PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Costs and effects of higher turnover of nurses and Aboriginal Health Practitioners and higher use of short-term nurses in remote Australian primary care services: An observational cohort study
AUTHORS	Zhao, Yuejen; Russell, Deborah; Guthridge, Steven; Ramjan, Mark; Jones, Michael; Humphreys, John; Wakerman, John

VERSION 1 – REVIEW

REVIEWER	Hilary Barnes University of Delaware, United States
REVIEW RETURNED	17-May-2018

GENERAL COMMENTS	Thank you for the opportunity to review this manuscript. This is an interesting study examining the impact on cost and some patient outcomes of staff/nursing turnover and use of agency nurses in primary care in remote Australian communities. The authors conducted a secondary analysis of multiple large data sets. Abstract: Does the journal require a more structured abstract? Would recommend revising the objective and using complete statements vs bullet points. This might make the abstract more compelling for readers. Are the authors really measuring "cost-effectiveness" of turnover rates; is this the correct term? It seems they would want to compare costs in settings with high turnover vs low turnover or look at the effect of turnover on costs…It is not clear how turnover could be used as a cost-effective strategy to improve outcomes. Cost-effectiveness makes more sense with the use of agency nurses. Perhaps the authors just need to revise the objective for clarity. I wonder if using "outcomes" vs "effectiveness" measures (ie, total hospitalizations and YLL) would be more appropriate. It was just a confusing to me. Article summary (line 104) – what primary data were collected? Introduction: This section needs to be revised and expanded to provide more of a background and support for conducting the study. The opening statement (line 116-118) is a run-on sentence and addresses multiple concepts. The first paragraph should be two paragraphs – one about patients and one about nurses/staff. Do the authors have any information on why turnover is high in these settings or what has been done to improve it? The authors should define what they mean by "staff" and be consistent with the terminology throughout. "Staff" is used in the title,

	but it seems that they focused primarily on nurses – is it all about nursing or other providers, too. For example, they use “resident clinical staff” (line 125) and aboriginal community workers (line 144) – are these nurses? Are they in the analyses? Midwives and AHPs (lines 134-5) and resident nurses (line 143) are mentioned also. Who is hired by the agencies (AHP, midwives, or nurses, or everyone?). A little background on the different roles and who is included in the analyses would be helpful for readers. Maybe revise the title if the study is really about nurses. Study Setting Section: The authors frame this paper within the context of decreasing disparities for Aboriginal populations in Australia. Why do they include non-Aboriginal/non-Indigenous data in the main analyses? They do remove the non-Aboriginal communities in the sensitivity analyses, but I would suggest this be the main analysis. The discussion of results and policy implications may be different especially since higher costs were found among the Aboriginal communities that had low agency-nurse use (line 263-265). Patient involvement section (lines 150-151) – this sentence needs to be revised for clarification. The authors used inpatient hospitalizations and age of death – aren’t these data patient data? Maybe the authors mean that primary data were not collected from the patients. Turnover Rate (lines 158-164): here the author calculate turnover using nurses and AHPs – what about the other individuals mentioned above? Please clarify and be consistent. Also, were agency nurses included in this calculation? This might artificially inflate the turnover rate since many agency nurses are on short-term contacts (at least in the US), and it is expected they will rotate through pretty quickly. The authors may have already considered this; it should be clarified. Lines 173-5: if there is evidence that agency nurses fill, on average, 13% of positions, why not use that as your threshold? Analyses section, lines 195-198: Recommend revising as it is not clear – what is “clinic months”? This is the first mention of this term. These objectives should match those in the abstract. Lines 263-265: The authors report higher costs in Aboriginal communities with lower agency-nurse use. This is an interesting finding and is in contrast to the findings reported in beginning of the paragraph. If the authors are framing this work as reducing disparities among Aboriginal communities, this should be highlighted and expanded upon in the discussion. Having said that, the authors should consider their framing – do they want to focus on Aboriginal communities or remote primary care? You’ll need to align the analyses and discussion with whatever you decided. Lines 284-286: This is an interesting calculation and can have policy and practice implications. Within the context of remote Australian communities and the Australian healthcare system, is this “potential” reasonable? Will these settings be able to cut the turnover rate in half and eliminate use of agency nurses? It is a lot of costs savings, but may not be reachable and thus, the authors should take care in using this dollar figure so boldly in the abstract, discussion, and conclusion. It feels like a misrepresentation/oversell of your results. Also, you used the threshold of 13% here in the text, but your

	analyses used a 10% threshold – please rectify. Discussion: This section needs to be revised and expanded. I would suggest the authors discuss how their results fit within the existing literature (have others found similar or contradictory findings?) and/or fit within existing healthcare issues (why do you think you found higher costs in Aboriginal communities with lower use of agency nurses – there may be other things the authors should consider that could account for these higher costs). The authors jump right into workforce recommendations. Finally, the authors should avoid the use of bullet points within the discussion narrative. These suggestions might work better in a table. Figure 2 and 4 are missing.

REVIEWER	Josée G. Lavoie University of Manitoba, Canada I have corresponded with Dr Wakerman over the years on potential joint studies, but these communications never resulted in a collaboration.
REVIEW RETURNED	04-Jun-2018

GENERAL COMMENTS	This is an excellent and timely paper that fills an important gap in the literature. Findings have implications across the circumpolar north as well as Australia. My only concern is with statements related to preventable hospitalizations, when total hospitalizations were used. Authors claim that total hospitalization and YLL rates are good proxy for the effectiveness of primary care, and cite two papers authored by themselves. A first paper measure preventable hospitalizations for diabetes. The second paper looks at healthcare outcomes and costs at different levels of primary care utilization for selected ambulatory-care sensitive chronic conditions. The rationale for using total hospitalizations is in my view not satisfactory explained and validated. There is no discussion of using Ambulatory Care Sensitive Conditions, which is a finer measure of the performance of primary care.

VERSION 1 – AUTHOR RESPONSE

- *Reviewer: 1 Thank you for the opportunity to review this manuscript. This is an interesting study examining the impact on cost and some patient outcomes of staff/nursing turnover and use of agency nurses in primary care in remote Australian communities. The authors conducted a secondary analysis of multiple large data sets.*

  Response: Thanks for your review and comments.

- *Abstract: Does the journal require a more structured abstract? Would recommend revising the objective and using complete statements vs bullet points. This might make the abstract more compelling for readers. Are the authors really measuring "cost-effectiveness" of turnover rates; is this the correct term? It seems they would want to compare costs in settings with high turnover vs low turnover or look at the effect of turnover on costs…It is not clear how turnover could be used as a cost-effective strategy to improve outcomes. Cost-effectiveness makes more sense with the use of agency nurses. Perhaps the authors just need to revise the objective for clarity.*

  Response: Objectives and conclusion are revised accordingly in Abstract (PP3-4).

- *I wonder if using "outcomes" vs "effectiveness" measures (ie, total hospitalizations and YLL) would be more appropriate. It was just a confusing to me.*

Response: Add “health outcomes” in Objectives (L68, P3). Revise “effectiveness” to “effects” to reduce confusion (L1, L64, L78, L 113, LL160-162, LL 229-235, L401, L408). Changed “effectiveness” to “outcome” (L308).

- *Article summary (line 104) – what primary data were collected?*

  Response: Change “primary data” to “primary care data” to avoid confusion. (L108, P5) There were no primary data collected in this study.

- *Introduction: This section needs to be revised and expanded to provide more of a background and support for conducting the study.*

  Response: This section has been revised and expanded. It now includes more detail about inequities in health outcomes and staffing patterns in remote NT communities. (LL121-165, PP5-7).

- *The opening statement (line 116-118) is a run-on sentence and addresses multiple concepts. The first paragraph should be two paragraphs – one about patients and one about nurses/staff. Do the authors have any information on why turnover is high in these settings or what has been done to improve it?*

  Response: Revised the opening statement by deleting “if we are …” and separated the opening paragraph into two as suggested. Additionally, an earlier study on nurse mobility in the NT has been cited, which provides some information about why turnover is high in the NT (in both remote and rural settings) and what has been done to improve turnover. (LL145-151)

- *The authors should define what they mean by “staff” and be consistent with the terminology throughout. “Staff” is used in the title, but it seems that they focused primarily on nurses – is it all about nursing or other providers, too. For example, they use “resident clinical staff” (line 125) and aboriginal community workers (line 144) – are these nurses? Are they in the analyses? Midwives and AHPs (lines 134-5) and resident nurses (line 143) are mentioned also. Who is hired by the agencies (AHP, midwives, or nurses, or everyone?). A little background on the different roles and who is included in the analyses would be helpful for readers. Maybe revise the title if the study is really about nurses.*

  Response: The Introduction has been modified to explain staffing patterns in remote NT health facilities. The text now reads: “In many remote NT communities, PC is mainly delivered by staff employed directly by the NT Government. In these remote communities ‘resident’ staff comprise, on average, 2 nurses or midwives (henceforth called nurses), 0.6 Aboriginal Health Practitioners (AHPs) and 2.2 other employees all of whom live in the communities on a medium to long-term basis. Agency-employed nurses provide, on average, 0.4 FTE of additional health manpower per clinic on a short-term, fly-in fly-out basis.(1) District medical officers and allied health professionals provide additional professional services to patients living in these remote communities through intermittent scheduled visits and telehealth consultations.” (LL 133-140, P6). The title has also been modified to more clearly specify the types of staff included in the study. The study aims clearly state that we are investigating turnover of nurses and AHPs as well as use of agency-employed nurses. (LL 159-16165).

- *Study Setting Section: The authors frame this paper within the context of decreasing disparities for Aboriginal populations in Australia. Why do they include non-Aboriginal/non-Indigenous data in the main analyses?*

  Response: This study analyses data for all NT government-run remote clinics. Most communities are predominantly Aboriginal, hence it is important to explain to readers about the disparities for Aboriginal populations. We have added two sentences to the limitations section of the manuscript: “There were a small number of non-Indigenous residents in remote Indigenous communities” and “Because the non-Indigenous residents were predominantly healthy workers, the impacts of non-Indigenous residents on clinic-month health measures were expected to be minimal” in limitations (LL412-415, P21).

- *They do remove the non-Aboriginal communities in the sensitivity analyses, but I would suggest this be the main analysis. The discussion of results and policy implications may be different especially since higher costs were found among the Aboriginal communities that had low agency-nurse use (line 263-265).*

Response: As explained above, this is a population study of all NT government-run clinics during the study period, so we do not feel it is appropriate to remove communities that are predominantly non-Aboriginal entirely from the paper, as these communities, too are difficult to service given their geographical remoteness. All analyses are now considered as main analyses and references to sensitivity analyses are removed. Delete "Sensitivity Analysis 1 and 2" in both Tables 1 and 2. Add "(excluding predominantly non-Aboriginal communities)" (P14). Add a new paragraph "For Aboriginal communities … the number of primary care consultations (Table 3)" in Discussion (LL347-358, PP 18-19).

- *Patient involvement section (lines 150-151) – this sentence needs to be revised for clarification. The authors used inpatient hospitalizations and age of death – aren't these data patient data? Maybe the authors mean that primary data were not collected from the patients.*

  Response: This sentence has been revised for clarification and now reads that patients were not directly involved in data provision (LL176-179, PP7-8).

- *Turnover Rate (lines 158-164): here the author calculate turnover using nurses and AHPs – what about the other individuals mentioned above? Please clarify and be consistent. Also, were agency nurses included in this calculation? This might artificially inflate the turnover rate since many agency nurses are on short-term contacts (at least in the US), and it is expected they will rotate through pretty quickly. The authors may have already considered this; it should be clarified.*

  Response: Nurses and AHPs are key providers of PC in remote NT and provide the majority of clinical services. This sentence has been changed to read "…where resident nurses and AHPS provide most clinical PC services." This will help to avoid confusion for readers (LL168-171, P7). Turnover rates used in this paper refer only to turnover of Department of Health employed nurses and AHPs and exclude turnover of agency-employed nurses. This is now specifically included in the definition of turnover rate. "PIPS data were used to calculate turnover rates of Department-employed nurses and AHPs in each month in each clinic (clinic-month)…" (LL 187-188, P8).

- *Lines 173-5: if there is evidence that agency nurses fill, on average, 13% of positions, why not use that as your threshold?*

  Response: Thank you for this suggestion. 13% is now used as the cut-off threshold for agency nurse proportions (see Methods LL 205-207, P9). The results in Tables 2 (P16), Figures 3 and 4 are revised accordingly. We also make corresponding changes to Results (L318, P15) and Abstract (L88-89, P4).

- *Analyses section, lines 195-198: Recommend revising as it is not clear – what is "clinic months"? This is the first mention of this term. These objectives should match those in the abstract.*

  Response: clinic-months are now defined in L188 (P8). It refers to "per clinic per month" and the term is now used consistently in the text. Change from "each month in each clinic" to "clinic-month" (L 194, L219). Add "… based on clinic-month rather than individual level data" in limitations (L520, P16).

- *Lines 263-265: The authors report higher costs in Aboriginal communities with lower agency-nurse use. This is an interesting finding and is in contrast to the findings reported in beginning of the paragraph. If the authors are framing this work as reducing disparities among Aboriginal communities, this should be highlighted and expanded upon in the discussion. Having said that, the authors should consider their framing – do they want to focus on Aboriginal communities or remote primary care? You'll need to align the analyses and discussion with whatever you decided.*

  Response: As described above, there were only a small number of non-Indigenous residents in the remote communities in our study. The research focus is on primary care provided in all NT government-run health services in communities in remote NT (*most* of which have a predominantly Aboriginal population, hence background information provides statistics on health outcomes for NT Aboriginal people)(PP5-6). We found communities that are predominantly Aboriginal and have lower use of agency-employed nurses have higher costs. This may be because the association is confounded. Our regression modelling showed

that geographical remoteness is associated with increased costs of running a health service (distance to the nearest hospital is highly statistically significant). Geographical remoteness may also be associated with the ability of health services to attract agency nurses willing to work there, and hence may have lower use of agency-employed nurses. The regression model shows that after geographical remoteness is taken into account there is a positive association between health care costs and the rate of using agency-employed nurses. This is now expanded upon in the discussion section (LL347-358, PP18-19).

- *Lines 284-286: This is an interesting calculation and can have policy and practice implications. Within the context of remote Australian communities and the Australian healthcare system, is this "potential" reasonable? Will these settings be able to cut the turnover rate in half and eliminate use of agency nurses? It is a lot of costs savings, but may not be reachable and thus, the authors should take care in using this dollar figure so boldly in the abstract, discussion, and conclusion. It feels like a misrepresentation/oversell of your results. Also, you used the threshold of 13% here in the text, but your analyses used a 10% threshold – please rectify.*

  Response: In another paper currently under development, we show that annual turnover of *all* staff (note: this paper is only about nurses and AHPs) from remote NT communities has declined significantly over time (reducing, in absolute terms by 83%, from 175% in 2004 to 92% in 2015). While we don't have the figures specifically for nurses and AHPs during this period, we do not think it is unreasonable to project our figures to a reduction of 60% per annum in annual turnover rates (from approximately 120% to 60%) in an unstated time frame. We used the turnover figure of 60% per annum, which is still at a level that is three times higher than what is considered high in other health care settings. Additionally, if the NT Deparment of Health is able to make Department employment attractive enough, for example by providing sufficient flexibility for staff to rotate in and out of the same community, and by offering attractive remuneration and leave options, then the Department could develop a greater depth of its internal pool of relief staff. In these circumstances it is feasible that the use of agency-employed nurses could be eliminated. We have adjusted the 10% approximation that we used as a threshold for use of agency-employed nurses, replacing the threshold with a 13% figure.

- *Discussion: This section needs to be revised and expanded. I would suggest the authors discuss how their results fit within the existing literature (have others found similar or contradictory findings?) and/or fit within existing healthcare issues (why do you think you found higher costs in Aboriginal communities with lower use of agency nurses – there may be other things the authors should consider that could account for these higher costs). The authors jump right into workforce recommendations. Finally, the authors should avoid the use of bullet points within the discussion narrative. These suggestions might work better in a table.*

  Response: Thank you for these suggestions. The discussion has been revised and expanded (PP18-22). In particular we have taken your suggestion and provided possible explanations for the observation of higher costs in Aboriginal communities with lower use of agency nurses and highlighted the results of the multiple regression analysis. We have also rectified our use of bullet points within the discussion narrative and discussed how the results fit within the existing literature.

- *Figure 2 and 4 are missing.*

  We apologise. There were some difficulties with the formatting of these figures. We have provided them in an alternative format. This revision has used the .tif format.

- *Reviewer: 2 This is an excellent and timely paper that fills an important gap in the literature. Findings have implications across the circumpolar north as well as Australia.*

  Response: Thank you for recognising these important qualities of our paper.

- *My only concern is with statements related to preventable hospitalizations, when total hospitalizations were used. Authors claim that total hospitalization and YLL rates are good proxy for the effectiveness of primary care, and cite two papers authored by themselves. A first paper measure preventable hospitalizations for diabetes. The second paper looks at healthcare outcomes and costs at different levels of primary care utilization for selected ambulatory-care*

sensitive chronic conditions. The rationale for using total hospitalizations is in my view not satisfactory explained and validated. There is no discussion of using Ambulatory Care Sensitive Conditions, which is a finer measure of the performance of primary care.

Response: Thank you for giving us the opportunity to explain our choice of total hospitalisations. We elected to use total hospitalisations as the indicator of primary care quality in this study because community population size is small (most communities are well under 1,000 population size) and so monthly rates for ambulatory-care sensitive condition hospitalisations (PPHs are <8% of total hospitalisations in this context) are frequently too small to be statistically stable. Further, in communities with an extremely unstable primary care workforce and low workforce supply, evacuation and hospitalisations for all conditions, not just potentially preventable conditions, are likely to be increased compared to communities with a stable workforce of adequate size for the population needs. Other research studies have also suggested that total hospitalisations have similar associations with indicators of access to primary care as do avoidable hospitalisations or hospitalisations for chronic ambulatory care-sensitive conditions (2, 3). Nevertheless, we have added potentially preventable hospitalisations as part of the analysis (far-right column in Tables 1 and 2, PP14 & 16) with additional explanation (L 269, L 275), including of the limitations of PPHs in the context of this study. (LL404-409 P21)

References

1. Russell DJ, Zhao Y, Guthridge S, et al. Patterns of resident health workforce turnover and retention in remote communities of the Northern Territory of Australia, 2013–2015. Hum Resour Health. 2017;15(1):52.
2. Gadomski A, Jenkins P, Nichols M. Impact of a Medicaid Primary Care Provider and Preventive Care on Pediatric Hospitalization. Pediatrics. 1998;101(3):e1-e.
3. Gill JM, Mainous AG, 3rd. The role of provider continuity in preventing hospitalizations. Arch Fam Med. 1998;7(4):352-7.