Rapid Response Systems as Secondary Responders to In-Hospital Clinical Deterioration: A Four-Year Observational Study

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ABSTRACT
Background:

In-hospital cardiac arrest (IHCA) is a major cause of preventable inpatient mortality, especially in low- and middle-income countries (LMICs) where rapid response systems (RRS) are still developing. Evidence regarding RRS performance in Indonesia is limited. This study evaluated the performance and operational challenges of an institutional RRS over a four-year period at a large tertiary referral hospital in Jakarta.

Objective:

This study aimed to determine the proportion of immediate survival following RRS activation and to investigate secondary outcomes, including the association between activation indications and mortality, and system-level barriers.

Methods:

This retrospective observational cohort study included all inpatient RRS activations at Cipto Mangunkusumo National General Hospital, Jakarta, Indonesia, from January 1, 2021, to December 31, 2024. Data from the hospital's RRS registry were analyzed for activation triggers, interventions, immediate outcomes, and operational issues.

Results:

Among 246,367 inpatient admissions, there were 5,900 eligible inpatient RRS activations, yielding an activation rate of 23.9 per 1,000 admissions. Immediate survival occurred in 4,763 (80.7%) events, while 1,137 (19.3%) patients did not survive. Cardiac arrest (8.0%) and respiratory arrest (6.5%) were the strongest predictors of non-survival (OR 48.17 and 27.13 vs. Red EWS reference, both $p<0.001$). Most activations occurred out-of-hours (63.0%), with significantly higher mortality (71.3% vs. 61.1%, $p<0.001$). The most frequent single-parameter triggers were oxygen saturation ≤90% (38.5%) and sudden consciousness deterioration (15.8%). Mismatched activations—where the patient's condition upon team arrival differed from the activation indication—were strongly associated with higher mortality (OR 17.3, 95% CI 14.3–20.2, $p<0.001$).

Conclusion:

The institutional RRS demonstrated a moderate activation rate and favorable immediate survival compared with similar LMIC settings. However, outcomes were influenced by delayed recognition, out-of-hours activation, and limited critical-care capacity. Strengthening early escalation culture, monitoring afferent-limb failure, expanding nighttime coverage, and increasing ICU capacity are essential to enhance RRS effectiveness and reduce preventable in-hospital mortality in resource-limited environments.

Keywords: in-hospital cardiac arrest, Indonesia, low-and middle-income countries, patient deterioration, rapid response system, resuscitation

INTRODUCTION

In-hospital cardiac arrest (IHCA) is a sudden, time-critical event that remains a major cause of preventable inpatient mortality. 1.2 to 10% per 1,000 hospital admissions worldwide.[1] In the United States, over 290,000 adults experience IHCA each year, and only about one in four survives to hospital discharge.[2,3] Despite its burden, IHCA has historically received less attention and fewer resources than stroke, myocardial infarction, or out-of-hospital cardiac arrest.[4]

Although IHCA is often perceived as an unpredictable event, it is frequently preceded by clinical warning signs that emerge hours before arrest.[5] Effective prevention depends on two complementary capabilities: reliable early identification of deterioration and timely, skilled intervention.[6] A Rapid Response System (RRS) is a structured patient safety program designed to address these needs by identifying and managing deteriorating patients before cardiac arrest occurs.[6] The RRS typically consists of four key components: an afferent arm (track-and-trigger tools), an efferent arm (a multidisciplinary response team), feedback mechanisms for continuous quality improvement, and administrative support to ensure system sustainability.[6] Evidence from multiple studies and meta-analyses shows that RRS implementation is associated with reduced IHCA rates and improved hospital outcomes, particularly when proactive rounding, audit-feedback loops, and integration with sepsis and deterioration pathways are emphasized.[7,8]

However, translating these successes to low- and middle-income countries (LMICs) remains challenging. Barriers include limited monitoring capacity on general wards, low staff-to-patient ratios, inadequate resuscitation equipment, limited higher level of care facilities, and lack of digital infrastructure or institutional governance.[9,10] Data from LMICs remain fragmented, and evidence on RRS effectiveness in such contexts is still limited.[11]

In Indonesia, neither a national registry nor the use of a standard reporting system for RRS activations and IHCA outcomes exists. Information at the institutional level is very limited; thus, local evaluation becomes important. Cipto Mangunkusumo National General Hospital or RSCM, is an Indonesian national referral hospital located in Jakarta and is among the largest teaching hospitals in Indonesia. Serving as a major facility for clinical education and providing high level care, RSCM employs over 6,000 healthcare professionals and staff with more than 1,000 resident physicians in various specialties. Since 2021, this hospital has admitted an average over 50,000 inpatients annually. Because of its place as the end of the referral line in the national healthcare system, inpatient treated at RSCM usually have complicated disease and are in advanced stage of illness. This therefor provides a high-acuity environment where timely recognition and intervention for clinical deterioration become an important aspect, hence increasing the relevance of the implementation and evaluation of the RRS system.

This descriptive study aims to analyze the performance and challenges of the institutional Rapid Response System (Sistem Reaksi Cepat, SRC) at RSCM over a four-year period. It focuses on patient demographics, activation indications and outcomes observed. Findings from this study are expected to inform future patient safety strategies and guide the development of context-sensitive RRS models in similar LMIC settings.

METHOD

Study Design and Data Collection

This retrospective observational cohort study analyzed all activations of the Rapid Response System (RRS) originating from inpatient wards at Cipto Mangunkusumo National General Hospital (RSCM), a tertiary referral center in Jakarta, Indonesia. The study covered a four-year period from January 1, 2021, to December 31, 2024. A retrospective design was chosen to enable a comprehensive evaluation of existing RRS activation records, facilitating the identification of activation patterns and system challenges within real-world clinical practice.

The RRS at our institution is organized as a two-tier response model. The primary response team consists of ward physicians and nurses (local RRS team), while the secondary response team/MET (Mediccal Emergency Team) comprises physicians trained in advanced resuscitation (central RRS team).

All resuscitation events are documented using standardized paper-based forms that capture clinical and operational parameters of each activation. These forms are subsequently entered by the secondary responders into an institutional digital RRS registry designed to support continuous quality improvement in hospital resuscitation services. The registry served as the primary data source for this study. Records with missing outcome data or clear duplicate entries were excluded.

Eligible cases included all inpatient activations both cardiac arrest and non–cardiac arrest events, triggered by elevated Early Warning Scores (Red EWS) or predefined single-parameter criteria. Activations from units with integrated resuscitation services (Emergency Department, Operating Rooms, Intensive Care Units) were not part of the registry dataset and were therefore unavailable for analysis. Activations occurring in outpatient clinics or non-patient areas (e.g., emergencies involving staff or visitors, parking lots) were excluded because of differing case characteristics and response workflows.

For each activation event, data were extracted on patient demographics, activation timing and criteria, and challenges encountered during resuscitation. Challenges were defined as issues related to human resources, equipment or medication availability, or systemic and logistical barriers. Survival status in this study refers to the immediate outcome following resuscitation, rather than 30-day or in-hospital mortality.

Study Outcomes

The primary outcome was the proportion of immediate resuscitation survival among all inpatient RRS activations during the study period.

Secondary outcomes of this study included: (1) the association between activation indications and odds of immediate non-survival using Red NEWS activation as the reference category; and (2) important clinical and operational challenges, such as the occurrence of do-not-resuscitate (DNR) decisions during events, discrepancies between ICU admission recommendations and actual admissions, delayed team responses, or limitations related to equipment, personnel, or system workflow.

Ethical approval for this study was obtained from the institutional ethics committee (approval number: KET-1614/UB2F1/ETIK/PPM.00.02/2025). Informed consent was waived due to the retrospective nature of the study. The final dataset included 6,872 activation records from the hospital's RRS registry. Authors have conducted and reported this study in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.

RESULTS

Data Entries

Between January 1, 2021, and December 31, 2024, there were 246,367 inpatient admissions and 6,872 entries on the RRT form. RRS activations originated from all across the hospital area except emergency department, operating rooms, and intensive care units as these areas operate under integrated resuscitation service which is not included in RRS registry. From all of those entries, 972 data were excluded from our analysis because they involved outpatient clinics, hospital staff, visitors, or non-clinical areas such as corridors and parking lots. The remaining 5,900 inpatient activations were analysed in the final dataset. No records were excluded due to missing outcome data and all eligible cases were analyzed in the final dataset. No duplicated data were also recorded because every single RRS activation has their own unique identification number.

Patient Characteristics

From all of the 5,900 records included in this study, 4,763 records (80,7%) survived after the resuscitation event while 1,137 patients (19,3%) did not survive. Baseline demographic and clinical characteristics presented in Table 1 shows no statistical significance on age, age group, sex distribution, length of stay, and number of cases with problems. The median patient age of overall entries were 50.2 years (IQR 31.7-62.0) with the 88.1 % of activation involving adult patients (88.1%) while pediatrics only accounted for 11.9% cases. Sex distribution in this study involved 51.5% male and 48.9% female patients. The median of hospital length of stay was 7 days (IQR 4-14) overall. Problems encountered during resuscitation were reported in 16.3% entries without significant difference in patient outcome after resuscitation. Based on patients' status of care, postoperative patients have no significant difference in outcome compared to non-post operative patients. However, post-ICU patients showed a significantly greater proportion of survivability (2.2%) compared to non-post ICU patients (p=0.003).

Variables with significant differences on baseline characteristics were timing of activation (p=<0.001) and activation indication (p=<0.001). Most activations occurred during out of hours periods (63.0%) while non survivors were significantly more likely to be activated out-of-hours compared with survivors (71.% vs 61.1%). Indications of RRS activation were categorized into four types of indication including cardiac arrest, respiratory arrest, red NEWS/PEWS score, and single criteria. Out of those indications, cardiac arrest has the most non-survivor proportion followed by respiratory arrest, single criteria, and red NEWS/PEWS score. Single criteria is the most common indication for RRS activation accounting 65.8% of activations. This criteria was later broken down into different types of criteria. These activation indications will be discussed further in the next section.

Indications for Rapid Response System Activation

The distribution of RRS activation indications was further detailed in Table 2 with their corresponding survival outcomes. Cardiac arrest and respiratory arrest contribute 8.0% and 6.5% respectively of all activations. The criteria used as reference to find mortality odds ratio was Red NEWS/PEWS criteria. Compared to reference criteria, cardiac arrest yields the highest odds ratio of mortality (OR=48.17; 95% CI =34.2-67.9, P<0.001). Respiratory arrest also shows high odds of non survival (OR=27.13, 95% CI=19.1-38.4, p<0.001) which make them both as the criteria with highest odds of mortality among other criteria.

As mentioned before, single criteria account for the most common indications for RRS activation. Single criteria consisted of threatened/obstructed airway, tachypnea, oxygen saturation ≤ 90%, hypotension, tachycardia, sudden consciousness deterioration, recurrent/prolonged seizures, and worrisome condition. The most frequent criteria found among those entries are oxygen saturation ≤ 90% (38.5%) and sudden consciousness deterioration (15.8%). The association with mortality were high on both criteria (OR=4.07, 95% CI=3.0–5.5, p < 0.001, and OR=5.10, 95% CI=3.7–7.0, p < 0.001, respectively). Other single criteria such as tachypnea, hypotension, and tachycardia did not show significant association with mortality. Recurrent or prolonged seizures and worrisome conditions have lower odds of mortality (OR=0.289 and OR=0.174 respectively) but did not show any significance statistically (p= 0.087 and p=0.084).

Activation Criteria and Initial Patient Assessment by MET/Secondary Responder

Table 3 summarizes the association between the congruence of activation indication and the patient's initial clinical condition at the time of secondary responder assessment. Overall, 86.2% (5087/5900) of activations showed matching indications between the initial reason for activation and the patient's actual condition upon team arrival, while 13.8% (812/5900) were categorized as mismatched. Among survivors, nearly all activations were appropriately matched (94.6%), whereas only half of the non-survivor cases (50.9%) demonstrated such congruence. Logistic regression analysis revealed that mismatched activations were strongly associated with higher odds of mortality compared with matched activations (OR = 17.3, 95% CI = 14.3–20.2, p < 0.001). This finding suggests that discrepancies between activation triggers and patients' real-time physiological status may reflect delayed recognition or misclassification of clinical deterioration, both of which substantially increase the risk of adverse outcomes

Identified Problems and Clinical Decisions During Resuscitation

Problems encountered during Rapid Response System activation sourced from several aspects such as unmet ICU need, resuscitation decisions, operational challenges, and delay indicators shown in Table 4. Among those entries, 3,320 events were recommended for ICU admission but only 651 (11,0%) patients successfully admitted. The remaining 2,669 (45.3%) patients could not be transferred to the ICU.

There were 1.196 (20.3%) cases were documented as do-not-resuscitate (DNR) representing situations in which continuation of resuscitation was deemed non-beneficial after clinical reassessment or following discussions with patients' family. Operational challenges were also identified in a subset of events. The most frequent were equipment-related limitations found in 186 (3.2%) events which included incomplete or malfunctioning airway tools, unavailable oxygen connectors, or monitor failures. Workflow or system-related issues found in 21 (0.4%) events were mainly due to delayed communication or patient transfer processes. Family-related factors found in 20 (0.3%) events included refusal of procedures or delayed consent, while human resource limitations were encountered in 27 (0.5%) events reflected the restricted availability of trained personnel during certain shifts. Other miscellaneous issues were noted in 14 (0.2%) events. In terms of response timeliness, delays of more than five minutes in team arrival occurred in 434 (7.4%) events and trolley or equipment arrival delays were observed in 274 (4.6%) events.

DISCUSSION

In this study, the inpatient Rapid Response System (RRS) activation rate was 23.9 per 1,000 admissions. This number is higher than many published averages from multicenter reviews ranged 2.5-40.3 per 1,000 with median of 15.1 per 1,000 admission.[12] Our RRS activation rate also within lower band of the effective dose based on study done by Jones, et.al (25.8-56.4 per 1,000).[12] This places our utilization near, but slightly below, commonly cited study by Lyons et. al. which says ideally, RRS activation close to 40 calls per 1,000 admissions.[13,14] In our cohort, the IHCA incidence was 472 events among 246,367 admissions (1.92 per 1,000 admissions), which is comparable to post-implementation rates described in mature programs. Prior studies showed that typical in-hospital cardiac arrest (IHCA) incidence ranged between 1.2 and 10 per 1,000 admissions, with large U.S. cohorts reporting a median 4.0 per 1,000 admissions, underscoring wide international variability.[7] Collectively, prior work shows that increasing RRS/MET "dose" correlates with reductions in in-hospital cardiac arrest (IHCA) rates.[15] A study that analyzed 20 years of data concluded that the introduction of Rapid Response System (RRS) resulted in a sharp, sustained decrease in hospital mortality, a benefit statistically correlated with an increasing Medical Emergency Team (MET) activation rate/dose.[16] Taken together, these data suggest our system is functioning at a moderate activation dose with a correspondingly toward the lower end of international ranges. However, further strengthening of the calling culture (e.g., encouraging escalation at earlier EWS thresholds) to approach ideal number of MET calls could plausibly yield additional reductions in ward cardiac arrests.

We also reported the immediate resuscitation outcome defined as alive or dead at the end of the RRS encounter. Our MET also functions as the code blue team in contrast to many high-income settings where MET/RRT are separated from cardiac arrest teams. Immediate survivors were 4763/5900 (80.8%), and non-survivors were 1137/5900 (19.3%). Parr et al. reported 6.9% deaths during the MET response in an early Australian series after MET calls.[17] This disparity could be attributed to several factors, particularly the functional overlap noted: because this MET also serves as the Code Blue team, the cohort's overall non-survival rate may be inflated by including patients who were already in full cardiac arrest when the team arrived, who generally have poorer immediate outcomes than patients whose clinical decline is intercepted prior to arrest. Importantly, our configuration in which the MET and code-blue roles are combined differs from systems that direct immediate life-threat activations to a distinct cardiac arrest team, which can influence on-scene death rates and case-mix.[18]

By baseline characteristics, immediate survival did not differ between adult and pediatric patients in our dataset. While direct age-stratified comparisons of immediate event survival after RRT/MET activation are scarce, pediatric RRT studies generally emphasize reductions in arrests and ICU transfers rather than acute event survival differences per se. Large adult RRT cohorts identify age and comorbidity as dominant mortality predictors, consistent with our finding of no sex-based difference in immediate outcome.[16]

Out of hours effect

A notable finding of this study was that the majority of activations (63%) occurred during out-of-hours periods, with significantly higher mortality among patients activated at these times compared to those activated during regular working hours (71.3% vs. 61.1%, $p < 0.001$). Further analysis showed that out-of-hours activations were more than twice as frequent for high-mortality indications such as cardiac arrest and respiratory arrest. Moreover, post-resuscitation survival rates were consistently lower during out-of-hours activations across several critical indications, including cardiac arrest, respiratory arrest, sudden loss of consciousness, desaturation, threatened airway, hypotension, and red Early Warning Score (Table 5).

This finding suggests potential delays across the activation response continuum of the resuscitation chain. Late activation may result from slower recognition of patient deterioration, reduced staffing, and limited senior oversight outside regular working hours, which can in turn slow diagnostic processes and decision-making. On the response side, restricted access to senior clinicians and limited responder availability may further compromise timely advanced interventions. Several studies also indicate that out-of-hours and weekend admissions are consistently associated with increased mortality and poorer patient outcomes, likely due to a combination of higher illness severity and deficiencies in resource and organizational factors that affect care quality and guideline adherence.

In our context, these findings highlight the need to strengthen nighttime and weekend coverage by increase senior/specialist staffing, improving early recognition of patient deterioration, reducing hesitation in activating the resuscitation team, enhancing training for ward-based responders, and ensuring consistent availability of senior clinical support.[19–22] Implementing a continuous RRS coverage model with clearly defined, tiered escalation pathways may help address these gaps.

Activation Indications and Association with Mortality

Cardiac and respiratory arrest at activation were the strongest predictors of non-survival, with odds ratios (OR) of 48.17 and 27.13, respectively, versus the Red NEWSS reference (both p<0.001). Although arrests comprised only less than 8% of activations, their prognosis was markedly poorer, consistent with international reports that a sizable fraction of calls in some systems still occur during cardiac and respiratory arrest, reflecting missed opportunities for earlier escalation.

Only 19.7% of activations were triggered by a Red Early Warning Score (EWS); most used single-parameter criteria. A combined trigger is therefore retained: aggregate EWS/PEWS to detect accumulating modest derangements, and single-parameter "red flags" to capture isolated but critical abnormalities. This hybrid approach aligns with evidence that structured early-warning and escalation pathways improve recognition of deterioration and can reduce in-hospital cardiac arrest and, in some contexts, mortality.[23,24]

Going forward, the program should shift the activation mix toward pre-arrest calls by strengthening the afferent limb: reliable monitoring, time-bound escalation to senior review, clear age-appropriate thresholds (EWS/PEWS or any critical single parameter), and routine audit/feedback. Pre-MET interventions at early-warning ("yellow/orange") levels, (such as oxygen titration, airway positioning/suction or bronchodilator as indicated, glucose correction, fluid/vasoactive therapy per shock bundles, timely antimicrobials and sepsis bundles, and rapid arrangement of higher-acuity monitoring) should be standardized. Coupled with staff education and adherence to observation-to-review targets, these measures are expected to reduce late activations (cardiac and respiratory arrest) and improve immediate outcomes across adult and pediatric patients.

Rapid patient deterioration or mismatch finding during resuscitation

A large gap was observed between the indication at call and the clinical state on MET arrival, with 1,255 patients in cardiac arrest at first MET assessment (including 381 ROSC), compared with 472 calls initially labeled as "cardiac arrest". This pattern is consistent with afferent-limb failure (ALF)

which is defined by delayed or absent escalation despite objective risk. ALF is typically caused by a combination of factors, including: deficient staff knowledge of activation criteria, poor compliance with monitoring protocols, systemic barriers, or reluctance to activate the MET due to cultural issues or personal judgment, compounded by recognition/triage errors during the call phase. [25] Both phenomena are linked to higher mortality in the literature. Contributors in our cohort were especially frequent among activations for respiratory arrest, sudden loss of consciousness, and oxygen desaturation, whichaccounted for much of the arrest-at-arrival burden.

Several targeted actions can address this problem effectively. First, implement proactive RRT/critical-care outreach rounding on high-risk wards (elevated EWS/PEWS, recent post-ICU discharges, nights) to identify deterioration early; programs adding proactive rounding report fewer ward cardiac arrests and code deaths with more timely transfers to higher acuity care.[26] Second, standardize a "first-5-minutes" bundle before MET arrival and enforce time-to-defibrillation targets ≤3 minutes for shockable rhythms, as delays to defibrillation are strongly associated with lower survival and are flagged in contemporary AHA guidance.[27] Third, sustain the gains with a set of supportive enablers: digital EWS/PEWS with auto-alerts and central surveillance, structured call-taker scripts plus SBAR hand-off, post-ICU safety-net / step-down surveillance, explicit afferent-limb failure metrics with dashboards, and out-of-hours surge coverage, each linked to earlier recognition, safer escalation, and fewer preventable arrests.

System-Level Constraints and Goals-of-Care

The provided data in Table 4 reveals a significant challenge in critical care: a severe supply-demand mismatch for ICU beds, with only 11.0% of the total patient cohort (and less than one-fifth of those recommended) obtaining admission. This scarcity, which is common in many Asian and Low- and Middle-Income Country (LMIC) settings, is compounded by a high rate of patients allowing only 3.6 per 100,000 population ICU bed availability.[28] The high rate of DNR may be inadvertently influenced by the intense resource strain and time pressure of real-time bed availability, potentially leading to end-of-life choices that do not fully reflect patient values.

Additionally, the system needs transparent ICU triage and escalation pathways to ensure equitable access, and a focus on communication quality and family support.[29,30] Alongside these process fixes, medium-term capacity building is crucial to alleviate the overall system strain. These measures aim to ensure that end-of-life decisions reflect patient values and preserve equitable ICU access for those most likely to benefit.

To address this challenge of limited capacity and late decision-making, the recommended safeguards focus on early, structured goals-of-care (GOC) integration.[31] Key practice implications include triggering routine GOC discussions and proactive palliative-care consultations for high-risk patients to decouple these vital conversations from immediate bed availability.[32]

Strengths and Limitations

This study, analyzing 5,900 in-hospital activations over four years, represents one of the largest evaluations of an RRS in Indonesia. The scale and longitudinal nature of the dataset are significant, facilitating granular analyses of activation timing, indication-specific outcomes, and system-level bottlenecks, offering valuable, real-world insights into RRS performance in a high-demand, tertiary referral setting. The inclusion of both clinical and operational variables, coupled with the rigorous methodology of integrating standardized resuscitation forms and centralized registry data, ensures a high degree of data consistency and validity. However, several limitations should be noted: outcome assessment was restricted to immediate post-resuscitation survival (lacking 30-day mortality and long-term data); the retrospective, registry-based design introduces potential information bias and underreporting of operational issues; and its single-center context may limit the generalizability of findings to institutions with different staffing models or RRS maturity. Despite these constraints, this investigation provides essential baseline evidence on RRS implementation challenges and outcomes, establishing a foundation for subsequent quality-improvement research.

CONCLUSION

The RRS demonstrated high utilization and a satisfactory immediate post-resuscitation survival rate (80.7%) over the four-year period, validating its critical role in managing acute clinical deterioration. However, key challenges are rooted in the afferent arm, evidenced by the high volume of Cardiopulmonary Resuscitation (CPR) activations and a strong association between mismatched initial assessments and patient mortality. Systemic vulnerabilities further compromise effectiveness, including a significant reduction in survival during out-of-hours events and a substantial bottleneck due to limited ICU bed capacity (45.3% denial rate). To inform future patient safety strategies, interventions must focus on strengthening the afferent arm through proactive rounding, optimizing out-of-hours team availability, and improving post-resuscitation patient flow. Ultimately, these findings guide the development of context-sensitive RRS models in similar LMIC settings by prioritizing early detection and ensuring adequate resources for advanced critical care disposition.

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Table 1. Baseline demographic and clinical characteristics of inpatients and outpatients who undergoes Rapid Response System activations

Variable	Overall (n = 5900)	Survivor (n = 4763)	Non-Survivor (n = 1137)	P1
Age [Median (IQR)]	50.2 (31.73-62.00)	50.1 (31.80-61.89)	50.8 (62.22-31.64)	0.558*
Age Group, n (%)				0.359 †
Pediatric	701 (11.9)	557 (11.7)	114 (12.7)	
Adult	5199 (88.1)	4206 (89.3)	993 (87.3)	
Sex, n (%)				0.155†
Male	3012 (51.5)	2410 (50.6)	602 (52.9)	
Female	2888 (48.9)	2353 (49.4)	535 (47.1)	
Timing of activations, n (%)				<0.001†
In hours	2181 (37.0)	1855 (38.9)	326 (28.7)	
Out of hours	3719 (63.0)	2908 (61.1)	811 (71.3)	
LOS [Median (IQR)]	7.0 (14.0-4.0)	7.0 (14.0-4.0)	8.0 (14.0-4.0)	0.214*
Post-Operative n (%)	363 (6.2)	302 (6.3)	61 (5.4)	0.234†
Post-ICU, n (%)	114 (1.9)	104 (2.2)	10 (0.9)	0.003†
Activation Indication				<0.001†
Cardiac arrest	472 (8.0)	149 (3.1)	323 (28.4)	
Respiratory arrest	382 (6.5)	172 (3.6)	210 (18.5)	
Red NEWS/PEWS	1161 (19.7)	1111 (23.3)	50 (4.4)	
Single Criteria	3885 (65.8)	3331 (80.7)	554 (48.7)	

Data are presented as n (%) or median [IQR]. P-values compare survivors and non-survivors within each category.
*P values were calculated with the of Mann-Whitney U test.
† P values were calculated with the use of chi-square test.

Table 2. Logistic Regression Analysis for Non-Survivor Odds Based on RRT activation indication.

Variable	Overall 5900(100%)	Survivor 4763/5900 (80.7%)	Non-Survivor 1137/5900 (19.3%)	OR (95% CI)*	P-Value
Indication of activations					
Cardiac Arrest	472/5900 (8.0%)	149/4763 (3.1%)	323/1137 (28.4%)	48.168 (34.2-67.9)	<0.001
Respiratory Arrest	382/5900 (6.5%)	172/4763 (3.6%)	210/1137 (18.5%)	27.129 (19.1-38.4)	<0.001
Single Criteria					
Threatened/Obstructed Airway	131/5900 (2.2%)	118/4763 (2.5%)	13/1137 (1.1%)	2.448 (1.3-4.6)	0.006
Tachypnea	55/5900 (0.9%)	51/4763 (1.1%)	4/1137 (0.4%)	1.743 (0.6-5.0)	0.303
Oxygen Saturation ≤ 90%	2272/5900 (38.5%)	1920/4763 (40.3%)	352/1137 (31.0%)	4.074 (3.0-5.5)	<0.001
Hypotension	91/5900 (1.5%)	88/4763 (1.8%)	3/1137 (0.3%)	0.758 (0.2-2.4)	0.646
Tachycardia	99/5900 (1.7%)	96/4763 (2.0%)	3/1137 (0.3%)	0.694 (0.2-2.2)	0.546
Sudden Consciousness Deterioration	932/5900 (15.8%)	758/4763 (15.9%)	174/1137 (15.3%)	5.101 (3.7-7.0)	<0.001
Recurrent/Prolonged Seizures	156/5900 (2.6%)	154/4763 (3.2%)	2/1137 (0.2%)	0.289 (0.1-1.2)	0.087
Worrisome Condition	129/5900 (2.2%)	128/4763 (2.7%)	1/1137 (0.1%)	0.174 (0.0-1.3)	0.084
Red NEWS (Reference)	1161/5900 (19.7%)	1111/4763 (23.3%)	50/1137 (4.4%)		

*Odds Ratios are calculated using Logistic Regression, comparing each indicator to Red NEWS as the reference category.

Table 3. Logistic Regression Analysis for Non-Survivor Odds Based on Indication and Initial Assessment Congruence

Variable	Overall	Survivor	Non-Survivor	OR (95% CI)*	P-Value
Indication and Initial Assessment Congruence					
Matching (Reference) (n, %)	5087/5900 (86.2%)	4508/4763 (94.6%)	579/1137 (50.9%)		
Mismatched (n, %)	812/5900 (13.8%)	255/4763 (5.4%)	558/1137 (49.1%)	17.3 (14.3-20.2)	<0.001

*Odds Ratios are calculated using Logistic Regression, matching indication and initial assessment was used as reference.

Table 4. Summary of Problems and Clinical Decisions Identified During In-Hospital Resuscitation Events

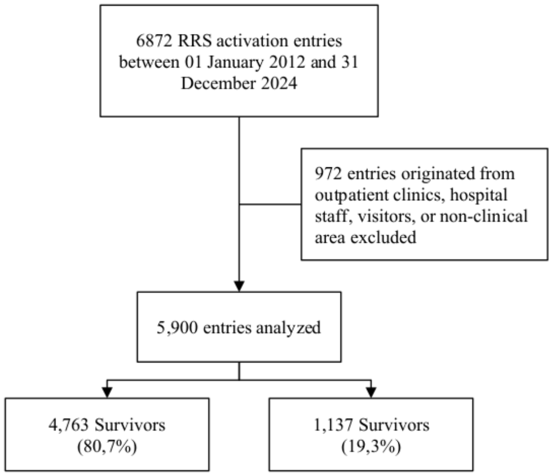
Problems	n	% (of total events)
Disposition after resuscitation		
Recommended for ICU transfer	3,320	56.3%
Admitted to ICU after recommendation	651	11.0%
Not Admitted to ICU despite recommendation	2,669	45.3%
Resuscitation decision		
Do-Not-Resuscitate (DNR) decision made during event	1,196	20.3%
Problems identified during resuscitation		
Equipment limitation or malfunction (e.g., incomplete airway set, faulty oxygen connection, monitor errors)	186	3.2%
Process/system issues (e.g., delayed communication,	21	0.4%

transport delay)		
Family related (e.g., refusal, interference, consent delay)	20	0.3%
Human resource/staffing limitation	27	0.5%
Other factors	14	0.2%
Delay indicators		
Team arrival delayed > 5 minutes	434	7.4%
Trolley/equipment delayed	274	4.6%

Table 5. Indications for Rapid Response Team (RRT) Activation for Inpatient Hospital Deterioration (n = 5900), Stratified by Activation Time (In Hours vs. Out of Hours)

Indication	Inpatient (n = 5900)			
	Overall	In Hours	Out of Hours	P_1
Cardiac arrest	472	151 (6.9%)	321 (8.6%)	<0.001
Respiratory arrest	382	102 (4.7%)	280 (7.5%)	
Threatened airway obstruction	131	48 (2.2%)	83 (2.2%)	
Bradycardia	20	10 (0.5%)	10 (0.3%)	
Hypotension	91	46 (2.1%)	45 (1.2%)	
Worrisome condition	129	61 (2.8%)	68 (1.8%)	
Prolonged/recurrent seizure	156	67 (3.1%)	89 (2.4%)	
Tachypnea	55	23 (1.1%)	32 (0.9%)	
Sudden decrease in Consciousness (GCS drop >2 points)	932	362 (16.6%)	570 (15.3%)	
Sudden oxygen desaturation <90%	2272	828 (38.0%)	1444 (38.8%)	
Tachycardia	90	49 (2.2%)	50 (1.3%)	
Red NEWs/PEWS	1161	434 (19.9%)	727 (19.5%)	

Figure 1. Flowchart of data entries after rapid response team activation.



RRT: Rapid Response Team

Rapid Response Systems as Secondary Responders to In-Hospital Clinical Deterioration: A Four-Year Observational Study

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