack any true justification. Why are you interested in these two points?

	- In what interest do you use google maps and tomtom naivgation as baseline? You mention these are popular navigation systems for civilians but are they actually used by emergency services? - Parts of the discussion read like a literature review, discussion should elaborate on how your work contributes to the literature. - A flow chart could be useful in introduction to explain how emergency calls are treated. - You introduce some economic arguments towards the end of the paper, perhaps you could bring these up in the introduction to provide more weight to your arguments for responding to this research question. - Typo page 9 line 6, page 17 line 10 I hope some of my comments will help you improve this paper. Kind regards

REVIEWER	Marung, Hartwig MSH Medical School Hamburg, Faculty of Health Sciences
REVIEW RETURNED	23-Apr-2024

GENERAL COMMENTS	The authors provide relevant insights into the highly relevant topic of emergency medical response. However, it is mandatory that the manuscript is thoroughly revised with regard to grammar and wording by a native speaker with an Emergency Medical Services (EMS) or at least medical background before it can be accepted for publication. This holds true for both emergency medical terminology and general wording, starting with the title of the publication: “Reducing the arrival time to the patient in medical rescue trips through intelligent routing systems - a simulation study” appears rather clumsy and unscientific and should be more precise, e.g. "Reducing emergency response time by use of intelligent routing systems – a simulation study" In addition, the terms “Patient Help time” is uncommon in the EMS literature. The term “travel time” is widely used in Public Health literature describing the amount of time for patients seeking medical assistance in hospitals. The Term “Travel Time to Patient, TTP” is also uncommon and should be replaced by “Emergency Response Time, ERT”, as is the case in the literature that the authors refer to (e.g., Gonzalez et al. 2009, Nehme et al. 2016) The term “special signals” is not part of the English language and should be replaced by the widely used term “Lights and Siren(s), L&S”. In addition, the manuscript should be revised in detail with regard to structure and content as follows: Abstract Adherence to BMJ Open`s Submission guidelines is mandatory and the abstract should be revised accordingly:

	p. 4, 17 “Setting” is supposed to provide information on the environment of the trial (urban vs. rural EMS district), not the affiliation of the researchers. 4, 22 The “Methods” section should be included in “Design”, the total number of measurements should be included in the “Results” section 4, 31 “Outcome measures” should be described in detail (exact start and end points of measurement) 4, 38 The sentence “Both time and distance comparisons were significant” is incomprehensible and needs to be revised with regard to both content and grammar 4, 49 “Conclusion” gives results, but not a clear conclusion from those results; please specify the relevance of your findings for emergency management. The structure of the article should be revised in accordance to the STROBE statement for cohort studies. Introduction In general, the introduction contains many specific results that belong in the Discussion section and should be revised/abbreviated accordingly. p. 6, 29 The study by Fleischman et al. (10) analysed transports to the hospital, not the ERT and should not be referred to at this point of the paper. Methods p. 10, 10 The informative value of Figure 1 is unclear. 10, 17 please specify the process of “random selection” 10, 45 please specify the rationale underlying the 15 km limit for classification of “short” vs. “long distance” 11, 15 please specify the rationale underlying the limits for classification of short, medium 1, medium 2 and long distance 11, 38 please specify the statement “the calculations of the smartphone were started at the same time as the calculations in the two browser versions”, as the use of a “smartphone” is not mentioned before or afterwards 11, 47 it remains unclear how security issues impeded the use of real time data as tracking of individual patients is never feasible. The authors should point out if this was due to political or legal reasons. Results This section should be abbreviated as the results are reported comprehensibly in the tables 1 to 4. p. 13, 17 The sentence “A total of 9,300 measurements were made at 1,550 points in time” is unprecise. How can six measurements be performed at one “point in time”? Please revise. Discussion p 17,57 The sentence “Improving these ratios can already be achieved with a technical solution and, thus, with significantly less financial and structural effort” provides the key massage of the paper and should be discussed accordingly, although the significance of the results is limited by the simulation setting. p. 18, 15 As far as the highly relevant topic of quality assurance in EMS is concerned, the authors should refer to current publications,

	not to those going back more than 25 years (17 Madler and Poloczek 1998). As the elapsed time for driving to the scene of a medical emergency is only one of the factors crucial for ERT in ground based EMS, others such as the problem of busy ambulances, i.e. non available emergency units, should be taken into consideration here, e.g. by Næss LE, Krüger AJ, Uleberg O et al. Using machine learning to assess the extent of busy ambulances and its impact on ambulance response times: A retrospective observational study. PLoS One 2024;19:e0296308. doi: 10.1371/journal.pone.0296308 As a peer reviewer, I shall be glad to look through the mansucript after thorough revision as indicated above. Thank you.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1
Dr. David Swan, Université Gustave Eiffel, Ecole Nationale Supérieure des Officiers de Sapeurs-Pompiers
Comments to the Author:
Dear Authors,

Thank you for the possibilty to review your article. Your work covers an important topic that largely justifies your study. However, the limits of your study approach are too great for me to give a positive verdict for publication. I can't help but feel that a revised version of your work would be more suitably published in a different journal with a greater focus on pre-hospital care. With this in mind, here are some of my thoughts on the paper :

My number one issue with your approach is the fact your results are based uniquely on simulations and so the time gains demonstrated can only be deemed theoretical. There really needs to be a discussion on the reality of these findings, my primary remark being that emergency ambulance drivers may already use such "short-cuts" on a day to day basis. Such experience of traffic conditions and the ability of ambulance drivers to adapt to them would perhaps render your results irrelevant from a public policy perspective.

-->Thank you for your comment. We have taken your comments into account and hope that our explanations, which we have also integrated into the introduction, will help to clarify them. The topic of intelligent, specific software is of great practical relevance in Germany because there is a high turnover of ambulance crews on the one hand and a shortage of personnel on the other. This goes along with a high degree of mobility in terms of where they live and work. As a result, ambulance crews rarely have detailed local knowledge (e.g. about shortcuts and detours) and are therefore dependent on the help of routing systems, which are also used regularly. This is particularly the case for larger cities, such as Frankfurt am Main. Due to this lack of local knowledge, the routes suggested by conventional navigation systems can only rarely be checked against the driver's own local knowledge in order to arrive at their destination more quickly. This makes the use of an intelligent routing system, which has more specific route planning solutions, all the more important.

I understand that there can be difficulty using real-data but am not convinced it is insurmountable as you seem to suggest with regards to data protection.
-->That's right, although data protection was relevant, it was not the biggest problem for our

investigation. In Germany, the state ambulance service laws generally do not allow an uninvolved person to be a passenger in an ambulance. Nevertheless, we had submitted a corresponding application for scientific purposes, which was not granted. The same applies to the entry of data by ambulance crews during the journey. Driving behind an ambulance with an emergency signal is also not permitted under traffic law in Germany. We tried to get authorisation for this as well, but we were not granted it, as the road traffic regulations do not allow any exceptions in this regard. Ultimately, however, the concept was also designed without the involvement of different crews and drivers in order to avoid confounder due to individual human differences and to be able to make simultaneous measurements at all.

You should perhaps also consider the safety implications with regards to such GPS tools. Is there not a greater risk being taken when using such "forbidden" routes
-->No, the authors see no major risk here. GPS devices have been used regularly during rescue operations for years. Every ambulance crew has to weigh up the risk for the route to be travelled with regard to potential hazards every time, regardless of whether and which software is used. Every ambulance in Germany is equipped with navigation software such as TomTom and this is used regularly. The routes suggested by the navigation systems are always supplemented by individual local knowledge, if available. If a vehicle with the right of way is travelling with an emergency signal in Germany, it must be granted the right of way or priority under traffic law, i.e. every normal vehicle must give way to this vehicle and allow it space to pass.

In many ways, I think your paper would be of much greater value if you were able to survey ambulance drivers in order to give greater insight of how such a gps tool may influence their driving.
-->As mentioned above, it is not permitted in Germany for an uninvolved person to be a passenger in an ambulance, not even for scientific purposes. The same applies to entering data on the trips made by the ambulance crew. Driving behind an ambulance with an emergency signal is also not permitted under traffic law in Germany. Your question of how such a gps tool may influence the driving of an ambulance also concerned us when setting up the study design. Since the authors include emergency physicians and experienced paramedics and a preliminary survey was conducted in 5 rescue control centres and at the conference of North German emergency physicians, this need for such intelligent software was confirmed not only by the authors, but also by every other experienced duty officer in this sector. In addition, everyone was very interested in being informed of the results.

More generally :

- The two main hypotheses are clear but lack any true justification. Why are you interested in these two points?
-->As we have clearly formulated the research question of the paper, the hypotheses would be an addition. We have now deleted this addition.

- In what interest do you use google maps and tomtom naivgation as baseline? You mention these are popular navigation systems for civilians but are they actually used by emergency services?
-->Alongside Garmin, TomTom is the most widely used navigation system in Germany. Both systems are used or integrated into proprietary systems in the automotive industry, among others. Google-Maps is very frequently used as a mobile system due to the existing smartphone integration and is one of the 5 best navigation apps for iPhone and Android smartphones in 2023 according to a survey in Germany. For this reason, we decided in favour of the two systems examined.

- Parts of the discussion read like a literature review, discussion should elaborate on how your work contributes to the literature.
-->We have completely revised the article accordingly.

- A flow chart could be useful in introduction to explain how emergency calls are treated.
-->Thank you for the good idea. We have integrated a flow chart as Figure 1 in the introduction.

- You introduce some economic arguments towards the end of the paper, perhaps you could bring these up in the introduction to provide more weight to your arguments for responding to this research question.
-->We restructured the discussion.

- Typo page 9 line 6, page 17 line 10
-->Thank you for pointing this out.

I hope some of my comments will help you improve this paper.

Kind regards

Reviewer: 2
Prof. Hartwig Marung, MSH Medical School Hamburg
Comments to the Author:
The authors provide relevant insights into the highly relevant topic of emergency medical response.

However, it is mandatory that the manuscript is thoroughly revised with regard to grammar and wording by a native speaker with an Emergency Medical Services (EMS) or at least medical background before it can be accepted for publication.

This holds true for both emergency medical terminology and general wording, starting with the title of the publication:
“Reducing the arrival time to the patient in medical rescue trips through intelligent routing systems - a simulation study”
appears rather clumsy and unscientific and should be more precise, e.g.
"Reducing emergency response time by use of intelligent routing systems – a simulation study"

-->Thank you very much for pointing this out. We have everything proofread by a native speaker with expertise in EMS. We have changed the title and also adapted it to the editor's comments.

In addition, the terms “Patient Help time” is uncommon in the EMS literature. The term “travel time” is widely used in Public Health literature describing the amount of time for patients seeking medical assistance in hospitals.

The Term “Travel Time to Patient, TTP” is also uncommon and should be replaced by “Emergency Response Time, ERT”, as is the case in the literature that the authors refer to (e.g., Gonzalez et al. 2009, Nehme et al. 2016)
The term “special signals” is not part of the English language and should be replaced by the widely used term “Lights and Siren(s), L&S”.

-->These terms have also all been replaced.

In addition, the manuscript should be revised in detail with regard to structure and content as follows:

Abstract

Adherence to BMJ Open`s Submission guidelines is mandatory and the abstract should be revised accordingly:
p. 4, 17 “Setting” is supposed to provide information on the environment of the trial (urban vs. rural EMS district), not the affiliation of the researchers.
-->As this is a simulation study and not a field study, we used a stable WIFI internet connection for the navigation calculations. The measurements were always taken in the same office of the authors. Consequently, affiliation and setting are identical. TomTom and Google-Maps are used directly via the provider's website on the PC. MapTrip 112 cannot be opened via the website, but only via an app on Android smartphones. The tests were started simultaneously on both websites and the MapTrip112 app. A stable WLAN connection was used specifically to exclude the influence of fluctuating mobile data in the field test as a confounder.

4, 22 The “Methods” section should be included in “Design”, the total number of measurements should be included in the “Results” section
-->Done

4, 31 “Outcome measures” should be described in detail (exact start and end points of measurement)
-->done

4, 38 The sentence “Both time and distance comparisons were significant” is incomprehensible and needs to be revised with regard to both content and grammar
-->We rewrote this sentence.

4, 49 “Conclusion” gives results, but not a clear conclusion from those results; please specify the relevance of your findings for emergency management.
-->done

The structure of the article should be revised in accordance to the STROBE statement for cohort studies.
-->We have completely revised the article accordingly.

Introduction
In general, the introduction contains many specific results that belong in the Discussion section and should be revised/abbreviated accordingly.
-->We have completely revised the introduction accordingly.

p. 6, 29 The study by Fleischman et al. (10) analysed transports to the hospital, not the ERT and should not be referred to at this point of the paper.
-->We have completely revised the introduction and discussion accordingly.

Methods
p. 10, 10 The informative value of Figure 1 is unclear.
-->We have deleted Fig. 1 at the request of the editor.

10, 17 please specify the process of “random selection”

-->The targets were selected with the help of the "leitstellenspiel.de" app, a training software for emergency service personnel in Germany.

10, 45 please specify the rationale underlying the 15 km limit for classification of “short” vs. “long

distance”
11, 15 please specify the rationale underlying the limits for classification of short, medium 1, medium 2 and long distance
-->We have integrated the following sentence into the sub-chapter ‘Route calculations’: The travel distances investigated were defined in consensus, for instance different distances in town or country or the classification as “short” or “long”, with the included rescue stations and their operational experience in the investigated regions and depending on the population density.

11, 38 please specify the statement “the calculations of the smartphone were started at the same time as the calculations in the two browser versions”, as the use of a “smartphone” is not mentioned before or afterwards
-->The MapTrip112 software was used on an Android smartphone via an app, as explained in the methods section; this navigation is not available as a webpage. Nevertheless, we have added a note at the point noted.

11, 47 it remains unclear how security issues impeded the use of real time data as tracking of individual patients is never feasible. The authors should point out if this was due to political or legal reasons.
-->Thank you for your comment. In Germany, the state ambulance service laws generally do not allow an uninvolved person to be a passenger in an ambulance. Nevertheless, we had submitted a corresponding application for scientific purposes, which was not granted. The same applies to the entry of data by ambulance crews during the journey. Driving behind an ambulance with an emergency signal is also not permitted under traffic law in Germany. We tried to get authorisation for this as well, but we were not granted it, as the road traffic regulations do not allow any exceptions in this regard. Ultimately, however, the concept was also designed without the involvement of different crews and drivers in order to avoid BIAS due to individual human differences and to be able to make simultaneous measurements at all. We have integrated these aspects into the discussion

Results

This section should be abbreviated as the results are reported comprehensibly in the tables 1 to 4.
-->The text contains information that is not in the table and vice versa, so we would like to leave the results section as it is.

p. 13, 17 The sentence “A total of 9,300 measurements were made at 1,550 points in time” is unprecise. How can six measurements be performed at one “point in time”? Please revise.
-->At each time point, 6 measurements were started simultaneously by mouse clicks, i.e. the travel time to the emergency scene and the distance travelled were recorded in each of the 3 software systems. We have corrected this sentence

Discussion

p 17,57 The sentence “Improving these ratios can already be achieved with a technical solution and, thus, with significantly less financial and structural effort” provides the key massage of the paper and should be discussed accordingly, although the significance of the results is limited by the simulation setting.
-->We have taken this aspect into account.

p. 18, 15 As far as the highly relevant topic of quality assurance in EMS is concerned, the authors should refer to current publications, not to those going back more than 25 years (17 Madler and Poloczek 1998).

-->We have deleted this reference.

As the elapsed time for driving to the scene of a medical emergency is only one of the factors crucial for ERT in ground based EMS, others such as the problem of busy ambulances, i.e. non available emergency units, should be taken into consideration here, e.g. by Næss LE, Krüger AJ, Uleberg O et al. Using machine learning to assess the extent of busy ambulances and its impact on ambulance response times: A retrospective observational study. PLoS One 2024;19:e0296308. doi: 10.1371/journal.pone.0296308
-->We have included this article in the introduction.

VERSION 2 – REVIEW

REVIEWER	Marung, Hartwig MSH Medical School Hamburg, Faculty of Health Sciences
REVIEW RETURNED	06-Jun-2024

GENERAL COMMENTS	Thank you very much for the comprehensive revision of the manuscript. Hereby, the quality of the draft has improved significantly. Still, the standard of written English is below publication standards, e.g.: page 1, line 57 In accordance with scientific writing standards, past tense should be used throughout the manuscript (“The aim of the study was…”) page 4 l. 3 “although” instead of “but” l. 10 “tested under real world conditions” instead of “investigated in real conditions” l. 26 real world conditions (see above) page 9 l. 8 “NEF” translates to “emergency physician vehicle” or "emergency physician response car", not “emergency ambulance” etc. It is therefore highly recommended that you perform a document check by use of a programme such as AJE`s Curie(R) or Grammarly (R) which takes only a few minutes and testing periods free of charge may be available. Following that procedure, the manuscript will be ready for publication in BMJ Open.

VERSION 2 – AUTHOR RESPONSE

Reviewer: 2
Prof. Hartwig Marung, MSH Medical School Hamburg
Comments to the Author:
Thank you very much for the comprehensive revision of the manuscript. Hereby, the quality of the draft has improved significantly.

Still, the standard of written English is below publication standards, e.g.:

page 1, line 57 In accordance with scientific writing standards, past tense should be used throughout the manuscript (“The aim of the study was…”)
--> we used past tense throughout the manuscript

page 4
l. 3 “although” instead of “but”
l. 10 “tested under real world conditions” instead of “investigated in real conditions”
l. 26 real world conditions (see above)
-->done

page 9
l. 8 “NEF” translates to “emergency physician vehicle” or "emergency physician response car", not “emergency ambulance”
etc.
--> done

It is therefore highly recommended that you perform a document check by use of a programme such as AJE`s Curie(R) or Grammarly (R) which takes only a few minutes and testing periods free of charge may be available.
--> We did not use AI for proofreading, but another native speaker from our university language editing service with expertise in this area did the proofreading.

Following that procedure, the manuscript will be ready for publication in BMJ Open.

Reviewer: 2
Competing interests of Reviewer: None.