Original Article

Blue code: Is it a real emergency?

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BACKGROUND: Cardiac arrests in hospital areas are common, and hospitals have rapid response teams or "blue code teams" to reduce preventable in-hospital deaths. Education about the rapid response team has been provided in all hospitals in Turkey, but true "blue code" activation is rare, and it is abused by medical personnel in practice. This study aimed to determine the cases of wrong blue codes and reasons of misuse.

METHODS: This retrospective study analyzed the blue code reports issued by our hospital between January 1 and June 1 2012. A total of 89 "blue code" activations were recorded in 5 months. A "blue code" was defined as any patient with an unexpected cardiac or respiratory arrest requiring resuscitation and activation of a hospital alert. Adherence to this definition, each physician classified their collected activation forms as either a true or a wrong code. Then, patient data entered a database (Microsoft Excel 2007 software) which was pooled for analysis. The data were analyzed by using frequencies and the Chi-square test on SPSSv16.0.

RESULTS: The patients were diagnosed with cardiopulmonary arrest (8), change in mental status (18), presyncope (11), chest pain (12), conversive disorder (18), and worry of the staff for the patient (22). Code activation was done by physicians in 76% of the patients; the most common reason for blue code was concern of staff for the patient.

CONCLUSION: The findings of this study show that more research is needed to establish the overall effectiveness and optimal implementation of blue code teams.

KEY WORDS: Blue code; Code activation; Hospital arrest

INTRODUCTION

Hospital emergency codes are used worldwide to alert staff for various emergency situations in hospitals. The use of codes is intended to convey essential information quickly with a minimum of misunderstanding to the hospital staff, while preventing stress or panic among visitors of the hospital.

"Blue code" is generally used to indicate a patient requiring resuscitation or otherwise in need of immediate medical attention, most often as the result of a respiratory or cardiac arrest. Each hospital, as a part of a disaster plan, sets a policy to determine which units provide personnel for code coverage. In theory, any medical professional may respond to a code, but in practice the team makeup is limited to those who had advanced cardiac life support or other equivalent resuscitation training. Frequently, physicians from anesthesia, emergency medicine and internal medicine are charged in the team. A rapid response team leader or a physician is responsible for directing the resuscitation effort and is said to "run the code".[1]

Cardiac arrest in hospital areas is common, and delayed treatment is associated with a lower survival rate.[2] In Turkey, hospitals have rapid response teams or "blue code teams" to reduce preventable in-hospital deaths. Although education about the blue code team program has been provided in all hospitals, true "blue code" activations are rare. Due to the lack of medical emergency teams (METs) in this country, it is thought that wrong blue code activations are given by medical

personnel in practice. This study aimed to explore the reasons of wrong blue code activations and also to ask if there is a need of another team as a MET to reduce blue code team efforts in hospitals.

METHODS
Study design and "blue code"
This study analyzed the "blue code" forms used between January 1 and June 1, 2012 in our hospital. The hospital moved to a new localization at the beginning of 2011 and currently it deals with approximately 72 000 patients per month. The hospital has a rapid response team composed of 2 experienced nurses and an emergency physician or an intensive care unit doctor to respond to all calls in all hospital areas except intensive care units and the emergency room. A "blue code" is defined as any patient with an unexpected cardiac or respiratory arrest requiring resuscitation and activation of a hospital-wide alert.

Cardiac arrest was defined as the cessation of cardiac mechanical activity as confirmed by lapse in circulation, which was determined by the absence of a palpable central pulse, unresponsiveness, and respiratory arrest defined as apnea. Education about the blue code team program had been provided through presentations to all hospital personnel including all doctors, nurses, and other auxiliary staff. All nursing staff strongly supported mandatory code blue training and believed that it would improve both patient outcome and their comfort in managing code blue situations. The first step of the "blue code activation" course program was finished at the end of 2011 (but it repeated regularly in 2012). All educational programs stated that blue code will be used only for cases of (cardiac) arrest. In other situations, the person who was at locality will take care for the patient. It was expected that all trained personnel would call only for instances of cardiac arrest. The instructions stated that if arrest is detected, the resuscitation protocol will begin immediately as stated in the AHA (American Heart Association) guidelines 2010, till the blue code team arrives to the locality.

In our hospital, any health staff (doctor, nurse or auxiliary staff like patient transporters, paramedics) gives an order for blue code by phone or directly to the security personnel for announcement. After the security personnel make the announcement, the local blue code team that is responsible for that region, runs to the scene. The maximum time of arrival was 2 minutes and 5 seconds in simulations.

Duration of the study
Between January 1 and June 1, 2012, the hospital's blue code reports were searched retrospectively and data were collected from the forms recorded. We noted the results of records only which had been filled completely. The forms of those that were incomplete or the blue code alarms which had been cancelled were excluded from the study. In the data there were demographics of the patients.

Statistical analysis
The data were recorded in a Microsoft Excel file and analyzed using the SPSS v16.0 statistics. The Chi-square test was used to analyze non-parametrical data.

Ethical issues
The Institutional Review Board of the hospital approved the study. The study was conducted in accordance with the principles of the *Declaration of Helsinki*.

RESULTS
In 94 blue code activations, 3 were excluded because of incomplete data and 2 were excluded because the blue code announcement was cancelled by a second announcement. Retrospective information was obtained on 89 activations. The median of the patients' ages was 68 years (range, 37–84 years). In this series, 58 (65.2%) were women and 31 (34.8%) men. The activations were finally diagnosed as cardiopulmonary arrest (8 patients, 9.0%), change in mental status (18, 20.2%), presyncope (11, 12.4%), chest pain (12, 13.5%), conversive disorder (18, 20.2%), and worry of staff about the patient (22, 24.7%). According to these results, 81 (91.0%) were wrong blue code activations in our hospital. The statistical analysis showed that the number of wrong activations for female patients were greater than for males ($P<0.001$). Blue code activations were done by doctors in 68 (76%) of all patients, rest by nurses and other hospital staff. The most common reasons for activation was worry about patient's clinical situation, pressure from patient's relatives because of the deterioration of conditions and need for help.

The most common places for blue code activations were the phlebotomy rooms and halls of outpatient clinics (68.5%, $n=61$). The rooms of inpatient clinics were next (31.5%, $n=28$), followed by invasive radiology clinics. There were significant statistical differences between the places of blue code activations (inpatient/outpatient clinics' rooms-halls) ($P=0.001$). Part of the alert system is the start of CPR. The percentage of CPR

delivered at arrival of the emergency team was 100% in 8 patients with cardiopulmonary arrest. In others, attempts were made to apply safety procedures for the patients.

The final diagnosis made by the team was cardiopulmonary arrest in all the 8 patients. Only 5 of the arrest patients were treated in the clinics. There was cerebrovascular accident as underlying disease in two of the patients; other patients were due to neutropenic fever, ileus, and aspiration pneumonia as underlying diseases. We knew nothing about the underlying diseases or the medical history of the others. Only one patient had anaphylactic shock produced by the contrast agent of tomography. Two of the 8 arrest activations were reported as acute myocardial infarction.

The overall response times after the completion of announcement were 105±10 seconds in our study. When we studied the outcome of activations, 6 of the 8 patients with cardiopulmonary arrests were sent to the intensive care unit, and 2 died at the locality. Twenty-eight patients were treated in wards, and others were sent to the emergency room. In these patients, only two were sent to the acute coronary unit and one was transferred to the ward with the diagnosis of acute gastrointestinal hemorrhage. Except these 3 patients, other patients who had been treated in the emergency room were discharged home.

DISCUSSION

This study on blue code emergencies shows that there are nonessential activations in our hospital. We found that although the optimal triggers for blue code team activation have been rigorously defined, they do not work in our hospital. The most common reasons of activations are worry about the clinical situation and pressure from relatives of patients because of the deterioration of their conditions and need for help. Another reason for wrong blue code activation may be crowding of our hospital (72 000 patients per month). Moreover the hospital staff do not have enough time for a detailed examination for each patient. When the blue code team arrives at the scene, the clinic's staff may take care of another patient. Also the isolation of wards from the patients' relatives is not possible in our hospital or elsewhere in Turkey. The agitation of the patient's relatives is suppressed when a new team arrives to take care of their patients only. The number of nurses and auxiliary staff are not enough in our hospital. The need for help in the wards or out-patient clinic corridors may be another reason for wrong blue code activation. In

our series, 6/8 of in-hospital patients with cardiac arrest survived. Thus CPR education was considered successful in the blue code team. The outcome of cardiac arrest and CPR is dependent on critical interventions such as early defibrillation, effective chest compressions, and assisted ventilation. In the past 50 years after the introduction of modern CPR, there have been great progresses in the performance of resuscitation. Despite considerable efforts made to improve the treatment of cardiac arrests, the reported survival rates are poor. Even in hospitalized patients, the rate of successful CPR is as low as 2%–6% although most studies reported a successful CPR rate of 13%–59%. Formal training of code blue team members enormously improved the skills of CPR teams and their level of competence in resuscitation.[3] Emergency response calls may be separated into blue code calls (cardiorespiratory arrests) and MET calls (physiologically acute changes in the patient's mental status, respiratory rate, heart rate, oxygenation, blood pressure, hypoxia, and chest pain).[4,5] It is impossible to reduce the number of patients in our country, but the number of the hospital staff and auxiliary staff must be increased so as to improve the conditions of the clinics. In addition, isolation of patients' relatives is also important. But it is hard to do because of the characteristics of the Turkish population and the lack of security personnel in hospitals.

In-hospital cardiac arrests are common and delayed treatment is associated with a lower survival rate and poor neurological outcomes. However, early recognition of "at-risk" situation is important for the safety of the patients.[6,7] But blue code alarms in response to the misused cases may demoralize the team, and the team could not respond to the alarm. Hence it is possible to set up an intermediate step called "confirmation step" between an initial blue code call and an activation of hospital-wide alert. For example, once an initial blue code call is received, a trained professional can reach the locality quickly to confirm the call qualified for a blue code activation before the emergency team is activated and reaches the patient. One disadvantage for this intermediate step is to scarify certain time for the response of the emergency team, but if it is practical it can help to exclude most of wrong blue code activations.

Improving the survival after in-hospital cardiac arrest requires an integrated set of coordinated actions that are described by the "chain of survival". The emergency team, which is a well-known tool for cardiac arrest is the first link in the chain of survival. It has been shown to have a positive effect in previously published

prospective, historically controlled studies. The presence of an emergency team can decrease the incidence of cardiac arrests in the general wards as well as the interruptions of ICU activities.[8]

The increasing use of an existing service to review patients meeting blue code criteria requires repeated education and a periodic assessment of site-specific obstacles to utilization. Simulation educational sessions increases responsiveness of the emergency team.[9] Although blue code team (BCT) has increasingly been adopted by hospitals, its effectiveness in reducing hospital mortality remains uncertain in Turkey. BCT is typically a multidisciplinary team of medical, and nursing staff, but standardization of the team members in all hospitals of Turkey are lacking.

Our study has several limitations because it is a single-center, retrospective, nonrandomized, observational study. The results of the study are unique to our hospital and our health care system. This study did not report outcomes instead of rates of diagnosis and hospital mortality of patients evaluated by BCT. The number of patients in whom no call to the alarm system was made could not be reported. We could not assess the effect of blue code on issues such as the satisfaction of the hospital staff, the prevention of in-hospital complications, and the cost-effectiveness of the process.

In conclusion, the findings in this study show that further study is needed to establish the overall effectiveness and the optimal implementation of blue code teams in Turkey. The need for emergency team may be interpreted, and the team can be used in local hospitals.

ACKNOWLEDGEMENTS

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