

Improving the Utilization of Medical Crisis Teams (Condition C) at an Urban Tertiary Care Hospital

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Purpose: Serious clinical deterioration precedes most cardiopulmonary arrests, and there is evidence that organized responses to this deterioration may prevent a substantial proportion of in-hospital deaths. We aimed to increase the utilization of our medical crisis response team (Condition C) to impact this source of mortality.

Methods: We have examined the change in numbers of Condition Cs and the main alternative response strategy (sequential stat pages) after the implementation of 4 strategies to increase Condition C utilization: (1) immediate reviews of all sequential STAT pages, (2) feedback to caregivers responsible for delays in Condition C activation, (3) creation of objective criteria for invoking a crisis response, and (4) dissemination of objective criteria through posting in units, e-mail, and in-service oral presentations.

APPROXIMATELY ONE HALF of in-hospital deaths and more than one half of in-hospital cardiopulmonary arrests are preceded by a period of clinical deterioration lasting several hours.¹⁻⁷ The creation of teams of health professionals that can be assembled immediately in response to inpatient crises has been associated with significant decreases in overall inpatient mortality and cardiopulmonary arrest incidence.^{8,9} Despite these benefits, many hospitals do not employ a medical emergency team or any other organized response for the management of evolving life-threatening crises. Instead, disorganized responses are used such as stat paging, in which caregivers use the paging system to seek out the help of a more experienced physician or a specialized consultant. Evidence that it is often an unsuccessful mechanism lies in the frequent need to place a rapid series of stat pages to recruit more expert assistance to the bedside.

At our medical center, a medical emergency team (Condition C) has been in place since 1989, but it was underused until 1999, when we began to implement various institutional changes in an attempt to increase its use. We report our experience with the particular interventions and the associated changes in measures of use, in particular numbers of organized responses (Condition C), and disorganized responses (sequential stat pages) to medical crises.

Results: Over a 3-year period, interventions were followed by increased use of organized responses to medical crises (Condition Cs) and decreased numbers of disorganized responses (sequential STAT pages). The interventions that involved objective definition and dissemination of criteria for initiating the Condition C response were followed by 19.2 more Condition Cs monthly (95% confidence interval [CI], 12.1-26.3; $P < .0001$) and 5.7 fewer sequential STAT pages monthly (95% CI, 3.2-8.2). The interventions that involved giving feedback to medical personnel based on review of their care were not associated with changes in the measures.

Conclusion: Utilization of an important patient safety measure may be increased by focused interventions at an urban tertiary care hospital.

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METHODS

Setting

This experience is part of a larger, ongoing patient safety and quality improvement effort at the University of Pittsburgh Medical Center (UPMC) designed to: (1) improve responses to medical crises and (2) investigate medical crises to uncover and remediate processes of care that may have contributed.

UPMC Presbyterian University Hospital (UPMC-P) is a tertiary care, university hospital complex with 567 licensed beds, with 116 critical care beds in 11 intensive care units. There are no pediatric, obstetric, or gynecology services. The service responsibility of the medical crisis response team includes 4 hospitals, on 4 adjacent city blocks, with their connecting bridges and tunnels: UPMC-P, UPMC Montefiore University Hospital,

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UPMC Eye and Ear Institute, and Western Psychiatric Institute and Clinic. Also included are rehabilitation and skilled nursing care units with an additional 50 beds. The team also serves a medical school building and several ambulatory care centers.

Definitions

Condition A (Arrest): A situation wherein an individual has undetectable circulation or respiration (cardiopulmonary arrest).

Condition C (Crisis): Any other medical crisis in which the immediately available resources are deemed to be insufficient to manage such crisis. For example, responders from different disciplines or more experienced medical staff may be needed. The specific criteria for a Condition C are listed in Table 1. Examples include seizure, acute mental status changes, chest pain, respiratory distress, severe hypotension or hypertension, and falls with associated trauma. These specific criteria were created during a process improvement initiative to improve recognition of crisis situations in 2001. Both Conditions A and C are triggered by calling a crisis number that is posted on all telephones in the medical campus. Hospital operators answer the crisis phone on the first ring.

Conditions C (and A) Response Team: Designated multidisciplinary team of experienced clinicians and equipment that create a virtual mobile intensive care unit (Table 2). The response teams are under the governance of the Medical Emergency Response Improvement Committee of the Medical Executive Committee.

Stat Page: An electronic page together with an overhead speaker announcement placed by the hospital operator, on the request of hospital staff, to summon the immediate response of either a specific individual (eg, Dr. Jones) or a class of professionals (eg, Respiratory Care). Stat pages are initiated by calling the operator (dialing 0).

Sequential stat Pages (SSPs): Any sequence of more than one stat page requesting assistance in the same location within 10 minutes of each other.

Crisis Response and Event Tracking

When a Condition A or C is called to the operator, the operator records the location and type of condition, simultaneously activates all the condition team pagers, and announces the condition type

Table 1. Criteria For Initiating Condition C

Respiratory
Rate <8 or >36
New-onset difficulty breathing
New pulse oximeter reading less than 85% for more than 5 min (unless patient is known to have chronic hypoxemia)
Heart rate
<40 or >140 with new symptoms; or any rate >160
Blood pressure
Systolic <80 or >200
Diastolic >110 with symptoms (neurologic change, chest pain, difficulty breathing)
Acute neurologic change
Acute loss of consciousness
New-onset lethargy or difficulty waking
Sudden collapse
Seizure (outside of seizure monitoring unit)
Sudden loss of movement (or weakness) of face, arm, or leg
Other
Multiple stat pages required to assemble the team needed to respond to a crisis
Patient complaint of (cardiac) chest pain (unresponsive to nitroglycerine, or doctor unavailable)
Color change (of patient or extremity): pale, dusky, gray, or blue
Unexplained agitation for more than 10 min
Suicide attempt
Uncontrolled bleeding
Bleeding into airway
Naloxone use without immediate response
Trauma, chest pain, or stroke (outside emergency department)

NOTE: Any person may initiate a Condition C team response any time a rapid response by critical care professionals is desired. Condition C team responses should be used to prevent crises, or to prevent crises from escalating. These guidelines are intended to assist in decision making by describing criteria for situations in which it is reasonable to initiate a Condition C team response. These criteria attempt to meet the needs of most patients in most circumstances. The ultimate judgment for initiating a Condition C must be made by the bedside clinician in light of the circumstances specific to that situation.

and location twice on overhead loudspeakers throughout the complex. Responders and equipment designated for that geographic site respond, usually within 90 seconds based on mock code testing. Later, the operators call the unit to obtain patient identifiers. This data is sent daily by e-mail to the Condition Review Subcommittee (the authors of this article, except M.M.B.) of the Patient Safety Committee. This subcommittee reviews the circumstances leading up to the crisis.

Table 2. Condition C Response Team Roles and Goals

Team Member	Role	Goals
ICU Physician*	Team leader	Direct team efforts; decision making
Anesthesia or Critical Care	Airway manager	Assure oxygenation and ventilation
Respiratory Care	Airway assistant	Oxygen supply, suction, respiratory equipment
Physician	Procedure physician	Perform required procedures: obtain arterial blood for analysis, thoracostomy, and central venous access
Physician	Chest compressions	Assess circulation, deliver chest compressions
ICU Nurse	Runs medication/equipment cart	Prepare medications, equipment, defibrillator for delivery to patient
ICU Nurse	Recorder	Coordinate data flow: record events, laboratory tests sent, obtain results, other data as required
Floor Nurse	Bedside nursing	Deliver medications, obtain vital signs, verify intravenous function

*A Critical Care Medicine attending faculty member is on call within the hospital at all times.
Abbreviation: ICU, intensive care unit.

Implementation

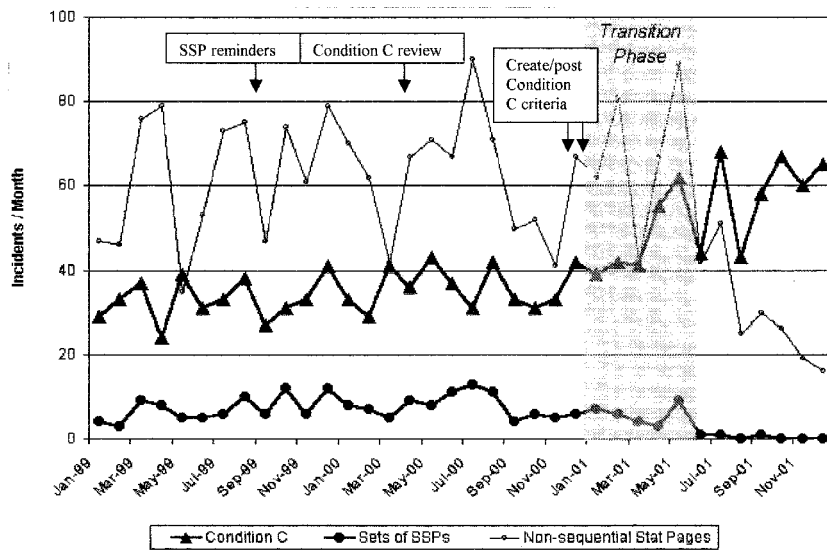
The Condition A response system has been in place for more than 30 years. The Condition C system was first implemented at UPMC-P in 1989 to prevent arrests of patients in transport to critical care areas. In 1999, efforts to increase the use of Condition C were initiated. The timeline of important Condition C related interventions are listed later and noted in the Figure 1 legend. Four key interventions that occurred at the time of this review were:

1. Immediate reviews of all sequential stat pages, with an e-mail reminder to unit directors to use a Condition C team response whenever sequential stat pages occurred (September 1999 to present).
2. Feedback to caregivers responsible for delays

in Condition C activation or other urgent treatments (April 2000 to present). This feedback was not only given to the physicians and hospital staff involved in the crisis patient's direct care, but also was shared with unit directors with the goal of ensuring a departmental as well as an individual improvement.

3. Creation of objective criteria for invoking a team crisis response (ie, a Condition C) (December 2000).
4. Dissemination of objective criteria through posting in units, e-mail, and in-service oral presentations (December 2000 to February 2001). E-mail reminders were brief, indicated the date and time of the event, were sent from the Chair of the Medical Emergency Response Improvement Committee to the medical or nursing di-

Fig 1. The monthly incidents of Conditions C, nonsequential stat pages, and sets of SSPs. E-mail reminders to use Condition C response instead of SSP were begun in September 1999. April 2000, Condition A and C case reviews were begun. Condition C Criteria were created and posted December 2000. The transition phase (gray) was from January 2001 through July of the same year (6 mo), during which staff were educated.



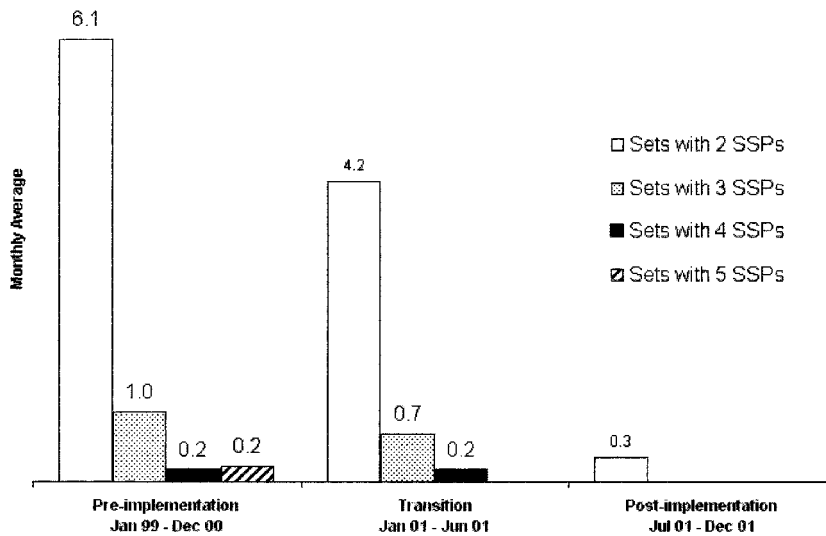


Fig 2. Frequencies of SSPs/set. There were 211 sets, containing 474 SSPs. SSPs occurred in sets of 2, 3, 4, or 5, with an average of 2.25 SSPs per set.

rector of the unit involved in the SSP. In-service presentations were given by nursing unit directors to their staff. Similar presentations were given to housestaff at specialty noon conferences.

Data Collection

The hospital operators maintain logs of every condition and stat page called to them. For stat pages and Conditions A and C, they record the location, type of page requested (stat, Condition A, or Condition C), the date and time, and the telephone extension it was called from. For stat pages, the operators record the paged party's name or function. For Conditions A and C, the operators record the patient's name and medical record number. We reviewed the operators' logs for the 3-year period from January 1999 through December 2001 and entered all Condition C and stat paging data into separate databases.

Statistical Analysis

A linear regression model was constructed to compare the number of Condition C events before versus after the introduction of each of the 4 interventions. The independent variables consisted of separate design variables for each of the 4 interventions (1 for times after the intervention was implemented, and 0 before the time of implementation). The dependent variable was the monthly incidence of Condition Cs (number of events per month per 1,000 admissions). Changes in the num-

ber of sequential stat pages were analyzed in a similar fashion.

Incidence rates of crisis events, cardiopulmonary arrests, and crises with fatal outcomes were compared before versus after the increase in Condition C use that occurred between January and June of 2000 (after the construction and dissemination of objective criteria). To compare these incidence rates, the 2-sample inference test for incidence rate data was used. Last, the correlation coefficient between Condition C and sequential stat page incidences were determined to test their interdependence.

RESULTS

Over a 3-year period, interventions increased the use of organized responses to medical crises (Condition C) and decreased the number of disorganized responses (sequential stat pages).

Effects of Particular Initiatives to Improve Use of Condition C

Between January 1999 and December 2001, there were 1,471 Condition Cs and 474 SSPs in 211 sets. Four main initiatives were undertaken during this time to increase use of Condition Cs: (1) immediate review of all sequential stat pages (September 1999), (2) feedback to caregivers responsible for delays in Condition C activation (April 2000), (3) creation of objective criteria for Condition C (December 2000), and (4) dissemination of objective criteria (December 2000). Figures

1 and 2 show the changes in Condition C and SSP use over this time period. Before any interventions, the monthly average of Condition Cs was 32.3 (95% confidence interval [CI], 27.0-37.7) and the monthly average of sequential stat pages was 6.2 (95% CI, 4.3-8.1). Immediate review of sequential stat pages was not followed by a significant change in either the number of Condition Cs (2.5; 95% CI, -5.5 to 10.6) or the number of sequential stat pages (2.2; 95% CI, -0.7 to 5.0). Feedback to caregivers also was not followed by any statistically significant change in the number of Condition Cs (1.6; 95% CI, -6.6 to 9.9) or the number of sequential stat pages (-0.4; 95% CI, -3.4 to 2.5). However, creation of objective criteria and dissemination of objective criteria were followed by statistically significant changes in both the number of Condition Cs and the number of sequential stat pages. Because these 2 initiatives were adopted simultaneously, it is impossible to distinguish what proportion of effect was attributable to each separate intervention. Nonetheless, after their implementation, the number of Condition Cs per month increased by 19.2 (95% CI, 12.1-26.3; $P < .0001$) and the number of sequential stat pages decreased by 5.7 (95% CI, 3.2-8.2; $P < .0001$). There was a statistically significant inverse correlation between the number of Condition Cs and the number of sequential stat pages called (correlation, $-.52$; $P = .0011$).

Correlation of Increased Condition C Use With Clinical Outcomes

Comparing the time period after the use of Condition C had increased (after January 2001) to the time period before the increase began (before July 2000), the incidence of fatal cardiopulmonary arrests decreased from 4.3 to 2.2 per 1,000 admissions ($P < .0001$) (DeVita et al, personal communication). The overall incidence of cardiopulmonary arrests also declined from 6.0 to 5.2 per 1,000 admissions, but this decrease did not reach statistical significance.

Characteristics of Sequential Stat Pages

Forty-five percent of the sets occurred in the first shift (7 AM - 3 PM), 36.5% in the second shift (3 PM - 11 PM), and 18.5% in the third shift (11 PM - 7 AM). Of the 211 sets of sequential stat pages, 146 (69.2%) contained pages for specified physicians, whereas 125 (59.2%) contained pages for generic

Table 3. The Number of Sets of SSPS In Which Each Class of Professionals Was Summoned

	N (% of All Sets)
Specified physicians	146 (69.2)
Generic intended responders	125 (59.2)
Respiratory care*	40 (19)
Critical care medicine fellow*	33 (15.6)
Anesthesia*	28 (13.3)
Electrocardiograph*	13 (6.2)
Resident or moonlighter*	12 (5.7)
Chest pain team*	9 (4.3)
Radiology*	8 (3.8)

NOTE: Other services were summoned less frequently.
*Generic intended responders.

intended responders (Table 3). Fifty-nine (28%) sets contained repeated pages for the same intended responder. The average time between the first and the last pages in all the audited sets of sequential stat pages was 3.88 minutes (95% CI, 3.35-4.41). In sets containing repeated pages for the same intended responder, the average time between the first and the last repeated pages was 3.98 minutes (95% CI, 3.18-4.78).

DISCUSSION

At an urban tertiary care hospital, it was possible to increase the use of a medical emergency team (Condition C at our institution) through institutional interventions. Before these interventions, in our hospital (as in most hospitals in the United States), stat paging was commonly used to immediately summon additional caregivers to the patient's bedside during medical crises (eg, more experienced nurses, a physician, a respiratory therapist, and so forth). In many cases, especially when multiple caregivers were desired to attend to the situation, this created an ad hoc crises response team that was neither organized nor rapidly assembled. We attempted to change this pattern. Two interventions involved specific feedback to caregivers after a peer-review mechanism established that their patients would have benefited from Condition C activation. These were not followed by an increase in use. In contrast, 2 interventions involved objective definition of the circumstances under which it was appropriate to activate the medical emergency team. These were followed by an increase in its use. In addition to increasing the use of Condition Cs, our interventions decreased the use of the alternative response to medical crises, sequential stat pages. Furthermore, after the

use of Condition Cs increased, the incidence of fatal cardiopulmonary arrests decreased. Our findings replicate the findings of several Australian teams^{8,10-13} at a university medical center in the United States, and have further described what we feel to be important contributors to that success.

Why were Condition Cs not called more reliably before creation and dissemination of objective criteria? Potential barriers to triggering a Condition C response included beliefs that help is not needed and that the person triggering the response would be criticized for using it inappropriately. Even after setting up a medical emergency team (MET) and educating nurses about the indications for invoking it, Daffurn et al¹⁴ found that nurses did not have complete awareness regarding what type of emergency ought to trigger a MET. In their survey, nurses would call a MET only 2.8% of the time that it was indicated, usually opting instead for calling a house officer. Buist et al⁷ reported that caregivers depended in such situations on their own skill and judgment, which varied considerably and resulted in unstructured and poorly standardized approaches. Daly et al¹⁵ has shown that creating criteria improves the likelihood of calling a team response. However, their criteria included severe respiratory distress, rapidly deteriorating blood pressure, and deteriorating conscious state. Because each of these criteria is open to interpretation (eg, some observers might conclude a respiratory rate of 26 constitutes severe respiratory distress, whereas others might require a rate of over 32 with nasal flaring), we believe that they contain ambiguity that may result in failure to activate the team response appropriately and reliably. We agree with Parr et al¹⁶ that objective criteria are more helpful for clinicians to identify deteriorating patients. In December 2000, we independently created criteria based on objective physiologic parameters that are not subject to ambiguity. This approach prevents variable interpretation of what is a crisis, and when help should be sought.

In our initial quality reviews, we identified that the team response was implemented sporadically, and crisis situations were preceded by delays in bringing and implementing needed treatments. Therefore, the Patient Safety Committee decided to create institutional interventions to identify crisis situations more reliably and to break down cultural barriers that had discouraged its use. On the basis of our data, we speculated that barriers were weak-

ened by the adoption of objective criteria, and by the subsequent affirmation of those criteria by leaders in nursing and medical staff. The steps comprising our successful interventions were 3-fold. (1) We created objective criteria based on review of crises. These criteria were, in part, informed by our review of all medical crises in our institution (eg, bleeding into an airway was not in the original criteria, but was added when our reviews identified this as a pattern). We believe that by separately designating, and posting, objective criteria that define a crisis, nurses and other caregivers are more likely to identify patients in crises. They are also more likely to trigger a crisis response. Furthermore, when patients meet the criteria, criticism of the caregivers triggering the Condition C response cannot be expressed legitimately. (2) We disseminated these criteria by educating the medical and nursing leadership, who in turn supported and fostered the program. We believe their support arose from their new awareness that delayed recognition of and response to crises occurred, and could be prevented through this mechanism. They were convinced that their patients would be better served by a rapid, expert response. (3) We also disseminated the criteria by educating the staff directly. For example, in addition to the leadership presentations, by the beginning of January 2001, these criteria were posted in every nursing unit and mailed to every faculty and trainee physician.

An organized response to medical crises has many evident advantages when compared with stat paging (Table 4). Calls to place stat pages do not receive any prioritization by the operators because there is not a dedicated telephone number to dial. In addition, multiple telephone calls are required to assemble in piecemeal fashion a response team by stat paging. The average time between the first and the last pages in the sets of sequential stat pages was almost 4 minutes; in contrast, a Condition C simultaneously activates everyone and everything required for a crisis response (average response time, 90 seconds). Furthermore, unlike activating a Condition C, stat paging does not guarantee a response, in part because more than half are pages for generic intended responders—unspecified individuals who were called by their service or function (eg, General Surgery Resident or Respiratory Care). This is a faulty response mechanism because the responsibility for action is ambiguous.

Table 4. The Advantages of the Condition C System Over Sequential Stat Paging in Summoning a Crisis Response Team

Sequential Stat Paging	Condition C
No dedicated telephone number	Dedicated telephone number
Calls go into paging queue	Operators answer on the first ring
More than one page is required	One page activates all responders and resources
The person summoned might not be the best-qualified responder	Summons best-qualified responders; trained and skilled in managing crises
Individual responses	Orchestrated team response
Not coordinated	Predefined and rehearsed roles and goals
Response is not guaranteed because intended responders may be unavailable	Guaranteed response by team
Secondary responders not summoned until failure of initial page recognized	All team members respond simultaneously
Intended responders may not be close to, or familiar with, crisis location	Responsibility areas designated within teams' immediate reach
Piecemeal access to expertise and equipment	Predetermined team and equipment
Tracking and documenting crises difficult	Condition criteria facilitates recognition of crisis patients and promotes investigating antecedent events

Each member of the summoned group may assume that another member will be responding to the stat page. Alternatively, many members of that discipline may respond, unnecessarily pulling staff away from other responsibilities.

There are limitations to this retrospective analysis of historically controlled but prospectively collected data. Our data, as well as data from other centers, were recorded during quality improvement initiatives rather than randomized clinical trials. Therefore, we can only suggest an association with improved clinical outcomes rather than show causality. Our study occurred at one medical center, and our results may not be generalizable to institutions with different resources or cultures. It is impossible to assess the individual contributions of the 2 interventions that were followed by increased Condition C use (development and dissemination of objective criteria). Last, it is difficult to exclude the possibility that there were interactions between the first 2 interventions (feedback after sequential stat page use or delays in Condition C activation), which were not followed by increased use, and the last 2 interventions, which were. For example, the

first 2 interventions may have created an atmosphere more amenable to change so that when the criteria were posted the staff were ready to implement the Condition C process. We e-mailed participants in sequential stat page sets the same day to remind them about the benefits of Condition C. (All clinicians here are on the same e-mail system, making immediate feedback possible). We also e-mailed them regarding delays in triggering an emergency team response within a week or two of the event. The immediacy and repetitive nature of the feedback probably raised awareness of the problem even though it did not alter behavior.

CONCLUSION

Our report focuses on the methodology used to foster behavior change. The rationales for the change are presented and focus on providing a more reliable and expert response to patient crisis. We show that a hospital can change recognition of and response to crisis. We suggest, but do not show, that the change desired may improve outcome.

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