PEER REVIEW HISTORY

This paper was submitted to the BMJ but declined for publication following peer review. The authors revised the paper and the re-submitted to BMJ Open where it was re-reviewed and then accepted.

ARTICLE DETAILS

TITLE (PROVISIONAL)	Development of a predictive model to identify inpatients at risk of readmission within 30 days of discharge (PARR-30)
AUTHORS	Bardsley, Martin ; Billings, John; Blunt, Ian; Georghiou, Theo; Lewis, Geraint

VERSION 1 - REVIEW

REVIEWER	van Walraven, Carl Ottawa Health Research Institute
REVIEW RETURNED	21-Feb-2012

THE STUDY	This is an interesting study deriving and internally validating a model to predict risk of 30-day urgent readmission. I've listed my comments below in the order that they appear in the paper. 1. Introduction, paragraph 3, sentence 1: Another reason is that only 20-30% of readmissions are deemed avoidable (CMAJ 2011;183(7):E391-402). 2. Methods, paragraph 1: clarify whether you limited your sample to only 1 observation per patient (or whether a single patient could be represented multiple times). We have found recently that the latter situation can significantly reduce a model's performance. 3. Same paragraph: i was uncertain what is meant by "admissions without a national tariff". 4. Methods, second paragraph: a more detailed description of the PARR algorithm would be helpful. I was also uncertain about the following: "number of episodes per spell in prior admissions"; was the number of different specialists consulted in the previous 12 months based on hospitalization data alone or did you have access to community consultations as well; what is meant by 'hierarchical diagnostic cost groups'. 5. Since there is a plan to use the predicted risk of readmission, a formal assessment of the model's calibration should be included. This could be done by dividing the cohort into deciles or 'vingtiles' based on predicted risk and then comparing the observed to expected risk in each group.

	6. The 1st paragraph of the discussion states that the model's covariates are easily entered. Is this true for 'index of multiple deprivation band" (i.e. can a clinician figure this out easily for a particular patient without too much hassle?). 7. In the methods and appendix 1, it is unclear to me how HOSPITAL TRUST was modelled. I would assume that one trust was chosen as the reference and the coefficients presented in appendix 1 indicate each trust's relative adjusted risk of readmission compared to the reference trust. If so, how was the reference trust chosen (and why does it seemingly have such a high risk of outcome relative to the others - only 8 trusts have a positive coefficient).

REVIEWER	Gruneir, Andrea Women's College Hospital, Women's College Research Institute
REVIEW RETURNED	29-Feb-2012

GENERAL COMMENTS	In this manuscript the authors describe the development and testing of the PARR-30. The PARR-30 is a predictive algorithm built on hospital administrative records in order to identify patient risk for hospital readmission within 30 days of discharge. This version is intended for use at the point-of-care with completion through either the hospital's computerized system or input from the patient and patient's notes. In addition to describing the development and performance of the PARR-30, the authors use the model to develop a "business case" in which they estimate costs of readmission and potential reductions in 30-day readmissions under various assumptions. Overall, I think that this is quite a useful study and it covers an area of great interest in England and other countries (including the United States and Canada). I think that the authors have taken a fairly rigorous approach to their data analysis and interpretation. I do have some concerns, however, that I would like to see the authors address in some manner. 1. I think that it is clear that the authors were interested in a predictive model that could be used at the point-of-care – so, presumably this would mean data that is relatively easy to collect from the patient and/or his or her chart. However, it does seem to me that some of the variables for this algorithm are actually quite complex (such as area of residence, which it appears is meant to be a proxy for socioeconomic status); if I am off base here, please let me know. Otherwise, can the authors comment on the importance of such variables in the predictive performance of the model relative to the ease with which they can be collected and input into the model? In other words, how much does it improve the model to include variables like area of residence compared against how difficult it might be to incorporate that type of data into the algorithm? 2. How was death handled in the model development? 3. In the last paragraph on page 7, the authors discuss the need to test models on data other than the data on which they were "trained". While I understand what the authors were trying to say

	here, I think that the way it is currently written is a little bit confusing. I think that this piece just needs to be written in a more direct manner. 4. I think that it would be helpful to readers to have the methods for the “business” case written up under a separate heading. 5. Related to the above point, I think that it also would be helpful to provide more information about how costs were estimated, especially given that it is such a large emphasis on this in the results. 6. I was actually a little bit surprised to see the emphasis on the costs and “business” case in the results because the introduction and methods section seemed to put much more emphasis on the development and testing of the model. I think that it would be helpful for readers if the authors made two adjustments: 1) provide a clearer rationale for the “business” case in the introduction along with more explanation about how costs were operationalized in the methods (as suggested above); and 2) re-orient the results section so that it follows the same flow as the methods section (i.e. explain the model and its predictive performance first, followed by the findings relevant to the “business” case). 7. I was unclear about what was meant by estimating the readmission costs for patients with and without readmissions. Can the authors clarify how patients without readmissions would have had costs related to the readmission? 8. I am glad to see that the authors are now testing the model’s performance using patient self-report data. I think that this a really important step in trying to move this from an exercise wit administrative data to a “real world” tool. 9. I think that the authors should take a look at a paper by Carl van Walraven which was published in the Canadian Medical Association Journal a little while ago. In that paper, Dr. van Walraven and his colleagues described the development and testing of a tool with similar intent to the PARR-30 (it is known as the LACE index). I think it could be potentially helpful to contrast the utility of the PARR-30 against something like the LACE, which is also intended to be used at the point-of-care. Here’s the reference information: CMAJ April 6, 2010 182:551-557.

REVIEWER	Finlayson, Kathleen Queensland University of Technology, Institute of Health and Biomedical Innovation
REVIEW RETURNED	13-Mar-2012

GENERAL COMMENTS	This predictive model and cost analysis should be extremely useful for health service managers and health professionals who need to quickly determine the level of risk of readmission to guide optimal interventions for their patients. The model provides a strong basis for future research to refine the model with additional predictors and to guide clincians and researchers to the population groups at greatest need of effective interventions to prevent hospital readmissions.

VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Recommendation:

Comments:
This is an interesting study deriving and internally validating a model to predict risk of 30-day urgent readmission. I've listed my comments below in the order that they appear in the paper.

1. Introduction, paragraph 3, sentence 1: Another reason is that only 20-30% of readmissions are deemed avoidable (CMAJ 2011;183(7):E391-402).

2. Methods, paragraph 1: clarify whether you limited your sample to only 1 observation per patient (or whether a single patient could be represented multiple times). We have found recently that the latter situation can significantly reduce a model's performance.

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6. The 1st paragraph of the discussion states that the model's covariates are easily entered. Is this true for 'index of multiple deprivation band" (i.e. can a clinician figure this out easily for a particular patient without too much hassle?).

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Additional Questions:
Please enter your name: Carl van Walraven

Job Title: Associate professor of medicine and epidemiology

Institution: University of Ottawa

Reimbursement for attending a symposium?: No

A fee for speaking?: No

A fee for organising education?: No

Funds for research?: No

Funds for a member of staff?: No

Fees for consulting?: No

Have you in the past five years been employed by an organisation that may in any way gain or lose financially from the publication of this paper?: No

Do you hold any stocks or shares in an organisation that may in any way gain or lose financially from the publication of this paper?: No

If you have any competing interests (either as indicated above or any other financial or non-financial interests) please declare them here:

Reviewer: 2

Recommendation:

Comments:
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Additional Questions:
Please enter your name: Andrea Gruneir

Job Title: Scientist

Institution: Women's College Research Institute

Reimbursement for attending a symposium?: No

A fee for speaking?: No

A fee for organising education?: No

Funds for research?: No

Funds for a member of staff?: No

Fees for consulting?: No

Have you in the past five years been employed by an organisation that may
in any way gain or lose financially from the publication of this paper?: No

Do you hold any stocks or shares in an organisation that may in any way
gain or lose financially from the publication of this paper?: No

If you have any competing interests (either as indicated above or any other financial or non-financial interests) please declare them here:

Reviewer: 3

Recommendation:

Comments:
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Additional Questions:
Please enter your name: Kathleen Finlayson

Job Title: Research Fellow

Institution: Queensland University of Technology

Reimbursement for attending a symposium?: No

A fee for speaking?: No

A fee for organising education?: No

Funds for research?: No

Funds for a member of staff?: No

Fees for consulting?: No

Have you in the past five years been employed by an organisation that may in any way gain or lose financially from the publication of this paper?: No

Do you hold any stocks or shares in an organisation that may in any way gain or lose financially from the publication of this paper?: No

If you have any competing interests (either as indicated above or any other financial or non-financial interests) please declare them here:

If you elected during submission to send your article on to another journal the article will be transferred in 5 working days. If you intend to rebut this decision please notify us before then.
The journal(s) (if any) you have selected at submission are:
If you want to speed up or stop this onward transmission please email the editorial office:
papersadmin@bmj.com

VERSION 3 - REVIEW

REVIEWER	Gruneir, Andrea University of Toronto
REVIEW RETURNED	28-Jun-2012

GENERAL COMMENTS	I think that this is a very clear and well written manuscript that covers an important issue in a rigorous manner. The authors have nicely responded to all of the comments that were raised in the earlier review.