PEER REVIEW HISTORY

ARTICLE DETAILS

TITLE (PROVISIONAL)	Socio-demographic variations in the amount, duration and cost of potentially preventable hospitalisation for chronic conditions amongst Aboriginal and non-Aboriginal Australians: a period prevalence study of linked public hospital data
AUTHORS	Banham, David ; Chen, Tenglong; Karnon, Jon; Brown, Alex; Lynch, John

VERSION 1 - REVIEW

REVIEWER	Judith Katzenellenbogen School of Population and Global Health, University of Western Australia
REVIEW RETURNED	15-May-2017

GENERAL COMMENTS	Objectives: The objectives are vague in the abstract but clearer in the manuscript. It could benefit from tightening of the language. Abstract: Objectives need tightening up. 'Such as angina and diabetes' could be replaced by ' selected chronic conditions' or some wording that provides readers with the criteria used for selection or the category. It would be good to include 'with respect to rates, length of stay and costs'. Study design not provided. For example: xxx (cohort/cross-sectional) study using linked administrative hospital records. Both design and data sources would enhance the abstract Primary outcome measures: "….were subsequently regressed…" is not the outcome measure it is the statistical method. Improve clarity of this outcome measure. Results – insert 'years' after (…70).typo? Third last line of the abstract (0.00.02). Streamline results somewhat to make it easier to read. Conclusion: Edit to improve readability Manuscript: Intro: could benefit from a clearer definition of PPH and provision of list of conditions (see supplementary tables below). I am still not clear what conditions you have used. On page 6 you provide a list – does that mean stroke, MI and CKD not included? Emphasise that AIHW uses unlinked data in their reports. Identify if this is a shortcoming (seeing that you are using linked data, one assumes there are benefits). It would be useful to reference research papers on the disparities in some of the selected chronic conditions as well as government reports. Provide reference for the Australia study (I think reference 45?) when you first mention it.

	As this is an international journal, the introduction could benefit from a few sentences about South Australia, possibly its location, population size, density and proportion of Aboriginal people. Methods: This section could benefit from some restructuring and editing (including some language typos) to improve readability and clarity. Study design: I am not convinced this is a cross-sectional study. Could this be considered a cohort study, with people being identified on their first PHH admission in the period and followed up for cumulative LOS and costs. Although I note you have not considered mortality. Add section 'Data sources' and describe these. When you mention linked data for the first time, describe which organisation and how linkage occurred (currently mentioned in subsequent paragraphs). Be explicit that linked data allowed a person-based analysis to take place. Under data analysis, it was not always clear that analysis was at the person rather than admission/event level. Tighten language eg the unit of analysis was at the person level. Last sentence of first paragraph needs some rewording. Second paragraph: 1.50 is a more conventional way to describe a ratio than 150? Last sentence of methods referring to sensitivity analysis results should appear under results rather than methods. Important details missing: - Were PPHs identified from principal diagnoses only, or secondary also? Please specify - Explain which was the index admission (first in the period?) - How did you handle inpatient and subsequent deaths, were death records linked? - Why were patients from APY lands excluded? Supplementary tables: - Add table of conditions and codes included. You refer to AIHW but might as well provide the reader with the list especially since you have not used all the PPH. Also include what constitutes 'diabetes complications'. These are useful supplementary details. Results: First heading: change to 'Crude separations' Second heading: Demographic and diagnostic profile (Person-based analysis) Some unnecessary repeat of details in the tables. Generally – wording needs to clarify that this is a person-based analysis. Third heading: Age-standardised LOS and costs (remove population –confusing) Titles of the tables and figures could be improved – review. Some details could be footnoted to remove some clutter in title (eg square root transformed) eg Table 1: Demographic and diagnostic distribution and rates pertaining to Aboriginal and non-Aboriginal patients admitted with a PPH in SA public hospitals, 2005-06 to 2010-11 Table 1: should there be another column on the right for ORs? You refer to these in the text Fig 1: Title: indicate that annual PHH rate is person- not event-based . Right hand Y axis title: mean number of chronic PPH per person…? Figure 2: Ratio of sex and age-adjusted public hospital LOS and costs for chronic PPH by Aboriginal status, disadvantage and remoteness in SA, 2005-6 etc. Also need to indicate near the graph what the size of the circles indicate (reflect population weighting)

	Discussion Limitation: no private hospitalisations yet population denominators used No consideration/description of type of hospitalisation (emergency/booked?) -

REVIEWER	John Busby Queens University Belfast, UK
REVIEW RETURNED	05-Jun-2017

GENERAL COMMENTS	This article uses routinely collected data from Australia to investigate if ambulatory care sensitive condition admission rates differ by Aboriginal Status, socioeconomic status and remoteness. This is a well-written and interesting piece of work. The analysis, while mostly descriptive, is sound and well presented. Although the findings would be of most interest to Australian readers, there are themes that would resonate in other healthcare settings with poor outcomes among minority populations (e.g. USA). I have attached some more specific suggestions for improvement below. Abstract • Should participants be all South Australian residents as they are used for the denominator? • There is an error in the results section – 0.00.02 should be 0.02 Introduction • Does a good job of setting the scene and reviewing past work. I've little knowledge of the Australian healthcare system, so can't comment on the validity of some of this content, but each section was well-written and interesting. • Overall, the introduction is a little long and unfocussed in places (e.g. the second paragraph about LOS is quite detailed, and much of it isn't strictly necessary for this study, while the paragraph on equity is interesting but probably a bit long). Methods • I didn't follow the rationale for splitting patients with diabetes complications from the rest of the cohort. Can the authors give some rationale on why they thought associations might differ a priori? • Findings from the sensitivity analysis (i.e. definition of aboriginality) should really be left to the methods section • Very minor, but I wasn't aware of what the word 'separation' with regards to hospitals and had to look this up. It appears that these are identical to hospital 'admissions' in the UK (and from my knowledge the USA) – the authors might consider noting this for the benefit of an international audience Results • I'm unsure what the 'persons per 1000 per year' label means in table 1 – is this the number of separations? Is needs to be clearer. • The textual description of table 1 is a bit labored and could perhaps be cut down. • I like figure 1 – but I think it tries to do too much in one figure. In particular, I think graphs with two different y-axis are rarely a good idea. This data would be much better if displayed on two separate figures. • Is there any value in giving the constant from the regression in table 3 – this is really a nuisance parameter and of little practical interest. • Did the authors check for linearity in their associations? I'd be surprised if the socioeconomic disadvantage and remoteness ranks

	were linear. They might want to split in to categories (e.g. into quintiles or deciles) to combat this although this analysis would obviously have less power. • The authors might wish to use interaction tests to formally test for differences in the socioeconomic status, and remoteness regression coefficients by Aboriginal status • In the last paragraph of the results the authors talk about how the 'base' was different between Aboriginal and non-Aboriginal populations. Is this just repetition of what has already been said for table 1 and 2 (i.e. Aboriginals are more likely to have separations)? If so this should be deleted. Discussion • I didn't understand this paragraph – can the authors edit to make clearer. It's particularly confusing as their study doesn't investigate mortality. 'If hospital LOS is a proxy measure for clinical severity as suggested by some, then the results provide a precursor to mortality figures displaying very similar associations between premature mortality outcomes in SLAs, disadvantage and remoteness among Aboriginal South Australians and disadvantage among non-Aboriginal South Australians.' • The authors might wish to go into a bit more detail on the types of interventions that have been used previously to reduce ACSCs internationally, rather than just sticking to those that have been applied in Australia before. Sarah Purdy's report for the Kings Fund : Avoiding hospital admissions What does the research evidence say?' would be a good starting point

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1
Abstract:
Objectives: The objectives are vague in the abstract but clearer in the manuscript. It could benefit from tightening of the language:
• Objectives need tightening up. 'Such as angina and diabetes' could be replaced by ' selected chronic conditions' or some wording that provides readers with the criteria used for selection or the category.
• It would be good to include 'with respect to rates, length of stay and costs'.
Action: Thank you and the Objectives are now amended to include these suggestions:
"To determine disparities in rates, length of stay and hospital costs of potentially preventable hospitalisations (PPH) for selected chronic conditions among Aboriginal and non-Aboriginal South Australians, then examine associations with area level socio-economic disadvantage and remoteness."
Study design not provided. For example: xxx (cohort/cross-sectional) study using linked administrative hospital records. Both design and data sources would enhance the abstract
Action: The Setting is now amended and describes our:
"Period prevalence study using linked, administrative public hospital records"
Please note the study design is also adjusted in response to the Method section, suggestion 2.

Primary outcome measures: "….were subsequently regressed…" is not the outcome measure it is the statistical method. Improve clarity of this outcome measure.
Action: The amended Primary outcome measures now refer to:
"Number and rates (unadjusted, then adjusted for sex and age differences) of chronic PPH, associated total length of stay (LOS) and direct hospital costs for Aboriginal and non-Aboriginal people."

Results – insert ‘years’ after (…70).typo? Third last line of the abstract (0.00.02).
Action: The text now includes these corrections.

Streamline results somewhat to make it easier to read.
Action: The Results are now streamlined as requested.

Conclusion: Edit to improve readability
Action: The Conclusion is now edited to improve clarity and readability.

Manuscript:
Intro: could benefit from a clearer definition of PPH and provision of list of conditions (see supplementary tables below). I am still not clear what conditions you have used. On page 6 you provide a list – does that mean stroke, MI and CKD not included?
Action: The introduction of PPH has been edited to improve clarity to the definition of PPH and its primary intent as an indicator (Background, paragraph 3).
The subsequent paragraph is also amended to add clarity around chronic PPH conditions reported in Australia while also referring the reader to a new Supplemental Table A detailing the diagnostic and procedural codes for those conditions. The Reviewer’s observation that stroke, AMI and CKD are not included in this list is correct and highlights the scope for further developing the indicator and this is now included in the text.

Emphasise that AIHW uses unlinked data in their reports. Identify if this is a shortcoming (seeing that you are using linked data, one assumes there are benefits).
Action: Background, paragraph 4 is amended to refer to AIHW’s use of unlinked data while the second last paragraph identifies the use of linked data in reporting aspects of people’s experience of using health services.

It would be useful to reference research papers on the disparities in some of the selected chronic conditions as well as government reports.
Action: The second last paragraph in the section now identifies the need for making use of increasingly available linked data in reporting health system indicators and which system elements are working for whom in what context.

Provide reference for the Australia study (I think reference 45?) when you first mention it.
Action: Yes, the previous Australian study considering chronic PPH and LOS was reference 45 (now 48) and is now appropriately referred to on its first mention.

As this is an international journal, the introduction could benefit from a few sentences about South Australia, possibly its location, population size, density and proportion of Aboriginal people.
Action: Two sentences introducing these attributes of South Australia have been included at the start of the Methods “Population and Statistical Geography” section.

Methods:
This section could benefit from some restructuring and editing (including some language typos) to improve readability and clarity.
Action: In addition to actioning the specific items identified in the following ten points, the Methods’ text has been further reviewed and a number of edits made.

Study design: I am not convinced this is a cross-sectional study. Could this be considered a cohort study, with people being identified on their first PHH admission in the period and followed up for

cumulative LOS and costs. Although I note you have not considered mortality.
Response: Yes, we understand how why you would refer to this as a cohort study. The study's descriptive analyses focuses on the prevalence of chronic PPH, total LOS and costs accumulated among Aboriginal and non-Aboriginal people.
However, the focus was not on determining a person's incident chronic PPH (i.e. applying an exclusion period for any previous chronic PPH) or linking related information of death events. There is a proposal to pursue these facets using a cohort design but currently there are no resources to support this.
Action: We have amended the paper and method and now describe it as a "period prevalence" study. However, we do indicate our willingness to amend this if Reviewer #1 feels strongly enough on the issue.

Add section 'Data sources' and describe these. When you mention linked data for the first time, describe which organisation and how linkage occurred (currently mentioned in subsequent paragraphs). Be explicit that linked data allowed a person-based analysis to take place.
Action: The additional section heading has been added together with amended sub-headings explaining the source of hospital separation data, then augmenting these data into hospital separations for individuals which enables person-level analysis.

Under data analysis, it was not always clear that analysis was at the person rather than admission/event level. Tighten language eg the unit of analysis was at the person level.
Action: Several changes to the text have been made to clearly differentiate where the analysis is focussed on individuals, then populations.

Last sentence of first paragraph needs some rewording.
Action: To help readability, the sentence has been split into two.

Second paragraph: 1.50 is a more conventional way to describe a ratio than 150?
Action: Agreed. The relevant change is now included.

Last sentence of methods referring to sensitivity analysis results should appear under results rather than methods.
Action: The relevant sentence has been moved to the end of the Results section.

Important details missing:
Were PPHs identified from principal diagnoses only, or secondary also? Please specify
Action: The text within the Data sources; Hospital separations section now includes reference to AIHW criteria. The Supplemental Online Table added also provides detail of each condition and the predominant use of primary diagnoses.

Explain which was the index admission (first in the period?)
Action: The text in Data sources; Hospital separations for individuals has been amended to make it clear the index event is that which occurred first in the period.

How did you handle inpatient and subsequent deaths, were death records linked?
Response: Our analysis of prevalent chronic PPH and related LOS makes no account for deaths among the patient group. However, the broader project includes the option of linking deaths data to these hospital records and may be pursued in future work if resourcing becomes available.

Why were patients from APY lands excluded?
Response: The overwhelming majority of hospital services for APY Land residents are delivered in a neighbouring jurisdiction, Alice Springs Hospital in the Northern Territory (NT). These separations are

not included in ISAAC and bias results hence we removed them from activity numerators and population denominators. This observation was important to make and, having done so, we have advised a range of colleagues to incorporate both SA and NT hospital records in their study designs.
Action: The text within the Data sources; Hospital separations section is now amended to better describe the necessary removal of APY separations and population from this analysis.

Supplementary tables:
Add table of conditions and codes included. You refer to AIHW but might as well provide the reader with the list especially since you have not used all the PPH. Also include what constitutes 'diabetes complications'. These are useful supplementary details.
Action: A further Supplemental Online Table A has been added with detail of the conditions, diagnosis and procedural codes.

Results:
First heading: change to 'Crude separations'
Action: This change has been made.

Second heading: Demographic and diagnostic profile (Person-based analysis)
Action: This change has been made.

Some unnecessary repeat of details in the tables.
Action: Agreed and the text associated with Table 1 in particular has been reduced.

Generally – wording needs to clarify that this is a person-based analysis.
Action: Agreed, the text is now more specific in referring to individual patients.

Third heading: Age-standardised LOS and costs (remove population –confusing)
Action: This change has been made.

Titles of the tables and figures could be improved – review. Some details could be footnoted to remove some clutter in title (eg square root transformed)
eg Table 1: Demographic and diagnostic distribution and rates pertaining to Aboriginal and non-Aboriginal patients admitted with a PPH in SA public hospitals, 2005-06 to 2010-11
Action: Table 1's title is now amended to "Demographic and diagnostic distribution of Aboriginal and non-Aboriginal patients experiencing chronic PPH in SA public hospitals, 2005-06 to 2010-11". Table 3's title is also amended to "Relationship of SLA attributes with standardised ratios# of LOS and cost by Aboriginality, SA public hospitals 2005-06 to 2010-11" with a suitable table footnote indicating the square root transformation was used.

Table 1: should there be another column on the right for ORs? You refer to these in the text
Response: Odds ratios are not necessary or included in the associated text, which is also now reduced to improve clarity.

Fig 1: Title: indicate that annual PHH rate is person- not event-based. Right hand Y axis title: mean number of chronic PPH per person…?
Action: Figure 1 is now retitled to "Rate of individuals with first chronic PPH and subsequent mean of chronic PPH by age and Aboriginality, SA public hospitals 2005-06 to 2010-11". It is also divided into two figures to better highlight the rate at which individuals experience a first PPH and the mean number of chronic PPH these individuals experienced as per Reviewer 2's suggestions.

Figure 2: Ratio of sex and age-adjusted public hospital LOS and costs for chronic PPH by Aboriginal status, disadvantage and remoteness in SA, 2005-6 etc. Also need to indicate near the graph what

the size of the circles indicate (reflect population weighting)
Action: Figure 2 is now retitled to “Ratio of sex and age adjusted public hospital LOS (Panel A) and costs (Panel B) for chronic PPH by Aboriginality, disadvantage and remoteness in SA, 2005-06 to 2010-11” with suitable notation about the marker size relating to population size.

Discussion
Limitation: no private hospitalisations yet population denominators used. No consideration/description of type of hospitalisation (emergency/booked?)
Action: Both these points are now included in the listed study limitations.
Reviewer: 2
Abstract
•Should participants be all South Australian residents as they are used for the denominator?
Action: The Abstract now refers to “all South Australian residents…. Focused on individuals experiencing chronic PPH”.

•There is an error in the results section – 0.00.02 should be 0.02
Action: The text now includes this correction.

Introduction
•Overall, the introduction is a little long and unfocussed in places (e.g. the second paragraph about LOS is quite detailed, and much of it isn’t strictly necessary for this study, while the paragraph on equity is interesting but probably a bit long).
Action: Both these paragraphs are now substantially reduced as suggested.

Methods
•I didn’t follow the rationale for splitting patients with diabetes complications from the rest of the cohort. Can the authors give some rationale on why they thought associations might differ a priori?
Response: Chronic PPH among Aboriginal people were known a priori to include a high proportion of diabetes complications which are also associated with large rate differences between Aboriginal and non-Aboriginal populations. We had much less understanding of the relationship between diabetes complications (and other chronic conditions) and area disadvantage and remoteness and whether one or the other of these would bias aggregated analysis.
Action: The text is supplemented and now reads:
“…diabetes complications are known to be substantially over represented among Aboriginal people70 as the largest single chronic PPH condition and up to 10 times the rate of the non-Aboriginal population. To examine any potential bias introduced by an association between diabetes complications, area disadvantage and remoteness, records were further stratified as either diabetes complications or all other chronic PPH with analyses repeated for each.”

•Findings from the sensitivity analysis (i.e. definition of aboriginality) should really be left to the methods section
Action: The relevant sentence has been moved to the end of the Results section.

•Very minor, but I wasn’t aware of what the word ‘separation’ with regards to hospitals and had to look this up. It appears that these are identical to hospital ‘admissions’ in the UK (and from my knowledge the USA) – the authors might consider noting this for the benefit of an international audience
Response: Using hospital extracts for admitted patients gathered at time of discharge, or separation from hospital appears to have influenced the terminology, but yes, they appear synonymous to ‘admissions’.
Action: This is clarified in two sentences now added to the Data sources section (requested by Reviewer 1) which read:
“Details of care provided to patients admitted to public hospitals are collated at time of their discharge,

or separation, from hospital then added to the Integrated South Australian Activity Collection (ISAAC). The term ‘separation’ is then used synonymously with ‘admissions’.”

Results

•I’m unsure what the ‘persons per 1000 per year’ label means in table 1 – is this the number of separations? Is needs to be clearer.
Action: Yes, Reviewer 1 also suggested this. The label is now amended to more clearly refer to first time chronic PPH “Patients per 1000 population each year”.

•The textual description of table 1 is a bit labored and could perhaps be cut down.
Action: Agreed. The relevant text is now substantially reduced and better focussed on findings relevant to the ensuing discussion.

•I like figure 1 – but I think it tries to do too much in one figure. In particular, I think graphs with two different y-axis are rarely a good idea. This data would be much better if displayed on two separate figures.
Action: Figure 1 is now revised into two separate figures as suggested. The associated text in the Results section is also amended (final paragraph under “Individuals”).

•Is there any value in giving the constant from the regression in table 3 – this is really a nuisance parameter and of little practical interest.
Response: We believe the reporting of the constants has merit in this particular case. The constants reinforce the gross disparity between Aboriginal and non-Aboriginal chronic PPH rates in comparison to the SA average. For example, before adjusting for further disparities associated with area disadvantage and remoteness standardised Aboriginal LOS rates were twice the SA average compared to half the SA average for non-Aboriginal. While this is our preference we do indicate our willingness to amend the table if the Reviewer #2 feels strongly enough on the issue.

•Did the authors check for linearity in their associations? I’d be surprised if the socioeconomic disadvantage and remoteness ranks were linear. They might want to split into categories (e.g. into quintiles or deciles) to combat this although this analysis would obviously have less power.
Response: Yes, we did check for linearity. We trialled alternative models with dummy variables for disadvantage quintiles and remoteness categories (major cities; regional; remote) and outcomes were consistent with those reported. Nonetheless, we also trialled quadratic and cubic terms to gauge potential for improving Aboriginal and non-Aboriginal models. Neither of these approaches markedly improved the models.
Accordingly, we present the models in Table 3 because we believe they are a reasonable representation of the data and are easier to understand than alternatives with polynomial terms. We also believe changing the models presented would in no way alter the paper’s conclusion.

•The authors might wish to use interaction tests to formally test for differences in the socioeconomic status, and remoteness regression coefficients by Aboriginal status.
Response: Interactions between area disadvantage and remoteness by Aboriginal status were formally tested during model development, particularly in light of interactions observed in earlier analysis of premature mortality by disadvantage, remoteness and Aboriginality (ref 53). No such interactions were observed in the current study.
Action: The final paragraph of the Results is amended to include reference to our consideration of interactions between disadvantage and remoteness.

•In the last paragraph of the results the authors talk about how the ‘base’ was different between Aboriginal and non-Aboriginal populations. Is this just repetition of what has already been said for table 1 and 2 (i.e. Aboriginals are more likely to have separations)? If so this should be deleted.

Response: Tables 1 and 2 report differences in chronic PPH using crude, unadjusted results. Table 3 reports sex and age standardised rate ratios with the disparities observed becoming all the more stark. For this reason we would prefer to retain the relevant text.

Discussion
•I didn't understand this paragraph – can the authors edit to make clearer. It's particularly confusing as their study doesn't investigate mortality. 'If hospital LOS is a proxy measure for clinical severity as suggested by some, then the results provide a precursor to mortality figures displaying very similar associations between premature mortality outcomes in SLAs, disadvantage and remoteness among Aboriginal South Australians and disadvantage among non-Aboriginal South Australians.'
Action: Agreed. On reflection the sentence needlessly interrupts the discussion and is now removed.

•The authors might wish to go into a bit more detail on the types of interventions that have been used previously to reduce ACSCs internationally, rather than just sticking to those that have been applied in Australia before. Sarah Purdy's report for the Kings Fund : Avoiding hospital admissions What does the research evidence say?' would be a good starting point
Action: Thank you for this suggestion. The Discussion text focussed on interventions is now improved by adding the following:
"Authoritative reviews of the international literature found chronic PPH74 75, and unplanned hospitalisation more generally76 among selected patient groups, were reduced by interventions promoting self-management support, continuity of care with a general practitioner, and integration of primary and secondary care. Other interventions, such as case management, appear to reduce LOS74-76. However, each review was restricted by a relative lack of robust evaluation of interventions as they are introduced into health systems."

VERSION 2 – REVIEW

REVIEWER	Judith Katzenellenbogen The University of Western Australia
REVIEW RETURNED	13-Jul-2017

GENERAL COMMENTS	The revision has addressed the issues raised in my first review. The quality of Figs 1 and 2 needs to be brought to publication level. See below for minor editorial suggestions. Abstract: minor editorial suggestions Setting: South Australian period prevalence study…. Participants: South Australian residents experiencing a chronic PPH admission in 2005/06 to 2010/2011 as defined by the ….. Pg 10 Line 47: editorial suggestion The mean number of chronic PPH separations and the associated mean, total LOS and hospital costs was determined. Pg 13, line 5: remove ''were'' Results: Table 2; is it worth indicate which differences were significant eg by putting in bold or italics? Improve quality of Fig 1 & 2 Discussion Pg 16, line 23 – remove second 'highlight'