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How are Medical Emergency Team activations evolving? A cohort study at a university hospital.

David Sá Couto da Maia Romão

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Estudante:
David Sá Couto da Maia Romão
david.sa.couto@gmail.com
Mestrado Integrado em Medicina
Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto

Orientadora:
Dra. Irene Aragão
irenearagao.ucip@chporto.min-saude.pt
Docente Convidada do Mestrado Integrado em Medicina do Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto
Assistente Hospitalar Graduada de Anestesiologia e Medicina Intensiva, Unidade de Cuidados Intensivos Polivalente, Centro Hospitalar Universitário do Porto

Coorientadora:
Professora Doutora Teresa Maria da Costa Cardoso
cardoso.tmc@gmail.com
Professora Associada Convidada do Mestrado Integrado em Medicina do Instituto de Ciências Biomédicas Abel Salazar, Universidade do Porto
Assistente Hospitalar Graduada de Medicina Interna e Intensiva, Unidade de Cuidados Intensivos Polivalente, Centro Hospitalar Universitário do Porto

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Assinatura do estudante

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Assinatura da Coorientadora

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Resumo

Introdução e Objetivos: Os Sistemas de Resposta Rápida Intra-hospitalar têm como objetivo o reconhecimento do doente em agravamento, de acordo com um conjunto de critérios predefinidos, e a ativação de uma resposta expedita através de uma equipa de emergência. Devido à heterogeneidade das necessidades organizacionais de cada hospital, surgiram vários modelos, diferentes práticas e debate acerca da melhor abordagem neste contexto. A falta de consenso torna difícil a comparação, não se verificando, ainda, a existência de evidência suficiente que demonstre o seu impacto na segurança e sobrevivência dos doentes. O principal objetivo deste trabalho é caracterizar a estrutura organizacional de uma Equipa de Emergência Médica Intra-hospitalar, bem como a evolução das suas ativações nos últimos três anos.

Materiais e Métodos: Foi realizado um estudo observacional, longitudinal e retrospetivo num hospital terciário universitário com cerca de 600 camas. As características de cada ativação da Emergência Médica Intra-hospitalar entre Janeiro de 2016 e Dezembro de 2018 foram registadas. A evolução de cada variável e o seu efeito na mortalidade à alta hospitalar foram estudadas para as ativações dirigidas aos doentes internados.

Resultados: Foram analisadas 950 ativações, das quais 749 correspondem a doentes internados e, portanto, foram incluídas na análise. 55,9% das ativações foram para doentes do sexo masculino e a mediana (intervalo interquartil) da idade foi 75 (63 – 83) anos. 53,1% estavam localizados em enfermarias médicas. Durante o período de estudo, houve um aumento do número de ativações atingindo uma taxa de 14,3 ativações para doentes internados/1000 admissões hospitalares. 24,4% das ativações resultaram num aumento do nível de cuidados . Apenas 21,4% necessitaram de medidas de Suporte Avançado de Vida no local. A taxa de mortalidade foi de 18,4% no local e de 50,1% à alta hospitalar. Para além disso, houve um número reduzido de doentes que receberam uma ativação nas vinte e quatro horas após alta dos cuidados intensivos e intermédios: 1,2% e 1,07%, respetivamente.

Conclusões: Não se verificaram variações significativas nas variáveis estudadas ao longo do período de estudo, exceto o aumento das ativações dirigidas aos doentes cirúrgicos. Aproximadamente, uma em quatro ativações resultaram num aumento do nível de cuidados para unidade de cuidados intensivos/intermédios ou para o bloco operatório. Este dado realça a importância destes sistemas na identificação precoce de doentes em necessidade de cuidados de um nível superior. A idade, localização em enfermaria médica e uma maior gravidade estão associados a uma maior mortalidade, enquanto as ativações durante o verão estão relacionadas com uma maior sobrevivência dos doentes à alta hospitalar.

Abstract

Introduction and Objectives: Rapid Response Systems aim to recognize the deteriorating patient following a set of predefined criteria and trigger a prompt response through an emergency team. Due to the heterogeneity of the hospitals organizational needs, various models, different practices and debate about the best approach have appeared. Lack of consensus makes it difficult to establish comparison and there is not sufficient evidence yet to clearly define the impact these systems have on patient safety and survival. The main purpose of this paper is to characterize the organizational structure of a Medical Emergency Team system in a large tertiary university hospital and the evolution of its activations in the last three years.

Material and Methods: This was an observational, longitudinal and retrospective cohort study conducted at a university, tertiary care, 600-bed hospital. The characteristics of each activation between January 2016 and December 2018 were collected. The evolution of each variable and their effect on the mortality at hospital discharge was tested for the activations directed to inpatients.

Results: The study population was 950 activations of which 749 were directed to inpatients and, therefore, included in the analysis. 55.9% were for male patients and their median (interquartile range) age was 75 (63 – 83) years. 53,1% were located in medical wards. There was an overall increase in the activations in the study period, reaching a rate of 14,3 activations directed to inpatients/1000 admissions. 24,4% of the activations resulted in an escalation of care. Only 21,4% required Advanced Life Support measures at the scene. The mortality rate was 18,4% at the scene and 50,1% at hospital discharge. Also, there was a low number of patients who had an activation in the twenty-four hours after intensive and intermediate care units discharge: 1,2% and 1,07%, respectively.

Conclusions: There were no significative variations trends in the variables studied, except for a rise in activations towards surgical patients. Approximately, one in four activations resulted in escalation of care either to high dependency units or the operating room, which highlights the role of these systems as early identifiers in appropriate care escalation. Age, medical ward location and increased severity were associated with higher mortality, while summer season were linked to increased survival.

Keywords: Hospital Rapid Response Team, Medical Emergency Team, Intensive Care Units, Emergency Medicine, Life Support Care, Critical Care Outcomes.

Abreviation list

ALS – advanced life support
AU-ROC – area under receiver operating characteristics
CAT – cardiac arrest team
$CI_{95\%}$ – 95% confidence interval
HDU – high dependency unit
ICU – intensive care unit
IQR – interquartile range
MET – medical emergency team
OPR – operating room
OR – odds ratio
RRS – rapid response systems
SPSS – Statistical Package for the Social Sciences

Table of contents

Table list

Figure list

Introduction and objectives

Rapid Response Systems (RRS) became a crucial element in the hospital chain of patient care; their implementation was related to the increase in severity of hospitalised patients over the past decades. Patients in general wards are not continuously monitored and lack 24/7 medical assistance onsite. With an increase in the complexity of patients' conditions, it is inevitable that the risk of clinical deterioration of hospitalised patients rises as well.[1] RRS are composed by four main elements: an afferent limb, that aims to recognize the deteriorating patient following a set of predefined criteria and triggers a prompt response from an emergency team, the efferent limb; the responsibility of adequate resource management, and promotion of regular internal audits to improve its efficacy. Although there are studies that show an overall decrease in hospital mortality and cardiac arrest rate with the implementation of these systems, their effect on these outcome measures is still controversial.[2-5] Other outcome measures, such as mortality in the first twenty-four hours and unplanned intensive care unit admissions, are also being studied, but the heterogeneity of RRS models and hospitals' individual contexts makes it difficult to establish a consensual outcome and achieve reproducible results.

Ideally, efforts should be put on the prevention of reversible deteriorating clinical status. If this is not possible, the prompt recognition and the quickest and effective treatment are the crucial steps that influence the survival of the patient.[6] The acute deterioration, with clear impact on survival of the patients, is time-critical, arising over minutes or hours rather days or weeks.[7,8] This justifies not only the RRS itself, but also its integration as part of a broader medical philosophy of clinical daily practice.

The role of the emergency team, the efferent limb of this RRS, is to deliver the most effective and appropriate level of medical and nurse expertise to the acute deteriorating patient in the shortest time possible. Following the development of each hospital's own RRS to meet their particular needs, practices and resources, debate about the best model and standard measures has appeared.[6,9]

There are many organizational models described; the emergency teams are usually either nurse-led, intensivist-led, or physician-led (non-intensivist). The concept of Medical Emergency Team (MET) indicates that the action is led by a physician. However, it is not clear which model is related to a better outcome and overall survival of the patients.[3,10] Despite, an active participation by intensive care specialists and staff is important to ensure high standards of care for the critically ill, service delivery and integration of the needs of all patients, namely in the allocation of resources, inter and intra hospital transfers and on the escalation/limitation of care and on end-of-life decisions.[7]

Like in most European hospitals, in our hospital, although a tertiary care university hospital and trauma centre, only the emergency department, the high-dependency unit (HDU) and intensive care unit (ICU) have a 24/7 medical care. In 1994 a cardiac arrest team (CAT) was summoned, the first 24/7 CAT nationwide, with an ICU-based team. The main goal was to respond to cardiac arrest situations across the hospital, but it has evolved along with the concept of RRS to address the management of the clinically deteriorating patient. This motivated the change of the activation criteria to include a broader range of patients, becoming a MET in 2010 with an increasing number of activations, mainly for non-cardiac arrest situations.[11]

Nowadays, it is an ICU-based, intensivist-led MET composed by an ICU nurse, a resident and a consultant. The activation criteria are similar to others worldwide and are focused on critical physiological variables above or below certain thresholds (Table I), but also allowing activations triggered by more subjective criteria like "worried staff". The team is deployed by a dedicated internal telephone line to the ICU on a 24/7 basis.

The development of MET represents a cultural change, whereby there is an earlier recognition of severity and risk of deterioration, as well as a better capacity to determine when to ask for help and an earlier reference beyond the primary clinical team.

To make this concept of early recognition of the patient at risk of clinical deterioration and to prompt activation of expert help effective, there is a need for continuous health education of all involved in patient care. To ensure that, the institution has created a certified basic life support school, that includes a specific training concerning the identification of the patient at risk, as well as, the recognition of situations that should trigger the calling of expert help, applied to all healthcare professionals in the hospital.

RRS are resource demanding, requiring the deviation of clinical staff, meaning that inadequate resourcing of the MET may have an adverse impact on the quality of care of ICU patients.[12] In an era where resource management is particularly difficult, it has become a priority to establish trusted, positive impact measures allowing the best quality of care. Systems where we can find a high level of efficacy with a smart asset appointment are on great demand.

Management and planning studies have been conducted in healthcare systems with some common goals, focussing primarily on patient safety in correlation with the relative scarcity of resources. The optimal staffing structure, organizational layout and criteria for activation are not completely well-defined, that is considering the regional needs, institutional missions, clinical expertise and the hospital's human resources. This heterogeneity makes studies on MET activations and outcomes difficult to preform and compare.

The main purpose of this paper is to characterize the organizational structure of a well-established MET system in a large tertiary care university hospital and the evolution of the MET activations over the last three years, aiming to a more efficient allocation of human and logistic resources in the future, maximising the quality of care and patient safety.

Material and Methods

This was an observational, longitudinal and retrospective cohort study conducted at Hospital de Santo António, Centro Hospitalar Universitário do Porto, a university, tertiary care, 600-bed hospital in Porto, Portugal, between June 2018 and April 2019.

The study protocol was approved by the local Institutional Ethics Committee.

Hospital de Santo António is a public hospital that serves a population of approximately 600.000 people that reside in half of the city of Porto and half of the northern region of Portugal.

The studied population consisted of all adult patients admitted to the wards who had at least one MET activation.

The MET team is headquartered in a mixed 12-bed ICU and integrates one consultant, one resident and one nurse from the same unit. The MET can be activated for anyone within the hospital, in response to at least one of the pre-defined MET activation criteria in accordance to the ones established in the MERIT study[4] (Table I, Attachment 1).

In each MET activation it is mandatory to fill in a registration form (Attachment 2), containing most of the data analysed. We screened all MET activations between January 2016 and December 2018. All activations directed to outpatients were excluded. Complementary data was obtained through parallel MET records in the hospital electronic record system.

The variables collected from each MET activation were: age, gender, time and duration of the activation, patient severity, location (medical/surgical ward – Table II), discharge from ICU/HDU/ Operating Room (OPR) in the previous twenty-four hours, patient's immediate destination (same ward/ICU/HDU/OPR/deceased) and outcome at hospital discharge (discharge/deceased). The number of patients admitted in the hospital in each year of the study was also registered.

Activations were grouped in four severity categories regarding the first assessment by the MET: "Resuscitation", "Emergent", "Urgent" and "Non-urgent", according the criteria elicited on Table III.

Activations were categorized according to the time of the MET call: morning shift refers to the time interval between 08:00 and 13:59, the afternoon shift from 14:00 to 19:59, and the night shift from 20:00 to 07:59. We defined Saturdays and Sundays as weekend days, and the remaining days as weekdays (including holidays).

Although the study only included the analysis of the activations during the years of 2016, 2017 and 2018, for a better understanding of the behaviour of the number of activations, global data from 2012 onwards was also used.

Data were described with medians and inter-quartile ranges (IQR) because they showed a skewed distribution. Categorical variables were described with absolute frequencies and percentages.

Mann-Whitney-U tests were used to compare continuous variables. For categorical variables, these comparisons were performed using Kruskal-Wallis and Chi-square tests.

All variables potentially associated with hospital mortality were studied through logistic regression. Those with a clear association in the univariate analysis ($p < 0.1$) were included in the multivariable analysis. The results of the multivariable models are expressed as odds ratio (OR) with 95% confidence interval ($CI_{95\%}$) and p-values. The accuracy of the models was assessed by the area under receiver operating characteristics (AU-ROC) curve and calibration was tested using the Hosmer-Lemeshow goodness-of-fit test. The significance level was defined as $p < 0.05$.

Data were analysed using Statistical Package for the Social Sciences (SPSS) version 25 for Windows (SPSS Inc., Chicago, IL, USA).

Results

During the study years there were a total of 950 activations, of which 56 were excluded due to lack of data and 145 because they were outpatients (visitors, staff, students, among others), leaving 749 activations directed to inpatients, referring to 699 inpatients (Figure 1).

There were 14,1 (n=247), 13,4 (n=264), 13,2 (n=257), 14,1 (n=267), 15,6 (n=291), 17,7 (n=337) and 18,0 (n=322) MET activations/1000 hospital admissions in 2012, 2013, 2014, 2015, 2016, 2017 and 2018, respectively (Figure 2). Our analysis focused on the inpatient group and there were 11,8 (n=221), 14,3 (n=273) and 14,3 (n=255) MET activations directed to inpatients/1000 hospital admissions in 2016, 2017 and 2018, respectively (Figure 2).

Table IV lists the general characteristics of the MET activation cases. Patients of the 749 MET activations, had a median (IQR) age of 75 (63 – 83) years and 55.9% were male. MET activations were for medical wards in 53,1% of the cases; 38,3% occurred at night and 77% on weekdays. The activation rate during weekdays was 76,3/100 days and on weekends 55,7/100 days (p=0,003). The median (IQR) duration of intervention was 30 (20 – 43) minutes.

Only 21,4% of MET activations required advanced life support (ALS) at the scene and, after MET activation, 24,4% of patients needed an upgrade of care: 11,5% to ICU, 10,9% to the HDU and 2% to the OPR. The immediate mortality rate was 18,4% and hospital mortality rate was 50,1%. Immediate outcome is depicted in Figure 3. The percentage of activations for patients who have been discharged in the previous 24h from ICU or HDU were 1,2% and 1,07%, respectively, and for those submitted to surgery in the previous 24h it was 10,7%.

The percentage of activations to surgical ward patients increased from 36,7% in 2016, to 51,8% in 2018 (p=0,001). Between 2016 and 2018, there was an increase in MET activations for men from 50,2% in 2016 to 61,2% in 2018 (p=0,016).

On the univariate logistic regression analysis (Table V), age, gender, ward location, severity, season and surgery in the previous 24h were associated with hospital mortality. The multivariate logistic regression analysis (Table VI), retained age, ward location, severity and season as independently associated with hospital mortality. The AU-ROC curve (CI95%) for this model was 0,77 (0,74 – 0,80) (Figure 4).

When comparing characteristics of the activations during summer with other seasons we found that, in summer, only 12,2% (n=17) of the patients needed resuscitation in contrast with 26,1% (n=57) in winter, 22,1% (n=43) in autumn and 21,8% (n=43) in spring. Besides, there was a lower percentage of medical inpatients compared to other season, being 42,4% (n=59) in the summer, 47,2% (n=92) in autumn, 58,3% (n=127) in winter and 60,9% (n=120) in spring.

Discussion and Conclusion

From 2012 onwards there was an increase in the rate of activations. Other studies conducted in acute care hospital settings have shown that a higher rate of activations is associated with improved outcomes.[7] In the present study the rate was 18 activations/1000 hospital admissions. Jones et al[6] have defined a rate of 25/1000 as sufficient to impact mortality. In our population, the specific effect of activation rate on hospital mortality has not yet been studied, however it is intended to be done.

The easy access to MET by phone, followed by the immediate presence onsite, without a judgemental query on the calling criteria, may explain the increase in the rate, nevertheless after assessing the patient, the team always debriefs with the ward team caring for the patient, reinforcing the early recognition of the clinical situation and the utility of activating expert help, also evaluating what could be improved.

The increasing number of activations in the last three years was not associated with variations in age, severity, duration of intervention, time of day, day of the week, season or outcome (immediate or at hospital discharge). However, there was an increased rate in calls for male patients and for surgical wards over the three years. Population aging and better/more advanced surgical techniques might explain the rise in patients with multiple comorbidities, also a shortage of surgeons working on the general ward (with most of their time dedicated to the outpatient clinic and the OPR) and the inexperience with medical emergencies, might as well be reasons for a higher number of MET activations.[13,14]

As in previous studies[12], MET activations were divided in four levels of severity (Table III). This filtered out some non-urgent activations and mistakes caused by the subjective activation criteria. This also allowed a better categorization of activations that fulfilled more than one criteria.

Only 21% of the activations required ALS interventions, reinforcing the idea that long gone are the days of CATs, the evolution is now towards early detection and intervention, which is associated with higher success rates and better outcomes.[5] Despite this classification being different from the ones used in other articles, several other investigators reported similar results when it comes to ALS needs and non-urgent activations.[12]

Following MET intervention 24% of the patients needed an upgrade in clinical care within the range reported by similar studies.[9,12,15-18] This highlights the importance of these systems in identifying inpatients who are being treated in a less adequately resourced unit.

On the other hand, only 2,3% of the activations were for patients that had a downgrade from ICU or HDU in the previous 24 hours. Since this is a small number of cases, it suggests that, at this hospital, MET activations are not due to rash downgrade in care. Nonetheless, further study on these cases should be done, since the reasons behind the activations and the outcome of these patients was not evaluated.

From all activations, 11% were for patients that had surgery in the previous 24h. One possible explanation might be the lack of HDU beds, which prompts a direct discharge of patients to the ward (a group that might benefit from a larger period of monitoring). A further study with anaesthesia would be of interest to collect these cases and plan adequate HDU resources in the hospital to the actual surgical activity.

There was a higher incidence of calls during the night shift and on weekdays, this is in concordance with other published papers[19] and similar to previous results in our institution.[11] Some authors even succeeded in demonstrating a relationship between planned ward round and higher rate of activations[20], which raises the question about the intrinsic relationship between closer monitoring and early recognition of the deteriorating patient with a higher rate of MET activations, however this was not evaluated in the present paper.

There was 18% immediate death rate and 50% hospital mortality rate. The analysis of these data needs to be complemented with the registration of end-of-life decisions made previously or during MET intervention. Further studies should be conducted on this topic, because it is crucial to separate the expected from the unexpected deaths, as well as the role of the team in the end-of-life decision making. Although this topic was not subject to analysis in the present study, a previous paper, written at our hospital, found that 5,1% of patients who received an activation had already a limitation of care in place, and that MET intervention lead to an additional 24,1%.[11]

Factors independently associated with higher mortality were age, increased severity, activation for a medical ward and the season of the year (other than summer).

The increased mortality in older and more severe patients was expected.[21] In the medical group, one can only presume that it could be due to a higher incidence of comorbidities and a higher rate of non-programmed admissions by comparison to the surgical wards. The same relation was described previously by other investigators.[22,23]

Kurita et al[14] described the relationship between shifts and risk of poor outcome, but we didn't find the same . One unexpected result was the association of summer season with lower hospital mortality. To our knowledge that relationship has not yet been described. However, one can think that these outcomes are the result of a different pool of patients in this season, since the ones admitted during the winter are more likely to be urgent admissions and thereby sicker, than in summer. Also, we found that during summer there is a lower percentage of patients in medical wards (which was the area associated with higher mortality) and the percentage of activations in which ALS intervention was needed was also lower.

This study has some limitations: MET interventions were not described in detail, mainly the recording of end-of-life decisions, nor patients general characteristics focusing on the comorbidities and overall health status. This would allow a more accurate analysis of mortality data.

To conclude, we found no significative differences on MET activations during the last 3 years. The exception being the rise in activations towards surgical patients. We also found that one in four patients were identified and benefited from escalation of care after an activation. Besides, on our secondary analysis, the mortality predictors that we found to have a significant association are coherent to most of the literature being age, medical ward location and increased severity associated to higher mortality, and summer linked to better survival at discharge.

The primary aim of RRS is the identification and immediate adequate treatment of the patient at risk. Our data reinforces the utility of an ICU based MET, with the intensivist arriving at bedside, making decisions and coordinating actions in the most effective way possible. We found that about 30% of the activations were for emergent situations prompting an upgrade in care. In this setting, an ICU based-team probably makes the difference by providing immediate critical care to the patient until his allocation to the ideal place.

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Table I – MET activation criteria

A
Threatened airway
B
Respiratory arrest
Respiratory rate < 6 or > 35 cpm
O_2 Saturation < 85% with FiO_2 > 21%
C
Cardiac arrest
Heart rate < 40 or > 140 bpm
Systolic blood pressure < 90 mmHg
D
Decrease > 2 point on Glasgow Coma Scale
Prolonged or repeated convulsions
OTHERS
Worried staff
Inadequate response to previous urgent intervention

bpm – beats per minute; cpm – cycles per minute; CPR – cardiopulmonary resuscitation; FiO_2 – fraction of inspired oxygen; MET – medical emergency team.

Table II – List of medical and surgical wards

MEDICAL	SURGICAL
Internal medicine	General surgery
Cardiology	Vascular surgery
Infectious diseases	Urology
Endocrinology	Neurosurgery
Gastroenterology	Ophthalmology
Nephrology	Otorhinolaryngology
Pulmonology	Orthopedics
Neurology	
Rehabilitation medicine	

Table III – Criteria for patient severity level classification

RESUSCITATION
Cardiac arrest
Respiratory arrest
CPR intervention
EMERGENT
Threatened airway
Prolonged or repeated convulsions
Orotracheal intubation
Electric cardioversion preformed
URGENT
Respiratory rate < 6 or > 35 cpm
O_2 Saturation < 85% with FiO_2 > 21%
Heart rate < 40 or > 140 bpm
Systolic blood pressure < 90 mmHg
Decrease > 2 point on Glasgow Coma Scale
Chest pain (suggestive of ischemic heart disease)
Acute pulmonary edema
NON-URGENT
All others (don't fit any of the above)

bpm – beats per minute; cpm – cycles per minute; CPR – cardiopulmonary resuscitation; FiO_2 – fraction of inspired oxygen.

Table IV – Comparison of MET activations' characteristics in 2016, 2017 and 2018

	2016 (n=221)	2017 (n=273)	2018 (n=255)	Total (n=749)	p value
Age, median (IQR)	76 (63-83)	75 (63-84)	73 (62-83)	75 (63-83)	0,312
Gender (Male), n (%)	111 (50,2)	152 (55,7)	156 (61,2)	419 (55,9)	0,056
Location, n (%)					
Medical	140 (63,3)	135 (49,5)	123 (48,2)	398 (53,1)	0,001
Surgical	81 (36,7)	138 (50,5)	132 (51,8)	351 (46,9)	
Previous 24h, n (%)					
Intensive Care Unit	2 (0,9)	4 (1,5)	3 (1,2)	9 (1,2)	0,439
High-dependency Unit	0 (0,0)	4 (1,5)	4 (1,6)	8 (1,1)	
Surgery	21 (9,5)	30 (11,0)	29 (11,4)	80 (10,7)	
Severity level, n (%)					
Resuscitation	49 (22,2)	58 (21,2)	53 (20,8)	160 (21,4)	0,282
Emergent	29 (13,1)	20 (7,3)	19 (7,5)	68 (9,1)	
Urgent	116 (52,5)	152 (55,7)	148 (58,0)	416 (55,5)	
Non-urgent	27 (12,2)	43 (15,8)	35 (13,7)	105 (14,0)	
Duration of intervention, median (IQR)	00:29 (00:20-00:45)	00:30 (00:20-00:44)	00:29 (00:19-00:40)	00:30 (00:20-00:43)	0,379
Season, n (%)					
Winter	56 (25,3)	89 (32,6)	73 (28,6)	218 (29,1)	0,276
Spring	65 (29,4)	60 (22,0)	72 (28,2)	197 (26,3)	
Summer	50 (22,6)	52 (19,0)	37 (14,5)	139 (18,6)	
Autumn	50 (22,6)	72 (26,4)	73 (28,6)	195 (26,0)	
Weekday	171 (77,4)	209 (76,6)	194 (76,1)	574 (76,6)	0.113
Weekend	50 (22,6)	64 (23,4)	61 (23,9)	175 (23,4)	
Immediate outcome, n (%)					
Intensive Care Unit	24 (10,9)	30 (11,0)	32(12,5)	86 (11,5)	0,458
High-dependency Unit	23 (10,4)	27 (9,9)	32 (12,5)	82 (10,9)	
Operating room	6 (2,7)	5 (1,8)	4 (1,6)	15 (2,0)	
Ward	119 (53,8)	165 (60,4)	144 (56,5)	428 (57,1)	
Deceased	49 (22,2)	46 (16,8)	43 (16,9)	138 (18,4)	
Deceased at hospital discharge	121 (54,8)	125 (45,8)	129 (50,6)	375 (50,1)	0,138
Shifts, n (%)					
Morning	75 (33,9)	102 (37,4)	85 (33,3)	262 (35,0)	0,637
Afternoon	68 (30,8)	66 (24,2)	66 (25,9)	200 (26,7)	
Night	78 (35,3)	105 (38,5)	104 (40,8)	287 (38,3)	
Weekday, n (%)					
Monday	44 (19,9)	41 (15,0)	34 (13,3)	119 (15,9)	0,235
Tuesday	35 (15,8)	35 (12,8)	37 (14,5)	107 (14,3)	
Wednesday	26 (11,8)	44 (16,1)	42 (16,5)	112 (15,0)	
Thursday	36 (16,3)	48 (17,6)	33 (12,9)	117 (15,6)	
Friday	30 (13,6)	41 (15,0)	48 (18,8)	119 (15,9)	
Saturday	32 (14,5)	26 (9,5)	35 (13,7)	93 (12,4)	
Sunday	18 (8,1)	38 (13,9)	26 (10,2)	82 (10,9)	

IQR – interquartile range.

Table V – Variables' influence on mortality at discharge – univariate analysis

	Final outcome				
	Discharge (n = 374)	Deceased (n = 375)	Total (n = 749)	p value	Crude OR
Age, median (IQR)	72,5 (60-82)	78 (66-85)	75 (63-83)	<0,001	1,022
Duration of intervention, median (IQR)	00:30 (00:20-00:45)	00:29 (00:20-00:40)	00:30 (00:20-00:43)	0,308	1,000
Gender, n (%)					
Female	180 (48,1)	150 (40,0)	330 (44,1)	0,025	1,000
Male	194 (51,9)	225 (60,0)	419 (55,9)		1,392
Location, n (%)					
Surgical	203 (54,3)	148 (39,5)	351 (46,9)	<0,001	1,000
Medical	171 (45,7)	227 (60,5)	398 (53,1)		1,821
Surgery in the previous 24 hours	52 (13,9)	28 (7,5)	80 (10,7)	0.005	0.5
Severity level, n (%)					
Resuscitation	13 (3,5)	147 (39,5)	160 (21,4)	<0,001	1,000
Emergent	39 (10,4)	29 (7,7)	68 (9,1)		0,066
Urgent	250 (66,8)	166 (44,3)	416 (55,5)		0,059
Non-urgent	72 (19,3)	33 (8,8)	105 (14,0)		0,041
Timing of activation, n (%)					
Winter	85 (22,7)	133 (35,5)	218 (29,1)	0,001	1,000
Spring	99 (26,5)	98 (26,1)	197 (26,3)		0,633
Summer	90 (24,1)	49 (13,1)	139 (18,6)		0,348
Autumn	100 (26,7)	95 (25,3)	195 (26,0)		0,607
Sunday	43 (11,5)	39 (10,4)	82 (10,9)	0,829	1,000
Monday	61 (16,3)	58 (15,5)	119 (15,9)		1,048
Tuesday	48 (12,8)	59 (15,7)	107 (14,3)		1,355
Wednesday	52 (13,9)	60 (16,0)	112 (15,0)		1,272
Thursday	63 (16,8)	54 (14,4)	117 (15,6)		0,945
Friday	70 (18,7)	49 (13,1)	119 (15,9)		0,772
Saturday	37 (9,9)	56 (14,9)	93 (12,4)		1,669
Weekend	80 (21,4)	95 (25,3)	175 (23,4)	0,202	1,000
Weekday	294 (78,6)	280 (74,7)	574 (76,6)		0,802
Morning	127 (34,0)	135 (36,0)	262 (35,0)	0,883	1,000
Afternoon	109 (29,1)	91 (24,3)	200 (26,7)		0,785
Night	138 (36,9)	149 (39,7)	287 (38,3)		1,016

IQR – interquartile range; OR – odds ratio.

Table VI – Variables' influence on mortality at discharge – multivariate analysis

	Final outcome			
	Discharge (n = 374)	Deceased (n = 375)	Total (n = 749)	Adjusted OR (CI95%)
Age, median (IQR)	72,5 (60-82)	78 (66-85)	75 (63-83)	1,027 (1,014-1,039)
Location, n (%)				
Surgical	203 (54,3)	148 (39,5)	351 (46,9)	1,000
Medical	171 (45,7)	227 (60,5)	398 (53,1)	1,638 (1,153-2,327)
Severity level, n (%)				
Resuscitation	13 (3,5)	147 (39,5)	160 (21,4)	1,000
Emergent	39 (10,4)	29 (7,7)	68 (9,1)	0,073 (0,34-0,155)
Urgent	250 (66,8)	166 (44,3)	416 (55,5)	0,068 (0,037-0,125)
Non-urgent	72 (19,3)	33 (8,8)	105 (14,0)	0,044 (0,022-0,090)
Season, n (%)				
Winter	85 (22,7)	133 (35,5)	218 (29,1)	1,000
Spring	99 (26,5)	98 (26,1)	197 (26,3)	0,678 (0,436-1,055)
Summer	90 (24,1)	49 (13,1)	139 (18,6)	0,411 (0,251-0,673)
Autumn	100 (26,7)	95 (25,3)	195 (26,0)	0,672 (0,430-1,050)

$CI_{95\%}$ – 95% confidence interval; IQR – interquartile range; OR – odds ratio.

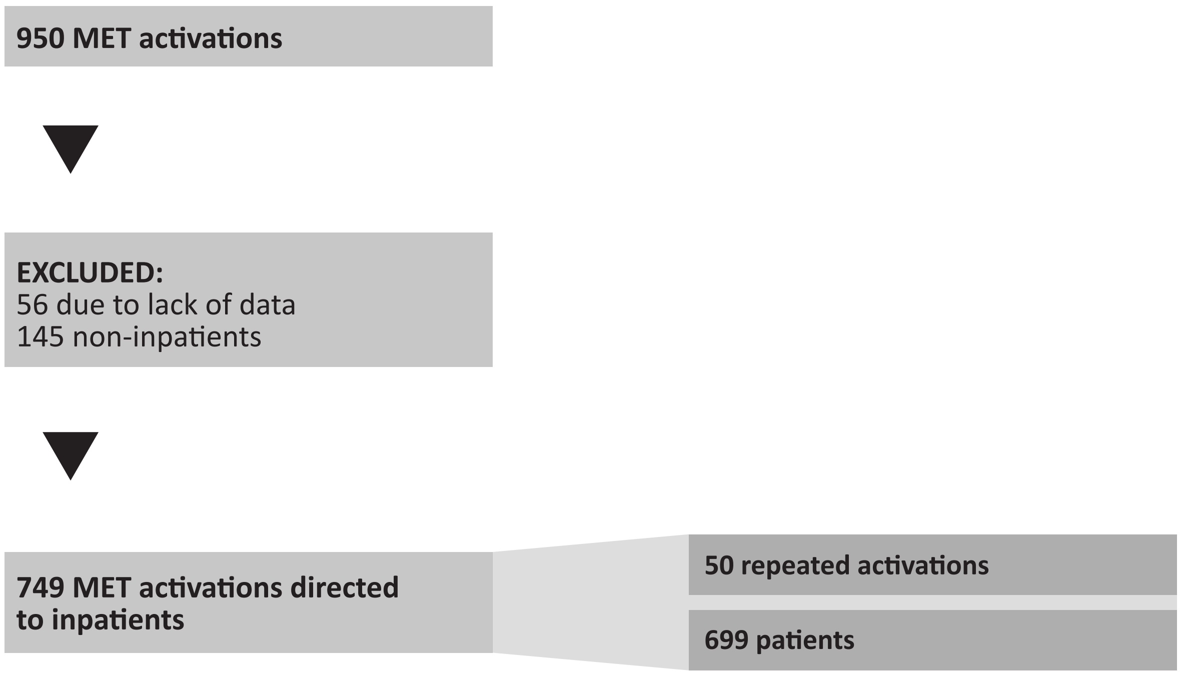

Figure 1 – Activations included in the study. MET – medical emergency team

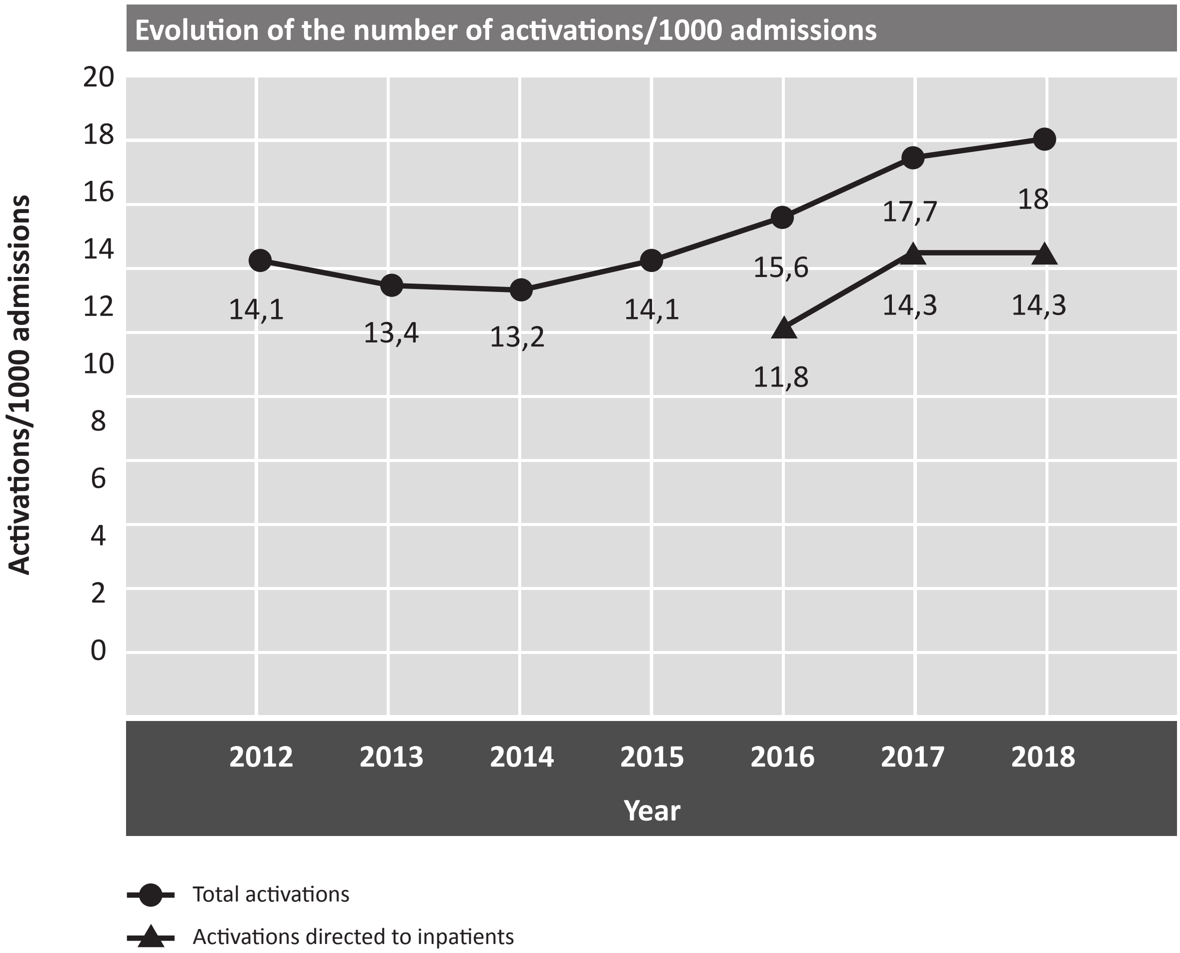

Figure 2 – Evolution of the number of activations/1000 hospital admissions. Total activations include the ones directed to inpatients and others.

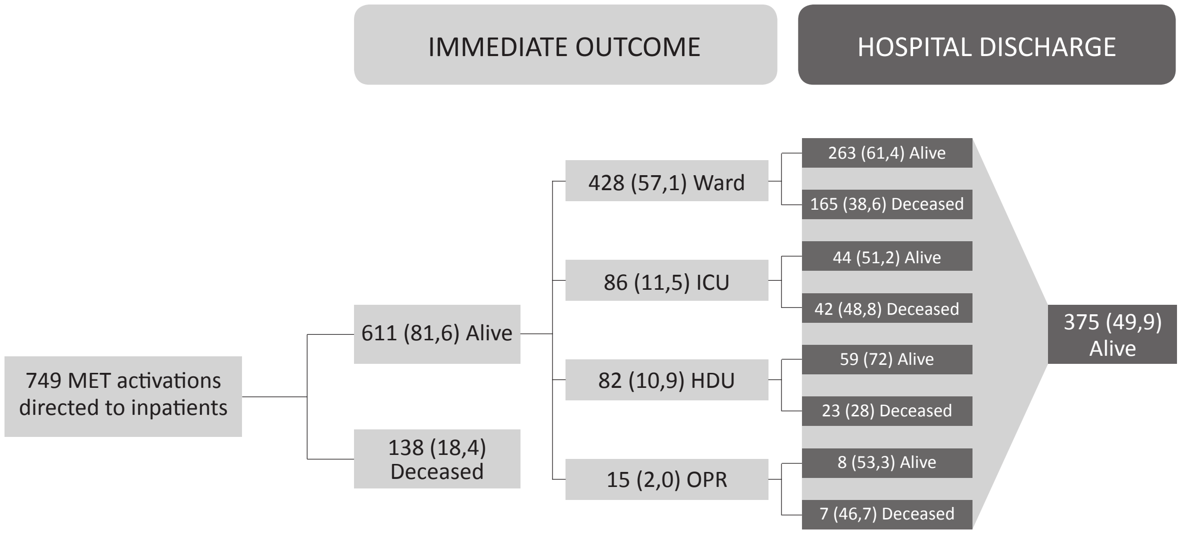

Figure 3 – Immediate outcomes, n (%). HDU – high-dependency unit; ICU – intensive care unit; MET – Medical Emergency Team; OPR – operating room.

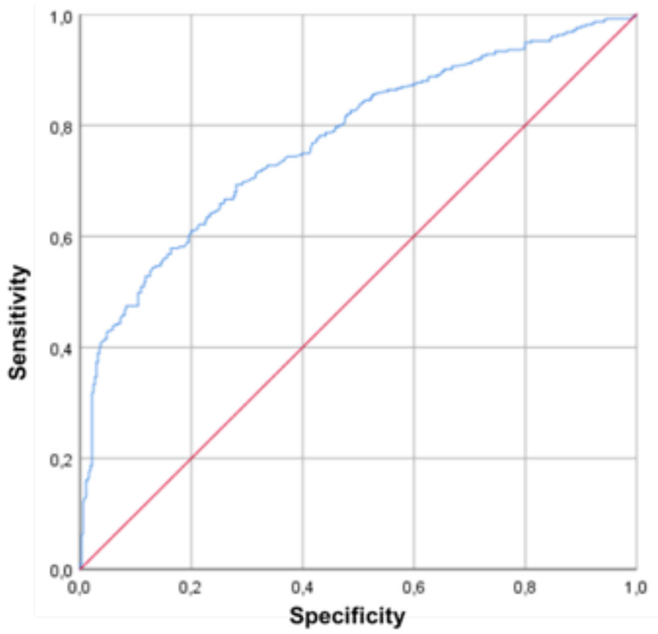

Figure 4 – Area under the receiver operating characteristics (AU-ROC) curve for the final model.

Attachment 1 – Original poster displayed around the hospital publicizing the MET activation criteria (in Portuguese)

[USAR O FURADOR NESTA ÁREA]

EMI
EMERGÊNCIA
MÉDICA INTERNA

« colar aqui a etiqueta do doente »

EMERGÊNCIA MÉDICA INTERNA (EMI) | REGISTO DE OCORRÊNCIA

1. IDENTIFICAÇÃO / DADOS DEMOGRÁFICOS

TIPO DE DOENTE:
- ☐ Médico
- ☐ Cirúrgico
- ☐ Outro ____________

LOCALIZAÇÃO DOENTE:
- ☐ BO /UCPA
- ☐ SU/OBS
- ☐ Enfermaria ____________
- ☐ Consulta Externa ____________
- ☐ Área Comum

ACTIVAÇÃO DA EQUIPA: ☐/☐/☐ HORA: ☐ h ☐
FIM DO EVENTO: ☐/☐/☐ HORA: ☐ h ☐

MÉDICO ____________ Nº DE ORDEM ____________
ENFERMEIRO ____________ Nº DE ORDEM ____________

2. DADOS PRÉ-EVENTO

NAS 24h ANTES DA ATIVAÇÃO:
- ☐ Esteve na SE
- ☐ Esteve em Intensivos
- ☐ Esteve em intermédios
- ☐ Cirurgia
- ☐ Procedimentos Invasivos

ESTADO DO DOENTE 6H ANTES DA ACTIVAÇÃO (ou avaliação clínica mais recente __h antes da activação):

FC ____________ bpm
PA ____________ mmHg
FR ____________ rpm
Temp ____________ °C
Sat O_2 ____________ %

Fornecimento O_2	Máscara ____________ l/m
	Cânula ____________ l/m

ECG: O_____V_____M_____ (________)

CRITÉRIOS DE ATIVAÇÃO:
- ☐ **A** - Compromisso da via aérea
- ☐ **B** - Paragem respiratória
- ☐ **B** - FR <6 ou> 35 ciclos/minuto
- ☐ **B** - Sat O2 <85% com Oxigénio suplementar
- ☐ **C** - Paragem cardíaca
- ☐ **C** - FC <40 ou> 140 batimentos/min
- ☐ **C** - PAS <90 mmHg
- ☐ **D** - Escala Coma Glasgow – diminuição > 2 pontos
- ☐ **D** - Crise convulsiva prolongada ou repetida
- ☐ **Outros** - Preocupação da equipa de saúde
- ☐ **Outros** - Resposta inadequada ao tratamento prévio urgente

3. ACTUAÇÃO DA EQUIPA EMI

AVALIAÇÃO DA EQUIPA EMI:

Parâmetro	Início: ____h____	Fim: ____h____
FC		
PA		
FR		
Temp		
Sat O_2		
Fornecimento O_2	Máscara ____________ l/m Cânula ____________ l/m	Máscara ____________ l/m Cânula ____________ l/m
ECG	O___V___M___(___)	O___V___M___(___)

ABORDAGEM DA EQUIPA EMI:

VIA AÉREA / VENTILAÇÃO
- ☐ Entubação Traqueal
- ☐ Adjuvante via aérea
- ☐ Aspiração secreções
- ☐ Máscara Hudson
- ☐ Máscara O2
- ☐ Ventilação c/ insuflador
- ☐ Nebulização
- ☐ VNI
- ☐ NenhumaIntervenção
- ☐ Outros ____________

MEDICAÇÃO:
- ☐ Adrenalina
- ☐ Atropina
- ☐ Vasopressores
- ☐ Sedativos
- ☐ Analgésicos
- ☐ Antiarritmicos
- ☐ Broncodilatadores
- ☐ Diurético
- ☐ Outros ____________

LIMITAÇÃO TERAPÊUTICA:	Já existente	Iniciada
DNR	☐	☐
Limitação Tratamento	☐	☐

CIRCULAÇÃO
- ☐ Acesso venoso
- ☐ Fluidoterapia
- ☐ Transfusão
- ☐ Monitorização
- ☐ RCP
- ☐ Cardioversão
- ☐ PaceMaker
- ☐ Nenhuma Intervenção
- ☐ Outros ____________

OBSERVAÇÕES / COMENTÁRIOS:

____

____

____

____

4. ESTADO DO DOENTE NO FINAL DA CHAMADA EMI

- ☐ FALECIDO
- ☐ NÃO FALECIDO:
  - ○ Permaneceu no mesmo local
  - ○ Transferido para Cuidados Intensivos: ____________
  - ○ Transferido para SE
  - ○ Transferido para Cuidados Intermédios
  - ○ Transferido para BO
  - ○ Transferido para outro Local: ____________

ESTADO DO DOENTE NA ALTA HOSPITALAR:
- ☐ ALTA
- ☐ MORTE

Attachment 2 – Medical emergency team activation form to be filled in each activation (in Portuguese).

How are Medical Emergency Team activations evolving? A cohort study at a university hospital.

David Sá Couto da Maia Romão

INSTITUTO DE CIÊNCIAS BIOMÉDICAS ABEL SALAZAR