



A retrospective cohort study of age-based differences in the care of hospitalized patients with sudden clinical deterioration



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ARTICLE INFO

Keywords:

Hospital rapid response team

Critical care

Mortality

Patient care planning

Age

ABSTRACT

Purpose: The proportion of elderly patients is increasing, but it is unknown if there are age-based differences in care of hospitalized patients with sudden clinical deterioration. We sought to examine the relation between patient age and care for hospitalized patients experiencing sudden clinical deterioration.

Methods: We identified hospitalized adults ($n = 5103$) in 4 hospitals with sudden clinical deteriorations triggering medical emergency team (MET) activation between January 1, 2007, and December 31, 2009. We compared intensive care unit (ICU) admission rates (within 2 hours of MET activation), goals of care (resuscitative vs nonresuscitative), and hospital mortality according to age (<50 , 50–64, 65–79, and 80+ years), adjusting for patient, physician, and hospital characteristics.

Results: Age was associated with decreased likelihood of admission to ICU ($P < .0001$) and increased likelihood of change in goals of care ($P < .0001$). Compared to patients younger than 50 years, patients 80 years or older had 67% lower odds of ICU admission (odds ratio, 0.33; 95% confidence interval, 0.26–0.41) and 587% higher odds (odds ratio, 6.87; 95% confidence interval, 4.20–11.26) of having their goals of care changed to exclude resuscitation. Hospital mortality was associated with patient age, ranging from 15% to 46% ($P < .0001$).

Conclusions: Patient age is associated with care for hospitalized patients with sudden clinical deterioration, suggesting that strategies to guide care of elderly patients during MET activation may be beneficial.

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1. Introduction

The demographic distribution of the world's population is rapidly changing with the proportion of elderly and very elderly patients steadily increasing [1]. As populations' age and our ability to treat previously fatal illnesses continue to advance, chronic disease, frailty, and disability are expected to become more prevalent and impact acute episodes of illness [2].

The relationship between patient age and both the delivery and outcomes of care for acutely ill hospitalized patients is unclear [3]. Studies of seriously ill hospitalized patients have identified modest independent associations between patient age and decisions to withhold life-sustaining treatments, delivery of health care services, and survival [4–6]. Conversely, studies of critically ill patients admitted to the intensive care unit (ICU) have produced conflicting results with some studies suggesting that patient age is a powerful predictor of care while others suggesting that comorbid diseases, functional status, and disease severity are more important [7–9]. Discrepancies between studies may be

explained by selection biases [3], differences in health care systems [10], or institutional practices [11].

We took advantage of the implementation of rapid response systems in 4 hospitals within a single health system that used standardized criteria to activate the medical emergency team (MET) to conduct a retrospective multicenter cohort study to examine the relation between patient age and care for a cohort of hospitalized patients experiencing sudden clinical deterioration.

2. Methods

2.1. Study cohort

We identified consecutive patients (excluding cardiac surgery and coronary care units) admitted to 4 hospitals (2 tertiary academic and 2 community) in Alberta, Canada, with sudden clinical deteriorations and MET activation from January 1, 2007, to December 31, 2009 [12,13]. We excluded patients with clinical deterioration, but without MET activation (eg, those receiving end of life care). Alberta Health Services manages all METs (each team composed of a physician, nurse, and respiratory therapist 24 hours per day 7 days per week—overseen by an ICU attending physician), medical-surgical ICUs (83 funded beds), and hospitals (4 study hospitals with a total of 2883 beds, each with a MET and medical-surgical ICU) in the Province of Alberta. Medical

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emergency teams are triggered by physiologically based criteria (respiratory, heart rate, blood pressure, neurologic, and worried) that are similar across Alberta Health Services institutions [12]. Physicians from the MET and most responsible medical team jointly make management decisions in consultation with patients and their families (including patient disposition and goals of care) on a case-by-case basis without a guideline, protocol, or decision-making support.

2.2. Sources of data

We used data from Alberta Health Services clinical and administrative databases that have been used for program evaluation and research [12–14]. The MET databases capture reason for assessment, vital signs, diagnostic and therapeutic interventions, and patient disposition, with data acquired at the time of patient assessment. The ICU databases are electronic patient information systems that prospectively capture demographic, clinical, and outcome data for all patients admitted to ICU. Alberta Health Services administrative databases capture data on all hospitalized patients, including vital status at discharge, dates of admission and discharge, and both diagnostic and procedure codes.

2.3. Patient, physician, and hospital factors

We identified patient, provider, and institutional factors that may impact processes and outcomes of care for patients with clinical deterioration and MET activation [12,13]. Patient factors included demographic variables, comorbid conditions, reason for MET activation, and goals of patient care (care that includes resuscitation vs care that does not include resuscitation). Presence of comorbid conditions was derived using the Deyo classification of Charlson comorbidities and validated *International Statistical Classification of Diseases, 10th Revision*, coding algorithms (summarized as a single comorbidity score for multivariable analyses) [15]. Physician factors included whether an ICU attending physician was present at the MET activation. Hospital factors included ICU occupancy (percentage of ICU beds occupied) [12], the day of the week (weekday [Monday 8 AM to Friday 5 PM] vs weekend), and time of day (daytime [8 AM to 5 PM] vs night time) of the MET activation [16].

2.4. Process and outcome measures

The primary outcome was admission to ICU within 2 hours of MET activation [12]. We examined 4 secondary outcome measures: (a) changes in goals of patient care (from care that includes resuscitation to care that does not include resuscitation) within 24 hours of MET activation; (b) inhospital mortality; (c) use of health care resources, evaluated by investigations and interventions performed during the initial MET activation or a new MET activation; and (d) admission to ICU during the remainder of hospitalization (ie, >2 hours after initial MET activation).

2.5. Statistical analysis

The primary analysis tested associations between patient age and admission to ICU within 2 hours of MET activation using a generalized estimating equation (GEE) model. We categorized patients into 4 prespecified age groups (<50, 50–64, 65–79, and ≥80 years) derived from previously used thresholds [6,7,17]. The unit of analysis was MET activation. We adjusted for patient, physician, and hospital covariates when analyzing outcome measures. All baseline variables measured at the time of MET activation were considered for inclusion, and those significant were retained. We selected GEE as it is an extension of standard logistic regression, which adjusts for correlation among observations [18,19] and provides “population-average” effect (average response for observations sharing the same covariates) that has familiar interpretation and is more useful when estimating effects at a population level [20,21]. We accounted for 2 types of clustering in our analyses, patients

with more than 1 hospitalization with a MET activation during the study period and patients clustered within hospitals. Robustness of the analysis was evaluated by conducting secondary analyses restricted to patients with goals of care that included resuscitation at the time of MET activation. Evaluations of the association between age and hospital mortality were interrogated with additional subgroup analyses according to whether goals of patient care were changed and whether patients were admitted to ICU. Because previous studies have suggested potential associations between patient age and care in relation to patient sex, we conducted additional analyses that incorporated an age-sex interaction term into all models. Statistical analyses were performed with the SAS system (SAS version 9.2; SAS Institute, Inc, Cary, NC) and a 2-sided $P < .05$ was considered significant. The Health Research Ethics Boards at the University of Calgary (EID22983) and University of Alberta (Pro00001872) approved this study and waived the need for informed consent from patients and physicians.

3. Results

3.1. Patient characteristics

We identified 5106 patients who experienced clinical deterioration and MET activation during the study period. Patient age was available for 5103 patients (99.9%) who were included in the analyses. The distribution of patients according to age is summarized in Fig. 1. The median age was 70 years (interquartile range [IQR], 55–80) with the largest age group being 65 to 79 years old ($n = 1637$, 32% of cohort) followed by 80 years or older ($n = 1385$, 27% of cohort). The characteristics of the patients are summarized in Table 1. Half the patients were female. Most patients had 1 or more comorbidities. The most common reasons for MET activation were respiratory (52%) and neurologic (45%). Intensive care unit attending physicians attended approximately a third of MET activations. Patient characteristics varied according to patient age.

3.2. Delivery of care

We examined the delivery of care during MET activations according to patient age (Table 2). The duration of MET activation varied across age groups and was significantly longer for those patients whose goals of patient care were changed from including resuscitation to not including resuscitation compared to those whose goals of patient care were not changed (median, 59 minutes [IQR, 39–91] vs 57 minutes [IQR, 35–86]; $P < .0001$). There were significant associations between patient age groups and the use of investigations and interventions (Pearson χ^2 test of proportions). Older patients were more likely to have electrocardiograms ($P < .0001$) and x-rays of the chest or abdomen ($P < .0001$). Oxygen ($P = .0015$) and nebulized medications ($P < .0001$) were more frequently provided to older patients. Conversely, invasive interventions including intubation and mechanical ventilation ($P < .0001$) and insertion of central intravenous lines ($P < .0001$) were provided less frequently to older patients.

3.3. Outcomes of care

Patient outcomes of care are summarized using crude data with adjusted P values in Table 3. Hospitalized older patients with sudden clinical deterioration were significantly less likely to be admitted to ICU within 2 hours of MET activation ($P < .0001$). In total, 29% of patients younger than 50 years and 11% of patients 80 years or older were admitted to ICU within 2 hours of MET activation. Among patients admitted to ICU within 2 hours of MET activation, the time to admission was similar ($P = .3459$). Among patients not admitted to ICU within 2 hours of MET activation, subsequent ICU admissions were less frequent for older patients ($P < .0001$). Older patients were more likely than younger patients to have their goals of care changed to not include resuscitation ($P < .0001$). In total, 2% of patients younger than 50 years had their

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