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***Clinical Research***

# Can Emergency Code Team (ECT) Activation be More Effective?

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**ABSTRACT**

**Objective:** The Emergency Code Team (ECT) system is activated under 'Code Blue' conditions in response to urgent cases. There are many factors affecting ECT activation, including transport to the scene and the intervention applied. Both the code-giving personnel and the responding emergency code teams' knowledge and experience are recognized as the two most important factors in this process. Unnecessary ECT activation wastes precious time and labour resources. For this reason, we analysed Code Blue calls and present the results herein.
**Material and Method:** This study was performed by examining hospital data between January 2012 and September 2014. After an intervention, the team completes an emergency code form, and the data for our study were collected from these forms. All data were classified by the research team, entered into computer media and analysed.
**Results:** The total number of Code Blue calls was 358. CPR was performed on 170 patients (47.5%), and 64 of these patients were declared exitus. The response time to the call was 1.75±0.769 min on average (1-5), and the longest response time, 5 minutes, took place in the outside of hospital and outpatient sections.
**Conclusion:** Unnecessary ECT activation is a waste of time and labour. Placing experienced staff where/when the unnecessary code activation is primarily performed as well as conducting repeated in-service training programmes may enable more accurate ACT activation and lower the post-CPR mortality rate.
***Keywords:*** *Code Blue, Emergency, Education.*

**ÖZET**

**Mavi Kod Aktivasyonu Daha Efektif Hale Getirilebilir mi?**
**Amaç:** Acil Kod Ekibi (AKE) 'mavi kod' çağrısıyla hastanelerde organize olan ve acil durum gerektiren hastalara anında müdahale eden bir organizasyondur. Ancak ekibin aktivasyonunu, olay mahalline intikalini ve devamında hastaya müdahale etme sürecini olumlu yada olumsuz etkileyen bir çok faktör bulunmaktadır. Gerek çağrıyı yapan gerekse müdahaleyi yapan personelin bilgi ve tecrübesi süreci etkileyen en önemli etken olarak karşımıza çıkmaktadır. Gereksiz Aktivasyonlar zaman ve işgücü kaybına neden olmaktadır. Bu nedenle kliniğimizde yapılan mavi kod çağrılarının analiz edilerek sonuçlarını vermeyi amaçladık.
**Gereç ve Yöntem:** Bu çalışma Kartal Koşuyolu Kalp Hastalıkları Merkezindeki Ocak 2012- Eylül 2014 tarihleri arasındaki hastane kayıtlarının incelenmesi ile yapılmıştır. Müdahale sonrası ekip acil kod çağrı formu doldurmakta ve bu form ile; çağrıların yapıldığı tarih ve zaman, olay mahali, AKE intikal süresi, hastaların klinik durumu ve yapılan müdahaleler elde edilmiştir. Tüm veriler araştırmacı ekip tarafından tasnif edilerek bilgisayar ortamına aktarılarak analiz edilmişlerdir.
**Bulgular:** Mavi kod çağrı sayısı toplam 358 dir. 170 hastaya (47.5%) CPR uygulanmıştır, 64 olgu exitus olmuştur. Çağrılara cevap süresi ortalama 1.75±0.769 dak. (1-5) olarak bulunmuştur. En uzun çağrıya cevap zamanı 5 dakika olmuştur ve çağrılar hastane binası dışındaki bölgeden ve poliklinik hizmet bölgesinden gelmiştir.
**Sonuç:** Gereksiz AKE aktivasyonları iş gücü ve zaman kaybına neden olmaktadır. Tecrübeli personelin gereksiz aktivasyon yapıldığı yerlerde ve saatlerde istihdam edilmesine ek olarak personele tekrarlı hizmet içi eğitim vermekle AKE aktivasyonlarını daha isabetli yapabilmekte ve CPR sonrası mortalite oranlarını düşürebilmektedir.
***Anahtar Sözcükler:*** Mavi Kod, Acil, Eğitim.

Code Blue is defined as any unexpected situation, such as cardiac arrest, respiratory arrest, loss of consciousness, and lack of pulse, occurring in any section of the hospital. All hospital personnel are informed of this definition at an in-service training programme. Activation of Code Blue can be initiated by a doctor, nurse or any other nearby health personnel. Code Blue activation must reach all locations within the hospital boundaries.

**Location**

All hospital sections are classified according to the following locations:

***Outside of wards*:** Patient registration and entrance hall, information centre, management and supportive service units.

***ER*:** Emergency room.

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***Outpatient*:** Polyclinic services, imaging centre, blood sampling, effort testing unit, and echocardiography laboratory.
***Ward*:** Wards in which patients are followed without monitoring.
***Cat lab*:** Catheterization laboratory.
***ICU*:** Intensive care unit.
***Outside of hospital*:** Garden, market and car park.
In addition, the operating room and cardiovascular surgery intensive care unit are located inside the units. The ECT is not activated for CPR in these sections.

**Activation of the team**

Emergency code calls can be made by any hospital staff witnessing the scene by calling the telephone operator and reporting 'Code Blue' as well as the location of the scene. The telephone operator declares Code Blue and states the location using the announcement system that can be heard from all hospital sections. The ECT includes one anaesthesiologist, one anaesthesia technician, one nurse and one security guard. Upon hearing the announcement, the team reports rapidly to the scene; other nearby health personnel can assist. The team both attends to the patient on the scene and transports the patient for further intervention.

**In-service training programme**

All hospital personnel receive annual in-service training organized by the quality department. All new staff members attend an in-hospital orientation programme. All personnel receive repeated CPR and Code Blue trainings annually. In addition, non-doctor health personnel also receive training for ECG and emergency case procedures. The distribution of the night shifts is arranged according to experience and achievement score on the training programme. At the end of the training programme, those with low achievement scores on the exam must repeat the programme.

**Data collection**

After the interventions, the team completes an emergency code form. The data for this study were collected from these forms. All data were classified by the research team and were entered into computer media and analysed. Data analysis was performed using SPSS for Windows, version 11.5 (SPSS Inc., Chicago, IL, United States). Data were presented as the number of cases and percentages. Nominal variables were evaluated using Pearson's chi-square or Fisher's exact test, where applicable. A p value less than 0.05 was considered statistically significant.

**Results**

The total number of Code Blue calls was 358. CPR was performed on 170 patients (47.5%), and 64 of these patients were declared exitus. The total exitus number was 73. Nine of the patients were not resuscitated; these were intubated, terminal stage patients in the intensive care unit. The response time to the call was 1.75±0.769 min on average (1-5), and the longest response time, 5 minutes, took place in the outside of hospital and outpatient sections. Arrhythmia, respiratory depression, and coronary ischaemia frequencies were statistically higher in patients on whom CPR was administered than for patients without CPR intervention (p<0.001). Frequencies of confusion, pulse weakness, and difficulty breathing were found to be statistically lower in the same group (p<0.001) (Table 1).

***Table 1.*** *Other clinical findings according to whether CPR was performed.*

| | CPR - (n=188) | CPR + (n=170) | p-value † |
|---|---|---|---|
| **Arrhythmia** | 26 (%13,8) | 100 (%58,8) | **<0,001** |
| **Respiratory Depression** | 46 (%24,5) | 143 (%84,1) | **<0,001** |
| **Arrhythmias** | 89 (%47,3) | 95 (%55,9) | 0,106 |
| **Coronary Ischaemia** | 12 (%6,4) | 67 (%39,4) | **<0,001** |
| **Consciousness** | 158 (%84,0) | 30 (%17,6) | **<0,001** |
| **Weak Pulse** | 186 (%98,9) | 79 (%46,5) | **<0,001** |
| **Difficulty Breathing** | 173 (%92,0) | 37 (%21,8) | **<0,001** |
| **IPR*** | 188 (%100,0) | 160 (%94,1) | **<0,001** |
| **Exitus** | 9 (%4,8) | 64 (%37,6) | **<0,001** |

† Pearson's chi-square, *Intervention with a positive response

When we examined the locations of Code Blue calls, most occurred in the ward section. The farthest section of the hospital was the car park, which showed the fewest ECT activations (two patients). Among patients who received CPR, compared to non-resuscitated patients, the frequencies of ward, ER, Cat lab and ICU activation were statistically higher (p=0.030; p=0.01; p<0.001 and p=0.003, respectively). Frequencies of activation outside of wards, in outpatient areas and outside of the hospital were significantly lower (p<0.001, p<0.001 and p=0.039, respectively) (Table 2).

***Table 2.*** *The distribution of patients according to the location of the groups with/without CPR.*

| Localization | CPR - (n=188) | CPR + (n=170) | p-value |
|---|---|---|---|
| **Outside of ward** | 24 (%12,8) | 2 (%1,2) | **<0,001**† |
| **ER** | 3 (%1,6) | 10 (%5,9) | **0,030**† |
| **Outpatient** | 48 (%25,5) | 6 (%3,5) | **<0,001**† |
| **Ward** | 91 (%48,4) | 105 (%61,8) | **0,011**† |
| **Cat lab** | 12 (%6,4) | 34 (%20,0) | **<0,001**† |
| **ICU** | 2 (%1,1) | 12 (%7,1) | **0,003**† |
| **Outside of hospital** | 8 (%4,3) | 1 (%0,6) | **0,039**‡ |

† Pearson's chi-square, ‡ Fisher's exact test.

In exitus patients, compared to surviving patients, frequencies of outside of ward and outpatient activation were statistically lower (p=0.030 and p=0.003, respectively), and the frequency of ECT activation in the ward section was statistically higher (p=0.034). There was no statistically significant difference among ER, Cat lab, ICU and outside of hospital activations

(p=0.151, p=0.070, p=0.744 and p=0.213, respectively) (Table 3).

***Table 3.*** *The distribution of patients according to the location of the groups of patients who survived or died.*

| Localization | Alive (n=285) | Exitus (n=73) | p-value |
|---|---|---|---|
| *Outside of ward* | 25 (%8,8) | 1 (%1,4) | **0,030**† |
| *ER* | 8 (%2,8) | 5 (%6,8) | 0,151‡ |
| *Outpatient* | 51 (%17,9) | 3 (%4,1) | **0,003**† |
| *Ward* | 148 (%51,9) | 48 (%65,8) | **0,034**† |
| *Cat lab* | 32 (%11,2) | 14 (%19,2) | 0,070† |
| *ICU* | 12 (%4,2) | 2 (%2,7) | 0,744‡ |
| *Outside of hospital* | 9 (%3,2) | 0 (%0,0) | 0,213‡ |

† Pearson's chi-square, ‡ Fisher's exact test

There was a statistically significant difference between resuscitated and non-resuscitated patients according to the distribution of the call time. In the resuscitated group, compared to non-resuscitated groups, the frequencies of calls between 00:00-03:59 and 04:00-07:59 were statistically higher and the frequency of calls between 08:00-11:59 was statistically lower (p=0.008, p=0.002 and p<0.001, respectively). For the time periods from 12:00-15:59, 16:00-19:59 and 20:00-23:59, there were no statistically significant differences in the frequency of calls (Table 4).

***Table 4.*** *The distribution of patients in terms of hours of calls according to the groups with/without CPR.*

| Call time | CPR - (n=188) | CPR + (n=170) | p-value † |
|---|---|---|---|
| *00:00-03:59* | 8 (%4,3) | 20 (%11,8) | **0,008** |
| *04:00-07:59* | 5 (%2,7) | 18 (%10,6) | **0,002** |
| *08:00-11:59* | 72 (%38,3) | 31 (%18,2) | **<0,001** |
| *12:00-15:59* | 62 (%33,0) | 43 (%25,3) | 0,111 |
| *16:00-19:59* | 25 (%13,3) | 34 (%20,0) | 0,088 |
| *20:00-23:59* | 16 (%8,5) | 24 (%14,1) | 0,093 |

† Pearson's chi-square, ‡ Fisher's exact test.

In the exitus group, compared to the surviving group, the frequency of emergency calls between 08:00 and 11:59 was statistically lower and the frequency of emergency calls was statistically higher between 20:00 and 23:59 (p=0.0042 and p=0.015, respectively). No statistically significant differences were observed between other time groups (Table 5).

***Table 5.*** *The distribution of patients in terms of hours of calls according to the groups of patients who survived or died.*

| Time | Alive (n=285) | Exitus (n=73) | p-value |
|---|---|---|---|
| *00:00-03:59* | 21 (%7,4) | 7 (%9,6) | 0,528† |
| *04:00-07:59* | 16 (%5,6) | 7 (%9,6) | 0,281‡ |
| *08:00-11:59* | 89 (%31,2) | 14 (%19,2) | **0,042**† |
| *12:00-15:59* | 86 (%30,2) | 19 (%26,0) | 0,487† |
| *16:00-19:59* | 47 (%16,5) | 12 (%16,4) | 0,991† |
| *20:00-23:59* | 26 (%9,1) | 14 (%19,2) | **0,015**† |

There was no statistically significant difference between resuscitated and non-resuscitated patients in terms of the distribution of days (p=0.704), seasons (p=0.091) or years (p=0.054). The exitus group, compared to the surviving group, included a larger number of patients in 2013 but a lower number in 2014 (p<0.001). No statistically significant difference was observed between groups in 2012 (p=0.541). In terms of the distribution according to days (p=0.114) and seasons (p=0.390), there was no statistically significant difference (Table 6).

***Table 6.*** *The distribution of cases in terms of season, year, and day according to the groups of patients who survived or died.*

| | Alive (n=285) | Exitus (n=73) | p-value |
|---|---|---|---|
| **Days** | | | 0,114† |
| *Monday* | 53 (%18,6) | 9 (%12,3) | |
| *Tuesday* | 45 (%15,8) | 20 (%27,4) | |
| *Wednesday* | 45 (%15,8) | 14 (%19,2) | |
| *Thursday* | 53 (%18,6) | 6 (%8,2) | |
| *Friday* | 37 (%13,0) | 11 (%15,1) | |
| *Saturday* | 28 (%9,8) | 6 (%8,2) | |
| *Sunday* | 24 (%8,4) | 7 (%9,6) | |
| **Seasons** | | | 0,390† |
| *Winter* | 81 (%28,4) | 18 (%24,7) | |
| *Spring* | 76 (%26,7) | 24 (%32,9) | |
| *Summer* | 78 (%27,4) | 23 (%31,5) | |
| *Autumn* | 50 (%17,5) | 8 (%11,0) | |
| **Years** | | | |
| *2012* | 87 (%30,5) | 25 (%34,2) | 0,541† |
| *2013* | 72 (%25,3) | 48 (%65,8) | **<0,001**† |
| *2014* | 126 (%44,2) | 0 (%0,0) | **<0,001**† |

† Pearson's chi-square, ‡ Fisher's exact test.

## DISCUSSION

For the success and effectiveness of the ECT, simply having well-educated team members is not sufficient; all hospital staff must be educated about Code Blue activation at in-service training programmes. The number of non-resuscitated patients after the activation of ECT was 188, and this number exemplifies unnecessary activation of the system. For 72 of these 188 patients, the code activation took place at outpatient and outside of ward sections. After the intervention, all these patients were stable and led to polyclinic control. It is also of interest that activation at these sections was mostly performed by non-doctor health personnel due to pulse weakness, respiratory distress, and loss of consciousness. In addition, patients in these sections did not constitute a hospitalized group, which is why in-service training of the non-doctor staff in these sections must be continuous. Additionally, by designing an emergency intervention room to be placed in proximity to these hospital sections, the patients can be taken to this room and examined, which may prevent unnecessary activation of the ECT. Eroğlu et al. (1) investigated unnecessary activation of the ECT and found that this situation demoralizes the team. Preoperative preparations are organized in polyclinics, and the patients are accepted to the wards after these preparations are completed in the cardiovascular surgery clinic. This is why hospitalization in the postoperative period is longer. Similarly, hospitalization after invasive interventions is longer in the cardiology clinic. Activation of the team that provides CPR generally takes place in wards that house this group of patients. Although it was not statistically significant, activation mostly occurred on the first days of the week; this period in particular is when patients who stay in the intensive care units over the weekend are sent to the wards. To prevent the activation of ECT in the wards, creation of an early warning control list as well as bedside monitoring of the patients who are at risk according to this list are thought to reduce unnecessary activation of the ECT (2-4). For the 48 patients in the exitus group (65.8%), activation occurred from the

wards, which highlights the importance of keeping the programme in the wards. When activation call time was examined, the 00:00-08:00 interval was the most intense period for CPR activation. Accurate ECT activation resulting in CPR is performed in this time interval by the experienced and educated on-duty personnel, while activation without CPR performed is performed more often in the daytime. These activations are mostly from ward and out of ward sections, respectively, and these latter patients may be visitors of patients or conversion cases. The effect of ECT activation in the hospital on the mortality rate is controversial (5, 6). Nevertheless, the basic question is how to render these activations more effective. All personnel are given in-service training about CPR and ECG annually, which is provided by the quality department. All staff members who fail the exam provided with the in-service training programme must repeat the course. Additionally, the personnel completing the in-service training CPR training programme is mandatory for all health personnel to attend at least once per year. The exitus rate increased in 2013, and no deaths were recorded after CPR intervention in 2014.

**Conclusion:** ECT activation is an effective and life-saving system. However, unnecessary activation results in a waste of time and labour. Keeping the experienced staff where/when unnecessary code activation primarily occurs and repeating in-service training programmes can lower the post-CPR mortality rate. In addition, increasing the number of ward visits at the most intense hospital sections and periods of code activation, early intervention for patients who are at risk according to the control checklist, and the use of scoring systems represents feasible solutions for lowering the number of ECT activations.

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