Article details: 2017-0023 [permission requested from CMAJ reviewers Mar 13 2017)	
Title	Incidence of clinically relevant medication errors in the era of electronically pre-populated medication reconciliation forms
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Reviewer 1	Stephanie Mueller MD MPH
Institution	Brigham and Women's Hospital, Medicine, Boston, Mass.
General comments (author response in bold)	The authors conducted a retrospective chart review of 151 patients to evaluate the incidence of medication discrepancies and errors of commission in the context of pre-populated medication lists at time of patient admission. My major and minor suggestions to the author are as follows. MAJOR: 1) The authors center their introduction and discussion on the impact of pre-populated medication lists (using access to electronic medication dispensing records), and how this has the potential to negatively impact medication reconciliation, namely by increasing errors of commission due to over-reliance on such pre-populated lists. However, the study does not directly address this question. Instead, it looks at a small sample of patients from a single hospital and retrospectively examines the types of medication discrepancies patients experience. These include errors of commission, but does not focus on the problem described. I would suggest a more useful examination of this problem would be a pre-post examination of the numer/rate of errors of commission before and after implementation of this type of pre-populated medication form. **We were unable to conduct a pre-post examination or experimental design of the impact of pre-populated medication reconciliation forms on the incidence of errors, as this study was designed after the implementation of pre-populated medications forms. We cannot retrospectively change the study design. To clarify this, we have changed the title of our paper. Please note, that we carefully phrased our objectives to state: "Our objective was to evaluate the incidence of medication discrepancies and errors of commission after implementation of an electronically pre-populated medication reconciliation form." We do not make the assertion that our paper would evaluate the impact of such an intervention. That was the reviewer's interpretation.** **We fully agree that a prospective multi-center study (if possible randomized) would be ideal to address the question this reviewer poses, and have discussed this in the discussion section. Such a study must be planned and carried in an institution in which pre-populated forms have not yet been implemented. We hope that our paper will serve to stimulate discussion amongst decision-makers, evaluators and clinicians about the importance of conducting such an evaluation alongside implementation, as otherwise, it will unlikely be planned or carried out. The absence of rigorous evaluation alongside implementation of new initiatives is unfortunately quite common in Canadian healthcare, where change is being demanded without rigorous evaluation. We believe that stimulating public debate about this important issue, potentially through an accompanying editorial, may be quite powerful.** 2) I would suggest the authors use a more accurate term for the outcome studied than "medication error". As they describe in their methods section, they used retrospective chart review to identify medication discrepancies, and were able to state whether these discrepancies were "explained" or "unexplained". However, I think it is a leap to state that all "unexplained" medication discrepancies are medical errors. This could be confirmed by asking the providers of care about the identified unexplained medication discrepancies, but this was not done as part of the study, thus would keep these defined as unexplained medication discrepancies. **We only categorized unexplained medication discrepancies as errors after members of the adjudication team (each experienced clinicians) identified the discrepancy as being inappropriate and unexplained after independent chart review and subsequent discussion. If there was any evidence in the medical record (including a review of all vital signs, laboratory and diagnostic tests, progress/history notes, nursing notes and consultations) of a rationale for the discrepancy, it was categorized as explained, and not considered an error. This is the most conservative interpretation possible, given the limitations of chart review.** **For example, if a patient's antihypertensive was stopped in the setting of hypotension but this was not explicitly stated, we did not consider this an error although this could be regarded as a discrepancy. If, however, a patient's aspirin was not re-ordered in the absence of a contraindication (i.e. bleeding), and despite a documented indication for life-long therapy (e.g., a stroke) in the absence of any medication to replace the aspirin, we would have considered this an error. As outlined in the discussion section, the inability to confirm the intentionality of medication discrepancies by interviewing prescribers is a limitation of our study design that we have acknowledged.** MINOR: 1) Introduction, Page 4, lines 32-36 "...the majority of published interventions relied heavily on pharmacist involvement, limiting their generalizability to institutions with adequate pharmacy resources. Most Canadian hospitals lack such pharmacy manpower...". I think the authors meant to say "without" adequate pharmacy resources? I would also disagree with this statement, as although the majority of literature suggests that the most successful medication reconciliation interventions are those that utilize pharmacy resources, this would be an argument for hospitals to hire more such resources, or re-allocate the resources they have, rather than an argument against generalizability. **The literature quoted is only generalizable to institutions that have adequate pharmacists, and are able to dedicate pharmacists to the medication reconciliation process. Thus, the literature quoted is only generalizable to institutions with adequate pharmacist resources, and not those without adequate resources. Thus, the sentence as worded is correct. We agree, that the evidence on medication reconciliation suggests that hospitals should dedicate pharmacist resources to the medication reconciliation process, as this is what was shown to be beneficial.** 2) Methods, Page 8-9, Lines 53-56 (page 8) and 4-18 (page 9): Would move this section about how authors were not able to determine intentionality of the medication discrepancy earlier in the methods section, when discussing Stage 2, about how they defined medication discrepancies. **We have moved this section as per this suggestion.** 3) Methods, Page 9, lines 8-12: I don't know what the authors mean by "explained inappropriate discrepancy"? **We have added an explanation to clarify this (line 163-166, page 8).**
Reviewer 2	Maitreya Coffey MD

Institution	Hospital for Sick Children, Toronto, Ont.
General comments (author response in bold)	Thank you for your submission which studies the incidence of medication errors after introduction of an electronic med rec process. Although this is a modestly sized, single centre with some limitations as you have described, the finding is critically important given that many jurisdictions will be looking at implementing similar systems which are potentially expensive and not as effective as imagined (perhaps even exacerbating harm from inadequate med rec). I have no major concerns; minor concerns are listed as follows: 1. For the title, I think it would be more accurate to say "Incidence of Clinically Relevant Medication Errors after Availability of Prescribing Database and Prepopulated Med Rec form." It's not clear that there was a new process or any formal implementation, but if there was please describe in more detail. **We have revised the title.** Please also comment on the finding that two thirds of forms were left blank. Does this mean they were potentially not seen or used at all, or they were but not written on, or we don't know? I think this is very important, because while you have studied this pragmatically, i.e. as 'actually used' it is imaginable that another setting might achieve greater process reliability and find a very different result. **Thank you for this important observation. Our medication reconciliation forms have three columns (Figure 1), the first two are "Medication History" columns, the first of which is a pre-populated list of "Medications as per PharmaNet" and the second a list of "Verified" medications. Only the third column indicates "Medication Orders". We have attempted to clarify the manuscript (line 200-203, page 10) to indicate that in only 32% of patients was the "Medication history" section actually completed. In all others, prescribers skipped the medication history section, and simply re-ordered what had been printed out from PharmaNet, indicating that they are skipping the medication history verification process.** 2) For the abstract, I think it would be great if you would state the overall incidence of clinically important discrepancies - would be ideal not to have to calculate a percent of a percent to get to the most relevant result. **We have revised the abstract.** 3) In the introduction, I think you should not limit this to Canadian scope/relevance. This practice is also required in other jurisdictions (e.g. US/Joint Commission). **We have made edits to the introduction to ensure it refers to an international context.** 4) This is minor but I find myself quite distracted by the assertion that the overwhelming evidence supporting pharmacist role in Med Rec is of limited generalizability to settings without adequate pharmacy resources. It's a bit circular - the studies themselves are not limited, it is the organizations themselves which are choosing or not choosing to fund resources to follow what the evidence suggests. Your point about relying on other providers is completely appropriate but I think you could frame that such that it advocates for evidence based practice rather than dismissing the evidence. Overall the clarity and succinctness of the intro is excellent, especially paragraph 3. **Thank you for your observation. We agree, and have tried to frame this evidence in the manner you suggest with edits in our discussion.** 5) page 6. I think for verbal interactions the correct term is 'interpreter' whereas translation refers to written material. **We have corrected this.** 6) For participant enrollment it's not totally clear who was eligible and how sampling was done. Was this a convenience sample based on availability of personnel? Any opportunity for sampling bias that needs to be addressed? **We have clarified this in the methods section (line 109-114, page 6). We included all patients admitted for at least 48h who were enrolled in the parent study.** 7) Page 6: Did the research pharmacist not intervene in any way when discrepancies were found? Perhaps this is implied but please clarify. **The research pharmacist was responsible for recording a BPMH for a research study (in research notes) while patients were in the emergency department and before admission orders had been written. Therefore, the discrepancies had not yet happened.** 8) Page 11. No AEs were found -- could you clarify how extensive the review was it? was it the full chart for the full length of admission? **The chart review was extensive. We clarified this in the methods section (lines 159-161, page 8).** 9) Interpretation. As you describe, the inter-rater reliability is poor for potential severity. I think it's worth adding as a limitation that when authors due the ratings they may be biased (ie have a vested interest in the findings of the study). **The adjudication committee members completed their severity assessments independently in order to mitigate bias. We have clarified this in the manuscript (line 169-172, page 9). None of the members of this committee had any preconceived notion about the severity of the errors we would find, and therefore, we do not believe this to be a limitation. Please note that our inter-rater agreement on severity is comparable to that found in prior studies.1 Therefore, it is likely to reflect the complexity of its determination rather than bias.** 10) In the concluding paragraph there is again a presumption of scarce pharmacist resources and a call for further research - this could potentially be reframed a bit as a call to action to deploy pharmacists to address where we already know there is high risk, with your study being an important contribution. **We agree, and have suggested this in the discussion section.** 11) Table 4 - I love that you have included this. Gives much meaning and weight to the numbers and stats. Are these actual or hypothetical? Please specify. Also gives relevance to the subjectivity issue -- for e.g. I am looking at this and can't believe giving anti-hypertensives to a hypotensive patient is not a III! **These are actual, as stated in the manuscript (line 227-233, page 11). We have clarified this in the title of Table 4.** In summary I think this is an important paper which sheds light and clarity on the under-discussed issue of 'commission' errors that are likely exacerbated by pre-population of historical information. I think this has a lot of myth-busting potential, as it is often assumed that a database like this is 'the answer.' Well done and thank you again for sharing this work. **Thank you.**

	References **1. Cornish PL, Knowles SR, Marchesano R, et al. Unintended Medication Discrepancies at the Time of Hospital Admission. Arch Intern Med. 2005;165:424-429.**
Reviewer 3	Robyn Tamblyn BScN MSc PhD
Institution	Department of Medicine, McGill University, Montréal, Que.
General comments (author response in bold)	This manuscript tackles the interesting question about the potential risks of using data from pharmanet in BC to pre-populate the community-drug list at hospital admission. While a population based repository of pharmacy dispensing data, funded in almost all provinces except Ontario, was expected to improve information exchange and reduce adverse drug events, the authors hypothesize that it could also lead to harm. Specifically, they are testing the hypothesis that pre-populating the community drug may lead to unintended discrepancies: stopped medications may be inadvertently re-started, and community medications that may be now contraindicated by a deteriorating health state would be continued. The main challenge with this manuscript is a lack of coherence and logic that would link the pre-population of data to the increased chance or error, particularly as it relates to errors of commission in continuing medication that is now contraindicated by a change in health status. This type of "error" has nothing to do with whether community medications are pre-populated by a feed from pharmanet or collected by the pharmacist or pharmacy technician at the time of admission. Both processes, the latter more onerous than the former, result in the compilation of the same community drug list that would need to be validated with the patient. **Thank you for this thoughtful comment. Reviewer 3 points to the tenuous assertion (that we do not make!) that pre-population of medication reconciliation forms leads to errors of commission, and believes that errors of commission may be just as likely when electronic medication dispensing data are simply made available. We agree with Reviewer 3's point, and carefully phrased our objectives accordingly to ensure our study is not misinterpreted as establishing any causality. Given our study design, we simply concluded that after implementation of a process with prepopulated forms, errors persist, and require further investigation. Our key point is that before other jurisdictions adopt electronic processes without further scrutiny and evaluation, this process needs to be investigated further to minimize all types of discrepancies, in particular, those that remain apparent after implementation of process that we thought would lead to improvement.** The decision about whether to continue to prescribe all or some of community-based drugs during hospitalization is a clinical judgment that is not related to the source of the information. The authors complicate the definition of these "errors of commission", also referred to as discrepancies, further by indicating that if the physician documented the reason for continuation then this would not be included but would be labeled "inappropriate prescribing", whereas if there was no documentation of the reason for continuing this would be classified as an error of commission or discrepancy. Not surprisingly, reasons for continuing or stopping medications are not well documented in the chart and there was poor agreement amongst physician reviewers in adjudicating these particular types of errors. **Reviewer 3 asserts that continuation of contra-indicated or discontinued medications is up to the clinical judgment of the prescriber. We agree, and therefore, if an inappropriate judgment was made to continue a medication even though it was contra-indicated or inappropriate given the situation, we conservatively did not label this a medication reconciliation error, but rather "inappropriate prescribing". Please note, that this removed that scenario from our numerator, and is the most conservatively interpretation possible. Also, two physicians searched the entire medical record (including vital signs, nursing notes, progress notes, and consultations) independently for any mention of any reason for continuations, in order to ensure we presented the most conservative (smallest) figure for errors of commission possible. We believe this approach was the most conservative approach possible. We have acknowledged the limitation of our methods in the discussion.** The second type of error relates to the continuation of drugs that have been stopped, as this information is apparently not available in pharmanet. This is a valid concern but is not inherently a problem of population based information exchanges such as pharmanet. The failure to show stopped medications in pharmanet is a design flaw in the specifications of the BC pharmanet exchange. These data do exist in pharmacy software systems, at least when this information is transmitted to pharmacies, and so the failure to retrieve, show, and include this information in pre-populated community drug lists is a remediable problem. It is important to highlight this completing avoidable shortcoming in the construction of population-based clinical information exchanges. **We fully agree and have added this point to our discussion.** Overall the second type of error is linked to pharmanet design and is of interest. While the sample is small and the manuscript would need a major re-write to focus on this issue alone, it would be useful as there is very little empirical evaluation of the Canadian investment in population-based drug information exchanges. **We agree. This is the critical point we aim to highlight in this publication. Canada Health Infoway is currently holding national workshops to discuss the creation of provincial medication information hubs with electronic medication dispensing data. Problems such as the one we highlight must be further discussed and investigated to identify interventions that can prevent these types of errors before electronic prescribing hubs are electronically linked to electronic medical records on a national level.**