

PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Variations in hospital resource use across stroke care teams in England, Wales and Northern Ireland: a retrospective observational study
AUTHORS	Lugo-Palacios, David G.; Gannon, B; Gittins, M; Vail, Andy; Bowen, Audrey; Tyson, Sarah

VERSION 1 - REVIEW

REVIEWER	Elena Pizzo University College London
REVIEW RETURNED	04-Apr-2019

GENERAL COMMENTS	<p>This is an original piece of work. The main aim is to identify drivers of variation in resource use across stroke care teams. More specifically identify whether stroke teams can influence length of stay.</p> <p>Some suggestions:</p> <p>Introduction.</p> <p>The introduction provides a good overview of the problem and explain what is the main aim of the work in a clear way.</p> <ol style="list-style-type: none">1. The first reference by Mathers et al is more than 10 years old (dated 2009). I would suggest the authors to include a more recent reference. For example, look for more recent evidence in the WHO website. Another reference is Thrift et al Int Journal Stroke 20172. Both references 2 and 3 have now been updated. Authors should refer to the most recent versions.3. Reference on costs per stroke can also be found here: https://www.stroke.org.uk/sites/default/files/costs_of_stroke_in_the_uk_report_-_executive_summary_part_2.pdf <p>DATA</p> <ol style="list-style-type: none">4. The data used in the analysis are those from June 2013 to July 2015. What is the justification for the choice of this time range? Why authors are not looking at more recent data?5. I would explain if the data are patient level data or aggregate, by trust etc. <p>METHODS</p> <ol style="list-style-type: none">6. In the methods pg. 9 line 26 I would explain what the variable yik represent as this is the first time it is mentioned in the text.7. It is not clear whether the mechanical Thrombectomy was included as a form of treatment for ischemic stroke, as this might have an impact on LOS, being more effective compared to thrombolysis is dissolving clots and allowing for recanalization.
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	<p>8. Not sure if authors took into account the time from stroke onset and arrival to hospital as this might have an impact on LOS</p> <p>RESULTS The results are well presented.</p> <p>DISCUSSION Limits of the paper are described as well as potential future work.</p>
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REVIEWER	Irene Papanicolas London School of Economics, UK
REVIEW RETURNED	15-Apr-2019

GENERAL COMMENTS	<p>The main objective of the article is to identify the main drivers of stroke care resource use in the UK using SSNAP data. Resource use is defined in terms of length of stay and a number of patient and provider characteristics are explored.</p> <p>Comments:</p> <ol style="list-style-type: none"> 1. I like how the analysis is done separately for the different type of stroke care teams, but I would like a bit more information on how these are distributed across the country. Does the location of the unit, or proximity, to other types of teams influence the resource use? Is there anyway to add to one of the models. 2. While the first model adjusts for patient history such as previously suffering a stroke, CHF, hypertension, atrial fibrillation and or diabetes, why only these comorbidities? Would it be possible to adjust for a commonly used co-morbidity index that is validated and captures more conditions, such as Elixhauser or Charleson comorbidity indices? 3. How are the 'need for therapy' variables constructed? Is this simply utilization of these therapies? If so, is this really measuring need? Can this not differ across teams for other reasons such as practice variations/ quality of care/ etc? Clarifying this is particularly important given that this variable is strongly associated with 4. Do the authors have any hypotheses for why dying in hospital is associated with 42% longer LOS in HASUs but with significantly lower LOS in other team categories? This finding seems particularly interesting. 5. Also it was of interest to me that rate of patients discharged as dependents in RATs had a significantly low length of stay, yet this was both lower and not significant for NRATs. I didn't see this discussed at all. 6. The conclusion seems to be that there are variations in resource use across care facilities that are largely explained by patient severity and treatment. Could the authors be a bit more specific as to what these findings can relate to policy makers? Are these factors modifiable at all? Are there lessons that can be learned from this that can be policy relevant? <p>Minor Comments</p>
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	1. The tables right now are quite long and not particularly user friendly. Could these be presented in a way that is easier for the reader to interpret. Perhaps the current version could go into the appendix and the main results be illustrated in a shorter table?
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REVIEWER	patrizia belfiore University of Naples Parthenope
REVIEW RETURNED	15-Apr-2019

GENERAL COMMENTS	Dear Author, this paper side is very interesting. Further insights could have important rispercussions for health management. Any adaptations of, model could also be taken into account by other countries.
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VERSION 1 – AUTHOR RESPONSE

Reviewer(s)' Comments to Author:

Reviewer: 1

Reviewer Name: Elena Pizzo

Institution and Country: University College London Please state any competing interests or state 'None declared': None

Please leave your comments for the authors below This is an original piece of work. The main aim is to identify drivers of variation in resource use across stroke care teams. More specifically identify wether stroke teams can influence Lenght of stay.

Some suggestions:

Introduction.

The introduction provides a good overview of the problem and explain what is the main aim of the work in a clear way.

1. The first reference by Mathers et al is more than 10 years old (dated 2009). I would suggest the authors to include a more recent reference. For example, look for more recent evidence in the WHO website. Another reference is Thrift et atl Int Journal Stroke 2017
2. Both references 2 and 3 have now been updated. Authors should refer to the most recent versions.
3. Reference on costs per stroke can also be found here:
https://www.stroke.org.uk/sites/default/files/costs_of_stroke_in_the_uk_report_-_executive_summary_part_2.pdf

We thank the reviewer for pointing this out. We have now updated these references in the manuscript's opening paragraph.

DATA

4. The data used in the analysis are those from June 2013 to July 2015. What is the justification for the choice of this time range? Why authors are not looking at more recent data?

We thank the reviewer for this observation. We acknowledge that the use of more recent data would have enriched our analysis. However, the National Institute for Health Research (NIHR) project that funded the research presented here started in April 2016 and the data analysed (June 2013-July 2015) was the most recent available at the start of the project (when the data was originally requested).

5. I would explain if the data are patient level data or aggregate, by trust etc.

We thank the reviewer for her helpful comment. We have now clarified this in the opening sentence of p.6.

METHODS

6. In the methods pg. 9 line 26 I would explain what the variable *yik* represent as this is the first time it is mentioned in the text.

We thank the reviewer for pointing this out. We have now defined the variable *yik* in p.10 line 1.

7. It is not clear whether the mechanical Thrombectomy was included as a form of treatment for ischemic stroke, as this might have an impact on LOS, being more effective compared to thrombolysis is dissolving clots and allowing for recanalization.

We thank the reviewer for this observation. Unfortunately, during the study period, SSNAP records at the patient level did not include data on thrombectomy. SSNAP records at the organisational level include two questions related to the thrombectomy interventions provided by the stroke team in question, but these were not included in the data sharing agreement.

8. Not sure if authors took into account the time from stroke onset and arrival to hospital as this might have an impact on LOS

We thank the reviewer for this comment and we agree with her about the potential impact this variable may have on inpatient length of stay. However, we decided not to include this variable in this analysis for two reasons: 1) we were unsure about the precision with which the time of stroke onset was measured as it was not always verifiable by the stroke team, and 2) the high proportion of missing values of the time of stroke onset.

RESULTS

The results are well presented.

DISCUSSION

Limits of the paper are described as well as potential future work.

Reviewer: 2

Reviewer Name: Irene Papanicolas

Institution and Country: London School of Economics, UK Please state any competing interests or state 'None declared': None declared

Please leave your comments for the authors below The main objective of the article is to identify the main drivers of stroke care resource use in the UK using SSNAP data. Resource use is defined in terms of length of stay and a number of patient and provider characteristics are explored.

Comments:

1. I like how the analysis is done separately for the different type of stroke care teams, but I would like a bit more information on how these are distributed across the country. Does the location of the unit, or proximity, to other types of teams influence the resource use? Is there anyway to add to one of the models.

We thank the reviewer for this observation. In the second stage analysis (specifically, in the RATs model reported in the first column of Table 4), we did include a variable indicating the geographic region of the stroke team in question; with the exception of two regions, we found that, in this case, hospital performance/resource use was not significantly associated with stroke team geographic location. We did not include dummy variables indicating the stroke team geographic region in the NRAT's model as there were only 32 teams clustered in few regions and some of them with only one NRAT team per region. We recognise the importance of a map representation of the distribution of the type of stroke teams across the country and we now include a reference to the SSNAP interactive maps in p.7, lines 2-4

We find the suggestion of exploring the influence of the proximity to other teams on resource use very interesting indeed. Such an analysis could apply spatial econometric techniques to investigate whether stroke teams change their resource use in response to the resource use of neighbouring teams and whether the magnitude of the response changes depending on the type of stroke teams. We believe, however, that this constitutes a whole research question on its own and, therefore, is out of the scope of the present paper.

2. While the first model adjusts for patient history such as previously suffering a stroke, CHF, hypertension, atrial fibrillation and or diabetes, why only these comorbidities? Would it be possible to adjust for a commonly used co-morbidity index that is validated and captures more conditions, such as Elixhauser or Charlson comorbidity indices?

We completely agree with the reviewer that the use of the Elixhauser or Charlson comorbidity indexes is preferable to the use of a limited list of health conditions to adjust for patient comorbidity. However, SSNAP does not provide information on secondary diagnoses and only reports if the patient suffered CHF, hypertension, atrial fibrillation, diabetes and/or a previous stroke prior to the admission in question. Hence, it was not possible to build any of the commonly used comorbidities suggested by the reviewer. We thank the reviewer for her observation and we now explicitly acknowledge this limitation in p.10. lines 19-22

3. How are the 'need for therapy' variables constructed? Is this simply utilization of these therapies? If so, is this really measuring need? Can this not differ across teams for other reasons such as practice variations/ quality of care/ etc? Clarifying this is particularly important given that this variable is strongly associated with

We are grateful to the reviewer for pointing this lack of detail in our original manuscript. The variables measuring "need for therapy" were taken directly from the SSNAP dataset. We intend to be clearer by adding the following sentence in p. 11, lines 13-16: "Stroke teams report the need for therapy in SSNAP by indicating, for each patient, whether he/she needed physiotherapy, occupational therapy, speech and language therapy or psychological therapy at any point during his/her stay in the stroke team."

4. Do the authors have any hypotheses for why dying in hospital is associated with 42% longer LOS in HASUs but with significantly lower LOS in other team categories? This finding seems particularly interesting.

We thank the reviewer for this helpful observation. We have now added the following paragraph in the discussion (p. 18, lines 3-15): "Results from the first stage model also show that dying in hospital is associated with 42% longer LoS in HASUs, but with significantly lower LoS in other team categories. These could be explained because HASUs were designed to provide hyper-acute care (rapid assessment with specialist clinical teams, diagnostic facilities and the capacity to provide thrombolysis) and to either discharge the patient or transfer him/her to a stroke team near his/her residence within 72 hours unless the patient is too unwell to be moved. Hence, these findings suggest that, on average, the poor condition of patients dying in HASUs prevented their transfer to a non-HASU team and, thus, stayed in the HASU longer than those well enough to be either discharged or transferred out. On the other hand, non-HASU teams have less pressure to discharge and/or transfer patients out than HASUs and, consequently, a patient will remain under the care of the stroke team until he/she is stable enough to be discharged or transferred out; his/her own death will shorten his/her stay."

5. Also it was of interest to me that rate of patients discharged as dependents in RATs had a significantly low length of stay, yet this was both lower and not significant for NRATs. I didn't see this discussed at all.

We thank the reviewer for her comment. The following paragraph was added in p. 18-19.

"Results from Stage 2 suggest that the rate of patients discharged as dependants is positively associated with RATs performance, but this association is not statistically significant for NRATs. By design, as briefly mentioned in the Introduction, RATs typically provide acute stroke care over the first seven days after stroke – Table 1 shows an average LoS of 13.9 days. Depending on the patient's progress, he/she will be discharged home or, if further inpatient care is needed, he/she will be transferred to an NRAT or a NAIT (both options are considered discharges from the RATs perspective). Once admitted to an NRAT or a NAIT, patients receive further care and rehabilitation until they are well enough to be discharged, thus tending to have longer stays than in other teams (average LoS of 23.1 and 37.4 days in NRATs and NAITs, respectively). Therefore, a possible explanation for the positive association between RATs performance and patient's dependency rate is that, in general, RATs are doing a good job in timely identifying patients needing further inpatient care (likely to be in a dependant state) and in opportunely transferring them to NRATs or NAITs. Identifying different stroke care pathways and analysing their outcomes in terms of length of stay and

dependency rates is needed to confirm this hypothesis. This is, however, beyond the scope of this paper.”

6. The conclusion seems to be that there are variations in resource use across care facilities that are largely explained by patient severity and treatment. Could the authors be a bit more specific as to what these findings can relate to policy makers? Are these factors modifiable at all? Are there lessons that can be learned from this that can be policy relevant?

We thank the reviewer for this observation. This is an exploratory study whose main contribution is the provision of evidence 1) that LoS is strongly associated with stroke severity, the need for therapy and the amount of therapy received, and 2) important variations in stroke care performance not explained by measurable patient and treatment characteristics. These findings do not show a causal relationship and, therefore, we are cautious to give any policy recommendation before conducting further research in two concrete areas. First, into the overall clinical and economic consequences of improving early detection therapy needs and increasing the amount of therapy provided to those patients in need (p. 18, lines 1-2). Second, operational and financial analysis that can help unmask the cause of the huge variations in stroke care performance (p.19, lines 21-22).

It is worth mentioning that the present manuscript is part of a larger project (SSNAPIEST) investigating and evaluating stroke therapy in the UK with emphasis on understanding how stroke therapy is provided, which factors associated with the amount of therapy provided and how this relates to health outcomes.

Minor Comments

1. The tables right now are quite long and not particularly user friendly. Could these be presented in a way that is easier for the reader to interpret. Perhaps the current version could go into the appendix and the main results be illustrated in a shorter table?

Following the reviewer’s comment we have included a shorter version of Table 2 and Table 4 in the main text and present the original version of the tables as supplementary material to be available online. Tables 1 and 2 are still slightly longer than 1 page in Word, but we hope that the editorial team can help us with the final format if this manuscript is accepted for publication.

Reviewer: 3

Reviewer Name: patrizia belfiore

Institution and Country: University of Naples Parthenope Please state any competing interests or state ‘None declared’: none declared

Please leave your comments for the authors below Dear Author, this paper side is very interesting. Further insights could have important rispercussions for health management. Any adaptations of, model could also be taken into account by other countries.

We thank the reviewer for her positive comments.

VERSION 2 – REVIEW

REVIEWER	Elena Pizzo University College London
REVIEW RETURNED	28-May-2019

GENERAL COMMENTS	I think the paper has been revised accurately, all my comments have been addressed and justification provided.
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