Article details: 2018-0072	
Title	Comparison of cardiac surgery mortality reports using administrative versus clinical data sources
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Reviewer 1	Blair O'Neill
Institution	Cardiology Division, QE II Health Sciences Centre, Halifax, NS
General comments (author response in bold)	The authors are to be commended for an elegant study comparing the impact of a registry replete with multiple clinical variables, the widely available STS registry, compared to administrative database, the CIHI-produced Care Care Quality Indicator (CCQI) derived risk adjustment for predicted mortality vs the actual mortality rate over defined cohorts over 3 years. Minor critiques: The reviewer is concerned about "Further, a small number of procedures were excluded for administrative reasons such as mismatches in patient identifiers or date of procedures". This represents ~ 9% of the isolated CABG cohort, 16% of the AVR cohort, and 13% of the CABG + AVR cohort. This represents a fairly large potential number excluded from the analysis and potentially influencing the conclusions. The authors should be more explicit about what these were and whether they were distinct potential patients or not. **These patients were excluded because we were aiming to emulate the CIHI CCQI analysis, where they exclude patients in the last month of the fiscal year (i.e., the month of March) to enable them to determine 30-day outcomes. CIHI must do this because they are not able to link patients between fiscal years, and therefore a patient who has surgery in March would not have 30-day outcomes because it must be linked to a different year of CIHI data. Again, as we were aiming to emulate the CIHI CCQI report, we reproduced their analysis.** **Manuscript Change R1-1. We have stated in the revised manuscript that dates, inclusion and exclusion criteria were selected to emulate the CIHI CCQI report and provided a link to the report in the Methods (page 6, para 1, line 2): Dates of the review, classification of patients in specific subgroups of procedures, inclusion and exclusion criteria and outcomes were selected to coincide exactly with those used in the CCQI report from which the risk adjustment models using administrative data only was derived. The complete details of inclusions and exclusion criteria are provided in the CCQI Indicator Library (https://www.cihi.ca/en/indicator-library).**
Reviewer 2	A. Kucharska-Newton
Institution	University of North Carolina, Epidemiology
General comments (author response in bold)	The generalizability of this work is impossible to judge without more information on how the data were obtained. For example, how were the administrative data collected? Are those billing records? If so, how were those obtained for patients who were not discharged? Conversely, if mortality was assessed post-discharge, do mortality data include all-cause mortality regardless of location. The information on outcomes and methods in general should be more transparent so that a reader not familiar with the Canadian health data systems can easily assess data quality. **Manuscript Change R3-1. A new paragraph was added in the methods section to provide additional information on data abstraction and to address the questions above. The outcome used for this study was in-hospital mortality, not post-discharge mortality. This is indicated in the methods section. The new paragraph (page 5, para 2) reads as follows:** **Data sources and abstraction** **The discharge abstract database (DAD) maintained by CIHI was the primary source of administrative data for this study. The DAD contains data from all hospital admissions and this data submission to CIHI is mandatory. The DAD is used primarily for surveillance, statistical reporting and administration. DAD submission is completed by trained data managers and nosologists upon patient discharge (or death) and includes basic patient demographics, admission information, diagnoses, treatments and status at discharge. Clinical data were obtained from the Division of Cardiac Surgery clinical database at the University Health Network (UHN). These data are prospectively collected by cardiac surgeons and experienced data managers for all cardiac operations performed at UHN and includes detailed pre-procedural, intraoperative and in-hospital outcomes.** Collection of data from only one hospital, further reduce the generalizability of findings. Specifically, both cited risk prediction models include only patient-level factors. Hospital (and system)-level factors were not included. Yet, the authors acknowledge the role of volume and referral patterns as influential characteristics, which, if nothing else, will contribute to the patient mix. **We believe that risk adjustment models should account for patient characteristics only. They do not account for hospital and system level factors, because these are the structural factors and processes that we are trying to compare using report cards. If hospital characteristics are included in the model, and thus adjusted for, we would not be able to benchmark hospitals.** The reported type of data included in the clinical and administrative models give rise to a question about the representativeness of those two data sources. For example, information on hypertension is available only for AVR patients and only in the clinical modes. That is surprising – I would have expected hypertension information (or more specifically, blood pressure data) to be easily available for all patients, regardless of admission cause/procedure. Likewise, the clinical data source does not provide information on cancer or dementia prevalence **The list of variables in Table 1 is not indicative of data availability, it is the list of the factors included in the various risk adjustment models (as determined by STS or selected by CIHI). All of the data elements listed in Table 1 were available for all patients. Information regarding cancer and dementia were available as part of the Charlson Index. In the interest of space we did not report the prevalence of any risk factors other than those showing large calibration deficits (i.e. those factors with large discrepancy between observed to expected mortality rates).** The total number of deaths is relatively low. Further, the very small number of deaths by exposure categories (i.e. types of procedures) precludes any stratified analyses. Results should therefore be reported only for the entire sample population and Table 1 should represent the availability of data for the entire population. **Table 1 does not represent the data availability but the specific elements in each of the risk adjustment models. Cardiac procedures are divided into Isolated CABG, Isolated AVR and CABG + AVR in both the STS and CCQI reports. Although we agree that the number of deaths is quite small and that the overall combined sample may yield more accurate predictions, the procedure-specific reporting is important and clinically relevant, and should therefore remain as presented, as this allows procedure-specific comparisons between institutions.** Please include references to the two prediction models (page 5 last paragraph). **Manuscript Change R3-5. References have been added as requested (page 6, para 2, line 5): Details of the model derivation for the CIHI model are provided in the CCQI General Methodology Notes and CCQI 2017 Indicators Technical Notes.[1,2] Details of the derivation and validation of the STS models have previously been published.[8-10]**

	Please provide the name of the hospital from which the data were collected. An abbreviation (UHN) is used, but that is not transparent to the reader. **The full name of the hospital was specified in the Abbreviations (page 3) and in the Methods section (page 5, para 2, line 7) under 'Data sources and abstraction'.** **REFERENCES** **1. Canadian Institute for Health Information. Cardiac care quality indicators general methodology notes, October 2017. Ottawa, ON: CIHI;2017.** **2. Canadian Institute for Health Information. Cardiac care quality indicators technical notes. 2017; https://www.cihi.ca/sites/default/files/document/ccqi-2017-indicator-specific-methodology-notes-en.pdf.** **3. Siregar S, Pouw ME, Moons KG, et al. The Dutch hospital standardised mortality ratio (HSMR) method and cardiac surgery: benchmarking in a national cohort using hospital administration data versus a clinical database. Heart. 2014;100(9):702-710.** **4. Lawson EH, Louie R, Zingmond DS, et al. Using Both Clinical Registry and Administrative Claims Data to Measure Risk-adjusted Surgical Outcomes. Ann Surg. 2016;263(1):50-57.** **5. Pasquali SK, He X, Jacobs JP, et al. Measuring hospital performance in congenital heart surgery: administrative versus clinical registry data. Ann Thorac Surg. 2015;99(3):932-938.** **6. Hammill BG, Curtis LH, Fonarow GC, et al. Incremental value of clinical data beyond claims data in predicting 30-day outcomes after heart failure hospitalization. Circ Cardiovasc Qual Outcomes. 2011;4(1):60-67.** **7. Lim E, Cheng Y, Reuschel C, et al. Risk-Adjusted In-Hospital Mortality Models for Congestive Heart Failure and Acute Myocardial Infarction: Value of Clinical Laboratory Data and Race/Ethnicity. Health Serv Res. 2015;50 Suppl 1:1351-1371.** **8. Shahian DM, O'Brien SM, Filardo G, et al. The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 1--coronary artery bypass grafting surgery. Ann Thorac Surg. 2009;88(1 Suppl):S2-22.** **9. O'Brien SM, Shahian DM, Filardo G, et al. The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 2--isolated valve surgery. Ann Thorac Surg. 2009;88(1 Suppl):S23-42.** **10. Shahian DM, O'Brien SM, Filardo G, et al. The Society of Thoracic Surgeons 2008 cardiac surgery risk models: part 3--valve plus coronary artery bypass grafting surgery. Ann Thorac Surg. 2009;88(1 Suppl):S43-62.**