Author’s response to reviews

Title: Patient characteristics, triage utilisation, level of care, and outcomes in an unselected adult patient population seen by the emergency medical services: a prospective observational study

Authors:

Carl Magnusson (carl.magnusson@vgregion.se)

Johan Herlitz (johan.herlitz@hb.se)

Christer Axelsson (christer.axelsson@hb.se)

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Response to reviewers

Dear reviewers

Thank you for taking the time to review this manuscript and considering it for publication. We are very grateful for the reviewer comments and have adjusted the manuscript accordingly. We have been able to change the paper in accordance with all the reviewer comments and hope that the paper now will be deemed appropriate for eventual publication.

For the authors

Carl Magnusson

Reviewer: 1

Abstract, Method section: describe and include the outcome measurements.

Response: Outcome measurements have been added to the abstract in the method section (Lines 22-23).
Please describe more about the EMS system/ambulance system in Sweden. What does EMS nurse do?

Response: A new section has been added with a description of the EMS system and the prehospital management of a patient in the study organisation and in Sweden (Lines 108-119).

Please add more information about the RETTS-A triage system.

Response: A more in-depth description about the RETTS-A has been added in the method section (Lines 129-139).

As you mentioned that one of the exclusion criteria was set as &lt; 16. In abstract, it shows aged &gt; 15 years was conducted in the study. it sounds like conflicted.

Response: All age data are presented with age in years, for clarification this has now been changed to greater or equal to (≥) 16 years (Line 21).

As you mentioned "of the 6,712 included..." in material section, please include one more box to explain the rest of 60 patients in Figure 1.

Response: Thank you, this has been complicated due to the fact that all patients were assessed once by the EMS nurse, but of the non-transported patients another 60 had a secondary assessment by a new EMS nurse within 72hrs and therefore they did not take part in the initial assessment. To better explain this, figure 1 has been changed with the addition of new boxes with the 60 cases reassessed and transported by the EMS to the ED within 72 hours (Figure 1). This has also been clarified in the methods section for table 2 (Line 101-103).

Line 148-149: "the median age was higher for ..." the author stated higher, but I'm confused. Higher compared to what?

Response: The median age was higher among patients in the transported group compared to the patients that were not transported. This has now been clarified in the manuscript (Lines 173-174).

I am not familiar with the ICD code groups, so please describe them.
Response: A description of the ICD code (groups) have been added in the method section, and they have been renamed to ICD chapters according to world health organisation (WHO) ICD-10 classification (Lines 102-106).

Reviewer: 2

Lines 17 and 18: Read "Crowding in the emergency department (ED) is a safety concern, and pathways to bypass the ED have been introduced to reduce the time to definitive care. Several low-acuity patients were assessed by the emergency medical services as requiring a lower level of care." It is not clear what the second sentence here is referring to, does the author mean to state "pathways" instead of "patients"?

Response: We want to state that despite the fact of using pathways to bypass the ED a relatively high number of non-emergent cases are transported to the ED contributing to the crowding. A lower level of care may be more appropriate for these patients but limited direct access to primary care in Sweden limits the options for the EMS nurse. We have changed the sentences in the abstract for clarification (Lines 16-18).

Line 23: Consider changing the term "non-conveyance" to "non-transport." The primary decision in the manuscript is whether or not a patient requires to be transported to the ED (transport vs non-transport). Authors should consider simply stating transport vs non-transport rather than "conveyance vs non-conveyance" and this could be changed throughout the manuscript.

Response: We have changed all instances of conveyance/ non-conveyance throughout the manuscript and tables to transport and non-transport instead.

Line 27: Please provide a succinct definition of what is meant by "a circulatory diagnosis." Does this refer primarily to cardiac, or stroke and cardiac, chf exacerbation, aortic dissection, syncope?

Response: This refers to the ICD-10 chapter IX ‘Diseases of the circulatory system (I00-I99). Going through the data of the most common diagnosis within past medical history of the circulatory system the following four was found: Hypertension, Stroke, Myocardial infarction and heart failure. We have added the most common diagnosis for diseases of the circulatory system in the result section (Line 165-166).
Line 29: Consider changing "mental disorders" to "psychiatric disorders" here and throughout the manuscript.

Response: This has now been changed for each occurrence of mental in the text. In order to refer to the tables correctly we have not changed mental when inside quotation marks ‘mental and behavioural disorders’ since it is part of a definition of a ICD chapter.

Lines 30-31: "Of the non-conveyed patients, 126 (9.6%) were admitted to 31 the ED within 72 hours and 12 (10.4%) were diagnosed with a time-critical condition." The statement "12 (10.4%) were diagnosed with a time critical condition" is misleading as clearly the authors are referring to the 126 patients admitted as 12 being diagnosed with a time-critical condition. This would be 10.4% of 126, but only 0.9% of the 1,312 patients not transported to the ED. Either state "12 (0.9%) of the 1,312 patients not transported were later admitted with time-critical conditions," or "12 (10.4%) of the 126 patients admitted were diagnosed with a time-critical condition."

Response: Thank you, this has now been changed in the abstract with your first proposed sentence (Lines 28-29).

Line 49: Consider changing "manned by" to "staffed by." Similarly consider changing "manned" to "staffed" throughout the manuscript.

Response: These changes have now been made throughout the manuscript.

Lines 150-152: "The most common DMI, 'chest pain/cardiac disease', was more common in the non-conveyance group (18.7%). On the other hand, the DMIs 'extremity/wound/trauma' and 'abdominal/urinary tract' was more common in patients initially assessed as requiring hospital care." These results seem contradictory as one would expect a patient with suspected chest pain or cardiac disease would require evaluation in the ED (ECG, serial cardiac biomarker testing, risk stratification for ACS), while patients with abdominal pain or urinary tract symptoms would be more common in the non-transported group.

Response: This is an important comment. However, the data that you refer to deal with dispatch indices which are assessed over the telephone with limited visuals and with an index system primarily with yes/no questions.

1. Indeed, a large group of dispatcher indices with chest pain have relatively benign causes when assessed at the scene by the EMS nurse such as anxiety, cough/infection or a musculo-skeletal etiology.
2. Furthermore, the EMS nurses may feel more insecure in the assessment of abdominal pain since here they lack a decision support tool such as an ECG. We have added a few sentences about this when discussing non-transported EMS nurse triaged chest pain later in the comments.

All Cause Mortality Results Section (Lines 226-232): It is difficult to determine from this paragraph what percentage of ED 72 patients died within 7 days and 30 days, can you clarify this in the paragraph (as 30 day mortality following an ED visit is important data)? There is later more data/information in the discussion section of all cause mortality that does not seem to be conveyed earlier in the results section (shouldn't it be in the results section first? - see my later comments).

Response: The all-cause mortality section in the results has now been expanded to include what is covered in the discussion with ED72 mortality including information on percentages for the transported group. (Line 233-237).

Line 259 Discussion: "For instance, almost 12% of patients triaged with 'chest pain' remained at the scene, with more males assessed as requiring hospital care." Did these patients all receive a screening ECG? What was the average age of these patients? This percentage for these chief completes appears quite high and it is not clear why this is so from the discussion, can the authors add a sentence or two to explain this high percentage (aside from the sex discrepancy which they explain).

Response: After re-check of the records, a total of 93 out of the 111 patients that were not transported and triaged with chest pain had an ECG recorded. Interestingly only a handful of them were digitally transmitted to the cardiac unit for consultation, something that otherwise is relatively common when transporting patients in order to try to bypass the ED or check up on prior ECG for comparison. This indicates that the EMS nurse has a low suspicion of a time-critical condition of cardiac origin. However, there is a risk involved with such a strategy, particularly in the older patients and those with cardiac risk factors where it is more difficult to rule out a time-critical condition. Analysis of biomarkers and instruments for risk stratification designed for prehospital use are proposed. We have expanded this section and further explained the problems with this group of patients and added possible explanations for the EMS nurse decisions (Line 287-295).
Lines 320 - 322 Discussion: "This indicates that not one single deviating VS but rather a combination of VS deviating from normal is of importance when it comes to the early identification of candidates for deterioration." I would disagree here, what about missing body temperature in a septic patient, missing pulse in a patient with SVT, Vtach, or missing oxygen saturation in a patient with dyspnea (from chf, pulmonary embolism, etc). Authors may want to edit this sentence to indicate importance of not missing a single vital sign in cases as I described.

Response: Thank You for this important comment. We agree with You that it is important not to miss any single vital sign as You perfectly exemplified. Barfod et al. reports that of all VS recorded the VS listed in the discussion (oxygen saturation, respiratory rate, systolic blood pressure, and level of consciousness) were predictive of the risk of in-hospital death and adverse events. In the discussion regarding the possibility of early identification of a deteriorating patient we still highlight the importance of a combination of VS (including body temperature) perhaps with a scoring system. For example, in the septic patient we agree that measuring body temperature is of importance. However, with the cutoffs in the RETTS-A it is required to have a very abnormal body temperature to be triaged to Red or Orange level (temperature &gt; 41 or &lt; 35 degrees Celsius). Therefore we propose to combine all VS and calculate a score. Thereby, perhaps we may identify a patient earlier with a small deviating VS in one critical parameter (one example is South Africa triage scale SATS). However, in order to do so with an improved EMS triage system, it is required to record all VS in order to calculate a score, triage level or some sort of discrimination. We have added the importance of recording all VS and especially in the cases mentioned (Lines 364-373).

Line 348 Discussion All Cause Mortality: This is a good discussion with results I was looking for in the results section (what percentage of patients in ED72 died within 7 days). It would be very helpful to include 30 day mortality here, as many ED clinical scores (e.g., Heart Score) utilize a 30 day mortality rate to determine the safety of discharging a patient home from the ED based upon a particular score.

Response: ED72 results have been added to the All-cause mortality section in the results including 30-day mortality. We have added this in results (Line 233-237).

Line 359 Strengths and Limitations: Wouldn't it be fair to state that another limitation is that "a consecutive sample was collected over the course of one year (2016) from the first 1,000 assignments each month." What about missing the remaining assignments each month that were not reviewed, could this have resulted in some level of selection bias?
Response: Thank You for this important comment. Yes, there could have been some level of selection bias since we don’t know the outcome of the other patients of the remainder each month. However, this was a manual review and it would not have been manageable to include all patients. The included patients conform 11.4% out of all primary assignments in a year in the EMS system under investigation and gives an impression of being quite representative. However, we can never prove it. Furthermore, by collecting data from each month, eventual fluctuations over the year may have been captured such as infections in the winter (calici virus), more patients with trauma related to the summer season, heat deterioration in the elderly etc. We have expanded the limitation section with comments on selection bias (Line 413-417).

Finally, in the United States (US) in most EMS systems, a significant majority of all patients who call our EMS system (“call 911”) are transported to the ED without consideration of triage to a lower level or care in the prehospital setting - although there are some systems currently testing this excellent strategy out. Some of this certainly can be driven by medical-legal considerations in the US, but I was hoping the authors could perhaps comment briefly on these differences between our systems, and in light of their current data, does their data point out that their system is still safe despite their findings, or should all patients who call EMS be transported to the ED so we don't "miss anything."

Response: Thank you for your interest in this paper and into the field. In Sweden (tax funded) health care system, the cost is high of specialist hospital care and is expected to increase in the future. Therefore there has been a national investigation on the possibility of re-directing a part of the patient flow towards primary care and home care instead. Therefore, we believe that the new strategy with assessment at the scene by the EMS and decisions on a lower level of care has come to stay in our country.

Introduction of prehospital geriatric specialist teams further increase the possibilities to treat and care for patients in their home environment. A new digital arena is under development, for example: point of care testing, mobile x-ray at the scene, digital video consultation with hospital specialists (stroke) and/or primary care physician. Even though the percentage of non-transported patients with time-critical conditions has been low, patient-safety is a concern. Further research is needed and instruments for risk stratification for example dizziness – stroke is under investigation which hopefully can be incorporated into a machine learning system helping the EMS nurse not only in the early assessment but also may propose a recommendation on the level of care. With the introduction of the use of prehospital biomarkers we may develop risk scores for prehospital use. We have commented on this (Lines 396-404).