ARTICLE DETAILS

TITLE (PROVISIONAL)	The Case for Hospital Nurse-to-Patient Ratio Legislation in Queensland, Australia Hospitals: An Observational Study
AUTHORS	McHugh, Matthew; Aiken, Linda; Windsor, Carol; Douglas, Clint; Yates, Patsy

VERSION 1 - REVIEW

REVIEWER	Sung-Heui Bae College of Nursing, Ewha Womans University Republic of Korea
REVIEW RETURNED	17-Jan-2020

GENERAL COMMENTS	Abstract How many units were included in this study? You can include that information in the participants. Background Please add references when you explain the policy intervention (page 4, lines 17-25) As you mentioned, there are many international studies examining this topic. What is the new contribution of this study to the current body of knowledge? I cannot find that. Methods "We linked individual surgical patient outcomes data with the aggregated nurse survey data describing medical-surgical nurse-to-patient ratios using a common hospital identifier." In which level, you aggregated nurse survey data? Is this hospital? Or nursing unit? (page 4) Those nurses you sent the email, how you obtain this list, is this publicly available? How do you know these nurses are working in adult medical-surgical nursing unit? (page 5). Please provide more information about the nurse sample and data collection procedure. "These conditions were selected because they account for a substantial share of hospital admissions, most hospitals care for these patients, and there are well established risk adjustment methods" Can you provide the percentage of those conditions in Australian hospitals? Or in the Queensland hospitals. I like to make sure if this is comparable with other countries' data.

When you measure the nurse-to-patient ratio, you seem to measure it for each shift (day, evening, and night). Please add that information (pages 5, 6).

In the quality of care and patient safety measure, this is based on nurses' perceptions in their wards. Then the data should be aggregated by nursing unit. But you aggregated the data in the hospital level. That can be a limitation (page 6).

Statistical analysis
Please add more information regarding data aggregation and unit of analysis (page 6).

Results
In the Table 3, 4, please add the sample size you used to analyze each analytic model.

Discussion
"higher nurse workloads were linked with patient mortality, worse quality of care and patient safety, and nurse burnout and job dissatisfaction." (page 7)
Does "Higher nurse workloads" mean worse nurse-to-patient ratio? I think you need to use the consistent term because the focus of your study is nurse-to-patient ratios.

"The finding that each additional patient per nurse was associated with increased odds of mortality is consistent with results from studies in the United States and Europe based on a similar protocol." (page 7)
I wonder if this is the first study of this topic in Australia. I saw previous studies regarding this topic evening using large datasets. Again, what is the new contribution of this study? Please add that.

In the page 8 (lines 6-23), this paragraph is not quite matching with your study finding. I think you can discuss more about the ratio legislation and implementation based on your study finding. I think that is your focus.

"if we were able to examine how changes in staffing over time align with changes in outcomes."
So then you can suggest for future study using this method.

In the Table 2, "n=146,456" n should be upper case. In the tables, N should be lower case.

References
Please add recent evidences about this topic.

REVIEWER	SUN tao
	Hangzhou Normal University, Hangzhou 311121, China
REVIEW RETURNED	17-Apr-2020

GENERAL COMMENTS	There is an unclear statement on the section of "Strengths and limitations of this study".
	The section of introduction in this manuscript is too simple; more literatures or reviews regard to their topic should be added to

provide a general profile of the current situation of research topic of Nurse-to-Patient Ratio and it's followed influence the results.

The essential hypothesizes for eliciting key variables of this paper and theoretical foundations should be added.

It is difficulty understanding in Table 2, that, the mean age (SD) is 62.8 (17.9)?

I suggest that this paper requires specialist statistical review.

There is irrelevant content with their subject in section of Conclusion of this paper.

REVIEWER	Alejandro Orgambídez Universidad de Málaga (Spain)
REVIEW RETURNED	18-Apr-2020

GENERAL COMMENTS	Thank you for the opportunity to review this manuscript. The manuscript covers important topics for nursing (e.g. nurse-to-patient ratio, burnout, job satisfaction), is relevant to the aims and scope of the journal and adds to current knowledge. I will first outline the positive about the paper and then mention about areas that could be improved. The manuscript is well written and presents a logical and rational structure. The design used is suitable for the objective of the study and the statistical analyses are sound. My only concerns relate to the measurement of quality of care and patient safety, burnout and job satisfaction. A further description of the scales used to assess the quality of care and patient safety would be helpful (e.g. dimensions, number of items) for the reader. It is necessary to indicate that the authors are evaluating emotional exhaustion and not burnout. It is important to differentiate that burnout is characterized by three dimensions: exhaustion, depersonalization and lack of personal accomplishment. Maslach (2006) especially recommends that the three dimensions should be examined to have a global and detailed vision of what nurses experience in hospitals. It would also be necessary to provide psychometric information from the scales used in the study. Statistics such as the omega coefficient and factor analysis of the structure of the scales (e.e. measurement model) could be calculated to provide information on this aspect. - Maslach, C. (2006). Understanding job burnout. In A. M. Rossi, P. Perrewe, and S. Sauter (Eds.), Stress and quality of working life: Current perspectives in occupational health, (pp.37-51). Greenwich, CT: Information Age Publishing. Finally, since much of the information used in the study comes from self-report measures, it would be useful to know whether the authors have performed any kind of control or diagnosis of the effect of the common method variance (Podsakoff et al., 2012). This bias may increase or weaken the relationships between study variables. Other biases related to the use of surveys (e.g. social desirability) should be mentioned in the limitations section.

- Podsakoff, P. M., MacKenzie, S., & Podsakoff, N. P. (2012). Source of method bias in social science research and recommendations on how to control it. Annual Review of Psychology, 63, 539-569. doi:10.1146/annurev-psych-120710-100452

I hope that these comments are helpful.

VERSION 1 – AUTHOR RESPONSE

Reviewer 1 comments

[Abstract]

COMMENT.R1a: How many units were included in this study? You can include that information in the participants.

RESPONSE.R1a: The analysis was of patients and nurses in hospitals characterized by facility-level medical-surgical staffing ratios. Nurse survey respondents reported their hospital of employment from a drop-down menu (as described in the text) as well as their unit type. Using this information, we aggregated responses to the hospital level to derive facility-level medical-surgical staffing ratios. While the hospital identification was specific and unique, the unit selection was categorical (e.g. "medical-surgical" vs. "intensive care" unit), reflecting the level at which the Queensland legislation prescribed minimum ratios. As a result, we do not have information on specific different units of the same type. Therefore, we report only the number of patients, nurses, and hospitals in the study.

[Background]

COMMENT.R1b: Please add references when you explain the policy intervention (page 4, lines 17-25)

RESPONSE.R1b: We have added additional information, on minimum nurse-to-patient ratios in California, including how the policy improved staffing ratios, and how better ratios were associated with improved nurse and patient outcomes. We have also cited the Queensland law directly (pg. 4, line 25).

COMMENT.R1c: Reviewer 1 requested clarity with respect to the study's unique contribution to the literature and whether this study is the first of its kind in Australia.

RESPONSE.R1c: Queensland is one of just a few places worldwide to implement minimum nurse-to-patient ratios. The purpose of this analysis was to examine variation in nurse-to-patient ratios across Queensland Health hospitals before the ratios legislation, and the association between these ratios and outcomes for patients and nurses. While some evaluation of similar policies have taken place in other locations, this is the first baseline study of staffing ratios prior to policy implementation. A common criticism of ratio policies is that there is not a problem with staffing levels and intervention is not needed—this is the first evaluation of the scope of staffing variation and its link to outcomes in a jurisdiction before ratios implementation. It is also useful to study relationships in different international contexts to understand if findings generalize regardless of healthcare systems and financing. We have added this explanation to the text (pg. 4, lines 30-33; pg. 8, lines 14-16).

[Methods]

COMMENT.R1d: Reviewer 1 requested additional information regarding our nurse sample, survey, and data aggregation.

RESPONSE.R1d: We have noted that an email survey was distributed to all nurses with an email address. We also report the number of respondents (overall and specifically medical-surgical nurses) as well as the overall response rate (29%). The list of nurses surveyed was maintained by and obtained from the nurses' union. Most (>85%) nurses in Australia belong to the union and the list accounted for 90% of all Queensland hospital nurses. It is not publicly available. We have noted the source of this list in the revised text (pg. 5, line 18). Individual nurse survey respondents reported their hospital of employment and the primary hospital unit type where they work. Data from those nurse respondents who chose "Adult medical-surgical ward" were used for the study. This allowed us to aggregate responses from adult medical-surgical wards to the hospital level (not unit level). But our focus was on medical-surgical nurses in those hospitals. We have clarified this in the revised text (pg. 5, lines 20-21).

COMMENT.R1e "These conditions were selected because they account for a substantial share of hospital admissions, most hospitals care for these patients, and there are well established risk adjustment methods"

Can you provide the percentage of those conditions in Australian hospitals? Or in the Queensland hospitals. I like to make sure if this is comparable with other countries' data.

RESPONSE.R1e: The three categories of surgeries account for about one-third of all adult surgical and medical patients in Queensland, Australia: general (11%), orthopedic (11%), and vascular (16%). We have included this language in the revised text (pg. 5, line 33).

COMMENT.R1f: When you measure the nurse-to-patient ratio, you seem to measure it for each shift (day, evening, and night). Please add that information (pages 5, 6).

RESPONSE.R1f: While we know whether the workload (or patients per nurse) reported by each nurse was for a day, evening, or night shift, we did not calculate shift specific nurse-to-patient ratios. There were simply not enough medical-surgical nurses on each type of shift in each hospital to allow us to do so. Thus, the staffing measure is an average nurse-to-patient ratio reported by all nurses working on any shift (day/evening/night) on medical-surgical units over the data collection period during which patients were admitted and discharged. This reflects the reality that over the course of a hospitalization, patients receive care from various nurses across multiple shifts and, often, in more than one hospital unit. Patient outcomes are determined, in part, by their exposure to staffing levels over the course of their hospitalization, which is captured by this aggregated measure. We have included this language in the revised text (pg. 6, lines 17-22). This is also consistent with the approach used in a large body of literature (see Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. JAMA. 2002; Aiken LH, Sloane DM, Bruyneel L, et al. The Lancet. 2014 for examples).

COMMENT.R1g: In the quality of care and patient safety measure, this is based on nurses' perceptions in their wards. Then the data should be aggregated by nursing unit. But you aggregated the data in the hospital level. That can be a limitation (page 6).

RESPONSE.R1g: We grouped nurses by unit type (i.e. medical-surgical wards), but cannot separate all nurses and patients by specific units of that type within hospitals. We have added this to the text and note in limitations (pg. 9, lines 8-10).

[Statistical analysis]

COMMENT.R1h: Please add more information regarding data aggregation and unit of analysis (page 6).

RESPONSE.R1h: Individual nurses reported their hospital of employment and the number of nurses and patients on their ward during their last shift. Facility-level staffing ratios were derived as the average nurse-to-patient ratio as reported by nurses on all medical-surgical units within the same hospital. Our outcomes and unit of analysis were individual patients (e.g. mortality) and individual nurses (e.g. burnout), but some of our predictor variables were measured at the hospital level. We used multi-level modelling to account for clustering of nurses and patient within hospitals. We added this to the text (pg. 7, lines 6-7).

[Results]

COMMENT.R1i: In the Table 3, 4, please add the sample size you used to analyze each analytic model.

RESPONSE.R1i: The regressions in Table 3 included 146,456 patients. The regressions in Table 4 included 4,372 nurses. We have added these to the respective tables.

[Discussion]

COMMENT.R1j: "higher nurse workloads were linked with patient mortality, worse quality of care and patient safety, and nurse burnout and job dissatisfaction." (page 7)

Does "Higher nurse workloads" mean worse nurse-to-patient ratio? I think you need to use the consistent term because the focus of your study is nurse-to-patient ratios.

RESPONSE.R1j: "Higher nurse workloads" means lower or worse nurse-to-patient ratios (i.e. additional patients per nurse). We have revised the text for clarity and consistent terminology (pg. 7, line 42; pg. 8, line 10).

COMMENT.R1k: "if we were able to examine how changes in staffing over time align with changes in outcomes."

So then you can suggest for future study using this method.

RESPONSE.R1k: Thank you. We have revised the text to suggest explicitly a longitudinal study as a direction for future research (pg. 9, lines 4-6)

COMMENT.R1l: In the Table 2, "n=146,456" n should be upper case. In the tables, N should be lower case.

RESPONSE.R1l: We have made the change to Table 2 as recommended.

[References]

COMMENT.R1m: Both Reviewers 1 & 2 encouraged us to include additional and more detailed evidence from current research.

RESPONSE.R1m: The evidence on staffing has emerged over the past 2-3 decades and our citations reflect that period of development although we substituted more recent examples along with major studies (pg. 4, line 10). Of our 35 original citations, 10 were published within the last 5 years. We have added additional recent citations and information regarding the impact of California's staffing mandate on ratios as well as nurse and patient outcomes (pg. 4, lines 16-20).

Reviewer 2 comments

COMMENT.R2a: There is an unclear statement on the section of "Strengths and limitations of this study".

RESPONSE.R2a: Thank you. We have edited this section for clarity (pg. 3, lines 3 & 11)

COMMENT.R2c: The essential hypothesizes for eliciting key variables of this paper and theoretical foundations should be added.

RESPONSE.R2c: The theoretical foundation for this study is the Quality Health Outcomes Model, which provides a framework for outcomes research that includes organizational factors (in the case of this study, nurse-to-patient ratios). As a system-level intervention, a policy mandating minimum nurse-to-patient ratios is reasonably evaluated using this framework. We have noted this theoretical foundation in the revised text (pg. 4, line 42 – pg. 5, line 1).

COMMENT.R2d: It is difficulty understanding in Table 2, that, the mean age (SD) is 62.8 (17.9)?

RESPONSE.R2d: We have added parentheses to 17.9 to further clarify that this is the SD and not a percent as otherwise indicated by the column header.

COMMENT.R2e: There is irrelevant content with their subject in section of Conclusion of this paper.

RESPONSE.R2e: The International Council of Nurses is a federation representing nurses worldwide. Their recent position statement on nurse staffing is relevant because it represents the recognition of safe staffing as an important issue by nurses worldwide. We have modified the citation to more directly reference this position statement, but we also introduce it at the beginning of the revised paper as well (pg. 4, line 11-13).

Reviewer 3 comments

COMMENT.R3a: Reviewer 3 requested a further description of the scales used to assess the quality of care and patient safety including psychometric information (e.g. omega coefficient and factor analysis of the structure of the scales).

RESPONSE.R3a: With the possible exception of nurse staffing and nurse burnout, all of the nurse outcomes (the quality and safety outcomes and job outcomes in Table 4) and predictor variables (i.e.; age, sex, experience, and hospital size) are derived from single items from the nurse and hospital surveys and don't require factor analysis or measurement models to assess. Our burnout measure, which is the emotional exhaustion scale of the Maslach Burnout Inventory, has been previously validated in studies of hospital nurses and patient outcomes in the U.S. and internationally by members of our team and others and found to have favorable psychometric properties. Nurse staffing reports (or nurse workloads) do not comprise a scale in the traditional sense, but rather a summary measure when aggregated to the hospital level. We would not expect them to be highly correlated (or "in agreement") across nurses within hospitals, since they vary within units by shift. But when reasonably large samples of nurses are used and their workloads are aggregated to the hospital level the resulting staffing measure has been shown to have substantial predictive validity (see Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. JAMA. 2002; Aiken LH, Sloane DM, Bruyneel L, et al. The Lancet. 2014 for examples).

COMMENT.R3b: Reviewer 2 requested that we differentiate more clearly between the global measure of burnout and our use of the emotional exhaustion subscale in this study.

RESPONSE.R3b: As in other work,1-3 we are measuring a key indicator of burnout (emotional exhaustion). For clarity, the revised text and tables now refer to this concept as emotional exhaustion (e.g. pg. 8, lines 18, 24, & 26).

References:

1.   Aiken LH, Clarke SP, Sloane DM, Sochalski J, Silber JH. Hospital nurse staffing and patient mortality, nurse burnout, and job dissatisfaction. JAMA. 2002;288(16):1987-1993.

2.   Aiken LH, Sermeus W, Vanden Heede K, et al. Patient safety, satisfaction, and quality of hospital care: cross-sectional surveys of nurses and patients in 12 countries in Europe and the United States. BMJ. 2012;344:e1717

3.   Sloane DM, Smith HL, McHugh MD, Aiken LH. Effect of changes in hospital nursing resources on improvements in patient safety and quality of care: A panel study. Med Care. 2018;56(12):1001-1008.

COMMENT.R3e: Finally, since much of the information used in the study comes from self-report measures, it would be useful to know whether the authors have performed any kind of control or diagnosis of the effect of the common method variance (Podsakoff et al., 2012). This bias may increase or weaken the relationships between study variables. Other biases related to the use of surveys (e.g. social desirability) should be mentioned in the limitations section.

RESPONSE.R3e: For the analyses reported in Table 4, to which this comment refers, we used multilevel models to test how individual nurse reports of the different outcomes were associated with a hospital-level measure of nurse staffing, or a measure derived by averaging workloads across all medical-surgical nurses in the hospital. Thus, we are not looking at whether individual nurse's reports of quality, safety, and job outcomes are related to their workload, but rather whether individual nurse's reports of these outcomes are related to the hospital-level staffing measure that is derived from all the

nurses in each hospital. Since the average hospital was represented by 64 nurse respondents, any individual nurse's workload contributes only 1/64th of the information (on average) to the hospital-level measure. This greatly obviates the concern with common method bias. We have noted in the limitations section, nonetheless, that because all of our outcomes (apart from mortality) are nurse reported, further research using outcomes and predictors from other sources would further substantiate our findings.

VERSION 2 – REVIEW

REVIEWER	SUN tao
	Department of Health Policy and Management of Hangzhou Normal University
REVIEW RETURNED	28-May-2020

GENERAL COMMENTS	Potential reasons or possible mechanisms relevant to the relationship between nurse-to-patient ratios and poorer outcomes for nurses should be explained to provide better understanding of the findings.

REVIEWER	Alejandro Orgambídez
	University of Málaga (Spain)
REVIEW RETURNED	30-May-2020

GENERAL COMMENTS	The amendments provide greater clarity. Thank you for the opportunity to read your work.

VERSION 2 – AUTHOR RESPONSE

Reviewer 1 comments -- None
Reviewer 2 comments
COMMENT.R2a: Potential reasons or possible mechanisms relevant to the relationship between nurse-to-patient ratios and poorer outcomes for nurses should be explained to provide better understanding of the findings.

RESPONSE.R2a: Thank you. We have added discussion in the limitations paragraph that research should focus on the mechanism through which staffing has its effect on outcomes should be explored further. Then we highlight one possible mechanism which has been presented in the literature. Evidence suggests that when staffing levels are poor, nurses often need to limit certain needed elements of care that they would like to provide but cannot due to lack of time. This includes direct communication and observation with the patient and family as well as first-hand surveillance and assessments to identify early signs of complications requiring intervention to ward off a poor outcome. We cite a recent study (Ball et al, 2018) empirically demonstrating this relationship between staffing, missed care, and mortality.

Reviewer 3 comments
COMMENT.3a: The amendments provide greater clarity. Thank you for the opportunity to read your work.

RESPONSE.R3a: Thank you for reviewing our work.