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Review of the utility of routine mortality reviews among deaths on General Internal Medicine wards in a Canadian tertiary care hospital

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ABSTRACT

Background Hospital morbidity and mortality reviews are common quality assurance activities, intended to uncover latent or unrecognised systemic issues that contribute to preventable adverse events and patient harm. Mortality reviews may be routinely mandated by hospital policy or for accreditation purposes. However, patients under the care of certain specialties, such as general internal medicine (GIM), are affected by a substantial burden of chronic disease, advanced age, frailty or limited life expectancy. Many of their deaths could be viewed as reasonably foreseeable, and unrelated to poor-quality care.

Methods We sought to determine how frequently postmortem chart reviews for hospitalised GIM patients at our tertiary care centre in Canada would uncover patient safety or quality of care issues that directly led to these patients' deaths. We reviewed the charts of all patients who died while admitted to the GIM admitting service over a 12-month time period between 1 July 2020 and 30 June 2021.

Results We found that in only 2% of cases was a clinical adverse event detected that directly contributed to a poor or unexpected outcome for the patient, and of those cases, more than half were related to unfortunate nosocomial transmission of COVID-19 infection.

Conclusion Due to an overall low yield, we discourage routine mortality chart reviews for general medical patients, and instead suggest that organisations focus on strategies to recognise and capture safety incidents that may not necessarily result in death.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Many organisations have established a formal morbidity review process, and the majority of these groups have reported that this activity is valuable, leading them to discover a significant rate of preventable clinical adverse events or quality-of-care issues. However, we suspect that morbidity reviews may not be equally useful for all specialities and patient populations. Patients cared for by the general internal medicine specialty are often affected by a substantial burden of chronic disease, advanced age and frailty, with reasonably foreseeable deaths due to natural causes, as opposed to quality-of-care issues.

WHAT THIS STUDY ADDS

⇒ In contrast to other groups who may have cared for patients with different characteristics, we found that patients who died under the care of the general internal medicine service had reasonably foreseeable deaths due to natural, organic causes, with only a small proportion of patients affected by a clinically adverse event.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ We discourage routine mortality chart reviews for general medical patients, and instead suggest focusing on ways to recognise and capture safety incidents that may not necessarily result in death.

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INTRODUCTION

Hospital morbidity and mortality reviews are common quality assurance activities, intended to uncover latent or unrecognised systemic issues that contribute to preventable adverse events and patient harm. Once systemic issues are identified, if they are thoroughly addressed with safeguards put in place, then the expectation is that future similar adverse events would be mitigated, thereby improving the safety and quality of care provided to patients.

Several groups have reported that a high in-hospital mortality rate can be attributed to poor-quality care.[1–5] Many organisations describe a formal morbidity review process of in-hospital deaths,[5–10] and the majority of these groups have found this activity to be valuable, leading them to discover a significant rate of preventable clinical adverse events or quality-of-care issues. However, one Norwegian group reported that only 2.9% of their in-hospital deaths were due to preventable causes.[11]

Mortality reviews may be routinely required based on hospital policy or for accreditation purposes, particularly for patients admitted to a medical specialty service such as general internal medicine (GIM). Jurisdictions such

as the National Health Service have a process by which, in the event of death, cases are routinely screened and selected systematically for case review, as required,[12] and the Mayo Clinic has instituted a '100% mortality review system'.[13] In Canada, GIM is a specialty that involves diagnosing and managing complex, polycomorbid, seriously ill patients suffering from advanced illness and/or diseases affecting more than one organ system. In-hospital mortality rates among hospitalised patients in Canada have been reported to range between 3.3 and 5%.[5 14] Given that at an average-sized, urban, tertiary care centre in Canada, a GIM admitting service would be expected to have a per annum caseload of several thousand, conducting routine mortality reviews of all patient deaths would be a significant time commitment. A thorough chart review for each deceased patient would be an onerous process, in the context of the complex presentations and comorbidities of many GIM inpatients, and their often complicated and lengthy hospital stays. Yet, we question the utility of routine mortality reviews in leading to impactful improvements in patient care or safety in this particular patient population. As many hospitalised GIM patients are affected by a substantial burden of chronic disease, advanced age, frailty or limited life expectancy, many of their deaths could be viewed as reasonably foreseeable and unrelated to poor-quality care.

The objective of this qualitative study is to assess how frequently postmortem chart reviews for hospitalised GIM patients at our tertiary care centre in Canada would uncover patient safety or quality of care issues that directly led to these patients' deaths. We hypothesise that in the majority of cases, these reviews would be unlikely to yield valuable information on active or latent systemic safety issues. If our hypothesis is supported by the data that we collect in our study, this would lead to a recommendation to use a more targeted approach in identifying which types of mortality cases are worthwhile to review. In addition, the time that would have been spent globally reviewing all mortality cases could be reallocated to other higher-yield patient safety and quality improvement (QI) initiatives.

METHODS

We performed a retrospective chart review between 1 July 2020 and 30 June 2021 for patients hospitalised under the care of the GIM attending service at the University of Alberta Hospital (UAH). UAH is a large urban academic tertiary care Canadian hospital operated by Alberta Health Services (AHS) in Edmonton, Alberta, and is one of the city's largest hospitals, serving a population of approximately 1.3 million people. UAH uses the Epic Systems Corporation clinical information system for all clinical tasks and documentation for patients who receive care at this centre. We generated a report within the Epic clinical information system, identifying all patients who were discharged from the GIM

Table 1 Alberta Health Services clinical adverse event rating

Grading	Description
1	There were no clinical adverse events detected.
2	There were no clinical adverse events detected. However, there were opportunities identified to improve care during hospitalisation.
3	There was a clinical adverse event(s) detected that was unlikely to have contributed to a poor or unexpected outcome for the patient.
4	There was a clinical adverse event(s) detected that directly contributed to a poor or unexpected outcome for the patient.

A clinical adverse event is defined as an event that could or does result in an unintended injury or complication arising from healthcare management with outcomes that may include (but are not limited to) death or serious harm.

service during the study period. Subsequently, we examined the subset of patients with a Discharge Disposition of 'Died in Facility'.

Two reviewers independently (KT and JN) conducted mortality reviews of electronic charts for all patients who died. Data abstracted included demographics, admission diagnosis, goals-of-care designation (GCD), length of hospitalisation, review of comorbidities and cause-of-death. Burden of chronic disease was documented using the Charlson Comorbidity Index (CCI) as a standardised prognosis-informing metric.[15–17] A score of 0 points on the CCI confers a 98% estimated 10-year survival; 1 point 96%; 2 points 90% ; 3 points 77%; 4 points 53%; 5 points 21%; 6 points 2% and 7 points or greater a 0% estimated 10-year survival. This is based on the equation: 10-year survival=$0.983^{(e^{CCI \times 0.9})}$.[15] All charts were thoroughly reviewed and assigned a score on the AHS clinical adverse event rating (CAER, table 1), in order to identify clinically adverse events (CAEs) and their contribution to patient mortality.

Data sources reviewed in the clinical chart included physician documentation, nursing and allied health documentation, investigation results, vital signs and other flowsheet data, and other clinical notations. In cases where multiple potential causes-of-death were present, a more thorough review was performed to determine the most predominant aetiology. Cases where the CAER assigned by each of the reviewers (KT and JN) differed were reviewed by a third reviewer (RP or PH) to arrive at group consensus.

Data were summarised by generating means and SD for continuous variables and frequency counts and percentages for categorical variables. Statistical comparisons were performed using t-tests for continuous variables and χ^2 or Fisher's exact tests for categorical variables. Statistical significance threshold was set at a p<0.05.

Patient and public involvement

Due to the nature of our retrospective mortality study, it was neither possible nor appropriate to involve patients or the public in the design, conduct or reporting of our research.

RESULTS

A total of 354 patient deaths were identified between 1 July 2020 and 30 June 2021, from a total of 4544 patients discharged alive or deceased, equating to an in-hospital mortality rate of 7.8%. Of the deceased patients, mean age was 77.8 years (IQR 70–88 years). 170 (48.0%) patients were of female sex. The mean CCI was 7.6 (median 7, IQR 6–9), with the most prevalent comorbidities being heart failure (33.6%), dementia (31.6%), chronic pulmonary disease (30%), coronary artery disease (27.1%) and metastatic cancer (27.1%) (table 2). The most common cause-of-death was related to non-COVID infection (28.0%), followed by complications of malignancy (18.1%), then by COVID-19 (16.7%); COVID-19 was considered independent of other infections due to its novel nature.

Only 4% of cases received a CAER of 3 or 4. There was reviewer agreement for the CAER in 347 cases. In seven cases, one reviewer assigned a higher CAER score, but on thorough group review involving a third reviewer, the patients' deaths were not found to be related to systems issues, therefore, the CAER score was reassigned to a lower category. Therefore, the Cohen's kappa statistical coefficient, representing the degree of accuracy and reliability between the two reviewers, was calculated as 0.98.

In 269 cases (76.0%), a GCD consistent with comfort, end-of-life care was present prior to death. At time of death, only 20 cases (5.6%) had a GCD consistent with resuscitative, intensive care unit (ICU)-level care, and among those, only 12 (3.4%) had expressed wishes for CPR in the event of cardiac arrest; this contrasts with 119 patients (33.6%) with GCD consistent with ICU-level care at admission.

DISCUSSION

In our study, we identified an overall mortality rate of 7.8%, which is higher than what has been reported in other Canadian studies.[5 14] One Canadian centre found that an institution-wide mortality of 3.3%, with 18.7% of cases reviewed having opportunities for improvements in care.[5] Our higher mortality rate may be due to differences in the patient population studied, as we reviewed only patients admitted to the GIM service. For example, patients admitted to the GIM service would generally be of older age and have more medical comorbidities than those admitted to surgical, obstetrical, neonatal or ICUs. In our cohort of patients, the mean CCI was 7.6, predicting a limited life expectancy, as CCI scores above 7 are associated with a 0% 10-year survival. We found that most deaths that occurred during the study period could be reasonably predicted, given the noted burden of medical comorbidity in this patient population. Furthermore, no

Table 2 Patient characteristics, comorbidities and causes of death

Variable (SD)	CAER=1 N=329	CAER=2,3,4 N=25	P value
Age, mean (SD)	77.8 (12.6)	77.4 (14.4)	0.91
Female sex, no. (%)	159 (48)	11 (44)	0.70
Goals of care on admission, no. (%)			0.07
R1	80 (24)	9 (36)	
R2	6 (2)	2 (8)	
R3	21 (6)	1 (4)	
M1	194 (59)	10 (40)	
M2	12 (4)	3 (12)	
C1	11 (3)	0 (0)	
C2	5 (2)	0 (0)	
Goals of care on death, no. (%)			0.10
R1	11 (3)	1 (4)	
R2	1 (0.3)	1 (4)	
R3	6 (2)	0 (0)	
M1	54 (16)	7 (28)	
M2	3 (0.9)	1 (4)	
C1	184 (56)	10 (40)	
C2	70 (21)	5 (20)	
Cause of death			0.72
Cancer	61 (19)	3 (12)	
Cardiac	40 (12)	5 (20)	
Chronic obstructive pulmonary disease	2 (0.6)	0 (0)	
COVID	53 (16)	6 (24)	
Non-COVID infection	92 (28)	7 (28)	
Stroke	8 (2)	0 (0)	
Other	73 (22)	4 (16)	
CAER score			–
1	329 (100)	0 (0)	
2	0 (0)	11 (44)	
3	0 (0)	7 (28)	
4	0 (0)	7 (28)	
Length of stay (LOS), mean (SD)	11.1 (12.5)	15.7 (11.3)	0.06
Charlson Comorbidity Index, mean (SD)	7.6 (2.7)	7.3 (2.9)	0.63
Myocardial infarction, no. (%)	86 (26)	10 (40	0.13
Heart failure, no. (%)	110 (33)	9 (36)	0.79

Continued

Table 2 Continued

Variable (SD)	CAER=1 N=329	CAER=2,3,4 N=25	P value
Peripheral vascular disease, no. (%)	28 (9)	6 (24)	0.02
Cerebrovascular disease, no. (%)	64 (19)	7 (28)	0.30
Dementia, no. (%)	106 (32)	6 (24)	0.39
Chronic obstructive pulmonary disease, no. (%)	97 (29)	8 (32)	0.79
Connective tissue disease, no. (%)	29 (9)	1 (4)	0.71
Peptic ulcer disease, no. (%)	30 (9)	3 (12)	0.72
Liver disease, no. (%)	32 (10)	3 (12)	0.72
Diabetes, no. (%)	67 (20)	2 (8)	0.19
End-stage renal failure, no. (%)	22 (7)	2 (8)	0.68
Cancer, no. (%)	135 (41)	8 (32)	0.37
HIV, no. (%)	2 (0.6)	0 (0)	–

CAER, clinical adverse event rating .

metric in our study accounted for frailty, which is another strong predictor of mortality, separate from multimorbidity.[18] Finally, the majority of patients in our study had been transitioned to comfort, end-of life care status prior to their death.

Of the significant CAEs identified, two major themes emerged, related to nosocomial COVID-19 infections or diagnostic errors (table 3). Nosocomial COVID-19 transmission is an unfortunate challenge faced by hospitals in multiple jurisdictions globally,[19 20] although the risk can be reduced if rigorous infection prevention and control measures are in place.[21] In our review, as time progressed and COVID-19 immunisation became available, there were fewer deaths associated with nosocomial COVID-19 infection. Pertaining to cases related to delays in diagnosis and/or management, we found that in the majority of scenarios, care providers documented that they recognised that a CAE that had occurred; they were taking steps to rectify the problem(s); and they provided event disclosure to the patient and his/her family. It is plausible that these front-line clinicians' positive behaviours, including early incident recognition and management, and providing open disclosure, could have been an indirect and favourable effect from their awareness that adverse events would later be uncovered by the default mortality reviews. Separately from our mortality review study, themes from some of the CAE cases had already been identified by front-line clinicians for further educational review and to form the basis for QI project

initiatives. In addition, at our hospital, we are working on initiatives to encourage physicians at our organisation to report all recognised adverse incidents as they occur in real-time, within an incident reporting (IR) system.

Overall, only 4% of mortality cases that we reviewed were associated with a significant CAE, with the majority of incidents having been recognised by the care team prior the patients' deaths. Of the significant CAEs identified, only half of those caused direct patient harm or contributed to death. Therefore, routine mortality reviews for patients admitted to our GIM service have a low signal-to-noise ratio, and may be a redundant mechanism to identify these CAE signals. We recognise the limitations of our study in that it was conducted retrospectively, was time-limited and conducted at only one institution, therefore may lack generalisability. In addition, this study was conducted during the COVID-19 pandemic, where accordingly, several adverse events identified were related to nosocomial-acquired COVID-19 infection, therefore, our findings would not be representative during non-pandemic times.

Our primary focus was to complete a qualitative assessment of how frequently postmortem chart reviews could uncover patient safety or quality of care issues that directly led to these patients' deaths. Exploratory logistic regression analysis was later performed to identify predictors of CAER 2, 3 and 4, but the model was, not unexpectedly, underpowered to identify significant associations. There were only 25 events and, of these, only 14 for CAER 3 and 4, therefore, power is very limited. We have not included the results of the logistic regression, because reporting an underpowered model is not useful. A limitation of our study is that while we found overall low yield in reviewing every mortality case, we were unable to identify specific factors that would warrant a targeted chart review. It would be worthwhile in a separate, better-powered study to develop and refine a few case criteria that would identify, among all in-hospital deaths, those cases more likely to be related to preventable adverse events.

One alternative strategy to a review of all deaths could be screening for adverse events at the time of death certification. In the UK, a Health and Care Bill 2021–2022 was introduced in 2021,[22] establishing a role for medical examiners to support front-line physicians in completing medical certificates of cause of death and to help identify possible care quality problems that could be escalated to a full mortality chart review. This is an objective screening process by an individual not directly involved in the patient's care, and could provide more timely feedback, while also eliminating the need to review every mortality case in depth.

A strength of our study was the use of manual chart review rather than administrative data, although we acknowledge that we may have undercaptured CCI data, due to incomplete documentation in the chart regarding the presence and/or severity of comorbidities (eg, degree of malignancy spread, presence of hemiplegia, severity of liver disease, diabetic complications). However, even

Table 3 Significant clinical adverse events

CAER	Rationale
3	Nosocomial COVID-19 infection in partially vaccinated patient with active COVID-19 pneumonia at time of death, although had been progressively worsening over month-long admission from inoperable aortic valve endocarditis with progressive aortic insufficiency, heart failure, splenic infarcts, vertebral osteomyelitis, renal failure.
3	Documentation surrounding patient demise scarce but appears to have been dealing with progressive hypoactive delirium, renal failure, hyperkalaemia in a frail elderly polycomorbid patient, with subcutaneous lorazepam for procedural sedation for echocardiogram on day of demise.
3	Deceased from COVID-19 pneumonia from nosocomial COVID-19 infection in frail unvaccinated patient with diffusely metastatic malignancy and cancer-associated pulmonary emboli.
3	Deceased from Enterococcal bacteraemia in elderly frail patient, with no intravenous antibiotics for 48 hours due to inability to obtain peripheral or central venous access, though both oral and intramuscular antibiotics were initiated after 24 hours without venous access.
3	Deceased from aspiration due to extensive vomiting with ileus in elderly patient with initial admission for heart failure complicated by poor pulmonary reserve from severe obesity hypoventilation syndrome—no nasogastric tube inserted as patient had not been nauseous or vomiting, and ileus had been clinically improving until day of death.
3	Deceased from prosthetic joint infection with significant delay to diagnosis and antibiotic initiation in elderly patient with dementia requiring long-term care.
3	Deceased from acute myocardial infarction in setting of large cardioembolic stroke from new atrial fibrillation identified on admission 4 days prior, without appropriate anticoagulation started as discussion with patient deferred.
4	Deceased from bacterial meningitis after presentation of fever and delirium without clear cause of either; lumbar puncture not attempted until admission day 3; not empirically treated for meningitis/encephalitis in interim.
4	Deceased from COVID-19 pneumonia from nosocomial COVID-19 infection in unvaccinated patient following admission for diagnosis of multiple myeloma and initiation of multiple myeloma.
4	Deceased from COVID-19 pneumonia from nosocomial COVID-19 infection in elderly but otherwise healthy and fully immunised patient rehabilitating weeks after resolved sepsis from cholangitis.
4	Deceased from recurrent aspiration resulting from hypoactive delirium following mechanical fall with head injury and nasal fracture, while recovering from congestive heart failure.
4	Decreased from COVID-19 pneumonia from nosocomial COVID-19 infection in elderly, unvaccinated, significantly comorbid patient otherwise rehabilitating.
4	Admitted with decreased level-of-consciousness without diagnosis on initial workup, 6-day delay until EEG showing encephalitis, 11-day delay until lumbar puncture confirming herpes simplex virus encephalitis.
4	Deceased from COVID-19 pneumonia in unvaccinated patient, had been maintained on 12 L/min supplemental oxygen prior to death. Was found on nursing assessment deceased with supplemental oxygen off for an unknown duration.

CAER, clinical adverse event rating.

accounting for under-reporting of comorbidities, the CCI disease burden in our patient population was already very high, with a mean value of 7.6. Another limitation of our analysis is that, as a retrospective chart review, clinical contextual factors or other undocumented details were unavailable to us; therefore, it is possible that significant CAEs were missed. Overall, it is unlikely that these study limitations would significantly impact the finding that our patient population unfortunately had limited life expectancy and overall guarded prognoses.

Although mortality reviews have been a routine quality assurance activity at our organisation, there are often adverse events that patients experience, which may not result in death but are important avenues for improvements in care. Mortality reviews are also just one method of capturing patient safety issues, but may not detect issues

that would be noted by an alternate method.[23] Furthermore, trying to capture CAEs through mortality reviews is a reactive, as opposed to proactive, approach to patient safety and QI. Other strategies exist to recognise and capture safety incidents that may not necessarily result in death. For example, our organisation uses an IR system, where reports of adverse events, near-misses and other safety hazards provide the opportunity to learn about latent errors, so that proactive solutions that address the identified deficiencies can be instituted. However, most voluntary IR systems detect only a small subset of events that healthcare personnel choose to report, thus lacking the ability to quantify the magnitude of each type of safety problem. Sources of harm that are unreported may remain unrecognised. Another limitation of IR systems is that they are underused by physicians.[24-26] Additional

safety monitoring strategies used at our organisation include patient complaints and executive walk rounds, each with their own advantages and disadvantages.[23] Shojania argues that no single method can provide a comprehensive snapshot of the various threats to patient safety at a particular hospital, therefore, it is important to leverage multiple methods to capture the full spectrum of safety issues.[23]

A primary challenge with using mortality reviews as part of an organisational QI strategy is generating timely and actionable follow-up. As we uncovered in our study, one common theme emerged, relating to delayed diagnoses and management, and these incidents were recognised and documented even prior to patients' deaths. Although some of these cases were identified for further educational review and QI initiatives, in the span of our 1-year review, similar incidents recurred, prior to specific solutions or safeguards being put in place. We acknowledge that even if valuable information is uncovered from a mortality chart review, that the struggle to engage various providers remains, particularly in addressing multifaceted systemic issues spanning multiple clinical areas or services. Remedies to such issues often require significant involvement from leadership, such as Department chairs or Division heads. Successful use of mortality reviews in a QI strategy requires dedicated leaders or working groups to drive and enforce systemic change.

CONCLUSION

Mortality reviews are a common quality assurance activity undertaken by many healthcare organisations, and reported to be valuable in identifying latent or unrecognised systemic issues that contribute to patient harm. However, we found that patients who died under the care of the GIM service had reasonably foreseeable deaths due to natural, organic causes, with only a small proportion of patients affected by a CAE. For patients in whom a CAE was identified through a postmortem chart review, the majority of those incidents were already recognised and reported prior to death. However, it is possible that front-line clinicians' awareness of the systematic mortality review programme at our centre may have been an indirect, important driver of their positive safety recognition and reporting behaviours. Additional work is required to identify criteria or patient characteristics that could be predictive of a preventable adverse event; our model in this study was underpowered to develop these criteria. Overall, we discourage routine mortality chart reviews for all general medical patients, and instead suggest incorporating other mechanisms to recognise and capture safety incidents that may not necessarily result in death. Once these incidents are identified, strategies should be in place to ensure for actionable follow-up and implementation of sustainable long-term solutions.

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