BRIEF REPORT

Enhanced End-of-life Care Associated with Deploying a Rapid Response Team: A Pilot Study

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HYPOTHESIS: Institution of a rapid response team (RRT) improves patients' quality of death (QOD).

SETTING: A 425-bed community teaching hospital.

PATIENTS: All medical-surgical patients whose end-of-life care was initiated on the hospital wards during the 8 months before (pre-RRT) and after (post-RRT) actuation.

STUDY DESIGN: Retrospective cohort study.

METHODS: Medical records of all patients were reviewed using a uniform data abstraction tool. Demographic information, diagnoses, physiologic and laboratory data, and outcomes were recorded.

RESULTS: A total of 197 patients died in both the pre-RRT and post-RRT periods. There were no differences in age, sex, advance directives, ethnicity, or religion between groups. Restorative outcomes, including in-hospital mortality (27 vs. 30/1000 admissions), unexpected transfers to intensive care (17 vs. 19/1000 admissions) and cardiac arrests (3 vs. 2.5/1000 admissions) were similar during the 2 periods. Outcomes, including formal comfort care only orders (68 vs. 46%), administration of opioids (68 vs. 43%), pain scores (3.0 ± 3.5 vs. 3.7 ± 3.2), patient distress (26 vs. 62%), and chaplain visits (72 vs. 60%), were significantly better in the post-RRT period compared to the pre-RRT period (all $P < 0.05$). During the post-RRT period, 61 patients died with RRT care and 136 died without RRT care. End-of-life care outcomes were similar for these groups except more RRT patients had chaplain visits proximate to their deaths (80% vs. 68%; $P = 0.0001$).

CONCLUSIONS: Institution of an RRT in our hospital had negligible impact on outcomes of patients whose goal was restorative care. Deployment of the RRT was associated with generally improved end-of-life pain management and psychosocial care. *Journal of Hospital Medicine* 2009;4:449–452. © 2009 Society of Hospital Medicine.

KEYWORDS: critical care, death, palliative care, rapid evaluation team.

In 2007, the Joint Commission for Accreditation of Healthcare Organizations (JCAHO) recommended deployment of rapid response teams (RRTs) in U.S. hospitals to hasten identification and treatment of physiologically unstable hospitalized patients.[1] Clinical studies that have focused on whether RRTs improve restorative care outcomes, frequency of cardiac arrest, and critical care utilization have yielded mixed results.[2-11] One study suggested that RRTs might provide an opportunity to enhance palliative care of hospitalized patients.[11] In this study, RRT personnel "felt that prior do-not-resuscitate orders would have been appropriate" in nearly a quarter of cases. However, no previous study has examined whether the RRT might be deployed to identify acutely decompensating patients who either do not want or would not benefit from a trial of aggressive restorative treatments. We hypothesized that actuation of an RRT in our hospital would expedite identification of patients not likely to benefit from restorative care and would promote more timely commencement of end-of-life comfort care, thereby improving their quality of death (QOD).[12-16]

Materials and Methods

Study Design and Settings

This retrospective cohort study was approved by the Institutional Review Board (IRB) of and conducted at Bridgeport Hospital, a 425-bed community teaching hospital. In October 2006, the hospital deployed its RRT, which includes a critical care nurse, respiratory therapist, and second-year Medicine resident. Nurses on the hospital wards received educational in-service training instructing them to request an RRT evaluation for: airway incompetence, oxygen desaturation despite fraction of inspired oxygen (FiO_2) $\geq$ 60%, respiratory frequency <8 or >30/minute, heart rate <50 or >110/minute, systolic pressure <90 or >180 mmHg, acute significant bleeding, sudden neurologic changes, or patient changes that troubled the nurse. The critical care nurse and respiratory therapist responded to all calls. If assessment suggested a severe problem that required immediate physician supervision, the resident was summoned immediately. Otherwise, the nurse assessed the patient and suggested to the patient's primary doctor of record a trial of therapies. If

ratified, the therapies were provided by the nurse and respiratory therapist until symptoms/signs resolved or failed to improve, in which case the resident-physician was summoned. The resident-physician would assess, attempt further relieving therapies, and, if appropriate, arrange for transfer to critical care units (in which case the case was presented to the staff intensivist who supervised care) after discussion with the patient and attending physician. No organizational changes in the administration or education of palliative care were implemented during the study period.

Data Extraction and Analysis

All patients dying in the hospital during the first 8 months of RRT activity (October 1, 2006 to May 31, 2007) and during the same months in the year prior to RRT were eligible for the study. Patients were excluded if they died in areas of the hospital not covered by the RRT, such as intensive care units, operating rooms, emergency department, recovery areas, or pediatric floors, or if they had been admitted or transferred to hospital wards with palliative care/end-of-life orders.

Physiologic data, including blood pressures (lowest), heart rate (highest), and respiratory rate (highest), were extracted from records of the 48 hours before and until resolution of the RRT assessment, or prior to death for those without RRT care. Outcomes were defined by World Health Organization (WHO) domains of palliative care (symptoms, social, and spiritual).[14] The symptom domain was measured using patients' pain scores, 24 hours prior to death (0-10). Subjective reports of healthcare providers recorded in hospital records, including the terms "suffering," "pain," "anxiety," or "distress" were also extracted from notes 24 hours prior to patients' deaths. Administration of opioids in the 24 hours prior to death was also recorded. Social and spiritual domains were measured by documentation of presence of the family and chaplain, respectively, at the bedside in the 24 hours prior to death.

Analysis was performed using SPSS software (SPSS Inc., Chicago, IL). Categorical variables, described as proportions, were compared with chi-square tests. Continuous variables are reported as means ± standard errors, or as medians with the interquartile ranges. Means were compared using Student t test if a normal distribution was detected. Nonparametric variables were compared with Wilcoxon rank sum tests. To adjust for confounding and assess possible effect modification, multiple logistic regression, multiple linear regression, and stratified analyses were performed when appropriate. Domains of the QOD were compared between patients who died in the pre-RRT and post-RRT epochs. Patients who died on hospital wards without RRT evaluation in the post-RRT epoch were compared to those who died following RRT care. Unadjusted in-hospital mortality, frequency of cardiopulmonary resuscitation, frequency of transfer from wards to critical care, and QOD were compiled

TABLE 1. Characteristics and Restorative Outcomes of Study Patients

	Total	Pre-RRT	Post-RRT	P value
Total admissions	25,943	12,926	13,017	
Number of deaths	394	197	197	NS
Age (years)	77.5 ± 13.2	77.1 ± 13.36	77.9 ± 13.13	0.5
Male gender	190 (48%)	99 (51%)	91 (46%)	0.4
From SNF	128 (32%)	54 (27%)	74 (38%)	0.02
Living will	135 (34%)	66 (33%)	69 (35%)	0.8
Race				0.3
White	314 (80%)	163 (83%)	151 (77%)	
Hispanic	32 (8%)	14 (7%)	18 (9%)	
Black	47 (12%)	19 (10%)	28 (14%)	
Other	1 (<1%)	1 (<1%)	0	
Religion (%)				0.8
Christian	357 (91%)	177 (90%)	180 (91%)	
Non-Christian	37 (9%)	20 (10%)	17 (9%)	
Admission diagnosis				<0.01
Malignancy	96 (24%)	56 (28%)	40 (20%)	*
Sepsis	44 (11%)	21 (11%)	23 (12%)	
Respiratory	98 (25%)	53 (27%)	45 (23%)	*
Stroke	31 (8%)	16 (8%)	15 (8%)	
Cardiac	66 (17%)	37 (19%)	29 (15%)	*
Hepatic failure	9 (2%)	4 (2%)	5 (2%)	
Surgical	17 (5%)	6 (3%)	11 (5%)	
Others	33 (8%)	4 (2%)	29 (15%)	*
Team				<0.01
Medicine	155 (39%)	64 (32%)	94 (47%)	
MICU	44 (11%)	3 (2%)	41 (21%)	*
Surgery	12 (3%)	9 (5%)	3 (1%)	
Restorative outcomes				
Mortality/1000		27/1000	30/1000	0.9
Unexpected ICU transfers/1000		17/1000	19/1000	0.8
CPR/1000		3/1000	2.5/1000	0.9

Abbreviations: CPR, cardiopulmonary resuscitation; MICU, medical intensive care unit; NS, not significant; SNF, skilled nursing facility (nursing home).
*Designates which variables accounted for differences across variable types.

and compared. A *P* value of <0.05 was considered statistically significant.

Results

A total of 394 patients died on the hospital wards and were not admitted with palliative, end-of-life medical therapies. The combined (pre-RRT and post-RRT epochs) cohort had a mean age of 77.2 ± 13.2 years. A total of 48% were male, 79% White, 12% Black, and 8% Hispanic. A total of 128 patients (33%) were admitted to the hospital from a skilled nursing facility and 135 (35%) had written advance directives.

A total of 197 patients met the inclusion criteria during the pre-RRT (October 1, 2005 to May 31, 2006) and 197 during the post-RRT epochs (October 1, 2006 to May 31, 2007). There were no differences in age, sex, advance directives, ethnicity, or religion between the groups (Table 1). Primary admission diagnoses were significantly different; pre-RRT

patients were 9% more likely to die with malignancy compared to post-RRT patients and less likely to come from nursing homes (38% vs. 27%; $P = 0.02$).

Restorative Care Outcomes

Crude, unadjusted, in-hospital mortality (27 vs. 30/1000 admissions), unexpected transfers to intensive care (17 vs. 19/1000 admissions), or cardiac arrests (3 vs. 2.5/1000 admissions) were similar in pre-RRT and post-RRT periods (all $P > 0.05$).

End-of-Life Care

At the time of death, 133 patients (68%) who died during the post-RRT epoch had "comfort care only" orders whereas 90 (46%) had these orders in the pre-RRT group ($P = 0.0001$; Table 2a). Post-RRT patients were more likely than pre-RRT patients to receive opioids prior to death (68% vs. 43%, respectively; $P = 0.001$) and had lower maximum pain scores in their last 24 hours (3.0 ± 3.5 vs. 3.7 ± 3.2; respectively; $P = 0.045$). Mention of patient distress by nurses in the hospital record following RRT deployment was less than one-half of that recorded in the pre-RRT period (26% vs. 62%; $P = 0.0001$). A chaplain visited post-RRT patients in the 24 hours prior to death more frequently than in the pre-RRT period (72% vs. 60%; $P = 0.02$). The frequency of family at the bedside was similar between epochs (61% post-RRT vs. 58% pre-RRT; $P = 0.6$). These findings were consistent across common primary diagnoses and origins (home vs. nursing home).

Adjusting for age, gender, and race, the odds ratio (OR) of patients receiving formal end-of-life medical orders in post-RRT was 2.5 that of pre-RRT (95% confidence interval [CI], 1.7-3.8), and odds of receiving opioids prior to death were nearly 3 times pre-RRT (OR, 2.8; 95% CI, 1.9-4.3). The odds of written mention of post-RRT patients' suffering in the medical record was less than one-fourth that of pre-RRT patients (OR, 0.23; 95% CI, 0.2-0.4).

To examine whether temporal trends might account for observed differences, patients in the post-RRT period who received RRT care were compared to those who did not. Sixty-one patients died with RRT assessments, whereas 136 died without RRT evaluations. End-of-life care outcomes were similar for these 2 groups, except more patients with RRT care had chaplain visits proximate to the time of death (80% vs. 68%; $P = 0.0001$; Table 2b). Outcomes (including comfort care orders, opioid administration, and suffering) of dying patients not cared for by the RRT (after deployment) were superior to those of pre-RRT dying patients (Table 2c).

Discussion

This pilot study hypothesizes that our RRT impacted patients' QOD. Deployment of the RRT in our hospital was associated with improvement in both symptom and psycho-spiritual domains of care. Theoretically, RRTs should improve quality-of-care via early identification/reversal of

TABLE 2. End-of-Life Care Outcomes

a. Prior to RRT vs. During RRT Deployment

	Pre-RRT (n = 197)	Post-RRT (n = 197)	P Value
Comfort care only	90 (46%)	133 (68%)	0.0001
Pain score (0-10)	3.7 ± 3.3	3.0 ± 3.5	0.045
Opioids administered	84 (43%)	134 (68%)	0.0001
Subjective suffering	122 (62%)	52 (26%)	0.0001
Family present	115 (58%)	120 (61%)	0.6
Chaplain present	119 (60%)	142 (72%)	0.02

b. During RRT Deployment: Those Dying with RRT Assessment vs. Those Dying Without

	Post-RRT RRT Care (n = 61)	Post-RRT No RRT Care (n = 136)	P Value
Comfort care only	46 (75%)	87 (64%)	0.1
Pain score (0-10)	3.0 ± 3.5	3.0 ± 3.5	0.9
Opioids administered	42 (69%)	92 (67%)	0.8
Subjective suffering	18 (29%)	34 (25%)	0.9
Family present	43 (71%)	77 (57%)	0.06
Chaplain present	49 (80%)	93 (68%)	0.0001

c. Comparing Before and During RRT Deployment: Those Dying Without RRT Assessment

	Pre-RRT (n = 197)	Post-RRT No RRT Care (n = 136)	P Value
Comfort care (only)	90 (46%)	87 (64%)	0.0001
Pain score (0-10)	3.7 ± 3.3	3.0 ± 3.5	0.06
Opioids administered	84 (43%)	92 (67%)	0.0001
Subjective suffering	122 (62%)	34 (25%)	0.0001
Family present	115 (58%)	77 (56.6%)	0.8
Chaplain present	119 (60)	74 (54.4%)	0.2

physiologic decompensation. By either reversing acute diatheses with an expeditious trial of therapy or failing to reverse with early actuation of palliative therapies, the duration and magnitude of human suffering should be reduced. Attenuation of both duration and magnitude of suffering is the ultimate goal of both restorative and palliative care and is as important an outcome as mortality or length of stay. Previous studies of RRTs have focused on efficacy in reversing the decompensation: preventing cardiopulmonary arrest, avoiding the need for invasive, expensive, labor-intensive interventions. Our RRT, like others, had no demonstrable impact on restorative outcomes. However, deployment of the RRT was highly associated with improved QOD of our patients. The impact was significant across WHO-specified domains: pain scores decreased by 19%; (documentation of) patients' distress decreased by 50%; and chaplains' visits were more often documented in the 24 hours prior to death. These relationships held across common disease diagnoses, so the association is unlikely to be spurious.

Outcomes were similarly improved in patients who did not receive RRT care in the post-RRT epoch. Our hospital did not have a palliative care service in either time period.

No new educational efforts among physicians or nurses accounted for this observation. While it is possible that temporal effects accounted for our observation, an equally plausible explanation is that staff observed RRT interventions and applied them to dying patients not seen by the RRT. Our hospital educated caregivers regarding the RRT triggers, and simply making hospital personnel more vigilant for signs of suffering and/or observing the RRT approach may have contributed to enhanced end-of-life care for non-RRT patients.

There are a number of limitations in this study. First, the sample size was relatively small compared to other published studies,[2-11] promoting the possibility that either epoch was not representative of pre-RRT and post-RRT parent populations. Another weakness is that QOD was measured using surrogate endpoints. The dead cannot be interviewed to definitively examine QOD; indices of cardiopulmonary distress and psychosocial measures (eg, religious preparations, family involvement) are endpoints suggested by palliative care investigators[12,13] and the World Health Organization.[14] While some validated tools[17] and consensus measures[18] exist for critically ill patients, they do not readily apply to RRT patients. Retrospective records reviews raise the possibility of bias in extracting objective and subjective data. While we attempted to control for this by creating uniform a priori rules for data acquisition (ie, at what intervals and in which parts of the record they could be extracted), we cannot discount the possibility that bias affected the observed results. Finally, improvements in end-of-life care could have resulted from temporal trends. This retrospective study cannot prove a cause–effect relationship; a prospective randomized trial would be required to answer the question definitively. Based on the available data suggesting some benefit in restorative outcomes[2-8] and pressure from federal regulators to deploy RRTs regardless,[1] a retrospective cohort design may provide the only realistic means of addressing this question.

In conclusion, this is the first (pilot) study to examine end-of-life outcomes associated with deployment of an RRT. While the limitations of these observations preclude firm conclusions, the plausibility of the hypothesis, coupled with our observations, suggests that this is a fertile area for future research. While RRTs may enhance restorative outcomes, to the extent that they hasten identification of candidates for palliative end-of-life-care, before administration of invasive modalities that some patients do not want, these teams may simultaneously serve patients and reduce hospital resource utilization.

Addendum

Prior to publication, a contemporaneous study was published that concluded: "These findings suggest that rapid response teams may not be decreasing code rates as much as catalyzing a compassionate dialogue of end-of-life care among terminally ill patients. This ability to improve end-of-life care may be an important benefit of rapid response teams, particularly given the difficulties in prior trials to increase rates of DNR status among seriously ill inpatients and potential decreases in resource use." Chan PS, Khalid A, Longmore LS, Berg RA, Midhail Kosiborod M, Spertus JA. Hospital-wide code rates and mortality before and after implementation of a rapid response team. *JAMA* 2008;300: 2506–2513.

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